Initial Project Description

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project

December 2025

APM-REP-05000-0210-R000

Prepared by: Nuclear Waste Management Organization (NWMO)

Nuclear Waste Management Organization

Acknowledgment of Truths

The Nuclear Waste Management Organization (NWMO) is grateful to all the First Nations and Indigenous Peoples that the organization has had the great fortune to meet and interact with while developing and implementing Canada's plan for the long-term management of used nuclear fuel. The NWMO is especially grateful to the Wabigoon Lake Ojibway Nation (WLON) who have indicated that they are willing and informed hosts for the proposed Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project (herein referred to as the Project).

The NWMO understands the unique long-term time scale of Canada's plan to build the Project, and the enduring relationship it will have with land and water for generations to come. The NWMO acknowledges that the Project will have an impact on traditional land and resource use, including through changes in access or perceptions of risk. The Project is located within the territory of WLON; which is the most proximate potentially impacted Indigenous group to the site. As such, the Anishinaabe peoples of WLON are expected to experience these impacts most.

The NWMO commits to build respectful relationships, and to seek the free, prior, and informed consent of impacted peoples of WLON before proceeding with development of the Project. The NWMO will respect WLON sovereignty and will aim to align its work with Anishinaabe Values, emphasizing protection and stewardship of land, water, and all Creation and will respect their traditional governance systems.

The NWMO is on a reconciliation learning journey. The NWMO has and will continue to build on advice and guidance received from the Council of Elders and Youth and the Indigenous communities with whom it has a relationship. The NWMO acknowledges there is still much learning to do as it moves through all phases of the Project.

The NWMO respects the truth that many Indigenous women and girls are at a higher risk of harm every day and therefore supports the National Inquiry into Missing and Murdered Indigenous Women and Girls and will find ways to action the Calls for Justice, specifically number 13, "Calls for Extractive and Development Industries."

The NWMO acknowledges, respects and honours that First Nation and Métis peoples of Canada have unique status and rights as recognized and affirmed in Section 35 of the *Constitution Act, 1982* (Government of Canada 1982). The NWMO is committed to respecting the Aboriginal rights and treaties of First Nation and Métis peoples. The NWMO also recognizes that there may be unresolved claims between First Nation and Métis communities and the Crown to be considered in relation to the Project site.

The NWMO will work with the Crown regarding the Crown's duty to consult and accommodate, as guided by decisions of the Supreme Court of Canada in fulfilling the NWMO's obligations under the *Nuclear Fuel Waste Act* (Government of Canada 2002a).

The NWMO recognizes the truth that the federal acts for which it is subject to, the *Nuclear Fuel Waste Act*, the *Nuclear Safety and Control Act* (Government of Canada 1997) and the *Impact Assessment Act* (Government of Canada 2019a) are being imposed on Indigenous Peoples as a result of Canada's plan. The NWMO's approach to implementing the Project is committed to respect and align with Anishinaabe Values, philosophies, and knowledge systems. The NWMO acknowledges the need to be mindful of potential burdens which result from its Project on potentially affected Indigenous groups.

Additionally, the NWMO recognizes the importance of data sovereignty as an important aspect of self-determination and cultural preservation for Indigenous communities. Currently, the data in the

Initial Project Description are not a full representation of the characteristics of the Indigenous identity of populations residing within district, municipal and unincorporated communities, nor are they a full representation of the characterization of on-reserve communities.

All of the NWMO's work with respect to Indigenous Peoples will be guided by Reconciliation.

Initial Project Description: Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project

APM-REP-05000-0210-R000

December 2025

Reviewed by: DocuSigned by: Mackenzie Denyes 03EA09A055B14D3...

Name: Mackenzie Denyes Date: December 9, 2025

Title: Director, Impact Assessment & Licensing

Organization: Nuclear Waste Management Organization

Approved by: DocuSigned by: Allan Webster 540D7AD4EA94492...

Name: Allan Webster Date: December 9, 2025

Title: Vice President, Regulatory Approvals

Organization: Nuclear Waste Management Organization

Accepted by: Signed by: Caitlin Burley 5B25E1AC7C174A1...

Name: Caitlin Burley Date: December 9, 2025

Title: Regulatory Decision Making Project Director

Organization: Nuclear Waste Management Organization

Document history

Title	Initial Project Description: Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project	
Report number	APM-REP-05000-0210	
Revision	000	December 2025
Prepared by	Jean-Marc Crew, Senior Environmental Assessment Specialist (WSP)	
Prepared by	Spencer Roth, Environmental Assessment Specialist (WSP)	
Prepared by	Maryse Sciberas, Environmental Assessment Specialist (WSP)	
Prepared by	Marley Gryfe, Environmental Assessment Specialist (WSP)	
Prepared by	Tamara Darwish, Principal Aquatic Ecologist (WSP)	
Prepared by	Amanda Reid, Technical Officer, Regulatory Permitting & Approvals (NWMO)	
Prepared by	Rojin Amani, Impact Assessment Associate (NWMO)	
Prepared by	Shelley Potter, Manager of Regulatory Studies (NWMO)	
Prepared by	Jeff Binns, Manager of Impact Assessment (NWMO)	
Reviewed by	Mackenzie Denyes, Director, Impact Assessment & Licensing (NWMO)	
Approved by	Allan Webster, Vice President, Regulatory Approvals (NWMO)	
Accepted by	Caitlin Burley, Regulatory Decision-Making Project Director (NWMO)	

Revision Summary		
Revision Number	**Date**	**Description of Changes/Improvements**
Draft	2025-01-31	External Draft for WLON Comment
Draft	2025-08-01	External Draft for WLON Review
Draft	2025-08-15	External Draft for Ignace Review
Draft	2025-08-15	External Draft for IAAC and GRT Review
R000	2025-12-09	Submission to IAAC

EXECUTIVE SUMMARY

Introduction

In 2002, the Government of Canada enacted the *Nuclear Fuel Waste Act* (NFWA) to establish a long-term approach for managing used nuclear fuel. The Act required the creation of the Nuclear Waste Management Organization (NWMO) to work with Canadians and Indigenous Peoples to recommend and implement a safe, long-term management plan.

Following a three-year national study with broad public input, the Government of Canada selected Adaptive Phased Management (APM) in 2007 as Canada's plan for the long-term management of used nuclear fuel. The approach includes the development of a Deep Geological Repository (DGR) to safely contain and isolate Canada's used nuclear fuel (hereafter referred to as "the Project").

After more than a decade of technical and community-based siting work, the Project site was selected in the Wabigoon Lake Ojibway Nation and Township of Ignace area of northwestern Ontario, approximately 21 km southeast of Wabigoon Lake Ojibway Nation and 43 km northwest of the Township of Ignace along Highway 17.

The Project is expected to span approximately 160 years, including site preparation, construction, operation (about 50 years), decommissioning and closure, and post-closure monitoring. The Project is subject to numerous laws, including the NFWA, *Impact Assessment Act* (IAA), and the *Nuclear Safety and Control Act* (NSCA). In addition, Wabigoon Lake Ojibway Nation is exercising its jurisdiction through its Regulatory Assessment and Approval Process. The Regulatory Assessment and Approvals Process is WLON's regulatory process grounded in Anishinaabe law, values, and responsibilities, and reflects WLON's authority to review and decide on development within its territory. The Canadian Nuclear Safety Commission (CNSC) will serve as the lifecycle regulator for all federally Licenced activities.

Why the Project is Needed

Canada's nuclear power plants have provided, and are expected to continue providing, clean, reliable, and low-carbon energy for decades. However, used nuclear fuel remains radioactive for a very long time and therefore requires careful, permanent management to avoid placing a burden on future generations.

A deep geological repository represents the internationally recognized best practice for the long-term management of used nuclear fuel. The Project provides a safe, permanent, and responsible solution that will ensure the used fuel is securely contained and isolated from people and the environment for generations to come.

Currently, used nuclear fuel is safely stored at reactor sites across Canada. While these interim measures are effective, they are not permanent and require active management. The Project will provide the long-term solution needed to protect people, communities, and the environment. This approach was endorsed by the Government of Canada when it selected APM inclusive of the Project in accordance with the NFWA and established oversight for its implementation.

The Project addresses an issue Canadians have consistently said should be resolved now rather than left for future generations. By safely containing and isolating used nuclear fuel, it also supports the continued role of nuclear energy as a reliable, low-carbon source of power and contributes directly to Canada's climate change commitments and goal of achieving net-zero emissions.

If implemented, the Project would:

- provide a permanent and safe disposal solution for used nuclear fuel

- support Canada's commitments to climate action and achieving net-zero by 2050 by ensuring nuclear energy remains a sustainable and socially responsible energy source
- eliminate the need for future generations to actively manage used nuclear fuel, thereby reducing long-term environmental risks and advancing intergenerational equity in managing Canada's nuclear legacy

Site Selection and Community Engagement

In November 2024, following a 14-year site selection process, extensive public engagement, and a comprehensive technical assessment demonstrating confidence in safety, the decision was made to locate the Project in the Wabigoon Lake Ojibway Nation and Ignace siting area. This milestone marked the completion of more than a decade of rigorous scientific study and a community-driven, consent-based siting process, advancing the Project into the regulatory decision-making phase.

Both Wabigoon Lake Ojibway Nation and the Township of Ignace have entered into Hosting Agreements with the NWMO for the life of the Project. These agreements reflect Canada's commitment to working with informed and willing host communities. While Wabigoon Lake Ojibway Nation's agreement remains confidential, the Township of Ignace's agreement is publicly available on the Township's webpage. Its objective is to enable the community to support and facilitate the Project by building capacity in areas such as infrastructure, economic growth, social and cultural development, and governance. The agreement also provides a framework for the Township to fulfill its roles and responsibilities within the regulatory process.

The site selection decision was based on two key pillars:

1. Confidence in safety – Over 10 years of scientific research, site characterization, and modelling have confirmed that the area's geology and environment are suitable to safely contain and isolate the waste.

2. Collaboration with communities – Site selection required the support of informed and willing hosts. Both Wabigoon Lake Ojibway Nation and the Township of Ignace confirmed their willingness through community-driven decision-making processes.

The Initial Project Description has been formally reviewed by Wabigoon Lake Ojibway Nation and the Township of Ignace, in keeping with their role as host communities for the Project.

Beyond the host communities, the NWMO continues to engage with:

- other potentially affected Indigenous groups
- local municipalities and councils
- the interested public, including residents, and land users with interests in the surrounding area, including those critical of the Project

The goals of this engagement are:

- to ensure that anyone who wants to learn about the Project has the opportunity to do so
- to ensure that those who may be potentially affected can participate in the regulatory process, so their knowledge, experiences, and perspectives contribute to meaningful assessments
- to work with Wabigoon Lake Ojibway Nation as they implement their Regulatory Assessment and Approval Process (RAAP); Wabigoon Lake Ojibway Nation is exercising its jurisdiction through its Regulatory Assessment and Approval Process; the Regulatory Assessment and Approvals Process is WLON's regulatory process grounded in Anishinaabe law, values, and responsibilities, and reflects WLON's authority to review and decide on development within its territory

Description of the Project

The Project will include:

- an underground repository, at a depth greater than 500 m below surface, where used fuel will be placed in engineered containers surrounded by a protective system involving clay and rock
- surface facilities for receiving, handling, and packaging the used fuel
- transportation activities along the primary and secondary access roads within the Project site
- supporting infrastructure, including access and haul roads, a rail spur, transmission line, a worker accommodation camp, and an excavated rock management area

The Project would contain and isolate approximately 5.9 million used fuel bundles, which is the projected total inventory of used nuclear fuel estimated to be produced in Canada from the current fleet of reactors to end of life, as outlined in the NWMO's 2024 Nuclear Fuel Waste Projections Report (NWMO, 2024). This projection is based on published refurbishment and life-extension plans for the Darlington and Bruce reactors, and the continued operation of Pickering A reactors (until end of 2024) and Pickering B reactors (until end of 2026), and on NWMO's assumptions used for planning purposes.

The Project is expected to last over 160 years, including site preparation, construction, operation, decommissioning and closure, and post-closure monitoring.

The Project does not include:

- transportation of used fuel from reactor sites to the Project beyond primary and secondary access roads at the Project site, as this is regulated separately under CNSC certification and uses existing transportation infrastructure
- NWMO's corporate offices or other off-site corporate infrastructure (e.g., Centre of Expertise)
- any capacity beyond 5.9 million bundles of fuel; increases in the proposed inventory would require approval from host communities and be approved by applicable regulators, including the CNSC as the lifecycle regulator for the Project

Regulatory Oversight

The Project is, and will remain, subject to the IAA, the NFWA, the NSCA and numerous other federal and provincial Licensing and regulatory requirements throughout its life. For example, a facility for the long-term management of radioactive waste, such as a DGR for used nuclear fuel, must meet the Licensing requirements of the *Class I Nuclear Facilities Regulations*.

In addition, under its Hosting Agreement, the NWMO has committed to honour the regulatory assessment and approvals process of Wabigoon Lake Ojibway Nation.

The NWMO's initial licence application to the CNSC will be submitted together with the Project's Impact Statement. This application will be prepared in general accordance with the guidance in REGDOC-1.2.3, *Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository*. While the technical studies and assessments will address impacts and mitigation measures for the full life of the Project, the integrated submission will provide detailed information specific to the activities covered by the initial licence.

The scope of the initial licence application includes the following key activities:

- site clearing, grading, terracing
- development and operation of water management facilities for site preparation activities
- construction and operation of a worker accommodation camp

- development of non-nuclear supporting infrastructure (including utilities, fencing, administration building, worker accommodation camp, helipad, primary access road, and Excavated Rock Management Area [ERMA] and Organics Management Area [OMA])

Management of Other Radioactive Wastes

As part of the management of the used nuclear fuel, the Project will generate low-level radioactive waste (LLW) and intermediate-level radioactive waste (ILW) during operations, and decommissioning. These include things like contaminated protective clothing, tools, filters, or other materials used in operating the facility.

- Project generated-interim management: All LLW and ILW generated during the life of the DGR will be safely managed on site in Licenced facilities, consistent with the CNSC requirements.
- Long-term management: The eventual disposal of LLW and ILW will follow Canada's Integrated Strategy for Radioactive Waste, which directs that LLW be placed in near-surface disposal facilities and that ILW (and certain other wastes) be disposed of in another deep geological repository, which will undergo a consent-based siting process.

These requirements are set out in *Canada's Policy for Radioactive Waste and Decommissioning* and the principle that waste generators are responsible for the safe, long-term management of their wastes.

By following these policies, the NWMO ensures the Project aligns with both its mandate and Canadian policy for responsible radioactive waste management.

Safety and Environmental Protection

Protecting people and the environment is the foundation of this Project. The purpose of the Project is to ensure used nuclear fuel is safely managed over the long term so that it does not pose a risk to human health or the environment. The facility's design follows international best practices and meets Canada's rigorous regulatory standards.

The CNSC is the independent federal regulator responsible for overseeing all stages of the Project's lifecycle. The CNSC enforces the NSCA and its supporting regulations, which together ensure that all nuclear activities in Canada protect the environment, human health, and safety.

Under the NSCA, the purpose of regulation is to:

- limit, to a reasonable level, the risks to national security, health, safety, and the environment associated with the use of nuclear energy and substances, consistent with Canada's international obligations
- implement measures related to the international control of nuclear energy, including the non-proliferation of nuclear weapons and explosive devices

In regulating the Project, the CNSC applies the precautionary principle and a graded approach, meaning that the level of oversight and control is proportional to the potential risks associated with each activity.

As part of the regulatory process for the Project, the CNSC will participate with the Impact Assessment Agency of Canada and other federal authorities, such as Fisheries and Oceans Canada, Environment and Climate Change Canada, and Health Canada, to ensure a thorough assessment of potential environmental impacts is conducted under the IAA. The Impact Statement, including the technical studies supporting the initial licence for the Project, will evaluate potential changes to air, water, land, plants, and animals, and will identify measures to prevent or mitigate harm.

Under the NSCA, the NWMO will be required to demonstrate application of the As Low As Reasonably Achievable (ALARA) principle in assessing environmental components, to ensure

protection of people and the environment. The ALARA principle means that all reasonable efforts are made to minimize exposures and releases from the Project, taking into account social, technical, economic, practical, and public policy considerations. In other words, exposures and risks are kept as low as reasonably achievable, without compromising the intended purpose or disproportionately increasing other risks. The NWMO's impact assessment methodology for the Project is proposed to build on the assessments supporting the initial licence (including air, water, land, plants and animals) and to demonstrate application of the ALARA principle in evaluating whether changes to air, water, land, plants, and animals may result in significant or somewhat significant impacts to Indigenous Peoples.

Additionally, under the NSCA, the NWMO must, throughout the life of the Project, maintain and update its licensing basis, which will be the set of requirements and documents demonstrating how health, safety, security, and the environment will be protected. This includes the safety case, which encompasses site characterization data, pre- and post-closure safety assessment reports, and human health and ecological risk assessments. The licensing basis will evolve across phases of the Project to reflect proposed activities. At each licensing stage, the public and Indigenous communities will have the opportunity to participate, including through various means such as public hearings. Under the NSCA, the NWMO will be required to conduct its Project activities in accordance with the licensing basis.

The safety case extends beyond dose calculations of potential exposure to radiation due to the Project. It also draws on a broad suite of evidence and arguments, including:

- the scientific, technical, and managerial foundations supporting safety
- the suitability of the site and facility design
- insights from natural analogues
- assessments of radiation risks from the Project
- assurance of the adequacy and quality of all safety-related work

This safety case will serve as a primary basis for dialogue with regulators, Indigenous communities, and other interested parties.

If the NWMO is successful in obtaining impact assessment and initial licensing approvals, the Impact Assessment (IA) decision statement and the licence issued by the CNSC will include enforceable environmental protection requirements, such as:

- limits on radioactive and hazardous releases (e.g., water effluent and air emissions)
- obligations for environmental monitoring and emissions reporting
- emergency preparedness and response plans

The NWMO will also be required to implement an Environmental Protection Program that monitors performance, ensures compliance, and drives continuous improvement.

Initial Screening of Potential Impacts of the Project

Environmental Components

The NWMO has undertaken extensive site characterization and environmental baseline studies in accordance with the NSCA and the CNSC's REGDOC-1.2.1, *Guidance on Deep Geological Repository Site Characterization*. This work ensures that the information supporting the siting and design of the repository is comprehensive and reliable, forming a strong foundation for the federal impact assessment and the initial licence application.

The NWMO will continue to update site characterization and environmental monitoring data throughout all phases of the Project. This date will be used in future licence applications for construction, operation, decommissioning, and closure.

Drawing on more than a decade of geoscientific research, environmental data collection, and safety assessments, the NWMO has confidence in the safety and suitability of the selected site. The impact assessment and initial licence will assess components with the highest potential for measurable effects, informed by lessons learned from other major nuclear and environmental assessments, including projects undertaken by Ontario Power Generation (OPG) and Atomic Energy of Canada Limited (AECL).

Project activities that could result in environmental interactions include land clearing, blasting and excavation, water management, construction and operation of surface and underground facilities, materials handling, and in-site transportation. For the purposes of the Initial Project Description submission, the NWMO has applied a pathways-of-change screening approach to identify these interactions and to incorporate proven environmental protection measures drawn from comparable projects. Examples include:

- air quality and dust control: water spraying, material covers, and wheel-washing stations
- noise and vibration management: temporary barriers, controlled blasting, and limited work hours
- erosion and sediment control: silt fencing, sedimentation ponds, and progressive revegetation
- surface water protection: engineered drainage, water collection ponds, and treated effluent release
- wildlife and habitat protection: seasonal clearing restrictions and habitat restoration

With these measures in place, the likelihood of significant adverse environmental effects is expected to be low. This conclusion is supported by the NWMO's extensive site characterization work across key biophysical components, including climate, geology, geochemistry, groundwater and surface water, vegetation, wildlife, species at risk, and ambient radioactivity. The studies completed to date are sufficiently advanced to support the initial screening assessment of potential effects presented in Section E of the Initial Project Description. Overall, the results indicate that, once mitigation measures are applied, most environmental components present a low risk of adverse effects, reflecting the NWMO's commitment to the ALARA principle and the CNSC's rigorous regulatory oversight.

Land Use

The Project will result in some unavoidable changes to land and resource use, including:

- restrictions on access for safety and security reasons
- concurrent use of land and water where infrastructure is located
- how surrounding lands and waters are used due to perception

While these changes are anticipated, their extent, nature, and the appropriate mitigation measures will be further defined through the impact assessment and licensing processes.

As part of this work, the NWMO's engagement program will play a central role in deepening understanding of how people use and value the lands and waters in the area. Additional engagement with potentially affected Indigenous groups will help identify and characterize potential effects on Indigenous land use and potential impacts on Indigenous Rights. These perspectives will meaningfully inform the assessment of significance and the development of mitigation measures to ensure that Indigenous interests and Rights are appropriately considered and respected as part of implementation of the Project.

Social, Economic, and Cultural Components

Socio-economic reporting for APM, including the assessment of the effects of the NWMO's activities on a community's way of life and its social, cultural, and economic aspirations, is a mandatory requirement of the NFWA. The NWMO has reported on the effects of APM every three years since it

was selected in 2007 as Canada's plan under Section 18 of the Act and, as required by Section 12(6), previously submitted mitigation measures for social, economic, and cultural impacts for all phases of the Project on the federal government as part of *Choosing a Way Forward* (NWMO 2005).

Beginning in 2007 when APM was selected as Canada's Plan, the NWMO was authorized to begin work on the Project including community engagement for the purposes of site selection and developing and undertaking the siting process. These activities were understood to have both positive and negative outcomes, and the mitigation measures for the siting phase of APM outlined in *Choosing a Way Forward*, implemented and activities reported on.

The NWMO's current socio-economic baseline is presented in the Social, Cultural, Economic, and Health Baseline Studies Report. The Report is supported by extensive data collection and engagement with nearly 500 individuals and 70 organizations, as well as targeted community-specific studies such as the Ignace Area Community Well-Being Studies (2023). These studies examined how the Project aligns with the Ignace community vision, which is structured around four themes: people, community and culture, infrastructure, and economics and finance. The findings indicate that the Project could strengthen long-term economic stability, attract new residents and businesses, and improve local services and infrastructure through proactive planning.

Among the Project activities with the greatest potential to influence social and cultural conditions is the operation of the worker accommodation camp. The camp will be a dry facility and subject to security checks and access controls. Mitigation measures common to infrastructure projects with accommodation camps will be implemented to manage potential social effects. These measures include strict behavioural policies and enforcement, local hiring and workforce training programs, on-site recreational amenities, transportation management, and ongoing community liaison and monitoring.

In many cases, for the social, economic, and cultural components studied, additional work will be completed to support the impact assessment process, particularly the assessment for the Anishinaabe Peoples of Wabigoon Lake Ojibway Nation and other potentially affected Indigenous groups. However, the work completed to date in the NWMO's Social, Cultural, Economic, and Health Baseline Studies, Preliminary Report, which has been reviewed by the IAAC and Government Review Team, is considered sufficiently advanced to support the screening-level assessment of potential effects presented in Section E of the Initial Project Description.

This assessment demonstrates that many of these components are anticipated to have a low level of risk of adverse effects following the implementation of mitigation measures, as both the likelihood of occurrence and the degree of potential negative impact are expected to be small. This approach is consistent with the Impact Assessment Agency of Canada's *Operational Policy Statement* (IAAC 2022), which seeks to balance focused and relevant information requirements with the need to identify potential effects that may be material to decision making.

In the case of social, economic, and cultural components, the wealth of available baseline studies completed in the area suggests that many of the anticipated impacts are positive. The publicly available Ignace Hosting Agreement further outlines commitments that reinforce these positive outcomes through sustained investment in community well-being, infrastructure, and economic development.

While the current baseline primarily reflects non-Indigenous and municipal communities, the NWMO recognizes that Indigenous data are not yet represented. The NWMO will work collaboratively with potentially affected Indigenous groups through the impact assessment process to ensure that Indigenous social, cultural, economic, and health data are respectfully incorporated into the assessment. This work is expected to be grounded in respect for Indigenous data sovereignty, ensuring that Indigenous Knowledge and information are used in accordance with community protocols.

Initial Project Description Conclusions

The proposed Project was selected by the Government of Canada as Canada's plan for the safe, long-term management of used nuclear fuel. It offers a permanent solution for future generations, grounded in decades of scientific research, sustained community engagement, and alignment with international best practices.

Key messages

- **Site selection**—The site for the Project was selected in 2024 following more than a decade of study and the confirmed willingness of informed host communities. The draft Initial Project Description has been reviewed by Wabigoon Lake Ojibway Nation and the Township of Ignace, in keeping with their roles as host communities under their respective Hosting Agreements.
- **Scientific foundation and safety**—More than a decade of geoscience, environmental, and safety studies confirm the site's suitability and preliminary safety. These studies form the foundation for the CNSC's graded approach to risk and licensing. As the Project advances through site preparation, construction, operation, decommissioning, and closure, the NWMO will submit progressively more detailed safety, environmental, and design documentation to support licensing under the NSCA.
- **Socio-economic and cultural outcomes**—The Project is expected to generate lasting socio-economic and cultural benefits, particularly for municipalities and regional economies. Uncertainty remains regarding potential effects to Indigenous Peoples based on baseline data collection to date and therefore cannot be ruled out as carrying a non-negligible risk of significant effects. These potential impacts will be a central focus of the Impact Statement and addressed through assessment studies with Wabigoon Lake Ojibway Nation and ongoing engagement with potentially affected Indigenous groups. This work is expected to be grounded in respect for Indigenous data sovereignty, ensuring that Indigenous Knowledge and information are used in accordance with community protocols.
- **Safety and environmental protection outcomes**—With the application of industry-standard mitigation measures, the risk of significant or somewhat significant effects to components under federal jurisdiction (such as air, water, soils, plants, and animals) are expected to be low. Under the NSCA, the NWMO must demonstrate the application of the ALARA principle—ensuring that potential exposures and releases are kept as low as reasonably achievable, taking social and economic factors into account. Independent oversight by the CNSC will ensure that all mitigation and monitoring commitments are met.
- **Land and resource use**—The Project will result in some unavoidable changes to land and resource use, including access restrictions for safety and security, direct overprinting of land where infrastructure is located, and perceived concerns that may influence how surrounding lands and waters are used. These issues will be examined through Indigenous engagement, Indigenous Knowledge and land use studies, and harmonization with Wabigoon Lake Ojibway Nation's Regulatory Assessment and Approval Process.
- **WLON Regulatory Assessment and Approvals Process**—Wabigoon Lake Ojibway Nation is exercising its jurisdiction through its Regulatory Assessment and Approvals Process. The Regulatory Assessment and Approvals Process is WLON's regulatory process grounded in Anishinaabe law, values, and responsibilities, and reflects WLON's authority to review and decide on development within its territory.
- **Waste management alignment**—Management of low- and intermediate-level wastes generated by the Project will align with Canada's Integrated Strategy for Radioactive Waste, so that all radioactive materials are managed safely, responsibly, and in accordance with national policy.

- **Lifecycle oversight**—The CNSC will act as the lifecycle regulator, providing independent oversight and issuing authorizations only when the Project is demonstrated to be safe for people and the environment. The Project will also remain subject to other federal, provincial, and Wabigoon Lake Ojibway Nation approvals and will be under CNSC licensing for approximately 160 years, ensuring comprehensive oversight across its entire lifecycle.

The Project represents a responsible step toward ensuring the health, safety, and sustainability of Canada's environment and communities for generations to come. It is responsible because it provides a safe and permanent solution to Canada's used fuel waste, an issue Canadians have been clear should be addressed now, rather than left for future generations. The Project is also a critical component of Canada's nuclear fuel cycle, providing the permanent solution required to address the final stage of managing used fuel responsibly. By securing long-term management of used fuel, it supports the continued role of nuclear energy as a reliable, low-carbon power source and contributes directly to Canada's commitments on climate change and achieving net-zero emissions.

TABLE OF CONTENTS

EXECUTIVE SUMMARY V

TABLE OF CONTENTS XIV

LIST OF TABLES XXI

LIST OF FIGURES XXIII

ACRONYMS AND ABBREVIATIONS XXIV

I. STATUTORY REGULATORY AND OVERSIGHT FRAMEWORK FOR THE PROJECT 1

II. THE NUCLEAR WASTE MANAGEMENT ORGANIZATION AND SELECTION OF ADAPTIVE PHASED MANAGEMENT 5

III. WABIGOON LAKE OJIBWAY NATION STORY 6

IV. TOWNSHIP OF IGNACE STORY 8

V. OBJECTIVES AND OVERVIEW 8

VI. CONCORDANCE WITH REGULATORY REQUIREMENTS 9

A. GENERAL INFORMATION 10

1. GENERAL PROJECT INFORMATION 10

2. PROPONENT INFORMATION 13

3. BUILDING RELATIONSHIPS WITH ANISHINAABE PEOPLES OF WABIGOON LAKE OJIBWAY NATION AND OTHER INDIGENOUS GROUPS IN CANADA 14

3.1 SUMMARY OF INDIGENOUS ENGAGEMENT ACTIVITIES TO DATE 17

3.2 KEY ISSUES RAISED IN ENGAGEMENT ACTIVITIES TO DATE 19

3.2.1 OVERARCHING THEMES 19

3.2.2 AREAS OF FOCUS AND SHARED COMMITMENTS WITH WABIGOON LAKE OJIBWAY NATION 20

3.3 PLAN FOR FUTURE INDIGENOUS ENGAGEMENT AND PARTICIPATION 22

4. PUBLIC AND INTERESTED PARTIES ENGAGEMENT 24

4.1 SUMMARY OF PUBLIC AND INTERESTED PARTIES ENGAGEMENT ACTIVITIES TO DATE 24

4.2 IDENTIFYING INTERESTED PARTIES 25

4.3 KEY ISSUES RAISED 27

4.3.1 OVERARCHING THEMES 27
4.3.2 AREAS OF FOCUS AND SHARED COMMITMENTS WITH THE TOWNSHIP OF IGNACE 29
4.4 ENGAGEMENT WITH NON-REGULATING FEDERAL AND PROVINCIAL DEPARTMENTS, MINISTRIES AND AGENCIES 31
4.5 PLAN FOR FUTURE PUBLIC AND INTERESTED PARTIES ENGAGEMENT 38
5. REGIONAL ASSESSMENT 39
6. STRATEGIC ASSESSMENT 40
6.1 STRATEGIC ASSESSMENT OF CLIMATE CHANGE 40
B. PROJECT INFORMATION 41
7. PURPOSE OF AND NEED FOR THE PROJECT AND POTENTIAL BENEFITS 41
8. RELATED PROVISIONS IN THE *PHYSICAL ACTIVITIES REGULATIONS* 43
9. ACTIVITIES, INFRASTRUCTURE, STRUCTURES AND PHYSICAL WORKS 44
9.1 OVERVIEW 44
9.2 CURRENT SITE INFRASTRUCTURE 50
9.3 PRELIMINARY LIST OF PROJECT ACTIVITIES PRIOR TO INITIAL LICENCE 50
9.4 SITE PREPARATION ACTIVITIES (TO BE UNDERTAKEN AS PART OF THE INITIAL LICENCE APPLICATION) 51
9.4.1 OVERVIEW OF THE ACTIVITIES, INFRASTRUCTURE AND PHYSICAL WORKS 51
9.4.2 LISTING OF SITE PREPARATION PHASE ACTIVITIES 51
9.5 CONSTRUCTION 57
9.5.1 OVERVIEW ACTIVITIES, INFRASTRUCTURE AND PHYSICAL WORKS 57
9.5.2 LISTING OF MAJOR CONSTRUCTION ACTIVITIES 57
9.6 OPERATIONS 65
9.6.1 OVERVIEW ACTIVITIES, INFRASTRUCTURE AND PHYSICAL WORKS 65
9.6.2 LIST OF MAJOR ACTIVITIES DURING OPERATIONS 66
9.7 DECOMMISSIONING AND CLOSURE 68
9.7.1 OVERVIEW ACTIVITIES, INFRASTRUCTURE AND PHYSICAL WORKS 68
9.7.2 LISTING OF MAJOR ACTIVITIES FOR DECOMMISSIONING AND CLOSURE 69
10. ESTIMATED MAXIMUM PRODUCTION CAPACITY OF THE PROJECT 73
10.1 DESCRIPTION OF PRODUCTION PROCESSES 73

11. ANTICIPATED SCHEDULE 75

12. ALTERNATIVES TO AND ALTERNATIVE MEANS 76

12.1 ALTERNATIVES TO THE PROJECT 76

12.1.1 ALTERNATIVES ASSESSED 76

12.1.2 RATIONALE FOR SELECTING THE PREFERRED ALTERNATIVE 85

12.1.3 SUMMARY OF PUBLIC CONSULTATION AND INDIGENOUS ENGAGEMENT 89

12.1.4 SUMMARY OF ALTERNATIVES TO THE PROJECT 94

12.2 POTENTIAL ALTERNATIVE MEANS 94

C. LOCATION INFORMATION AND CONTEXT 95

13. PROPOSED LOCATION 95

13.1 PROPOSED GEOGRAPHIC COORDINATES 95

13.2 DESCRIPTION OF THE LAND AND SURROUNDING AREAS 95

14. BIOPHYSICAL ENVIRONMENT 98

14.1 METEOROLOGICAL ENVIRONMENT 100

14.1.1 CURRENTLY AVAILABLE BASELINE DATA 100

14.1.2 PLANNED WORK 106

14.2 GEOLOGY AND GEOLOGICAL HAZARDS 106

14.2.1 CURRENTLY AVAILABLE BASELINE DATA 106

14.2.2 SUMMARY 110

14.2.3 PLANNED WORK 111

14.3 GEOCHEMISTRY OF MINED OR EXCAVATED MATERIALS 112

14.3.1 CURRENTLY AVAILABLE BASELINE DATA 112

14.3.2 PLANNED WORK 113

14.4 TOPOGRAPHY, SOIL AND SEDIMENT 113

14.4.1 CURRENTLY AVAILABLE BASELINE DATA 113

14.4.2 PLANNED WORK 115

14.5 ATMOSPHERIC, ACOUSTIC AND VISUAL ENVIRONMENT 115

14.5.1 CURRENTLY AVAILABLE BASELINE DATA 115

14.5.2 PLANNED WORK 116

14.6 GROUNDWATER AND SURFACE WATER 117

14.6.1 CURRENTLY AVAILABLE BASELINE DATA 117

14.6.2 PLANNED WORK 124
14.7 VEGETATION, RIPARIAN AND WETLAND ENVIRONMENT 125
14.7.1 CURRENTLY AVAILABLE BASELINE DATA 125
14.7.2 PLANNED WORK 128
14.8 FISH AND FISH HABITAT 128
14.8.1 CURRENTLY AVAILABLE BASELINE DATA 128
14.8.2 PLANNED WORK 130
14.9 BIRDS, MIGRATORY BIRDS AND THEIR HABITAT 130
14.9.1 CURRENTLY AVAILABLE BASELINE DATA 130
14.9.2 PLANNED WORK 133
14.10 TERRESTRIAL WILDLIFE AND WILDLIFE HABITAT 134
14.10.1 CURRENTLY AVAILABLE BASELINE DATA 134
14.10.2 PLANNED WORK 137
14.11 SPECIES AT RISK AND THEIR HABITAT 137
14.11.1 CURRENTLY AVAILABLE BASELINE DATA 137
14.11.2 PLANNED WORK 139
14.12 CLIMATE CHANGE 139
14.12.1 CURRENTLY AVAILABLE BASELINE DATA 139
14.12.2 PLANNED WORK 140
14.13 AMBIENT RADIOACTIVITY 140
14.13.1 CURRENTLY AVAILABLE BASELINE DATA 140
14.13.2 PLANNED WORK 143
15. HEALTH, SOCIAL & ECONOMIC CONTEXT 144
15.1 CURRENTLY AVAILABLE BASELINE DATA FOR HEALTH CONDITIONS 146
15.1.1 CURRENTLY AVAILABLE BASELINE DATA 146
15.1.2 PLANNED WORK 148
15.2 SOCIAL DETERMINANTS OF HEALTH 148
15.2.1 CURRENTLY AVAILABLE BASELINE DATA 148
15.2.2 PLANNED WORK 149
15.3 ACCESS TO COMMUNITY HEALTH CARE 150
15.3.1 CURRENTLY AVAILABLE BASELINE DATA 150
15.3.2 PLANNED WORK 153

15.4 TRADITIONAL FOODS AND MEDICINES 153
15.4.1 CURRENTLY AVAILABLE BASELINE DATA 153
15.4.2 PLANNED WORK 154
15.5 POPULATION AND DEMOGRAPHICS 154
15.5.1 CURRENTLY AVAILABLE BASELINE DATA 154
15.5.2 SUMMARY 158
15.5.3 PLANNED WORK 159
15.6 COMMUNITY AND CULTURE 159
15.6.1 CURRENTLY AVAILABLE BASELINE DATA 159
15.6.2 SUMMARY 164
15.6.3 PLANNED WORK 165
15.7 INFRASTRUCTURE AND SERVICES 165
15.7.1 CURRENTLY AVAILABLE BASELINE DATA 165
15.7.2 SUMMARY 169
15.7.3 PLANNED WORK 170
15.8 NON-INDIGENOUS LAND AND RESOURCE USE 170
15.8.1 CURRENTLY AVAILABLE BASELINE DATA 170
15.8.2 SUMMARY 173
15.8.3 PLANNED WORK 173
15.9 ECONOMIC CONDITIONS 173
15.9.1 CURRENTLY AVAILABLE BASELINE DATA 173
15.9.2 SUMMARY 180
15.9.3 PLANNED WORK 181

D. INDIGENOUS, FEDERAL, PROVINCIAL, TERRITORIAL, AND MUNICIPAL INVOLVEMENT AND EFFECTS 182

16. FINANCIAL SUPPORT FROM FEDERAL AUTHORITIES 182

17. FEDERAL LAND THAT MAY BE USED 183

18. INDIGENOUS, FEDERAL AND PROVINCIAL ENVIRONMENTAL APPROVALS 184
18.1 WABIGOON LAKE OJIBWAY NATION'S REGULATORY ASSESSMENT AND APPROVALS PROCESS 184
18.2 FEDERAL IMPACT ASSESSMENT AND LICENSING 184
18.3 OTHER FEDERAL APPROVALS 186

18.4 POTENTIAL PROVINCIAL APPROVALS 187
18.5 CANADIAN CODES AND STANDARDS 190
18.6 SAFEGUARDS 190
18.7 INTERNATIONAL GUIDANCE 191
E. POTENTIAL EFFECTS OF THE PROJECT 192
19. DESCRIPTION OF ANY CHANGES TO COMPONENTS OF THE ENVIRONMENT THAT ARE WITHIN THE LEGISLATIVE AUTHORITY OF PARLIAMENT 192
19.1 OTHER LEGISLATIVE REQUIREMENTS AND APPLICATION OF PRECEDENTS 193
19.2 IDENTIFICATION OF POTENTIAL EFFECTS, PATHWAYS OF CHANGE AND RISK SCREENING 194
19.2.1 VALUED COMPONENTS, INTERMEDIATE COMPONENTS, MEASUREMENT INDICATORS AND ASSESSMENT ENDPOINTS 195
19.2.2 METHODS 201
19.2.3 PATHWAYS OF CHANGE AND PRELIMINARY RISK ASSESSMENT SCREENING 205
19.3 CONCLUSIONS OF PATHWAYS OF CHANGE AND PRELIMINARY RESIDUAL EFFECTS RISK SCREENING 248
20. POTENTIAL CHANGES TO THE ENVIRONMENT ON FEDERAL LANDS OR LANDS OUTSIDE ONTARIO 250
21. POTENTIAL EFFECTS ON ANISHINAABE PEOPLE OF WABIGOON LAKE OJIBWAY NATION AND OTHER INDIGENOUS GROUPS IDENTIFIED IN SECTION 3 251
21.1 VALUED COMPONENTS OF INTEREST TO WABIGOON LAKE OJIBWAY NATION AND OTHER INDIGENOUS GROUPS THAT MAY BE AFFECTED BY THE CARRYING OUT OF THE PROJECT 251
21.2 INITIAL PROJECT DESCRIPTION CONCLUSIONS FOR POTENTIAL EFFECTS ON WABIGOON LAKE OJIBWAY NATION'S ANISHINAABE PEOPLE AND OTHER INDIGENOUS PEOPLES 252
22. ESTIMATE OF GREENHOUSE GAS EMISSIONS 255
23. LIST OF POTENTIAL WASTE AND EMISSIONS 256
24. ENVIRONMENTAL MANAGEMENT SYSTEM 260
25. OVERALL CONCLUSIONS AND PATH FORWARD 261
F. SUMMARY 263
REFERENCES 264

APPENDICES

APPENDIX A: LICENSING APPENDIX

APPENDIX B: ENGAGEMENT APPENDIX

APPENDIX C: CONCORDANCE TABLE

APPENDIX D: CHOOSING A WAY FORWARD: THE FUTURE MANAGEMENT OF CANADA'S USED NUCLEAR FUEL

APPENDIX E: COMMITMENTS MADE IN THE INITIAL PROJECT DESCRIPTION

LIST OF TABLES

Table 1.1: Project Name, Sector and Location 10
Table 2.1: Proponent Information 13
Table 3.1: Engagement with Indigenous Peoples to Support Site Selection 18
Table 3.2: Overarching Themes of Key Issues Raised in Indigenous Engagement 20
Table 4.1: Communities, Organization and Select Individuals Expressing Interest in the Adaptive Phased Management 26
Table 4.2 Roles and Engagement with Federal and Provincial Departments, Ministries and Agencies 32
Table 9.1: Preliminary List of Project Facilities 48
Table 9.2: Activities During Site Preparation Phase 52
Table 9.3: Activities During Construction 57
Table 9.4: Activities During Operations 66
Table 9.5: Activities During Decommissioning 69
Table 11.1: Assumed Project Phases and Planning Timelines 75
Table 12.1: Features for Option 1—Deep Geological Disposal in the Canadian Shield 77
Table 12.2: Features for Option 2—Storage and Nuclear Reactor Sites 79
Table 12.3: Features for Option 3—Centralized Storage, Above or Below Ground 81
Table 12.4: Features for Option 4—Adaptive Phased Management 83
Table 12.5: Potential Alternative Means for the Project 94
Table 14.1: Climate Normals Data—Dryden (1981 to 2010) 102
Table 14.2: Precipitation Normals Data—Dryden (1981 to 2010) 103
Table 14.3: Wind Normals Data—Dryden (1981 to 2010) 104
Table 14.4: Meteorological Observation Station Data (July 2022 to June 2023) 105
Table 14.5: Summary of Average Major Oxides in Rock Types of IG_BH02 112
Table 14.6: Birds Detected Within and Surrounding the Project Site 132
Table 15.1: Community Profiles of First Nations and Métis Communities 160
Table 18.1: Canadian Nuclear Safety Commission Regulatory Documents Applicable to the Project 185
Table 18.2: Other Potential Federal Permits and Approvals for the Project 186
Table 18.3: Potential Provincial Permits, Approvals or Authorizations for the Project 188
Table 18.4: International Guidance Applicable to Safety Assessment 191

Table 19.1: Valued Components and Associated Measurement Indicators and Assessment Endpoints 196

Table 19.2: Definitions for Different Degree and Likelihood Ratings 204

Table 19.3: Risk Matrix 205

Table 19.4: Pathways of Change Screening for Intermediate and Valued Components 207

Table 19.5: Preliminary Residual Effects Risk Screening Associated with the Air Quality Intermediate Component 217

Table 19.6: Preliminary Residual Effects Risk Screening Associated with the Climate Change Valued Component 218

Table 19.7: Preliminary Residual Effects Risk Screening Associated with the Noise, Vibration and Light Intermediate Component 220

Table 19.8: Preliminary Residual Effects Risk Screening Associated with the Hydrogeology Intermediate Component 222

Table 19.9: Preliminary Residual Effects Risk Screening Associated with the Hydrology Intermediate Component 225

Table 19.10: Preliminary Residual Effects Risk Screening Associated with the Surface Water Quality Intermediate Component 226

Table 19.11: Preliminary Residual Effects Risk Screening Associated with the Surface Water Quality Intermediate Component 228

Table 19.12: Preliminary Residual Effects Risk Screening for the Fish and Fish Habitat Valued Component 231

Table 19.13: Preliminary Residual Effects Risk Screening for the Vegetation, Riparian and Wetland Environments Valued Components 234

Table 19.14: Preliminary Residual Effects Risk Screening for the Migratory and Species at Risk Bird Valued Component 238

Table 19.15: Preliminary Residual Effects Risk Screening for Terrestrial Wildlife and Wildlife Habitat Valued Component 241

Table 19.16: Preliminary Residual Effects Screening for Non-Indigenous Health Conditions 244

Table 19.17: Preliminary Residual Effects Screening for Non-Indigenous Social Conditions 247

Table 19.18: Preliminary Residual Effects Risk Screening Results 249

Table 21.1: First Nations, Preliminary Valued, Components, Measurement Indicators, Assessment Endpoints and Components that Could Influence or Inform Their Assessment 252

Table 23.1: List of Potential Waste and Emissions 257

LIST OF FIGURES

Figure 1.1: Project Location 11
Figure 1.2: Regional Communities 12
Figure 9.1: Currently Proposed Conceptual Site Plan 45
Figure 9.2: Currently Proposed Conceptual Site Plan - Satellite 46
Figure 9.3: Illustration of Generic Project Site Layout (Surface and Underground) 47
Figure 13.1: Land Tenure and Land Use 97
Figure 14.1: Surface Bedrock Geology 109
Figure 14.2: Examples of Granodiorite-tonalite at the Project site 110
Figure 14.3: Typical Landscape of the Wabigoon Lake Ojibway Nation and Ignace Area 116
Figure 14.4: Results from Borehole Hydraulic Packer Testing, Reported as Transmissivities (m^2/s) 118
Figure 14.5: Summary of Results from Opportunistic Groundwater, Porewater, and Long-Term Monitoring Groundwater Samples 120
Figure 14.6: Local Watersheds and Water Flow Directions 122
Figure 14.7: Watersheds, Waterbodies and Watercourses 123
Figure 14.8: Wetlands and Low-lying Areas 127
Figure 14.9: The Annual Outdoor Effective Dose (μSv) from Cosmic Radiation for Canada and the United States 141
Figure 15.1: Bait Harvest Areas, Registered Traplines, Bear Management Areas and Ontario Trail Network 172
Figure 19.1: Source – Pathway – Environmental or Social Component 201
Figure 19.2: Pathway of Change Evaluation Process 202

ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
µSv	microsievert
AECL	Atomic Energy of Canada Limited
AHM	Aquatic Habitat Mapping
ALARA	as low as reasonably achievable
APM	Adaptive Phased Management
Bq	becquerels
Bq/m^3	becquerel per cubic metre
CD	Census Division
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
cm	centimetre
CNSC	Canadian Nuclear Safety Commission
COPC	Contaminant of Potential Concern
CSA	Canadian Standards Association Group (formerly Canadian Standards Association)
CSWB	Community Safety and Well-Being
DFO	Fisheries and Oceans Canada
DGR	Deep Geological Repository
DRHC	Dryden Regional Health Centre
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
eDNA	Environmental Deoxyribonucleic Acid
ERMA	Excavated Rock Management Area
FZ	fracture zone
GBA Plus	Gender-based Analysis Plus
GHG	Greenhouse gas
ha	hectare
HC	Health Canada
HHERA	Human Health and Ecological Risk Assessment
IA	Impact assessment
IAA	*Impact Assessment Act*

IAAC	Impact Assessment Agency of Canada
IG HCF	hydraulically conductive feature
ILW	Intermediate-level waste
IPD	Initial Project Description
KDSB	Kenora District Services Board
km	kilometre
km^2	square kilometre
kt	kiloton
kv	kilovolt
L/day	litre per day
LLW	Low-level waste
LSB	Local Service Board
m	metre
m^2/s	square metre per second
m^3	cubic metre
m^3/day	cubic metre per day
MBCA	*Migratory Birds Convention Act, 1994*
MBCHCH	Mary Berglund Community Health Centre Hub
mbgs	metres below ground surface
MECP	Ontario Ministry of the Environment, Conservation, and Parks
ML	Magnitude utilized in the Richter Scale
mm	millimetre
mmol/kgw	millimoles per kilogram of water
mN	magnitude utilized in the Nuttli Scale
mSv	milliesievert
MW	megawatt
MNR	Ontario Ministry of Natural Resources
NFWA	*Nuclear Fuel Waste Act*
NLCA	*Nuclear Liability and Compensation Act*
NRCan	Natural Resources Canada
NSCA	*Nuclear Safety and Control Act*
NWHU	Northwestern Health Unit

NWMO	The Nuclear Waste Management Organization
OMA	Organics Management Area
Project	Adaptive Phased Management Deep Geological Repository Project
PYLL	Potential Years of Life Lost
RAAP	Regulatory Assessment and Approval Process
REGDOC	Regulatory Documents
SAR	Species at Risk
SARA	*Species at Risk Act*
STEM	Science, technology, engineering and mathematics
SWH	Significant Wildlife Habitat
UFC	Used Fuel Container
UFPP	Used Fuel Packaging Plant
UFTP	Used Fuel Transportation Packages
µSv	Microsievert
VC	Valued Component
Wabigoon	Village of Wabigoon
WLON	Wabigoon Lake Ojibway Nation

i. Statutory Regulatory and Oversight Framework for the Project

Overview of the Project and Legislative Context

The Nuclear Waste Management Organization (NWMO) is proposing the site preparation, construction, operations, and decommissioning and closure of a Deep Geological Repository (DGR) for Canada's used nuclear fuel (herein referred to as the Project), which is part of Adaptive Phased Management (APM). The NWMO is required by the *Nuclear Fuel Waste Act* (NFWA) (Government of Canada 2002a) to implement APM, which was selected in 2007 by the Governor in Council as Canada's plan for the sustainable, safe, long-term management of used nuclear fuel, to protect people and the environment.

As proposed, the Project would contain and safely isolate approximately 5.9 million bundles of used nuclear fuel. The Project is expected to span approximately 160 years, including site preparation, construction, operation (about 50 years), decommissioning and closure, and post-closure monitoring. During this time, the Project would be Licenced by the Canadian Nuclear Safety Commission (CNSC), which will serve as the lifecycle regulator for all federally Licenced activities associated with the Project.

If implemented, the Project would:

- provide a permanent and safe disposal solution for Canada's used nuclear fuel
- support Canada's commitments to climate action and achieving net-zero by ensuring nuclear energy remains a sustainable and socially responsible energy source
- eliminate the need for future generations to actively manage used nuclear fuel, thereby reducing long-term environmental risks and advancing intergenerational equity in managing Canada's nuclear legacy

The Project will undergo an integrated impact assessment and initial licence application under the *Impact Assessment Act* (IAA) and the *Nuclear Safety and Control Act* (NSCA), consistent with the Government of Canada's objective of "one project, one assessment," thereby discharging both federal assessment and lifecycle regulator requirements in a single, coordinated process.

Social, Economic, and Cultural Oversight and Reporting for the Project

When the NFWA was developed in 2002, the regulatory framework in place focused primarily on environmental assessments rather than the broader scope of impact assessment now required under the IAA. To address the absence of a mechanism for assessing social, economic, and cultural impacts, the NFWA embedded these considerations within its governance provisions.

Under Sections 12 and 18 of the NFWA, the NWMO is required to assess, mitigate, and report on social, economic, and cultural effects for the life of the Project. This includes evaluating the effects of its activities on a community's way of life and its social, cultural, and economic aspirations, and providing mitigation measures for these effects. The NWMO has fulfilled this requirement by reporting every three years since 2007, when APM was selected as Canada's plan, and by submitting mitigation measures for all phases of the Project to the federal government as part of *Choosing a Way Forward*.

Building on this legislated foundation, the NWMO incorporated these principles into its site selection process and the associated Hosting Agreements for the Project, which further define commitments related to community well-being, economic participation, and cultural sustainability.

Advisory Council Established Under the *Nuclear Fuel Waste Act*

In accordance with the NFWA (2002), the NWMO's Board of Directors established an Advisory Council to provide independent advice on the organization's activities and to ensure that the views of the public, Indigenous organizations, and communities of interest are considered in a balanced and transparent manner. As the Project progresses and potentially affected Indigenous and regional representatives are identified, the NFWA requires their inclusion on the Council. The Advisory Council's role is to advise on the quality, openness, and soundness of NWMO's processes, and its findings are made public through study reports and triennial reports to the Government of Canada.

Efficiencies and Alignment with the *Impact Assessment Act*

The integration of requirements under the NFWA with those of the IAA provides opportunities to achieve efficiencies and reduce regulatory duplication, consistent with the Impact Assessment Agency of Canada's *Operational Policy Statement* (IAAC 2022) on proportionality and risk. As the NWMO is already legislatively required under the NFWA to assess, mitigate, and report on social, economic, and cultural effects for the life of the Project, the residual risk of overlap with IAA-mandated factors is considered low. Given these established obligations, the NWMO submits that the prohibition outlined in Section 7 of the IAA should not apply to the ongoing development of social or economic programs with communities. Accordingly, programs are being addressed through the NFWA framework and associated Hosting Agreements, rather than through the scope of factors for the federal Impact Assessment.

Site Selection and Host Community Commitments

The NWMO launched its community-driven, consent-based site selection process for the Project in 2010, guided by a commitment that Canada's plan for used nuclear fuel could only proceed in an area that met rigorous safety standards and where communities were informed and willing to host the Project. The process also required that the Project be implemented in a way that supports community well-being, as defined by the potential host communities themselves.

Following a 14-year site selection process, extensive public engagement, and a comprehensive technical assessment demonstrating confidence in safety, the decision was made in November 2024 to locate the Project in the WLON and Ignace siting area. In July 2024, the Township of Ignace confirmed its willingness to host the Project, followed by WLON in November 2024 after a community-wide decision-making process open to all members. On November 28, 2024, the NWMO announced the selection of WLON and the Township of Ignace as the hosts for Canada's proposed deep geological repository for used nuclear fuel Project. This milestone marked the completion of more than a decade of rigorous scientific study and a community-driven, consent-based siting process, advancing the Project into the next phase of Canada's plan, which includes regulatory decision-making, impact assessment, and licensing.

The Project will bring lasting benefits to both communities, the surrounding region, and Canada as a whole over its approximately 160-year lifespan, including new employment opportunities, investments in community well-being, and initiatives aligned with priorities identified by the host communities. Both WLON and the Township of Ignace have entered into Hosting Agreements with the NWMO for the life of the Project. These agreements reflect Canada's commitment to working with informed and willing host communities. While WLON's agreement remains confidential, the Township of Ignace's agreement is publicly available on the Township's website. Its objective is to enable the community to support and facilitate the Project by building capacity in areas such as infrastructure, economic growth, social and cultural development, and governance. Both agreements also provides a framework for the two communities and the NWMO will work to fulfill their roles and responsibilities within the regulatory process.

Thus, in addition to meeting all statutory and regulatory requirements, oversight for the Project is also embedded within the Hosting Agreements. Through these agreements, the NWMO is contractually

obligated to meet all conditions established by both WLON and the Township of Ignace. The Hosting Agreements reflect the social, economic, and cultural aspirations of the host communities and include commitments related to ongoing engagement, participation in regulatory processes, governance, business development, and other priorities identified as important by each community. Together, these agreements serve as a governing mechanism for advancing the Project in a manner that upholds community well-being, transparency, and shared responsibility throughout its lifecycle.

Regulatory Framework and Wabigoon Lake Ojibway Nation Assessment Process

The Project is subject to multiple legislative and regulatory frameworks, including the NFWA, the IAA, and the NSCA. In addition, Wabigoon Lake Ojibway Nation is exercising its jurisdiction through its Regulatory Assessment and Approval Process (RAAP). The RAAP is WLON's regulatory process grounded in Anishinaabe law, values, and responsibilities, and reflects WLON's authority to review and decide on development within its territory.

Regulatory Oversight and Safety Framework

In regulating the Project, the CNSC applies the precautionary principle and a graded approach, meaning that the level of oversight and control is proportional to the potential risks associated with each activity. The CNSC will work collaboratively with the Impact Assessment Agency of Canada (IAAC) and other federal authorities, including Fisheries and Oceans Canada, Environment and Climate Change Canada, and Health Canada, to ensure a comprehensive assessment of potential environmental and health effects under the IAA.

The NWMO's Impact Statement, supported by technical studies and the submission of the initial licence application to the CNSC, will detail the Project's design and evaluate potential changes to air, water, land, plants, and animals, and will identify measures to prevent or mitigate harm. Under the NSCA, the NWMO must demonstrate application of the As Low As Reasonably Achievable (ALARA) principle to minimize exposures and releases, taking into account social, technical, economic, and policy considerations. The NWMO's impact assessment methodology will build upon these studies to evaluate potential changes and their significance, particularly as they relate to impacts on Indigenous Peoples.

Throughout the Project lifecycle, the NWMO must maintain and update its licensing basis, which outlines how health, safety, security, and environmental protection will be achieved. The licensing basis includes the safety case, which will evolve over time and incorporate site characterization data, safety assessment reports, and human health and ecological risk analyses. The safety case will demonstrate:

- the scientific, technical, and managerial foundations supporting safety
- the suitability of the site and facility design
- insights from natural analogues
- assessments of radiation and environmental risks
- the adequacy and quality of all safety-related work

At each licensing stage, the Township of Ignace, Anishinaabe peoples of WLON, potentially affected Indigenous groups, and the public will have opportunities to participate, including through public hearings.

If the Project receives approval under the IAA and an initial licence from the CNSC, both the IA decision statement and the CNSC licence will include enforceable environmental protection requirements, such as:

- limits on radioactive and hazardous releases to water and air

- obligations for environmental monitoring and public reporting
- emergency preparedness and response plans

The NWMO will also implement an Environmental Protection Program to monitor performance, ensure compliance, and support continuous improvement. When the operating licence is issued, the Project is expected to be designated a nuclear installation and will therefore be subject to financial security requirements under the *Nuclear Liability and Compensation Act* (NLCA).

In addition to the oversight provided by the lifecycle regulator, the CNSC, the NWMO will remain subject to the requirements of the NFWA for the life of the Project, maintaining transparency and accountability consistent with Canada's legislated approach to the long-term management of used nuclear fuel.

Canadian Nuclear Safety Commission Licensing Process

The CNSC regulates all stages of a Project's lifecycle under the NSCA via a comprehensive, risk-informed licensing system. This system governs site preparation, construction, operation, decommissioning, closure, and post-closure monitoring, applying oversight proportionate to the potential risks associated with each phase.

Consistent with CNSC regulatory guidance, including REGDOC-1.2.3 (*Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository*) and REGDOC-1.2.1 (*Guidance on Deep Geological Repository Site Characterization*), the NWMO is preparing an initial licence application for site preparation activities including construction of non-nuclear below surface infrastructure, supported by ongoing site characterization work. This work is being developed in a manner complementary to the Impact Statement, as the technical documents prepared under the CNSC's rigorous safety and environmental protection frameworks will directly inform key conclusions within the Impact Statement.

The initial licence application will be submitted as an annex to the Impact Statement, demonstrating integration between the impact assessment and licensing processes. Further information on the CNSC licensing process and its alignment with the Impact Statement is provided in Section E and Appendix A: Licensing Appendix.

Relationship of the Project to Adaptive Phased Management

The Project, as described here for consideration of approvals under the IAA and NSCA, is part of APM, the approach selected by the Government of Canada in 2007 as Canada's plan for the safe, long-term management of used nuclear fuel.

APM combines a technical method for the long-term containment and isolation of used nuclear fuel in a deep geological repository with a management system that is adaptive to scientific advances, societal priorities, and ongoing dialogue with Canadians and Indigenous Peoples. The Project represents the implementation of the technical component of APM and advances the broader management system through continuous engagement, transparency, and the integration of new knowledge over time.

Under the NFWA, the NWMO is responsible for implementing APM and reporting on its progress. These reports describe both technical performance and the social, cultural, and economic dimensions of the program, ensuring accountability to Canadians for the life of the Project. If, for technical reasons beyond its control, the NWMO could not implement APM, including the Project as approved by the Governor in Council, or if a new internationally recognized method for managing used nuclear fuel were developed, the NWMO would be required under the NFWA to report this and propose an alternative approach. In such a case, the Governor in Council would make a new decision under Section 20 of the NFWA.

The next section provides additional context regarding the NWMO's mandate and the Government of Canada's selection of APM as Canada's plan for the long-term management of used nuclear fuel.

ii. The Nuclear Waste Management Organization and Selection of Adaptive Phased Management

Canada's Nuclear Context

In Canada, nuclear power currently produces about 15 per cent of the country's electricity through 19 operable Canada Deuterium Uranium (CANDU) reactors at four generating stations (World Nuclear Association 2024). Canada has long been a leader in nuclear technology, exporting CANDU reactor systems and producing a significant share of the world's medical radioisotopes. Nuclear power provides a reliable baseload source of low-carbon electricity, supporting economic growth and improved human welfare. The Government of Canada has affirmed that nuclear energy will play a vital role in achieving national decarbonization and net-zero emissions by 2050 (Canada Energy Regulator 2022).

Origins of the NWMO and the *Nuclear Fuel Waste Act*

The NWMO was established as a result of a previous federal environmental assessment. Its creation was a key recommendation of the Seaborn Panel, an Environmental Assessment Panel chaired by Blair Seaborn, which reviewed Atomic Energy of Canada Limited's proposed concept for managing used nuclear fuel between 1989 and 1998. The Panel concluded that Canada required a dedicated organization to ensure long-term safety, environmental protection, and public confidence in the management of used nuclear fuel. This recommendation led to the creation of the NFWA in 2002 and, subsequently, the NWMO.

The NFWA established the legal framework for Canada's long-term management of used nuclear fuel and mandated the NWMO to develop and implement a comprehensive, integrated, and economically sound plan on behalf of Canadians and Indigenous Peoples.

Adaptive Phased Management and the Path to Site Selection

Canada's long-term plan for managing used nuclear fuel is known as APM. It combines a technical method, the construction and operation of a Deep Geological Repository (i.e., the Project) to safely contain and isolate used nuclear fuel, with a management system that emphasizes adaptability, ongoing learning, and sustained engagement with Canadians and Indigenous Peoples.

APM was developed by the NWMO through a three-year dialogue involving approximately 20,000 Canadians and Indigenous Peoples, including over 500 experts in the natural and social sciences. Three priorities emerged from this dialogue:

1. This generation, which has benefited from nuclear power, must take responsibility for managing the associated waste.
2. The approach should remain adaptable, allowing future generations to improve it as knowledge and priorities evolve.
3. Protecting people and the environment must remain the highest priority.

In 2005, the NWMO submitted *Choosing a Way Forward, The Future Management of Canada's Used Nuclear Fuel* (NWMO 2005), to the Minister of Natural Resources, recommending APM as Canada's plan. The Government of Canada accepted this recommendation in 2007 (Canada Gazette 2007).

To implement APM, the NWMO launched an open and consent-based site selection process in 2010 to identify an informed and willing host. Over 14 years, through technical evaluation, community dialogue, and partnership development, the Wabigoon Lake Ojibway Nation (WLON) and the Township of Ignace were confirmed in 2024 as hosts for the Project. Hosting Agreements signed with both communities formalize commitments to collaboration, participation in regulatory processes, and shared decision-making throughout the Project lifecycle.

The NWMO recognizes and values the leadership of WLON and the Township of Ignace, whose willingness to host the Project enables Canada to take responsibility for the safe, long-term management of its used nuclear fuel. The Project represents a pivotal step in implementing APM, protecting people and the environment for generations to come.

More information on the story of the NWMO, APM, and the Project can be found on the NWMO website: www.nwmo.ca.

iii. Wabigoon Lake Ojibway Nation Story

The NWMO appreciates the opportunity to include the following section, authored by Wabigoon Lake Ojibway Nation, in the IPD for the Project.

An introduction to Wabigoon Lake Ojibway Nation's Story from 2012–2024

When the Township of Ignace expressed interest in 2010 to be considered as a potential host for the Nuclear Waste Management Organization's Deep Geological Repository project, Wabigoon Lake Ojibway Nation (WLON) was involuntarily brought into the conversation. At that time, WLON leadership began considering what this proposal could mean for their People, the land, and future generations. Rather than react quickly or accept assumptions, WLON chose to lead their own learning. What followed was over a decade of Ceremony, knowledge sharing, and community-led reflection. This work was not only about understanding the project; it was about ensuring that any decision made was rooted in the responsibilities WLON has held since time immemorial. As a function of WLON's decision, WLON has agreed to host the DGR if it can be constructed and operated in a manner that is proven safe, that respects the environment and upholds Anishinaabe Values.

Over a Decade of Learning and Reconnection

Over the past 12 years WLON has walked its own path of learning. This work included technical studies, time on the land, and deep community reflection. Engagements with Knowledge Keepers (Elders, Spiritual Leaders, land users), community, and youth were central throughout the journey.

Gatherings were held on and off reserve with national and regional sessions in Thunder Bay, Winnipeg, and Calgary. Members travelled from across Canada and internationally to attend. While these gatherings were framed as opportunities to learn about the project, they became something more: spaces of healing, reconnection, and relationship-building. Some Members traced their family trees for the first time. Others, including survivors of the Sixties Scoop and those raised outside of WLON, returned to community. Many shared that these gatherings were the first time they had smudged, sung, or been in Ceremony. The learning was as much spiritual and cultural as it was technical. This process sparked healing, identity reclamation, and a return to relationships that colonial systems had tried to sever.

As WLON created space for open dialogue, Members were encouraged to share their concerns, ask difficult questions, and say no at any point if they believed the project was unsafe. This openness coupled with transparency and respect helped build the foundation for a decision that was truly community-driven.

A Community Decision

In preparation for a community decision, WLON held a dedicated session to walk Members through the proposed Hosting Agreement. WLON leadership made it clear: no benefit could ever override safety, and no agreement would move forward without the informed support of the People. Throughout this journey WLON's priority has remained the same: upholding Anishinaabe responsibilities to the land, air, water, and future generations, while ensuring that any development aligns with these responsibilities.

On November 16, 2024, WLON held a community referendum; 87.4% of participating Members expressed a willingness to proceed into regulatory phases of the project. This decision emerged from more than a decade of learning, Ceremony, and community leadership.

Looking Ahead

The story does not end here. As WLON moves into this next chapter, the momentum of the last 12 years remains strong. Members who reconnected through this process are stepping forward with renewed interest in leadership, research, and community development. Off-reserve Members are expressing a desire to return home, to raise their families on the land and contribute to the Nation's future. This journey has sparked deeper conversations around family, culture, and Nationhood. Many Members have begun pursuing skills and careers that align with WLON's priorities, including youth who now see themselves as part of long-term planning and decision-making for their Nation.

WLON's sovereignty and jurisdiction guide all decisions related to development within its territory. WLON continues to determine its path forward with NWMO in alignment with Anishinaabe laws, values, and responsibilities. WLON will continue to hold space for intergenerational learning, Ceremony, and critical dialogue. Every future step will reflect the Nation's inherent governance and the voices of its People.

WLON's Regulatory Assessment and Approval Process (RAAP)

Wabigoon Lake Ojibway Nation is exercising its jurisdiction through its RAAP. The RAAP is WLON's regulatory process grounded in Anishinaabe law, values, and responsibilities, and reflects WLON's authority to review and decide on development within its territory. Through RAAP, proposed projects are assessed against WLON-specific areas of interest and concern. Determinations hinge on safety, environmental respect, and alignment with Anishinaabe Values. WLON sets conditions, monitoring, remedies, and enforcement to uphold responsibilities to the land, air, water, and future generations. Participation in this process is determined by WLON in accordance with its own protocols. While WLON may choose to share information about the RAAP, its design and direction remain solely with WLON.

iv. Township of Ignace Story

The NWMO appreciates the opportunity to include the following section, authored by the Township of Ignace, in the IPD for the Project.

For over 15 years, the Township of Ignace has been actively engaged with the NWMO in the site selection process, with a shared vision that the Project will contribute to the community's long-term well-being. From the earliest conversations, community well-being has been a priority for both the people of Ignace and the NWMO.

There are many publications and resources presenting the community well-being goals of Ignace residents. The Hosting Agreement between the Corporation of the Township of Ignace and the NWMO is one resource that includes provisions designed to support capability and capacity building, guided by six foundational pillars: People, Economics and Finance, Infrastructure, Community and Culture, Natural Environment, and Governance. These principles, further defined through Community Studies, reflect Ignace's vision for a vibrant, resilient, and inclusive future.

As a key "anchor institution" in Ignace, the NWMO will act as a catalyst for positive change, leveraging its resources, expertise, and partnerships to help advance shared priorities in accordance with operational and regulatory requirements. Through a strong partnership, the NWMO and the Township of Ignace will advance a shared vision, one where the DGR Project supports economic diversification, community resilience, and the well-being of residents now and for generations to come.

v. Objectives and Overview

This document provides the information required in an *Initial Project Description* for a Designated Project, as outlined in Schedule 1 of the *Information and Management of Time Limits Regulations*. It describes the completed, ongoing, and planned studies that will support the IAAC and the *CNSC* in determining the information needed for the federal regulatory review and licensing of the Project under the IAA and the NSCA.The Project is a key component of Canada's plan for the safe, long-term management of used nuclear fuel and an important part of the country's transition to net-zero emissions. It will provide a permanent and safe disposal solution for used nuclear fuel, reduce long-term environmental risks, and ensure that nuclear energy continues to support Canada's climate commitments in a sustainable and socially responsible way. By removing the need for future generations to actively manage this waste, the Project advances intergenerational equity and strengthens Canada's clean energy future.

The *Cabinet Directive on Regulatory and Permitting Efficiency for Clean Growth Projects* therefore applies to this Project, reflecting its importance and alignment with national clean energy objectives. The NWMO supports this federal effort to advance regulatory efficiency while maintaining the highest standards of environmental protection, safety, and reconciliation.

Two previous environmental assessments for proposed deep geological repositories in Canada concluded that, with the application of appropriate mitigation, the technology is safe and acceptable. Building on these findings, this IPD incorporates mitigation measures, lessons learned and a strengthened commitment to reconciliation, ensuring Indigenous voices, rights, and perspectives are integrated into all aspects of the assessment and decision-making process.

The Project has been developed within an established federal legislative framework, including the NFWA and the NSCA and is supported by more than two decades of scientific research, technical development, and engagement with Canadians and Indigenous Peoples. As part of this framework, and as contractually committed, the Project will also be subject to WLON's assessment outcomes.

This IPD summarizes the scope of work, studies, and monitoring programs that will inform the Impact Statement and subsequent regulatory submissions. It also describes how the NWMO will evaluate the effectiveness of mitigation measures, apply adaptive management where needed, and continue advancing knowledge to ensure environmental protection and community well-being throughout all phases of the Project.

The IPD uses the data collected to date to provide an initial risk assessment of adverse effects, enabling the IAAC to make risk-informed decisions in developing the *Tailored Impact Statement Guidelines* (TISG) for the Project. This approach is consistent with the IAAC's *Operational Policy Statement*, which emphasizes that the development of project-specific guidelines should reflect the nature and complexity of the project, its environmental and social context, and the potential for effects on Indigenous peoples. The policy further indicates that the assessment should focus on key issues that are material and relevant to decision-making, using a risk-based approach that considers both the likelihood of an adverse effect and the degree of impact after mitigation.

To support the application of this policy, the NWMO has included a Commitments List with this IPD (Appendix E). The list outlines in-design mitigation measures and follow-up monitoring and mitigation commitments that can be confirmed at this stage, helping the IAAC tailor its guidelines based on a risk-informed approach.

An accompanying Engagement Appendix (Appendix B) further demonstrates the NWMO's understanding of key issues identified by potentially affected Indigenous groups and the public, including, and most notably, the host communities for the proposed Project, the Township of Ignace and the Anishinaabe people of WLON. The NWMO has been engaged in community learning and addressing concerns for more than 20 years, and this ongoing engagement continues to guide the design and planning of the Project.

vi. Concordance with Regulatory Requirements

A table of concordance, which cross references the information requirements identified in Schedule 1 of the Information and Management of Time Limits Regulation with the relevant section of this IPD containing this information, is shown in Appendix C: Concordance Table.

A. GENERAL INFORMATION

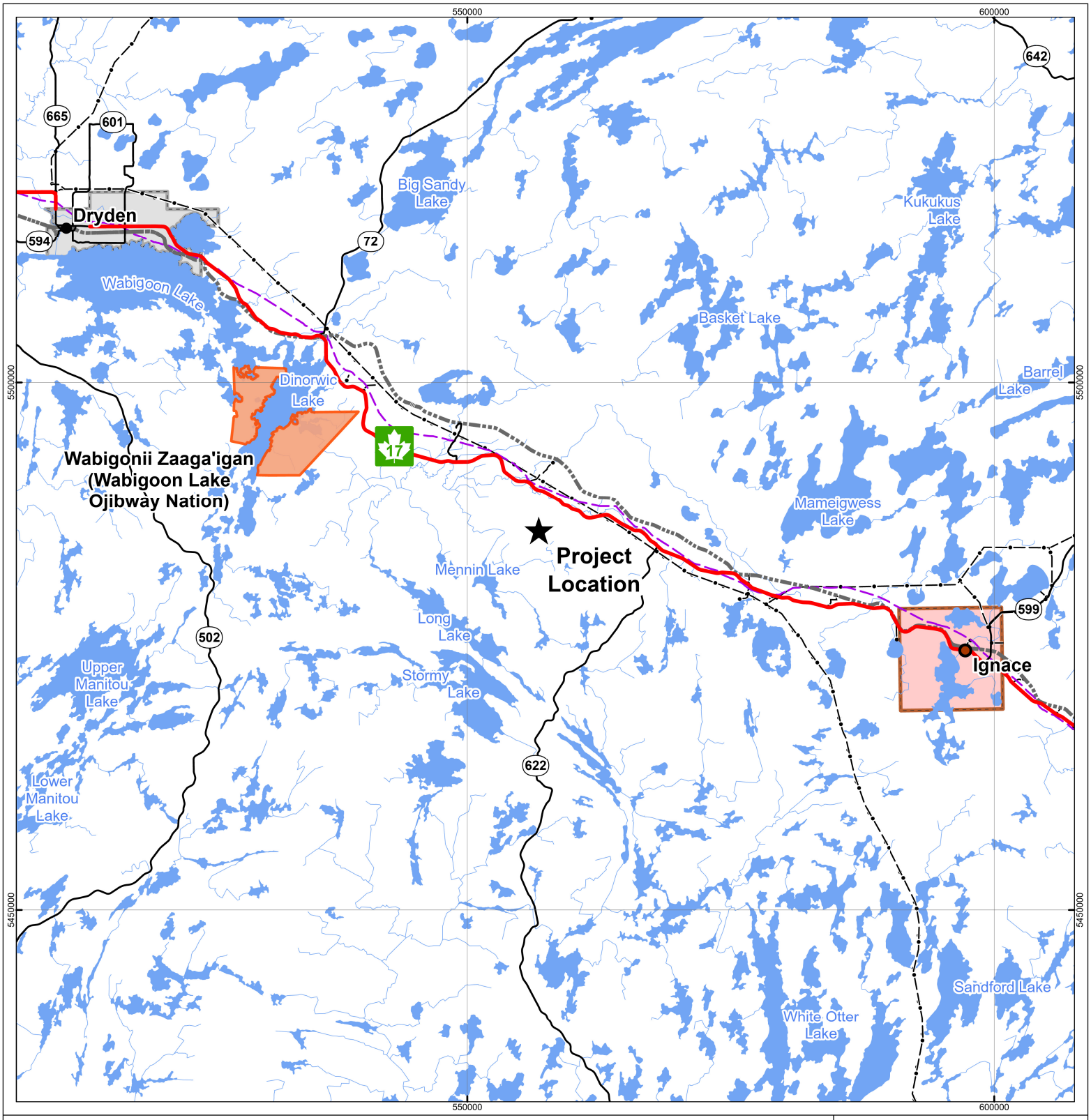
1. General Project Information

Table 1.1 provides the Project name, sector, type and location. The general Project location, regional communities, First Nations and Indigenous groups are displayed in Figure 1.1 and Figure 1.2, respectively.

Table 1.1: Project Name, Sector and Location

Project Name	Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project
Sector	Nuclear
Project Type	Nuclear Facility
Location	WLON and Ignace Area. The Project is located within WLON's territory, approximately 21 km southeast of the WLON reserve lands (Band #157), 12 km from the nearest WLON resident and 43 km northwest of the Township of Ignace (Ignace), Ontario, along Trans-Canada Highway 17. The Project site is on the Canadian Shield, about 240 km northwest of Lake Superior (Thunder Bay) (cross country).

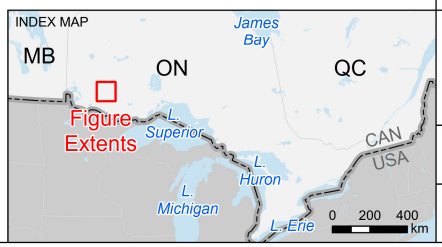
DGR = Deep Geological Repository; WLON = Wabigoon Lake Ojibway Nation.



LEGEND

Hosting Communities
- Wabigoon Lake Ojibway Nation
- Township of Ignace

- Project Location
- Community
- Municipal Boundary
- Highway 17
- Highway
- Railway
- Transmission Line
- Natural Gas Pipeline
- Watercourse
- Waterbody



REFERENCE

Data: CanVec, Government of Ontario, GEO
Projection: Universal Transverse Mercator
Datum: NAD 83
Coordinate System: UTM Zone 15N

OCT-10-2025

0 5 10 km

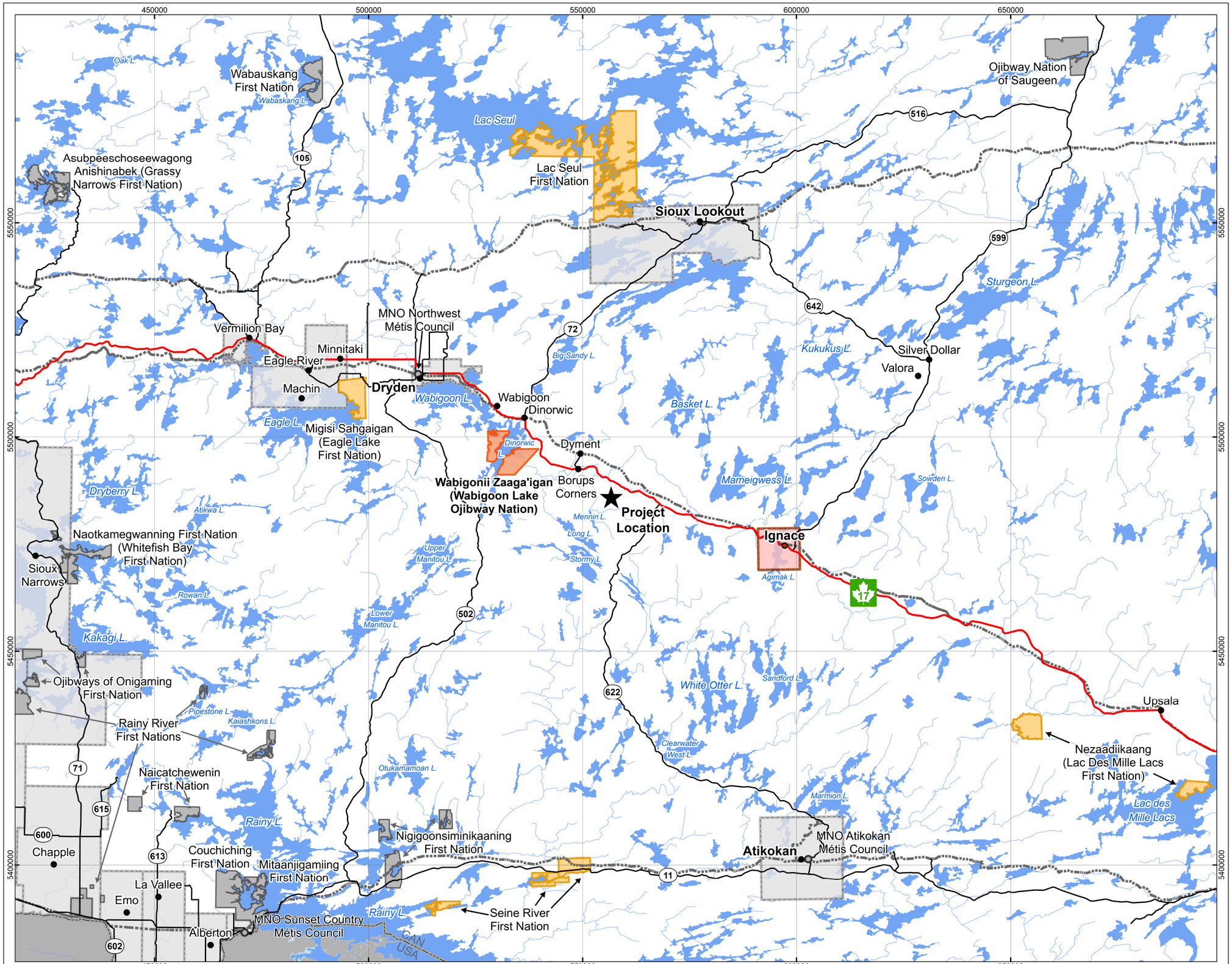
SCALE 1:500,000

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

TITLE

Project Location

FIGURE: 1.1



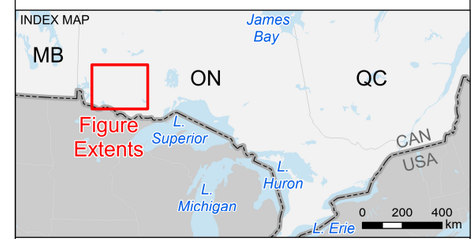
LEGEND

Hosting Communities
- Wabigoon Lake Ojibway Nation
- Township of Ignace

Potential Crown Consultation List Communities
- First Nation Reserve

Other Communities
- Community
- Northwestern Ontario Métis Community (Métis Nation of Ontario Region 1)
- Municipal Boundary
- First Nation Reserve

- Project Location
- Highway 17
- Highway
- Railway
- Watercourse
- Waterbody



REFERENCE

Data: CanVec, Government of Ontario, GEO, MNO, CIRNAC
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 15N

OCT-10-2025

0 10 20 30 km

SCALE 1:850,000

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

TITLE

Regional Communities

FIGURE: 1.2

2. Proponent Information

Table 2.1 provides the proponent's name, contact information and supporting consultant.

Table 2.1: Proponent Information

Proponent	Nuclear Waste Management Organization (NWMO) https://nwmo.ca
Executive Contact	Allan Webster Vice President, Regulatory Approvals Nuclear Waste Management Organization 22 St. Clair Avenue East, 4th floor Toronto, Ontario, Canada M4T 2S3 Email: awebster@nwmo.ca
Proponent Contact	Mackenzie Denyes, PhD., P.Geo., QP_{RA} Director, Impact Assessment & Licensing Nuclear Waste Management Organization 22 St. Clair Avenue East, 4th floor Toronto, Ontario, Canada M4T 2S3 Email: mdenyes@nwmo.ca Karine Glenn Director, Regulatory Affairs Nuclear Waste Management Organization 22 St. Clair Avenue East, 4th floor Toronto, Ontario, Canada M4T 2S3 Email: kglenn@nwmo.ca
Supporting Consultant	WSP Canada Inc.

3. Building Relationships with Anishinaabe Peoples of Wabigoon Lake Ojibway Nation and Other Indigenous Groups in Canada

Commitment to Dialogue and the Foundation of Adaptive Phased Management

For over 20 years, engagement with Indigenous Nations and Peoples has been central to the NWMO's work towards implementing APM. Through the NFWA, the NWMO is federally mandated to design and implement Canada's plan for the safe, long-term management of the country's used nuclear fuel. APM emerged as the plan through a three-year study and dialogue with Canadians, Indigenous Peoples and technical experts. The NWMO has continued that dialogue and remains committed to building and maintaining strong, lasting relationships with Indigenous Peoples, including ongoing relationships with national and provincial Indigenous organizations to ensure that continuous dialogue persists.

Legislated Engagement and Alignment with Federal Processes

As outlined in Section i, Statutory, Regulatory, and Oversight Framework, the Project is governed by multiple legislative instruments, including the NFWA, the IAA, and the NSCA. The NFWA establishes ongoing obligations for the NWMO to engage communities; assess and mitigate social, economic, and cultural effects; and report publicly on these outcomes throughout the life of the Project.

Federal Coordination through the Natural Resources Canada–Nuclear Waste Management Organization Memorandum of Understanding

A Memorandum of Understanding between Natural Resources Canada (NRCan) and the NWMO was signed on August 14, 2009. It clarifies the roles and responsibilities of the Crown, as represented by the Minister of Natural Resources, and the NWMO with respect to consultation with Indigenous communities, pursuant to the Government's duty to consult, and accommodate if necessary, and the NWMO's statutory obligations under the NFWA. As mentioned above, the NWMO is required under the NFWA to report to the Minister of Energy and Natural Resources every three years (i.e., in triennial reports) on the results of their engagements with communities. The NWMO are also required to report to NRCan annually on their Indigenous engagement activities under the NRCan-NWMO Memorandum of Understanding. Through engagement efforts since 2009, the NWMO conducted a diverse range of outreach activities, including open houses, presentations, interviews, and meetings. Conversations during this period covered a spectrum of topics, including Project safety, field studies, economic impacts, and the long-term vision of the communities involved.

Community-Driven Site Selection and Demonstration of Willingness

Following collaborative development, the site selection process development was finalized **in** 2010 and the approach published in the NWMO's report "*Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel*" (NWMO 2010). The siting process reflected the ideas, experience and best advice of a broad cross-section of Canadians and Indigenous Peoples who shared their thoughts on what an open, transparent, fair and inclusive process for making this decision would include. It was built on a set of guiding principles and was developed within the NWMO's ethical and social framework. The process was community driven and designed to ensure that above all, the site selected was safe, secure, and had informed and willing hosts. A principal of the siting process was that both the Indigenous host Nation and host municipal community must understand the Project and how they are likely to be impacted by the Project. As well, the local community must demonstrate that it is willing to accept the Project, through a process of their own choosing. In 2020, the NWMO narrowed that process to finally focus on two potential host sites in Ontario: the WLON and Ignace area and the Saugeen Ojibway Nation-South Bruce area.

Wabigoon Lake Ojibway Nation's Hosting Agreement and Regulatory Process

In November 2024, the Anishinaabe people of WLON voted to move forward from site selection into the regulatory decision-making phase of the Project. As part of this process, WLON entered into a Hosting Agreement with the NWMO, confirming its role as the most proximate First Nation community to the Project site and a willing, informed, and supportive host for the Project. The Hosting Agreement with WLON is confidential at the request of the Nation.

Through this grassroots demonstration of willingness and the signing of the Hosting Agreement, WLON has formally confirmed its decision to host the proposed Project for its full duration, pending the receipt of all necessary approvals and permits. This includes approval through WLON's Regulatory Assessment and Approval Process. The NWMO acknowledges with gratitude the willingness of the Anishinaabe people of WLON to proceed with the regulatory decision-making phase.

Broader Indigenous Engagement and Guiding Principles for Relationship-Building

The NWMO recognizes the importance of maintaining and strengthening relationships with all Indigenous groups that may be affected by the Project. In addition to its partnership with WLON, the most proximate First Nation to the Project site, the NWMO has established long-standing Learn More Agreements with several other First Nation and Métis communities in the regional area. These agreements have supported early engagement, the exchange of information, and opportunities for participation in studies and community learning related to the Project.

The NWMO is committed to ongoing communication, engagement, and participation with potentially affected Indigenous groups throughout the Impact Assessment and licensing processes. This commitment will be carried out in accordance with the NWMO's Reconciliation Policy and Indigenous Knowledge Policy, and through the specific actions and engagement plans described in Section 3.3 of this IPD. The NWMO will continue to build on the relationships that have been developed and is dedicated to cultivating new relationships where engagement has not yet occurred.

The NWMO has identified the importance of trust in relationships. The Council of Elders and Youth is an independent advisory body to the NWMO that provides support in the application of Indigenous Knowledge in the implementation of the Project and that provides advice on issues that could enhance the development and maintenance of good relations with Indigenous Nations. The Council of Elders and Youth has made significant contributions to the development of NWMO policies.

Applying the NWMO's learnings from Elders, knowledge holders, practitioners and First Nation members, the engagement and participation objectives for the Project with the Anishinaabe people of WLON and other potentially impacted Indigenous groups include:

- Amplifying and uplifting Indigenous voices and knowledge systems.
- Incorporating Indigenous perspectives and knowledge into Project planning and decision-making.
- Building a respectful relationship grounded in reciprocal truth, honesty and trust.
- Creating opportunities for equitable participation, collaboration and partnership.

The NWMO is dedicated to actively engaging with diverse Indigenous group populations, including women, men, youth, and Elders, to gather different viewpoints. Furthermore, the NWMO recognizes the ongoing risks faced by Indigenous women and girls and supports the National Inquiry into Missing and Murdered Indigenous Women and Girls. The NWMO will work to address the Calls for Justice, with particular attention to number 13, which pertains to extractive and development industries.

The Nuclear Wate Management Organization's Reconciliation Journey

The NWMO is on a Reconciliation Journey. In 2019, as part of the Journey and birthed through ceremony, a Reconciliation Policy was created which sets out how the organization will contribute to Reconciliation. Under the policy, the NWMO commits to engagement with Indigenous Peoples and communities, providing cultural awareness and Reconciliation training to staff and contractors, and annually publishing a Reconciliation implementation plan. Additionally, in 2016 and updated in 2020, the NWMO published an Indigenous Knowledge Policy to ensure it is guided by a clear set of principles as it works with communities and Indigenous Knowledge holders. Under that policy, the NWMO commits to considering Indigenous Knowledge in its work and respecting the value of what both Indigenous Knowledge systems and western science methodologies can contribute to Project development and decision-making processes. In 2023 the NWMO published a Water Statement that commits the NWMO to water protection by considering how the agency of water (from surface to underground) may be in relationship with the Project and its surrounding area. The Water Statement is a sister document to the NWMO's Environmental Responsibility Statement.

During the site selection process for the Project, First Nation and Métis communities clearly expressed the need to understand how the DGR and its future operations could affect the environment, particularly the interconnected systems of water. Communities emphasized the importance of approaching this question from a worldview that extends beyond contemporary scientific frameworks. In response, the NWMO formed an internal working group made up of staff with expertise in both Indigenous Knowledge and western science. Together, they developed an integrative narrative that explored the relationship between water and the DGR's multiple-barrier system—rock, clay, and copper. This presentation was created in collaboration with Anishinaabe peoples of WLON and the Council of Elders and Youth, so that it was grounded in First Nation perspectives and accessible to those seeking to learn more about the Project.

Guidance from the Council of Elders and Youth informed the NWMO's polices and commitments, which are deeply embedded in all work undertaken at the NWMO, from human resource interview questions to technical studies and assessments for regulatory review and relied on herein. The NWMO publishes to its website a Reconciliation Evaluation Report for full transparency on the NWMO's progress towards Reconciliation (NWMO 2022).

The NWMO will continue to apply Indigenous Knowledge to both technical safety and community well-being aspects of the Project when given permission to do so by the Indigenous Knowledge holders. In addition to building capacity and awareness within the NWMO and its contractors, as of 2022 the NWMO had contributed millions of dollars in investment in its Indigenous partners to support their communities.

Other highlights from the NWMO's Reconciliation Journey and efforts to uphold and respect Indigenous Knowledge are outlined below:

- **2018**
  - provided cultural awareness training to 85 percent of NWMO staff
  - finalized Reconciliation Statement through Indigenous ceremony
- **2019**
  - published Reconciliation Policy
  - developed and delivered a Reconciliation Training Program
  - developed a corporate Reconciliation baseline assessment tool
  - enhanced sponsorships and donations program to include a focus on Reconciliation
  - continued to communicate the NWMO's Reconciliation program with communities involved in the site selection process
  - began assessment of the NWMO policies and procedures against Reconciliation assessment tool

- **2020**
  - enhanced policies and procedures to address Reconciliation
  - enhanced procurement program to include an Indigenous strategy
  - assessed corporate Reconciliation baseline and developed a Reconciliation measurement matrix
- **2021**
  - continued to enhance Reconciliation Training Program to include unconscious bias training
  - included Indigenous Knowledge in-water protection plans
  - applied Reconciliation assessment tool to regional engagement strategies
  - embedded Reconciliation within corporate culture
- **2022**
  - enhanced Reconciliation Training Program to include learning specific to Treaties and Métis peoples
  - publicly released the first annual Reconciliation Report
  - applied the Reconciliation assessment tool to governance as part of the NWMO's Management System transformation
  - expanded Reconciliation Training Program to communities and external partners
- **2023**
  - continued leveraging the Reconciliation assessment tool to review the NWMO policies
  - rolled out Reconciliation tool kit to complement existing learning session
  - held the sixth annual Indigenous Knowledge and Western Science workshop
  - released Water Statement
- **2024**
  - established an internal Reconciliation working group that met quarterly
  - created a tracking matrix to track the implementation and limitations of policy commitments on Indigenous Knowledge and Reconciliation within prioritized work streams such as IA, sustainability, engineering and design, social safety and willingness framework
  - expanded Reconciliation assessments to include the Sustainability Statement and Water Statement
  - co-created a Water Statement implementation plan that incorporates Indigenous Knowledge
  - worked with Human Resources to assess the effectiveness of incorporating the Indigenous Knowledge and Reconciliation policies into Human Resources practices and procedures
  - advanced Reconciliation learning with the NWMO's existing external relationships, including those in siting areas

3.1 Summary of Indigenous Engagement Activities to Date

As required by the NFWA and the government-selected APM approach, the NWMO's Indigenous engagement program was initiated long before the current regulatory phase of the Project. Indigenous engagement activities prior to the site selection decision, focused on facilitating understanding of the Project, particularly related to safety, geoscience, land use, and how hosting the Project may contribute to community well-being for many generations to come. A key objective of the program was to ensure the potential host communities of the Project were willing and informed, and that a Hosting Agreement for the life of the Project was in place.

Between 2012 and 2024, the NWMO engaged extensively with WLON and other Indigenous Nations and organizations in the regional area surrounding the Project. Engagement also included outreach to Nations located at greater distances, including those who expressed an interest in learning about the Project, even where the potential for direct impacts is low.

Engagement with Indigenous Peoples Before Site Selection Decision

The NWMO's engagement with WLON prior to the site selection decision resulted in WLON deciding to become a willing host and WLON signing a Hosting Agreement with the NWMO.

In addition to WLON, the following outlines the Indigenous communities and organizations within the area of the Project site with whom the NWMO established Learn More Agreements to support Indigenous engagement prior to the site selection decision, as summarized in Table 3.1, which identifies when formal engagement was initiated. Engagement activities between 2012 and 2022 were documented through annual reports submitted to NRCan as outlined in the 2009 Memorandum of Understanding and through triennial reports submitted in accordance with the NFWA. In 2017/18, NWMO offered multi-year funding support for regional Traditional Knowledge (TK) studies. Several Indigenous Communities accessed this funding, with some having completed their studies while others are continuing their work. As part of the broader siting process, the NWMO undertook site characterization activities and was designated by the provincial Crown as the duty-to-consult delegate for the borehole drilling program. Consultation on the public record included engagement with WLON, Eagle Lake First Nation, Seine River First Nation, Lac des Mille Lacs First Nation, Lac Seul First Nation, the Métis Nation of Ontario, and the Ojibway Nation of Saugeen. Key concerns raised included potential environmental effects, impacts on Indigenous rights and traditional territories, and the importance of meaningful participation and respect for TK in project planning.

Table 3.1: Engagement with Indigenous Peoples to Support Site Selection

Indigenous Community and Organization	Date when the NWMO Initiated Formal Engagement
Aboriginal People of Wabigoon	First engaged on October 24, 2015, and signed a Learn More agreement in 2018 (expired early 2025).
Dryden Native Friendship Centre	First engaged on March 16, 2020, and signed a Learn More agreement in 2020 (expires end of March 2026).
Eagle Lake First Nation	First engaged on May 10, 2011, and signed a Learn More agreement on December 21, 2017 (expired August 2022).
Grand Council Treaty #3	First engaged on October 4, 2022, through a relationship agreement (expired at the end of March 2025).
Lac Des Milles Lac First Nation	First engaged on September 30, 2015, and signed a Learn More agreement on April 28, 2016 (expired end of 2024).
Lac Seul First Nation	First engaged on April 20, 2012, and signed a Learn More agreement on September 21, 2017 (expired end of 2024).
Naotkamegwanning First Nation	First engaged on October 19, 2016, and signed a Learn More agreement in 2021 (expired end of 2024).
Nigigoonsiminikaaning First Nation	Signed a Learn More Agreement in 2018 (expired end of 2024).
Northwestern Ontario Métis Community, Northwest Métis Council (formally Métis Nation of Ontario Region 1):	First engaged on October 19, 2016, and signed a Learn More agreement in 2021 (expired end of 2024).

Indigenous Community and Organization	Date when the NWMO Initiated Formal Engagement
Ojibway Nation of Saugeen	First engaged on April 27, 2016, and signed a Learn More agreement on September 12, 2018 (expired end of 2024).
Seine River First Nation	First engaged on April 20, 2012, and signed a Learn More agreement on August 25, 2016 (expired end of 2024).
Wabauskang First Nation	First engaged on November 24, 2021, and signed a Learn More agreement in 2021 (expired end of 2024).
Wabigoon Lake Ojibway Nation	In February 2014, a protocol agreement was signed between the NWMO and WLON which allowed engagement to begin, including an NWMO community open house held in April 2014. Engagement has continued since 2014. Multiple agreements followed until WLON entered into a final agreement with the NWMO in 2024.

NWMO = Nuclear Waste Management Organization; WLON = Wabigoon Lake Ojibway Nation.

Summary of Engagement Activities Post Site Selection to Present Day

After the site selection decision and through preparation of the IPD, the NWMO has worked with WLON to review and refine the language of the IPD through two opportunities to review and comment on the draft IPD and coauthor select sections. Through Chief and Council, WLON authored "Wabigoon Lake Ojibway Nation's Story", presented in Section iii.

The NWMO engaged on the IPD with Eagle Lake First Nation, Lac Des Mille Lac First Nation, Lac Seul First Nation, and Seine River First Nation on July 29, 2025, by sending each Nation a letter that included an update on the upcoming regulatory process for the Project and an invitation to meet and share information on the Project and to discuss next steps. A copy of each letter is provided in Appendix B. To date, there has been no formal response from any of the Nations to the letters).

3.2 Key Issues Raised in Engagement Activities to Date

3.2.1 Overarching Themes

Throughout more than a decade of engagement with WLON and other Indigenous groups and organizations, including engagement on the IPD (Appendix B), the NWMO has received important input across a broad range of topics. While concerns vary, Table 3.2 outlines the overarching themes that have consistently emerged.

Table 3.2: Overarching Themes of Key Issues Raised in Indigenous Engagement

Safety and Environmental
Concerns about the overall safety of the Project, including risks of radiological and conventional contamination to persons (external and internal), water, land, and air, and potential impacts on species important to Indigenous communities.
Emphasis on the need for the Project to focus on the following: • Protect water, land, air, and wildlife, with attention to species of cultural importance (e.g., moose, fish, wild rice, lynx). • Involve Indigenous Peoples in environmental data collection. • Consider habitat disturbance and the loss of access to lands used for traditional practices.
Social, Economic, and Health
Potential impacts on historical and current use of sovereign territories, that have cultural and economic importance.
Risk of disturbance to archaeological sites or other culturally significant lands.
The Project must meet key needs: • Respect and protect traditional lands, cultural sites, and values. • Create employment, training, and capacity-building opportunities. • Be carried out through fair collaboration and partnership with First Nations. • Support continuous monitoring and adaptation to emerging nuclear waste disposal technologies.
Indigenous Rights and Title
Concerns regarding unceded title, treaty rights, and how the Project may affect these rights.
Calls for clear processes regarding: • Compensation, recognition of jurisdiction, and equitable partnership. • Sustained employment and business development opportunities. • Participation in decision-making frameworks, including Indigenous assessments.
Future Adaptability
The importance of integrating new technologies over the life of the Project.
A desire for continued evaluation and responsiveness to evolving knowledge and First Nation values.

3.2.2 Areas of Focus and Shared Commitments with Wabigoon Lake Ojibway Nation

WLON continues to demonstrate strong leadership in shaping how the Project is planned, communicated, and integrated with Nation priorities. The participation of WLON in the Project has been both elevated and sustained, offering important insight into how the Project interacts with the Nation's values, responsibilities, governance, and rights. Anishinaabe peoples of WLON have shared perspectives that continue to shape the NWMO's understanding of key areas of importance. These perspectives reflect commitments that both parties acknowledge must be advanced through the IA process for the full lifecycle of the Project and ongoing collaboration and harmonization of studies. The following is not an exhaustive list, but rather a reflection of topics that are known at this time to

be particularly important to the Anishinaabe peoples of WLON and to the NWMO's continued planning.

All information shared by WLON is understood to be subject to the Nation's data governance protocols. A joint WLON–NWMO Data Governance Subcommittee will support the implementation of shared protocols. Any use of Indigenous Knowledge or other sensitive information will be governed by those protocols, and the principles of respect, consent, and stewardship.

Governance and Decision Making

- All decisions affecting WLON's lands, waters, and people must uphold the Nation's laws, knowledge systems, and decision-making protocols; co-development and co-design are important in all planning, governance and implementation processes. This includes but is not limited to environmental, territorial, cultural, and project-related planning/decisions grounded in Anishinaabe Inaakonigewin and the Nation's responsibilities to the land, water, and future generations.
- Ceremony and spiritual grounding are foundational to WLON's governance, responsibilities, decision making, and the exercise of jurisdiction.
- Data governance is a critical priority for the Nation. All data must be stored, shared, and applied in ways that uphold WLON's inherent data sovereignty, protect Intellectual Property, and follow Nation-led protocols that reflect WLON's laws, responsibilities, and consent processes.

Environmental Protection and Stewardship

- A holistic approach to protecting water, air, soils, and wildlife, rooted in Anishinaabe Inaakonigewin and the understanding that all relations are interconnected.
- Emphasis on the protection of culturally significant species such as clan relations, moose, wild rice, and medicinal plants, and the ecosystems that support them.
- All environmental and cultural monitoring must be directed/led by WLON following Nation-defined protocols and processes that uphold Anishinaabe Inaakonigewin. This ensures monitoring is grounded in the laws, values, and relationships that sustain long-term care for the territory.
- WLON will guide the respectful handling, management, and potential re-use of excavated rock in accordance with responsibilities and cultural teachings.
- Water is sacred. All water-related infrastructure, activities, and management plans must be co-developed with WLON and reflect Anishinaabe laws, values, conditions, and knowledge systems, consistent with commitments made through the Hosting Agreement.
- Participation in geological investigation and verification activities is a priority, to ensure Anishinaabe perspectives and knowledge inform the assessment of geological safety.

Land Use and Occupancy

- The continued exercise of land-based responsibilities must be protected and upheld, including but not limited to hunting, fishing, agriculture, medicine gathering, and access to significant sites (e.g., burial grounds, ceremonial spaces, wild rice harvesting areas).

Social, Economic, and Cultural Well-being

- Emphasis on economic-development opportunities that support community well-being, including wage employment and sustainable resource use.
- The need for a dedicated, culturally appropriate space on site for ceremony and cultural practices, designed in collaboration with the community.
- Ensuring the design and operation of the worker accommodation camp reflects community values, including the presence of cultural and environmental monitors.

- Collaboration with WLON's fire and emergency management team in the co-design of fire protection infrastructure and emergency response planning, including the firewater pipeline, to ensure culturally and technically appropriate responses.
- Support for the transmission of Anishinaabe Knowledge, including ceremony, language, land-based and cultural responsibilities, through programming and design that supports intergenerational learning.
- All aspects of project planning and implementation must support the overall health, safety, and wellness of Anishinaabe peoples of WLON rooted in a holistic understanding of health, safety, and continuity.

These areas of shared focus align with the NWMO's commitment, as stated later in this document in Section 9.1, to collaborate with WLON on the planning and implementation of the Project, and to uphold WLON's cultural protocols, including ceremonial requirements. The NWMO's partnership with WLON will be guided by jointly developed data governance protocols and a respect for WLON's sovereign processes.

3.3 Plan for Future Indigenous Engagement and Participation

Based on the NWMO's engagement to date with WLON, the NWMO understands that WLON will be affected by the carrying out of the Project.

In addition to WLON, the following other Indigenous groups may also be affected by the carrying out of the Project:

- Eagle Lake First Nation
- Lac Seul First Nation
- Lac des Mille Lacs First Nation
- Seine River First Nation

The NWMO will also engage with any other Indigenous group that may be affected by the carrying out of the Project.

In addition to the NWMO working with WLON through harmonization of studies with their regulatory process, the NWMO will work together with WLON on the integrated Impact Statement.

The NWMO will focus on providing Indigenous groups that may be affected by the Project appropriate opportunity to participate in regulatory studies through dialogue to share their insights, information sharing, Indigenous Knowledge sharing, and/or offered the opportunity to collaborate on the development of the studies. This engagement and participation will seek to gain their input on the potential impacts of the Project. The NWMO will work collaboratively with these groups to develop a methodology and process for how Indigenous Knowledge is shared, protected, and respected in regulatory work, including IA and nuclear licensing. Should Indigenous Knowledge be shared, opportunity would be provided for validation by the Indigenous group that shared it.

The NWMO will seek to design and conduct communications, participation and engagement activities to reflect community-specific preferences. To support this effort, the NWMO aims to create a versatile toolbox of engagement methods, which includes three key methods:

- in-person and virtual sessions, including interviews, workshops, and forums facilitated by the NWMO or independent facilitators
- information sharing and plain-language documents
- online and interactive tools

The NWMO notes that the IAAC's *Guide to Preparing an Initial Project Description and a Detailed Project Description* (IAAC 2025) requires proponents to identify Indigenous groups that may be affected by carrying out the Project, provide a summary of engagement undertaken with Indigenous peoples of Canada, and outline plans for future engagement. Accordingly, the term potentially "affected Indigenous groups" has been used intentionally throughout Sections 3 and 21 of this Initial Project Description to ensure alignment with federal guidance and concordance across sections.

4. Public and Interested Parties Engagement

4.1 Summary of Public and Interested Parties Engagement Activities to Date

Overview of Engagement Approach

In addition to engagement with Anishinaabe people of WLON and other Indigenous groups, the NWMO has engaged extensively with the public and interested parties, such as municipalities, businesses, service providers, and environmental organizations, for over two decades. The NWMO's approach to developing engagement methods and activities begins with early initiation and aims to establish enduring and transparent relationships with interested communities, individuals and organizations.

Engagement Requirements

Engagement, participation, and communication are embedded across all statutory, regulatory, and oversight frameworks governing the Project as described in Section i. These obligations are established under the NFWA, the NSCA and the Hosting Agreements with the Township of Ignace and Wabigoon Lake Ojibway Nation.

The NFWA requires ongoing dialogue with communities, transparent reporting on social and economic effects, and independent review through the Advisory Council. Under the NSCA, the NWMO will maintain a Public Information Program and Disclosure Protocol in accordance with CNSC REGDOC-3.2.1, ensuring timely and accessible communication about Project safety and performance.

The Hosting Agreement with the Township of Ignace outlines formal engagement obligations for both parties, including participation in regulatory reviews, technical studies, and public hearings. The NWMO will continue to engage transparently and inclusively throughout all phases of regulatory decision-making.

Site Selection Engagement Activities

The site selection process for the Project began in 2010, with 22 communities expressing proactive interest by 2012. The objective of public engagement at this stage was to raise awareness and provide balanced, objective information to the public and interested parties. Along the way, many of the interested communities entered Learn More agreements with the NWMO, which facilitated the public engagement efforts and provided communities with additional capacity to learn about the Project. Part of these site selection efforts included the establishment of Community Liaison Committees (CLCs) with respect to the area surrounding the potential Project site. The CLCs were created as committees of the local municipal council, if the Township passed a resolution to create one. They were comprised of community members who met regularly on many topics related to the Project, including information presented by the NWMO staff and international experts, on matters related to hosting a DGR. This information was aimed at facilitating an understanding of the Project including its scientific, safety, and ethical aspects.

In 2020, the NWMO narrowed their focus to two potential host sites in Ontario: the WLON and Ignace area and the Saugeen Ojibway Nation-South Bruce area. Together, working with the municipalities and Nations, the NWMO assessed each site for its potential to meet the Project's robust safety requirements and to build supportive and resilient partnerships. This process involved increasingly intensive social engagement and technical evaluations. Each community in the site selection process established its own methods for defining and expressing willingness to host the Project. At this stage, the community-driven engagement was tailored to address each community's needs, providing the necessary information for informed decision making, continuing to raise awareness, and informing the broader public.

As a result of the input received, the site selection process culminated in the selection of the WLON and Ignace area as the host site for the Project.

The Township of Ignace undertook a multi-phased municipal community engagement program led by a third-party engagement consultant that included direct dialogue with residents, youth engagement and a community vote open to residents 16 years of age and older. In addition, a volunteer Willingness Ad Hoc Committee considered the results of the engagement activities and provided guidance to the Township's Council on the community's willingness to host the Project. As specified in the Hosting Agreement (Township of Ignace, 2024), the NWMO will provide business opportunities, participation in regulatory decision-making employment and training, financial benefits, and support emergency services. The NWMO is grateful to have received the willingness of the people of Ignace. Their willingness contributed to the NWMO completing the siting process and continuing to meet its mandate to implement APM on behalf of all Canadians and Indigenous Peoples. Following site selection, the NWMO engagement activities have become focused on meeting the obligations of the Hosting Agreement with Ignace related to regulatory decision making.

As part of site selection, a range of communications products and reports available to the public (e.g., webinars, brochures, technical reports and summary reports, implementation plan, and videos including 3D models and simulations) on the NWMO's website that can be employed or adapted to support Project communications and engagement.

Initial Project Description Engagement Activities

Following the site selection announcement, the NWMO's engagement activities with the public and interested parties transitioned toward discussions on the Initial Project Description (IPD) and the regulatory decision-making processes that apply to the Project, specifically the integrated impact assessment and initial licence application to the CNSC.

To support this engagement, the NWMO developed plain-language materials summarizing an early draft of the IPD. These materials were made publicly available through the NWMO's website, local offices, and in print at community events. The summary included information about the Project's purpose and benefits, key design features, baseline data collection programs completed to date, and preliminary conclusions regarding potential effects.

During this phase, the NWMO held a total of six engagement events with the public, including four in-person sessions in Ignace, two in-person sessions in Dryden, and one virtual event. Details of these activities are provided in Appendix B.

The engagement strategy for this phase emphasized:

- Early identification of public and affected interests.
- Accessible and inclusive engagement methods, including online and in-person participation.
- Targeted engagement linked to key Project deliverables.
- Transparent record-keeping and incorporation of feedback into Project design.
- Integration of Gender-Based Analysis Plus (GBA Plus) into engagement design and data collection.

The sections that follow outline the interested parties identified and summarize the key themes and issues raised during engagement, including areas of focus and shared commitments with the Township of Ignace.

4.2 Identifying Interested Parties

In implementing APM the NWMO developed an extensive list of public and interested parties associated with the siting of the Project. Table 4.1 identifies the communities, organizations, and individuals who have expressed interest in the implementation of APM, including the Project in the

WLON and Ignace area. The NWMO anticipates continuing to engage these groups through future phases of the project.

As the Project progresses, the number and diversity of these groups may evolve. The NWMO remains committed to transparent and inclusive engagement, ensuring all voices are heard and respected throughout the assessment process.

Table 4.1: Communities, Organization and Select Individuals Expressing Interest in the Adaptive Phased Management

Communities and Service Boards
Host community (Ignace)
Immediate surrounding communities (inclusive of City of Dryden, Village of Wabigoon LSB, Melgund LSB)
Nearby communities (inclusive of Kenora District Municipal Association members): • City of Kenora • Municipality of Red Lake • Municipality of Sioux Lookout • Township of Ear Falls • Township of Pickle Lake • Township of Sioux Narrows-Nestor Falls
Public interest groups and environmentally focused organizations and agencies
Siting community supporters and critical voice organizations;
National, regional and local civil society organizations: • We the Nuclear Free North • Northwatch • Environment North • Sunset Country Spirit Alliance • No Nuclear Waste in NWO • NOCANDU • Northwest Nuclear Watch
Regulatory authorities and Government Ministries or Agencies:
Federal authorities: • IAAC • CNSC • NRCan • ECCC • DFO • Department of Justice Canada • CIRNAC • TC • Employment and Social Development Canada • HC

Provincial authorities: • MECP • MNR • MTO • IAFNER • MCM
Industry and Academic Organizations
Ontario Power Generation
Bruce Power
Hydro-Québec
Hydro One Networks Inc.
New Brunswick Power
Atomic Energy of Canada Limited
Nuclear and energy industry representatives, trade unions, chambers of commerce
University professors, researchers, and related nuclear expert committees
International Used Nuclear Fuel Management Organizations: • NUMO (Japan) • Andra (France) • Nagra (Switzerland) • SKB (Sweden) • Posiva (Finland)

ANDRA = French National Radioactive Waste Management Agency; CIRNAC = Crown-Indigenous Relations and Northern Affairs Canada; CNSC = Canadian Nuclear Safety Commission; DFO = Fisheries and Oceans Canada; ECCC = Environment and Climate Change Canada; HC = Health Canada; IAAC = Impact Assessment Agency of Canada; IAFNER = Ontario Ministry of Indigenous Affairs and First Nations Economic Reconciliation; LSB = Local Service Board; MCM = Ontario Ministry of Citizenship and Multiculturalism; MECP = Ontario Ministry of Environment, Conservation, and Parks; MNR = Ontario Ministry of Natural Resources; MTO = Ontario Ministry of Transportation; NAGRA = National Cooperative for the Disposal of Radioactive Waste; NOCANDU = Northern Ontario Coalition Against Nuclear Dumping Underground; NRCan = Natural Resources Canada; NUMO = Nuclear Waste Management Organization of Japan; NWO = northwestern Ontario; SKB = Swedish Nuclear Fuel and Waste Management Company; TC = Transport Canada.

4.3 Key Issues Raised

4.3.1 Overarching Themes

Since 2013, the NWMO has published annual What We Heard reports summarizing feedback from individuals, organizations, and communities engaged in the site selection process. These reports reflect perspectives shared by residents in and around potential siting areas, as well as by members of the broader Canadian public, and have helped shape the NWMO's overall engagement approach. These reports are publicly available on NWMO's website.

Following site selection, public dialogue continued to inform Project design and planning, including preparation of the Initial Project Description. The What We Heard reports prepared specifically from engagement on the IPD are provided in Appendix B.

Feedback received through the IPD engagement process continues to inform the development of the regulatory decision-making process. The key themes and areas of interest most frequently raised during this phase of engagement are summarized below.

Protection of People and the Environment

Throughout engagement on the Initial Project Description, participants consistently emphasized the importance of protecting human health and the natural environment. Many community members expressed that the Project must be implemented in a way that is demonstrably safe, secure, and environmentally responsible. Specific concerns raised included:

- **Human health and safety**
  - potential risks associated with radioactivity and contamination from used nuclear fuel
  - confidence in the long-term safety of the Project, including design, implementation, and monitoring
  - interest in how surface facilities will be designed and how the reliability of storage systems will be ensured over time
- **Environmental protection and design**
  - potential impacts on air, water, land, and wildlife, including from construction, traffic, and noise
  - interest in the design of water management systems and how they will protect local ecosystems
  - questions about the suitability of the geological formation to host a deep geological repository
  - concerns about the Project's resilience to extreme weather events and natural disasters, and the associated energy and water footprints

Community Well-Being and Readiness

In addition to technical and environmental matters, the NWMO has heard a wide range of views related to social and economic conditions. Some of these concerns reflect broader challenges already present in the region, while others speak to anticipated impacts and opportunities that could arise if the Project proceeds.

To the extent feasible, the NWMO aims to design and implement the Project in ways that respond to these priorities:

- **Community infrastructure and social conditions**
  - concerns about existing housing shortages and the increased demand on infrastructure and public services that could result from population growth
  - interest in how the Project could support local priorities such as youth retention, education, and training
  - anticipated impacts on community cohesion, resource access, and social well-being as the Project progresses
- **Economic development and opportunity**
  - the potential for local employment, new business opportunities, and long-term economic revitalization
  - interest in how benefits from the Project will be sustained and equitably shared with the local area
- **Health and social services**
  - readiness of local and regional health care systems to support new families and workers relocating to the area
  - interest in enhancing community well-being alongside Project development

The NWMO continues to document and reflect on what it hears from the public. Insights from engagement are reviewed regularly with host communities and shared with the NWMO's Advisory Council (described in Section i), which provides independent advice pursuant to the NFWA. Community voices will continue to guide planning, assessment, and decision making as the Project moves forward.

4.3.2 Areas of Focus and Shared Commitments with the Township of Ignace

The Township of Ignace continues to play an active leadership role in shaping how the Project is planned and communicated within the broader community. Its participation reflects a shared commitment to ensuring that the Project contributes to local well-being, supports long-term sustainability, and aligns with the Township's vision for growth and revitalization.

Section iv of the IPD was co-developed by the NWMO and the Township of Ignace following the Township's review of a draft version of the IPD and Appendix A, the Licensing Appendix, which was added specifically to address several comments raised seeking clarity on the process for regulatory review, design optimization, and safety oversight for the Project.

Through ongoing engagement with the NWMO, including community sessions, formal document reviews, and implementation of the Hosting Agreement, the Township provides guidance on social, economic, environmental, and infrastructure priorities that ensure the community continues to benefit from the Project. These commitments are summarized below.

Municipal Leadership, Transparency and Coordination

Ignace's leadership emphasizes transparency, open communication, and joint decision making on matters that directly affect residents, infrastructure, and land-use planning. Shared priorities include continued coordination through established committees and working groups, communications to keep residents informed, and ensuring that municipal perspectives are reflected in Project design and implementation.

Participants have encouraged both the Township and the NWMO to continue strengthening governance and planning capacity to ensure positive outcomes are realized for residents. They also highlighted the importance of early investment in infrastructure to prepare for potential growth, including housing, emergency services, and local amenities.

Residents consistently expressed a desire for clear information on Project timelines, phases, and the regulatory review process. They asked whether anyone may participate in public hearings of the IAAC and the CNSC, how comments can be submitted, and how agencies will coordinate their oversight responsibilities. The Township and the NWMO share a commitment to transparency, accessible communication, and public participation throughout the review and licensing process.

Economic and Social Development

Ignace places strong emphasis on maximizing the economic and social benefits associated with the Project. Priorities include attracting and retaining professional and skilled workers, supporting local business development, and enhancing community infrastructure such as housing, healthcare, roads, and essential services.

Participants reiterated their aspiration for Ignace to host as many Project-related staff and services as possible, including administrative and professional personnel, as well as worker accommodation facilities. While some specialized personnel such as emergency response and on-site operations staff must be based at the Project site, Ignace underscored its interest in locating complementary functions within the Township wherever feasible.

Participants encouraged the NWMO to "think outside the box" to help the Township achieve long-term prosperity, including exploring opportunities to attract or support new amenities such as a grocery store, airport upgrades, and expanded community infrastructure. Many also called for

revisiting the Hosting Agreement to better align it with the community's current needs and economic-development vision.

The Township and the NWMO are collaborating to align workforce training, business-readiness initiatives, and procurement programs with local capacity and to ensure that grassroots and community organizations are included in future studies and planning. These efforts aim to foster inclusive participation, build community resilience, and ensure benefits extend beyond the life of the Project.

Facility Design, Safety and Nuclear Stewardship

The Township of Ignace emphasized that the Project must be clearly understood not only as a construction or mining project but as a nuclear facility subject to the highest safety standards. Participants encouraged greater communication about radiation protection, nuclear safety culture, and the extensive regulatory requirements governing design, construction, and operation under the NSCA.

Questions were raised about the repository design, particularly the absence of a ramp and reliance on vertical shafts. Participants expressed concern that multiple access routes could enhance safety and evacuation options in the unlikely event of an emergency. The NWMO has committed to continuing dialogue on design rationale, risk mitigation, and emergency preparedness measures, including how fire scenarios, hoist safety, and evacuation protocols are managed and assessed.

Concerns were also expressed about the potential for blasting during periods of used fuel emplacement. Reviewers of the IPD emphasized that explosive and waste emplacement should not occur concurrently and sought assurance that safety assessments will define appropriate separation distances, scheduling restrictions, and safety verifications. The NWMO has committed to communicating how these procedures are confirmed through regulatory review and safety-case documentation.

Ignace also expressed strong interest in how emergency response planning will extend to municipal and neighbouring communities, and how local emergency personnel will be trained and resourced to respond to potential events. The Township and the NWMO share a commitment to ensuring that local plans are integrated and that emergency response preparedness reflects the actual, limited risks associated with a deep geological repository, which are different from those of an operating nuclear reactor.

Environmental Protection, Baseline Data and Monitoring

Participants re-affirmed the importance of maintaining strong environmental protection measures and transparent reporting. Concerns were raised about environmental releases and the expectation that doses to people and the environment should be as close to zero as reasonably achievable.
The Township and the NWMO agree on the goal of ensuring that there are no significant off-site releases and that all effluent discharge points remain on site, with comprehensive monitoring and reporting.

Questions were raised about potential effects on lake temperatures, aquatic ecosystems, and fish populations, particularly in nearby lakes such as Mennin Lake, Lowery Lake, Church Lake and Long Lake. Participants also sought clarity about the placement of the organics management area to reduce potential risks such as algal blooms.

Ignace underscored the importance of credible baseline data, particularly for uranium and other naturally occurring elements, to demonstrate that existing environmental conditions are well understood and that future monitoring can distinguish Project-related effects from background levels. Participants also inquired whether residents would be asked to provide well-water samples and noted prior studies reporting elevated background radioactivity in some wells.

Ignace further encouraged the NWMO to incorporate lessons from previous Canadian and international facilities, including the work of Atomic Energy of Canada Limited (AECL) and the

Seaborn Panel, to ensure that the DGR reflects best available international practices and lessons learned.

Shared Commitment to a Safe, Sustainable and Thriving Future

Together, these areas of focus reflect a partnership grounded in mutual respect, transparency, and shared responsibility. The Township of Ignace and the NWMO are working collaboratively to ensure that the Project supports a safe, sustainable, and thriving future, one that balances economic opportunity, environmental protection, and nuclear safety for present and future generations.

4.4 Engagement with Non-Regulating Federal and Provincial Departments, Ministries and Agencies

Since its inception, the NWMO has engaged regularly with all levels of government to support the implementation of APM. This engagement provides updates on the project's progress, facilitates alignment on key policy and regulatory requirements, and ensures transparency around public engagement efforts.

Fostering relationships with government and ensuring all levels of governments are up to date on project advancements is essential to building support for Canada's plan.

The following table summarizes the federal and provincial departments, ministries and agencies roles and the NWMO's engagement activities to date. The summary is not exhaustive and does not include individual names or meeting dates.

Table 4.2 Roles and Engagement with Federal and Provincial Departments, Ministries and Agencies

Federal and Provincial Departments, Ministries and Agencies	Roles and Engagement to Date
Federal	
NRCan	NRCan serves as the federal department responsible for oversight of Canada's approach to the long-term management of used nuclear fuel. NRCan provides policy direction and ensures compliance with the NFWA. NRCan also facilitates coordination among federal departments, supports regulatory and policy development, and ensures that Canada's APM aligns with national interests, international commitments, and public expectations. In compliance with sections 16(1), 16(2), and 23(1) of the NFWA, the NWMO submits annual reports and triennial reports to the Minister of Natural Resources Canada and to the public at the same time. The Minister must table the reports in Parliament and issue a statement on each report. An MOU between NRCan and the NWMO was signed on August 14, 2009. This MOU clarifies the roles and responsibilities of NRCan and the NWMO with respect to any obligation for consultations with Indigenous Peoples, pursuant to the Government's duty to consult and the NWMO's statutory obligations in relation to the NFWA. This MOU covered the period during that part of our work which precedes the identification of a site for the Project. On an annual basis, the NWMO submits an engagement report to NRCan and meets with lead officials to review engagement activities. NRCan assisted the NWMO in convening annual cross-departmental meetings. The cross-departmental meetings provided a venue for the NWMO to update government on the status of APM.
ECCC	ECCC plays a supporting role in the regulatory oversight of major projects by providing expert advice to both the CNSC and the IAAC. The NWMO has regularly engaged ECCC to ensure they are informed of the progress in implementing APM and has also discussed regulatory matters under their responsibility. ECCC participated in cross-departmental meetings.
Global Affairs Canada	Global Affairs Canada supports domestic projects like APM by ensuring alignment with Canada's international commitments, particularly in areas such as nuclear non-proliferation, environmental protection, and Indigenous rights. Global Affairs Canada provides guidance on how domestic actions may be perceived globally and facilitates international cooperation, knowledge exchange, and compliance with treaties and agreements. The NWMO has engaged various Canadian embassies and consulates as it navigated legislative challenges within the US. Several US lawmakers tabled and passed non-binding resolutions opposing the NWMO's work in southwestern Ontario, citing concerns over Great Lakes safety.

Federal and Provincial Departments, Ministries and Agencies	Roles and Engagement to Date
	The NWMO has engaged with Canada's Permanent Mission to the United Nations in Vienna (IAEA) to maintain NWMO's presence on the international stage and support the IAEA's various programs.
CIRNAC	The NWMO has engaged CIRNAC on various files related to Indigenous engagement. The NWMO facilitated discussions between CIRNAC and Indigenous communities involved in site selection process. CIRNAC participated in cross-departmental meetings.
Health Canada	Health Canada participated in cross-departmental meetings.
Indigenous Services Canada	Indigenous Services Canada participated in cross-departmental meetings.
Innovation, Science, and Economic Development	The NWMO has engaged Innovation, Science, and Economic Development on several occasions to discuss our research and development program. Innovation, Science, and Economic Development participated in cross-departmental meetings.
Internation Joint Commission	The NWMO engaged the Internation Joint Commission to provide overviews of its mandate and potential activities within the Great Lakes basin as it navigated legislative challenges within the US. Several US lawmakers tabled and passed non-binding resolutions opposing the NWMO's work in southwestern Ontario, citing concerns over Great Lakes safety.
Privy Council Office	The NWMO has regularly engaged the Privy Council Office to ensure they are informed of the progress in implementing APM and has also discussed regulatory matters under their responsibility.
TC	TC will have regulatory oversight of future transportation program. The NWMO organized a cross-jurisdictional transportation working group to seek input from provinces and federal government on the early development of transportation technical and engagement program. TC provided input per their role in future regulation of our transportation activities. The NWMO has sought government datasets to support technical route assessments. Engagement with TC has been sporadic because their formal role in our activities will not occur until the deep geological repository and transportation program is operational. Officials have noted that due to capacity constraints, TC is unable to regularly engage as they will not have regulatory authority for decades.

Federal and Provincial Departments, Ministries and Agencies	Roles and Engagement to Date
Ontario	
Ministry of Energy	The Ministry of Energy leads the province's work on all nuclear related files, including the implementation of APM. On a regular basis, the NWMO has met with officials to provide updates on progress on our program. The Minister of Energy also chairs a cross-ministry Assistant Deputy Minister (ADM) forum. The forum was established early in the NWMO's program to provide a venue for cross-government discussions. The forum convened as needed throughout the site selection process and has recently been re-established now that a site for Canada's used fuel repository has been selected.
MTO	The NWMO organized a cross-jurisdictional transportation working group to seek input from provinces and the federal government on the early development of the transportation technical and engagement program. The NWMO has sought government datasets to support technical route assessments. MTO participated in ADM Forum.
Ministry of Agriculture, Food, and Agribusiness	The NWMO engaged with the Ministry of Agriculture, Food, and Agribusiness while it managed the purchase of land parcels and potential zoning considerations when the NWMO was considering repository locations in southwestern Ontario.
Ministry of Economic Development, Job Creation and Trade	The NWMO engaged with the Ministry of Economic Development, Job Creation and Trade to share future job projections. The Ministry of Economic Development, Job Creation and Trade participated in ADM Forum.
Ministry of Emergency Preparedness and Response	The NWMO organized a cross-jurisdictional transportation working group to seek input from provinces and federal government on the early development of its transportation technical and engagement program. The NWMO has sought government datasets to support technical route assessments. Emergency Preparedness and Response participated in ADM Forum.
MECP	MECP participated in ADM Forum.
Ministry of Finance and Ontario Finance Authority	The Ministry of Finance, via the Ontario Finance Authority, co-chaired the early iteration of the Ontario ADM Forum. The NWMO engaged the Ministry of Finance during siting process to discuss property taxation legislation and will continue to engage as it navigates implementation in northern Ontario. The NWMO holds regular meetings with the Ontario Finance Authority to discuss Ontario Power Generation's funding requirements of the NWMO's work as required by the NFWA and federal funding formula.

Federal and Provincial Departments, Ministries and Agencies	Roles and Engagement to Date
IAFNER	The NWMO engaged IAFNER throughout the site selection process to share the status of engagement activities with Indigenous communities. The NWMO sought clarification on potential future provincial Crown consultation lists of communities throughout depending on where the deep geological repository was sited. IAFNER also provided guidance to MNR for consultation requirements for borehole drilling activities. IAFNER participated in ADM Forum.
Ministry of Health	The NWMO engaged regional health authorities, including Medical Officers of Health to share our safety case. In early stages of the siting process, communities were learning about impacts of radiation and Medical Officers of Health were seen as trusted local sources of information. The Ministry of Health participated in ADM Forum.
Ministry of Mines	The NWMO worked closely with the former the Ministry of Mines to access and review government data, including staking claims to support land withdrawal orders in numerous potential siting areas. Land withdrawals were required for technical evaluation throughout the site selection process. Withdrawal orders were processed via the Ministry of Mines. The NWMO shared datasets gathered through geomagnetic survey work, via the Ontario Geological Survey. The Ministry of Mines participated in ADM Forum.
Ministry of Municipal Affairs and Housing	The Ministry of Municipal Affairs and Housing participated in ADM Forum.
MNR	Withdrawn lands are now administered by MNR. The NWMO is engaged with MNR to formally transfer lands under NWMO control. MNR was engaged throughout technical site evaluations as it provided permissions for borehole drilling activities and associated Crown consultations. The NWMO and MNR signed a MOU related to borehole activities. MNR delegated the NWMO formal consultation requirements for borehole drilling activities. MNR participated in ADM Forum.
Ministry of Northern Economic Development and Growth	The Ministry of Northern Economic Development and Growth participated in ADM Forum.

Federal and Provincial Departments, Ministries and Agencies	Roles and Engagement to Date
Washington Office	The NWMO engaged Ontario's representative in Washington as needed while it navigated legislative challenges within the US. Several US lawmakers tabled and passed non-binding resolutions opposing the NWMO's work in southwestern Ontario, citing concerns over Great Lakes safety.
New Brunswick	
Natural Resources and Energy Development	Natural Resources and Energy leads the province's work on all nuclear related files, including the implementation of APM. On a regular basis, the NWMO has met with officials to provide updates on progress.
Transportation and Infrastructure	The NWMO organized a cross-jurisdictional transportation working group to seek input from provinces and the federal government on the early development of a transportation technical and engagement program. The NWMO has sought government datasets to support technical route assessments.
Québec	
Économie, Innovation et érergie	The NWMO provided introductory briefings to departmental leads. The focus of discussion was on future transportation activities.
Ministère des Transports	The NWMO organized a cross-jurisdictional transportation working group to seek input from provinces and the federal government on the early development of its transportation technical and engagement program. The NWMO has sought government datasets to support technical route assessments. The NWMO provided introductory briefings to departmental leads. The focus of discussion was on future transportation activities.
Sécurité publique	The NWMO organized a cross-jurisdictional transportation working group to seek input from provinces and the federal government on the early development of its transportation technical and engagement program, including emergency response measures. The NWMO provided introductory briefings to departmental leads. The focus of discussion was on future transportation activities.
Secrétariat du Québec aux relations canadiennes	The NWMO provided introductory briefings to departmental leads. The focus of discussion was on future transportation activities.

Federal and Provincial Departments, Ministries and Agencies	Roles and Engagement to Date
Secrétariat aux relations avec les Premières Nations et les Inui	The NWMO provided introductory briefings to departmental leads. The focus of discussion was on future transportation activities.
Saskatchewan	
Crown Investments Corporation	The NWMO provided introductory briefings to departmental leads. Crown Investments Corporation is lead ministry for SaskPower, who is considering developing nuclear capacity in the province.
Energy and Resources	The NWMO had preliminary meetings with the government of Saskatchewan in early stages of the site selection process, when three communities in the province had expressed interest in participating in the siting process.
Environment	The NWMO had preliminary meetings with the government of Saskatchewan in early stages of the site selection process, when three communities in the province had expressed interest in participating in the siting process. Environment provided technical support when the NWMO conducted its early desktop studies. This engagement concluded when Saskatchewan communities were screened out of the siting process.
Alberta	
Affordability and Utilities	The government of Alberta has initiated interest in developing nuclear capacity in their province. The NWMO provided introductory briefings to departmental leads.
Energy and Minerals	The government of Alberta has initiated interest in developing nuclear capacity in their province. The NWMO provided introductory briefings to departmental leads.
Environment and Protected Areas	The government of Alberta has initiated interest in developing nuclear capacity in their province. The NWMO provided introductory briefings to departmental leads.

ADM = Assistant Deputy Minister; APM = Adaptive Phase Management; CIRNAC = Crown-Indigenous Relations and Northern Affairs Canada; CNSC = Canadian Nuclear Safety Commission; ECCC = Environment and Climate Change Canada; IAAC = Impact Assessment Agency of Canada; IAEA = International Atomic Energy Agency; IAFNER = Ontario Ministry of Indigenous Affairs and First Nations Economic Reconciliation; MECP = Ontario Ministry of the Environment, Conservation, and Parks; MNR = Ontario Ministry of Natural Resources; MOU = Memorandum of Understanding; MTO = Ontario Ministry of Transportation; NFWA = *Nuclear Fuel Waste Act*; NRCan = Natural Resources Canada; NWMO = Nuclear Waste Management Organization; TC = Transport Canada; US = United States.

4.5 Plan for Future Public and Interested Parties Engagement

The NWMO will continue open and transparent engagement with the public and interested parties throughout the regulatory decision-making process. Building on the engagement completed during site selection and development of the IPD, future engagement will focus on sharing information, obtaining input, and ensuring accessibility at key Project milestones.

As the integrated impact assessment and initial licence processes advance, the NWMO will provide plain-language materials such as fact sheets, summaries, and online content, and will host public sessions to discuss Project progress, potential effects, and mitigation measures. Engagement methods will be regularly reviewed and adjusted based on feedback to ensure inclusiveness and effectiveness.

Future engagement will reflect two main levels of participation:

- **Involve:** Direct collaboration with the Township of Ignace, as outlined in the Hosting Agreement, to participate in regulatory planning, provide local knowledge, and share input on social, economic, environmental, and infrastructure considerations.
- **Inform:** Ongoing communication with nearby communities, the public, and interest groups to share updates on Project activities and regulatory milestones, including opportunities for feedback through meetings, events, or Learn More agreements.

This approach ensures that engagement remains responsive, accessible, and proportionate to the needs and interests of the public and communities most affected by the Project.

5. Regional Assessment

Based on the NWMO's review of public information sources, there are no regional studies or Regional Assessments conducted for the area in proximity to the Project site. There is one Regional Assessment in progress in the Ring of Fire area, which will be centred on the mineral deposits in northern Ontario, approximately 534 kms northeast of the Project site.

6. Strategic Assessment

6.1 Strategic Assessment of Climate Change

The Strategic Assessment of Climate Change (Government of Canada 2020) conducted under Section 95 of the IAA is applicable to the Project. An initial estimate of greenhouse gas emissions for the Project is provided in Section 22.

The energy needs of the Project will be substantially met by electricity provided by the Province of Ontario. For the remaining small amount of energy that needs to be produced on site such as standby power generation, the NWMO will complete a best available technologies and best environmental practices assessment.

The NWMO will meet the requirements of the Government of Canada's Strategic Assessment of Climate Change and will prioritize the implementation of best available technologies and environmental practices to reduce direct greenhouse gas emissions between start of site preparation and construction activities.

Based on public information sources, there are no other applicable strategic assessments required.

B. PROJECT INFORMATION

7. Purpose of and Need for the Project and Potential Benefits

The Project is a key component of Canada's plan for the safe, long-term management of used nuclear fuel and an important part of the country's transition to net-zero emissions. It represents the implementation of APM, which was selected by the Government of Canada in 2007 under the NFWA as Canada's plan for managing used nuclear fuel.

As described in Sections i and ii, APM combines a technical method, which includes the construction and operation of a Deep Geological Repository (i.e., the Project), with a management system that is adaptive, inclusive, and grounded in engagement with Canadians and Indigenous Peoples. The Project will be Licenced by the CNSC for its full lifecycle, from site preparation to post-closure monitoring, ensuring independent oversight, transparency, and accountability. The Project will also remain subject to the conditions of the NFWA.

Purpose of the Project

The purpose of the Project is to provide a permanent, safe, and environmentally responsible solution for the management of all of Canada's used nuclear fuel. The Project will safely contain and isolate approximately 5.9 million used fuel bundles in a stable geological formation, eliminating the need for ongoing active management and protecting people and the environment for generations to come. In doing so, the Project fulfills Canada's legislated requirements under the NFWA to implement APM on behalf of Canadians and Indigenous Peoples.

The capacity of 5.9 million used fuel bundles is the projected total inventory of used nuclear fuel estimated expected to be produced in Canada from the current fleet of reactors to end of life, as outlined in the NWMO's 2024 Nuclear Fuel Waste Projections Report (NWMO 2024). This projection is based on published refurbishment and life-extension plans for the Darlington and Bruce reactors, and the continued operation of Pickering A reactors (until end of 2024) and Pickering B reactors (until the end of 2026), and on NWMO's assumptions used for planning purposes.

Need for the Project

Currently, used nuclear fuel is safely stored in Licenced interim facilities at reactor sites. While effective in the short term, this approach requires continuous active management and imposes a long-term burden on future generations. The need for the Project arises from the requirement to transition from interim storage to a permanent, passive disposal solution that ensures long-term safety, minimizes environmental risk, and upholds intergenerational responsibility. The Project also addresses the broader policy objective of sustaining nuclear energy as a low-carbon, reliable power source that contributes to Canada's climate goals.

Potential Benefits

The Project will generate enduring benefits for host communities, the region, and Canada as a whole. These include:

- permanent and safe containment of used nuclear fuel, ensuring protection of people and the environment
- support for Canada's climate action and net-zero objectives by ensuring nuclear energy remains a sustainable and socially responsible energy source
- long-term employment, training, and business opportunities in northwestern Ontario and across Canada

- advancement of intergenerational equity by removing the need for future generations to actively manage nuclear waste and reducing long-term environmental risks

The Project advances Canada's legislated and policy objectives for the long-term management of used nuclear fuel. By implementing APM through the development of the Project, the NWMO is fulfilling its mandate under the NFWA and contributing to Canada's clean energy future in a manner that is scientifically sound, socially responsible, and environmentally sustainable.

8. Related Provisions in the *Physical Activities Regulations*

Section 28(b) of the *Physical Activities Regulations* (Government of Canada 2019b) identifies as a designated project "the construction and operation of a new facility for the long-term management or disposal of irradiated nuclear fuel or nuclear waste." The proposed Project meets this description as it involves the construction and operation of a Deep Geological Repository for the long-term management of Canada's used nuclear fuel.

The Project is not part of a larger project that is listed on the Project List under the IAA. Its scope includes lifecycle phases associated with the construction and operation of the DGR as defined in Section 28(b), while site characterization, decommissioning, closure, and post-closure monitoring phases will remain under the regulatory oversight of the CNSC pursuant to the NSCA (Government of Canada 1997). These phases do not independently trigger the IAA, as they are not listed in the *Physical Activities Regulations* (Government of Canada 2019b).

The impact assessment for the Project will be conducted in an integrated manner with the initial licence application to the CNSC. This integrated assessment will include a conceptual post-closure safety analysis consistent with the CNSC's graded approach, which allows for detailed design information to be developed and refined at later licensing stages.

In accordance with *REGDOC-1.2.1, Guidance on Deep Geological Repository Site Characterization*, site characterization is a distinct and essential phase that precedes site preparation. It provides the scientific and technical information required to support the DGR design and safety case and forms a necessary part of the data set for future licensing under the NSCA. REGDOC-1.2.1 specifies that site characterization information is re-evaluated throughout the DGR lifecycle, including site preparation, construction, operation, decommissioning, and closure.

Accordingly, site characterization work is not a designated activity under the IAA and is not subject to the prohibitions in Section 7 of the Act, as it is required for the impact assessment and by the CNSC to support the initial licensing process for the site preparation, construction and operation of a DGR.

9. Activities, Infrastructure, Structures and Physical Works

9.1 Overview

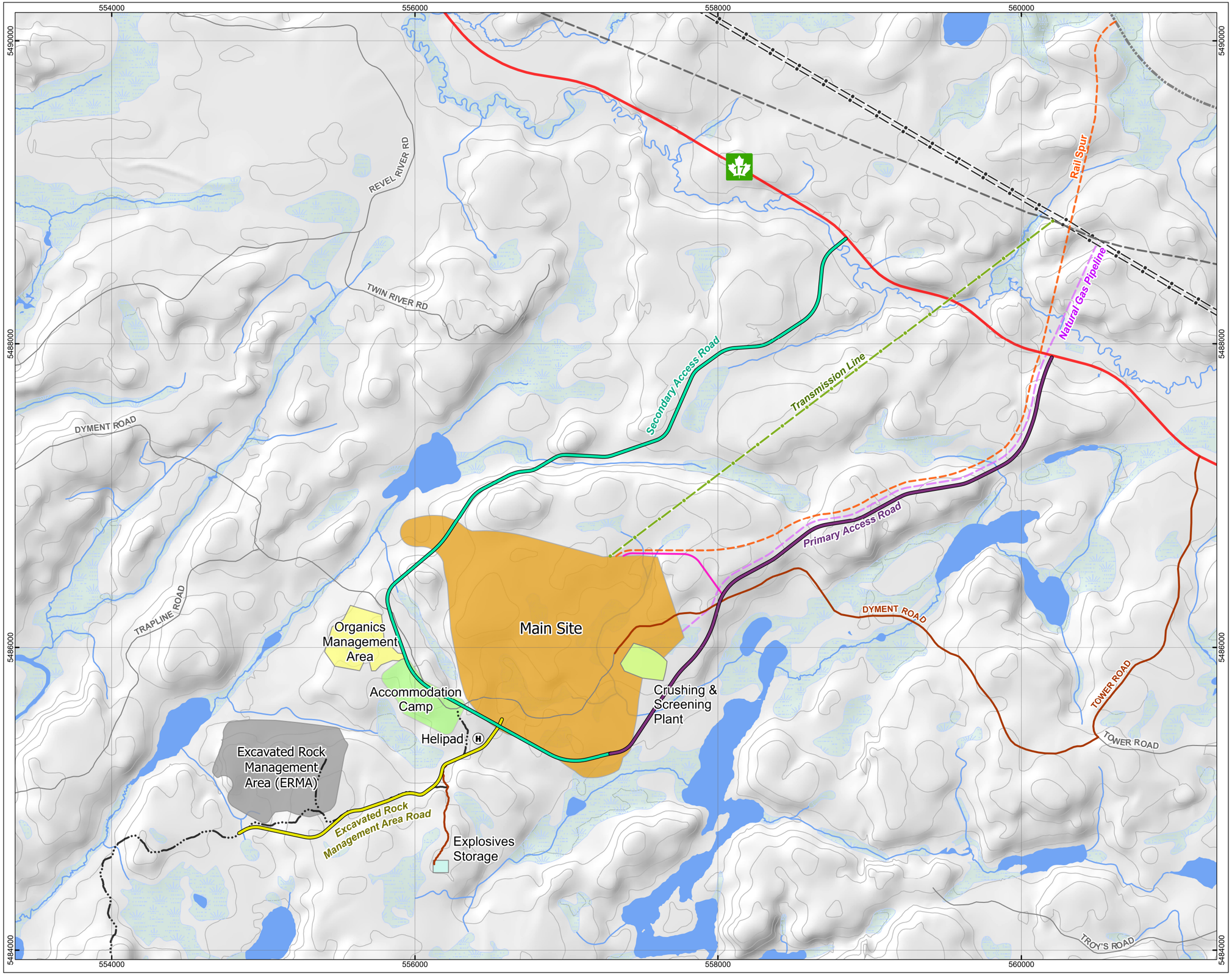
This section describes the Project and the facilities and infrastructure required to safely receive, repackage, and emplace used nuclear fuel within the Deep Geological Repository (DGR). The safety of the Project is achieved through a system of multiple natural and engineered barriers designed to work together to protect people and the environment over the long term. These barriers include the geological characteristics of the site, the Used Fuel Container (UFC), bentonite clay, the fuel cladding, and the ceramic used fuel pellets.

The DGR will include surface and underground facilities, as well as ancillary structures and systems required to support construction and operation. These may include onsite access roads and a rail spur, water management systems, utilities, an Excavated Rock Management Area (ERMA), an Organics Management Area (OMA), explosives storage, and other related infrastructure. The current conceptual site plan for the Project and associated surface facilities is shown in Figure 9.1 and Figure 9.2. A generic illustrative layout of the underground facility in relation to the surface facilities is provided in Figure 9.3. The conceptual design may evolve through the impact assessment and licensing processes. The proposed surface facilities currently occupy approximately 340 hectares.

Both WLON and the Township of Ignace provided detailed comments on this section during their review of the draft Initial Project Description, including on the design of the Project and opportunities for optimization. The NWMO is committed to continuing to work collaboratively with both host communities throughout the impact assessment and licensing phases to ensure their perspectives inform ongoing design refinements and decision making.

The NWMO will work collaboratively with WLON to understand and uphold appropriate cultural and environmental monitoring practices, including any ceremonial requirements prior to the commencement of activities. WLON's ceremony and cultural protocols will be respected, with specific practices to be confirmed in dialogue with the Nation.

As part of its engagement with the Anishinaabe peoples of WLON and other Indigenous groups described in Section 3.3, the NWMO also plans to work with Knowledge holders and land users, including WLON Anishinaabe trappers, hunters, and harvesters, to support a shared understanding of land and resource use in the Project area. This work will be undertaken in accordance with WLON's data governance protocols and the Hosting Agreement to ensure Indigenous Knowledge and subject matter expertise meaningfully inform Project planning and implementation.



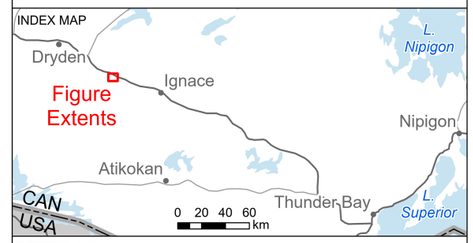
LEGEND

Proposed Project Infrastructure

- Main Site
- Excavated Rock Management Area (ERMA)
- Accommodation Camp
- Organics Management Area
- Crushing & Screening Plant
- Explosives Storage
- Transmission Line
- Natural Gas Pipeline
- Rail Spur
- Primary Access Road
- Secondary Access Road
- Excavated Rock Management Area Road
- Direct Substation Access Road
- Existing Road Upgrades
- Helipad

Existing Present Day Infrastructure

- Transmission Line
- Natural Gas Pipeline
- Railway
- Highway 17
- Road
- Temporary Access Road
- Elevation Contour (10m interval)
- Watercourse
- Waterbody
- Wetland



REFERENCE

Data: GEO, Government of Ontario, Natural Earth
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 15N

OCT-10-2025

0 0.5 1 km

SCALE 1:24,000

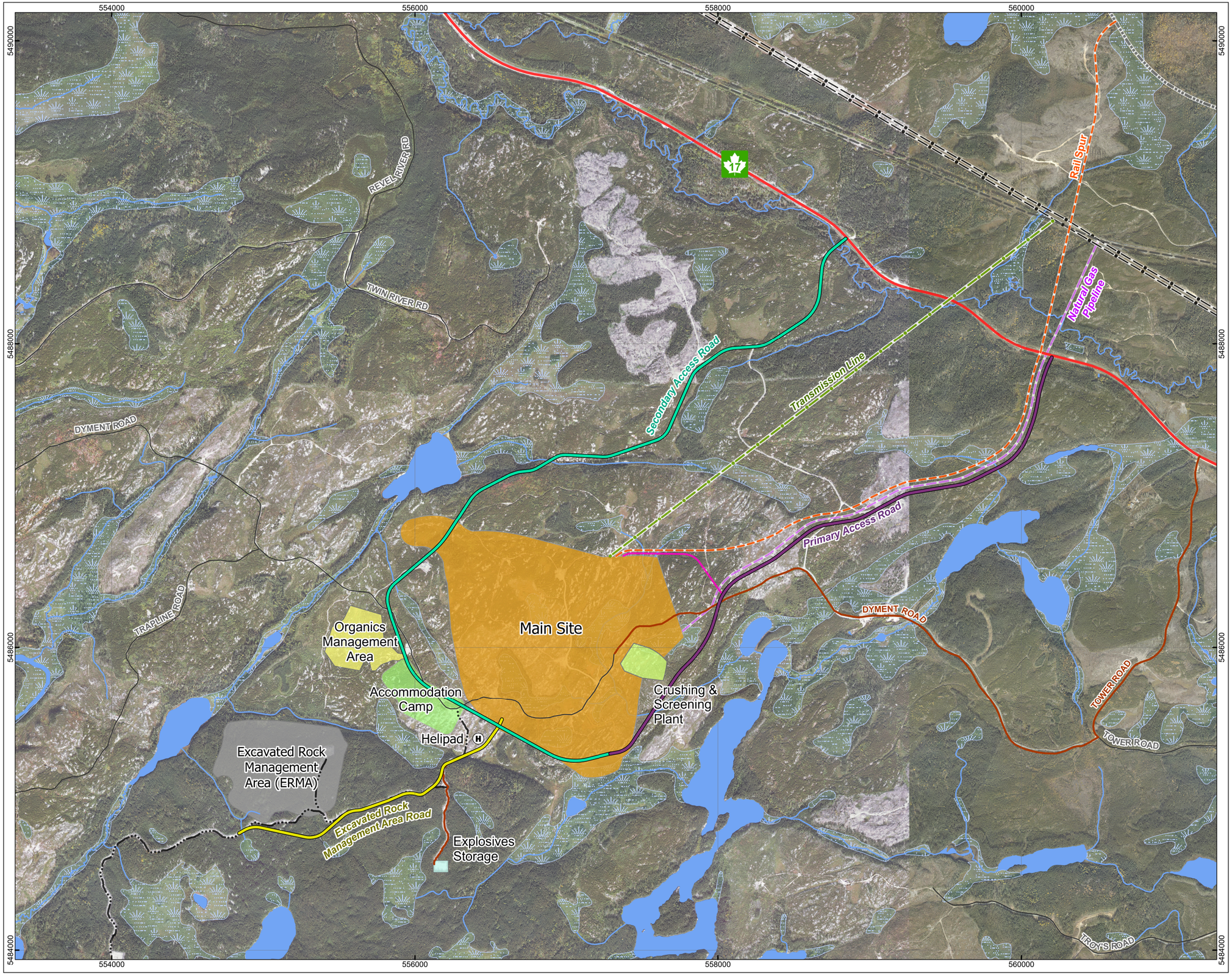
nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

TITLE

Currently Proposed Conceptual Site Plan

FIGURE: 9.1



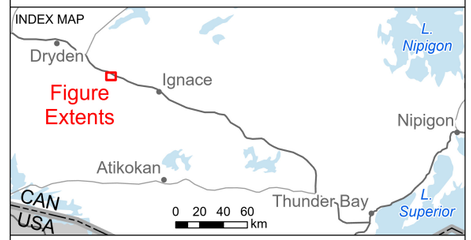
LEGEND

Proposed Project Infrastructure

- Main Site
- Excavated Rock Management Area (ERMA)
- Accommodation Camp
- Organics Management Area
- Crushing & Screening Plant
- Explosives Storage
- Transmission Line
- Natural Gas Pipeline
- Rail Spur
- Primary Access Road
- Secondary Access Road
- Excavated Rock Management Area Road
- Direct Substation Access Road
- Existing Road Upgrades
- Helipad

Existing Present Day Infrastructure

- Transmission Line
- Natural Gas Pipeline
- Railway
- Highway 17
- Road
- Temporary Access Road
- Watercourse
- Waterbody
- Wetland



REFERENCE

Data: GEO, Government of Ontario, Natural Earth
The left satellite image was taken in September 2021, and the right satellite image was taken in October 2017.
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 15N

OCT-10-2025

0 0.5 1 km

SCALE 1:24,000

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

TITLE

Currently Proposed Conceptual Site Plan Satellite

FIGURE: 9.2

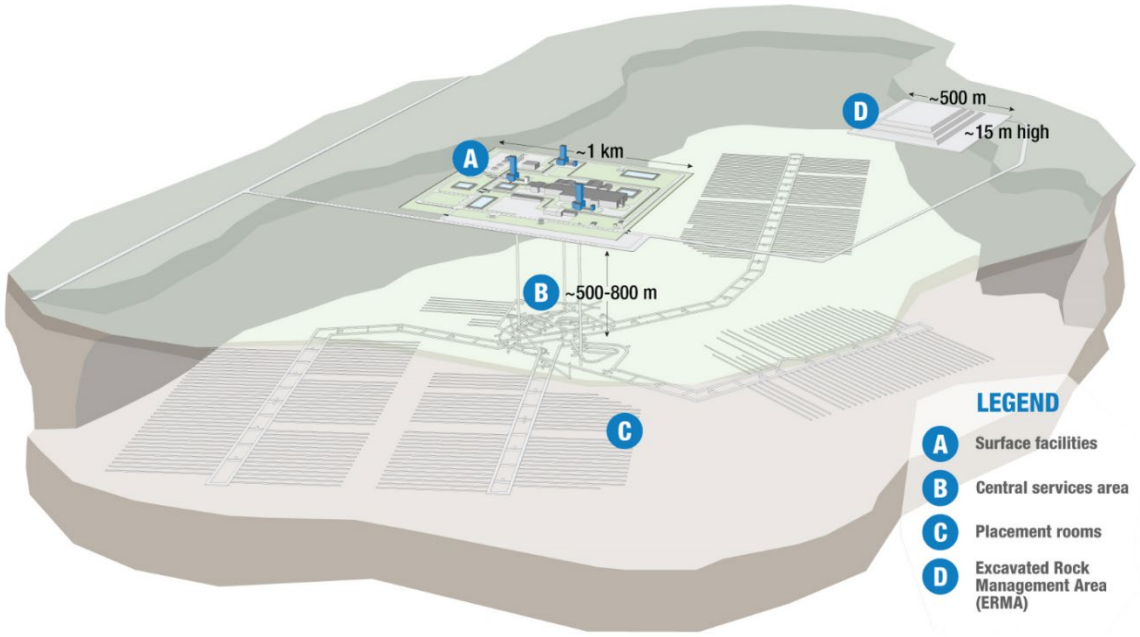


Figure 9.3: Illustration of Generic Project Site Layout (Surface and Underground)

The Project surface facilities are anticipated to be surrounded by a perimeter fence. For security purposes, certain areas of the surface facilities will have restricted access and will be located inside a secondary security fence, in compliance with the applicable requirements of the relevant *Nuclear Security Regulations*. This area is called the Protected Area. The Protected Area will include the used fuel packaging plant (UFPP), main shaft complex, service shaft complex, ventilation shaft complex, and low-level waste (LLW) and intermediate-level waste (ILW) storage facilities. LLW is characterized as materials with radionuclide content above established unconditional clearance levels and exemption quantities (set out in the *Nuclear Substances and Radiation Devices Regulations*) but generally has limited amounts of long-lived radionuclides. Examples of LLW include slightly contaminated rags, mops, clothing and floor sweepings. ILW generally contains long-lived radionuclides in concentrations that require isolation and containment for periods greater than several hundred years. ILW will be generated during the decontamination of certified transportation packages, UFPP operational areas, and UFCs.

All the shafts that provide access to the underground repository will be included in the Protected Area. Surface facilities located outside the Protected Area, but inside the outer perimeter fence, which are not directly involved in the handling of the used nuclear fuel are referred to as the Balance of Site.

The DGR will be accessed by three vertical shafts and consists of a centrally located services area, placement arms extending outwards from the services area, and placement rooms extending from the placement arms. The placement arms consist of a series of placement rooms excavated out of the rock that will be filled with the loaded UFC. Each UFC will be surrounded in bentonite, a type of clay that expands in the presence of water (which reduces or prevents the flow of water or other particles). Once each panel is filled, it will be sealed and isolated from the rest of the underground facility.

The Project will require a series of licences from the CNSC as the Project is implemented (Appendix A). It is expected that the initial licence, if granted, will authorize the NWMO to begin its development of the site. While these activities are underway, the NWMO would apply for a Licence to

Construct, and as it nears completion of construction, the NWMO would apply for the Licence to Operate. Overall, the NWMO assumes that it will take approximately 10 years to develop the site and construct the DGR. Lateral excavation of the underground facility is anticipated to be continued during operations. The Project is then expected to operate under a CNSC licence for approximately 50 to 60 years.

Once operations are complete, there is planned to be an approximate 100-year phase of extended monitoring, decommissioning and closure under CNSC licensing. During this 100-year period, the DGR would be monitored for several decades to confirm that the natural and design features are performing as expected and containing the radioactivity of used fuel bundles. The site would then be decommissioned and closed and the NWMO would eventually apply to be released from CNSC licensing. When the Project is no longer a nuclear facility Licenced by the CNSC, it would transition into the institutional control that would be established by the Government of Canada and of the Province of Ontario. This may include ongoing environmental monitoring as well as other active controls, such as prohibiting mining in the area of the repository.

A preliminary list of all known Project facilities within the Project site is presented in

Table 9.1. Temporary facilities identified in

Table 9.1 are intended to be in place until the permanent infrastructure is in place. The Project facilities will continue to be refined as the Project progresses.

Table 9.1: Preliminary List of Project Facilities

Surface
Temporary Facilities and Infrastructure
Temporary laydown area
Temporary fuel facilities
Temporary communication system
Temporary waste rock stockpile
Temporary rock crusher
Temporary explosives magazine
Temporary concrete batch plant
Temporary electrical supply
Temporary sumps and underground dewatering infrastructure
Temporary water management
Temporary work trailers, lunchrooms, washrooms and training facilities
Accommodation camp temporary utilities
Primary Buildings/Facilities
ERMA and auxiliaries
OMA and auxiliaries
UFPP
LLW storage facility
ILW storage
Active solid waste handling facility
Active liquid waste treatment system
Waste management area
Quality control office and laboratories
Administration buildings (including offices)
Maintenance garage
Sealing material storage bins
Sealing material compaction plant
Warehouse and storage building(s)
Service shaft complex

Surface
Main shaft complex
Exhaust ventilation shaft complex
Concrete batch plant
Emergency response building(s)
Water Management
Water management ponds
Freshwater pumphouse and pipeline
Water management infrastructure and distribution system
Water storage tanks
Service water treatment plant
Potable water treatment plant
Domestic sewage treatment plant
DGR dewatering settling pond
Process water settling pond
Discharge pipeline and associated discharge infrastructure
Power Supply
Electricity transmission line
Switchyard and substation
Emergency generators
On-site electrical distribution lines
Fuel and Reagents
Warehouse and hazardous materials storage building
Diesel and propane tanks
Reagents/chemicals storage areas
Air compressor building
Other On-site Infrastructure
Parking area
Weigh scales
Communications infrastructure
Primary and secondary access roads within property
Guardhouses
Natural gas distribution system
Utility corridor
On-site roads
Security infrastructure and fencing
Accommodation camp
Storage yard
Helicopter pad
Primary access road connection to Highway 17
Secondary access road connection Highway 17
Rail spur connection to regional rail line
Connection to regional Hydro One transmission line
Connection to regional natural gas pipeline
Connection to regional telecommunications line
Underground
Central services area
Placement arms
Placement panels and placement rooms
Main shaft
Exhaust ventilation shaft
Service shaft
Underground Demonstration Facility
Explosives magazine

Surface
Auxiliary facilities

ERMA = Excavated Rock Management Area; ILW = intermediate-level waste; LLW = low-level waste; OMA = Organics Management Area; UFPP = Used Fuel Packaging Plant.

9.2 Current Site Infrastructure

The Project site is within an area subject to an Ontario Ministry of Natural Resources (MNR)-issued Sustainable Forest Licence and has been subject to some development pursuant to that use, including operational roads branching off Dyment Road used for tree harvesting operations. The NWMO has cleared a small amount of land for access roads and drill pads to conduct initial field investigations of the geological conditions of the site as needed to confirm its suitability for the Project. The site is otherwise undeveloped, without on-site infrastructure and facilities.

9.3 Preliminary List of Project Activities Prior to Initial Licence

The following is a high-level preliminary list of all activities planned prior to the initial CNSC licence:

- working with the host First Nation and community
- engagement with the public, interested parties, and Indigenous Peoples
- applications for, and receipt of environmental related permits
- ongoing engineering studies
- completion of ongoing site characterization studies
- development and implementation of environmental protection and monitoring, radiation protection, worker safety and security and emergency response plans for Project activities

The following are activities that are expected to occur throughout the lifecycle of the Project:

- working with the host First Nation and community
- ongoing engineering studies, hiring and procurement of materials and equipment
- applications for future and renewal of CNSC licences (as required)
- ongoing engagement with the public, interested parties, and Indigenous Peoples
- implementation of environmental protection and monitoring, radiation protection, worker safety and security and emergency response plans for Project activities

The sections that follow describe the physical activities required for the Project, including incidental activities, during each project Phase and are based on current conceptual level facilities design. This will continue to be refined as the Project progresses and may change.

The transportation of nuclear materials (i.e., used nuclear fuel) and non-nuclear materials within established transportation corridors is not considered and incidental activity to the Project. This is because these activities are ongoing, independently regulated, would not require changes to federal or provincially approved design standards for existing highways and railways and these activities are expected to continue regardless of the Project's implementation. Movement of nuclear and non-nuclear materials within established transportation networks is governed by federal and provincial regulations, such as the CNSC's *Packaging and Transport of Nuclear Substances Regulations, 2015* (Government of Canada 2015a) and the *Transportation of Dangerous Goods Regulations*, which ensure safety and oversight outside the scope of the Project. Since these transportation activities support broader national and regional systems and the public and interested parties, and do not require infrastructure upgrades or changes directly attributable to the Project, they are distinct and not

subordinate or complementary to the designated activity (i.e., construction and operation of the DGR).

Accordingly, the Project does not include the transportation of used fuel from reactor sites to the Project beyond the primary and secondary access roads at the Project site, as this is regulated separately under CNSC certification and uses existing transportation infrastructure.

For the licensing and impact assessment process, it is anticipated that the geographic extent of effects from the transportation of nuclear and non-nuclear materials would be limited to transportation along the new access roads and the rail spur and not within established transportation corridors. To this end, any transportation-related activities from the implementation of the Project presented in this IPD are specific to traffic and transportation of materials along the access roads, site roads and rail spur.

9.4 Site Preparation Activities (to be undertaken as Part of the Initial Licence Application)

The following subsections describe the activities, infrastructure, and physical works that the NWMO considers part of the Project's site preparation phase. The CNSC has issued regulatory guidance to support preparation of the initial licence application for these activities through REGDOC-1.2.3, *Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository*. Site preparation represents the first licensing phase under the NSCA.

The scope of site preparation also includes the construction of non-nuclear infrastructure such as roads, site water management features and the accommodation camp. The initial licence application for NWMO's site preparation activities will be integrated with the impact assessment process, as described in Section I and Appendix A of this IPD.

9.4.1 Overview of the Activities, Infrastructure and Physical Works

This section describes activities to prepare the site for the construction and operation of the Project. Activities associated with the initial licence includes initial clearing, grubbing, terracing, and contouring of the Project site to provide the necessary topography to construct the surface facilities. Necessary permits and approvals would need to be obtained prior to the applicable physical work being performed at the site.

Effective water management is a central design priority for the Project, with the goal of minimizing potential impacts on water quality and downstream users. During site preparation, the NWMO proposes to establish an integrated water management system for the site to manage contact water from the surface facilities. The integrated system will include the collection and treatment of contact water as required. Treated discharge to the environment is anticipated to be localized and will be in accordance with regulatory requirements.

9.4.2 Listing of Site Preparation Phase Activities

A preliminary list of the major activities anticipated in the site preparation phase are included in Table 9.2. Construction practices will apply proven technology and processes to be protective of the environment and workers. The subsections that follow provide additional information for key activities and facilities. Further detail will be provided in subsequent regulatory submissions as appropriate.

Table 9.2: Activities During Site Preparation Phase

Surface
Initial site survey and demarcation
Existing road upgrade(s) for site access
Clearing and grubbing
Construct water management infrastructure and holding ponds to support site preparation activities
Grading and terracing
Construction of primary and secondary access roads
Complete site survey and install temporary perimeter fencing around construction areas
Establish temporary laydown areas
Install temporary facilities and utilities
Set up work trailers, lunchrooms, washrooms, training facilities
Temporary electrical supply
Construct and install utility corridor, and install utility connections
Initiate rock stockpiling/ERMA, including ditching and associated water management and perimeter fence
Initiate organic material and overburden stockpiling/OMA, including ditching and associated water management and perimeter fence.
Install temporary concrete batch plant
Construct/install raw water distribution network from source to site
Construct pumphouse and auxiliaries
Construct central mechanical services building
Construct sewage treatment plant or holding tanks and auxiliaries
Construct/install emergency generator building(s)
Install distribution systems (including potable water system, natural gas, fire water, communications and security)
Construct/install administration building, quality control office/laboratory, garage and warehouse
Construct/install fuel storage tanks and dispensing stations
Construction of worker accommodation camps
Construct helipad
Construct parking lot
Traffic along access roads

ERMA = Excavated Rock Management Area; OMA = Organics Management Area.

The following are preliminary descriptions of some of the activities and facilities that are currently planned to be undertaken during site preparation (initial licence). These activities will continue to be refined as the Project progresses and may change.

Construction of On-site Access Roads, Clearing, Grubbing and Terracing of Site

Clearing and grubbing will be performed within the Project site to remove existing vegetation and timed to avoid environmentally sensitive periods where practicable (i.e., outside of the bird nesting

season, generally mid-May through mid-July). Where practicable, clearing and grubbing is anticipated to be staged to ensure that the period when soils are exposed is minimized and the areas are suitable for construction activities.

Trees will be felled, skidded and piled in the cut area and may be disposed of by chipping, piling or handled in accordance with MNR permissions and approvals. Wood materials that are chipped may be reused on the site in landscaping activities. Wood materials may also be disposed of at a suitable location in accordance with established forestry management processes.

Re-use of overburden materials will be considered wherever practicable during the initial licensing (site preparation) activities. Overburden materials determined to be not acceptable for re-use will be stored in the OMA.

The Project site will be graded, including terracing as required, to provide flat surfaces necessary to support construction and development of various facilities. Site grading is expected to include blasting and use of conventional earth moving equipment including bulldozers, excavators, dump trucks, blade scrapers and water trucks (for dust control).

Perimeter ditching is anticipated to be established around facilities, as required, to receive water run-off for direction into water management ponds, where the water will be allowed to settle out any solids, undergo sampling and subsequently be treated, if necessary, prior to discharge to the environment.

On-site roads are planned to support the construction and operations phase configuration of the Project site. These will be constructed in a manner that meets applicable requirements and guidelines. Initially, the existing site road(s) will be upgraded to permit safe site access.

Primary Access Road, Secondary Access Road and Existing Logging Road

The primary access road and secondary access road are planned to connect the Project surface facilities with Highway 17 (Trans-Canada Highway). Both access roads will be built to accommodate high traffic volumes and large vehicles.

Discussions with WLON and the Ontario Ministry of Transportation will be undertaken to confirm the best connection options at the potential intersection of Highway 17 and the access roads.
Any changes to the existing Highway 17 right-of-way (i.e., turn-off lanes to the access road) will be undertaken in accordance with the requirements established by the Province of Ontario.

The existing logging road will be widened and redeveloped to provide initial access for site preparation activities and subsequent construction activities. This road will be the main site access route until the primary access road has been completed.

Laydown Areas

As site grading, grubbing and site access roads are developed, appropriate temporary laydown areas for site contractors will be provided within the Project Development Area which will be defined through the Impact Assessment process, at locations of future development where practicable.

Laydown areas are proposed to be comprised of general fill with adequate surfacing for light vehicles and surface water drainage. Where appropriate excavated overburden and clean excavated rock from the Project site will be utilized for construction of these temporary laydown areas.

Temporary Facilities and Utilities

The facilities planned to support construction contractors' mobilization will be developed during the early stages of the site preparation (initial licence) activities, commencing as soon as the site advances sufficiently to support the temporary installations. Development will be conducted in accordance with industry best practices, like those used at mining sites in the regional area.

Temporary facilities planned to be installed to support site preparation activities are likely to include temporary power (generators), office trailers and/or complexes and accommodations, fuel depots, waste management systems/equipment, rock crushers, temporary water supply and temporary explosives magazine. The temporary explosives magazine will be away from the site and would meet regulatory requirements including the *Explosives Act* (Government of Canada 1985d). Where appropriate, erosion and sediment release to the environment may be management using suitable temporary water management infrastructure or other applicable means.

Construction of Utility Corridor and Utility Connections

The main power will be provided by Hydro One's local grid via a new 230 or 115-kilovolt (kv) transmission line to the site. Step-down transformers will reduce the voltage to a switchyard for distribution and use across the site. Diesel generators will provide emergency power to critical loads during a power outage or failure of the regular power distribution system. A power corridor from the transmission line to the Project site will be developed either adjacent to the primary access road or in some other suitable location based on the point where the transmission line is accessed.

Natural gas generators will provide temporary power to the site during the initial stages of site preparation. Once the electrical equipment is available for service, the temporary power equipment will be replaced by the permanent power supplied by the grid.

A natural gas pipeline and telecommunications infrastructure are planned to be installed along the transmission line or primary access road corridors.

Excavated Rock Management Area

During site preparation, the use of overburden and suitable rock material from site preparation activities will be maximized where practicable for preparation of the site, including the access roads. Excavated rock not utilized for site preparation or later during construction will be transported and managed in the ERMA. If an off-site use for the excavated material is found, the NWMO will explore the potential off-site use of the material. The location of the ERMA and proposed footprint, suitable for all phases of the Project, is presented in Figure 9.1. The final footprint and location of the ERMA will be confirmed through design evolution.

Organics Management Area

The OMA will be one of the first facilities constructed and will store organics from clearing and grubbing activities during site preparation and construction. The use of organics and overburden from clearing and grubbing activities will be maximized where practicable for preparation of the site. Overburden or organics not utilized for site preparation or later during construction will be transported and managed in OMA. A preliminary location for the OMA is provided in Figure 9.1 The final footprint and location of the OMA will be confirmed through ongoing design evolution.

Temporary Concrete Batch Plant

A temporary concrete batch plant is expected to be mobilized to site to support site-preparation foundation and concrete works. It may also remain in service during the construction phase to supply concrete for building foundations and shaft-related works, including foundations, collars, and liners needed to prevent surface water ingress during shaft sinking.

Fresh Water Supply and Pumphouse

A phased approach will be implemented to satisfy water demand from the initial licence (site preparation) and construction activities which will consider water use and treatment requirements.

Initially, service and potable water requirements are planned to be met by trucking water to the site. A water withdrawal and distribution system will be established to meet water requirements on site

through the lifecycle of the Project. The Project is expected to make efforts to optimize water recycling.

Fresh water for the Project site will be sourced from a local water body or groundwater source in close proximity to the Project site. The source and location will be identified through future studies including engagement with Indigenous communities and regulatory authorities.

A pumphouse may be constructed to transfer the water from the source into on-site water storage tank(s). The water will then be treated as needed for on-site use.

Potable and Domestic Water Treatment

Water intended for domestic and potable use will be withdrawn from on-site freshwater tanks and treated to meet requirements per applicable regulations, codes and standards prior to use.

The water treatment system is expected to include chemically assisted filtration means, and equipment to perform primary disinfection and secondary disinfection. Two parallel water treatment systems will be required (one duty, one standby), to facilitate continuous operation during maintenance and cleaning activities.

Water Treatment

Temporary washrooms will be installed to support site preparation activities. The domestic sewage waste is planned to be collected in holding tanks and transported off site for further treatment and disposal at an existing waste management facility.

The permanent on-site domestic sewage system is designed to collect and treat all domestic sewage at a central location. The domestic sewage treatment plant is likely to treat liquid effluent to a suitable quality for direct environmental discharge. A connected sludge treatment system is proposed to dewater and stabilize solid sludge for disposal in accordance with applicable regulatory requirements, partially by transport to an existing off-site landfill.

The NWMO proposes to establish an integrated water management system during site preparation to manage water from surface facilities. It is planned that precipitation and surface runoff that comes into contact with surface facilities can be collected in ditches and collection ponds.

The NWMO plans to use the best available, and economically achievable, technologies for treatment of contact water. Treated discharge to the environment is anticipated to be localized and will be in accordance with applicable regulatory requirements. Receiving locations for treated water discharge are still under evaluation and will be located within a 2 to 10 km radius from the centre of the site.

A review of site topography is planned to be completed to determine the location of ditches and collection ponds to minimize the site contact water footprint and prevent uncontrolled discharge to the environment. The water management system is expected to use standard engineering criteria for ditches and water storage ponds.

Install Distribution Systems (including potable water system, natural gas, fire water, communications and security)

As site construction continues, the necessary distribution piping network and communications backbones will be constructed for connection to facilities as required.

Surface Fuel Storage and Dispensing Facility

A temporary fuel facility to store and supply gasoline, diesel, propane and/or natural gas is planned to be available during site preparation. Portable fuel tanks would be procured for temporary use to support site preparation activities. The selected tanks are expected to be appropriate for inter-modal transport by road and temporary storage of fuel at the Project site.

The temporary on-site facility will include storage tanks, pumps and secondary containment per applicable regulatory requirements, to provide storage and distribution of fuel for on-site vehicles, construction equipment and power generators until such time that the permanent fuel storage tank dispensing area is fully commissioned and available for use.

Aggregate Crushing and Screening Plant

An on-site aggregate crushing and screening plant is planned to be installed to support both site preparation and construction activities.

For the initial stages of site preparation, aggregate for road construction and site grading may be purchased from external suppliers. Following installation and commissioning of the on-site crushing and screening plant, aggregate needs for the balance of site-preparation work are expected to be met through processing of rock excavated during surface activities, supplemented as needed with purchased material.

Aggregate requirements for the construction phase are expected to be met primarily using rock generated through future underground development.

Explosives Management Area

The explosives management area will be constructed for the blasting activities for both the surface and underground development. The explosives management area will manage the distribution of explosives for the various blasting programs activities required. This area will be subject to enhanced security requirements, and explosives will be managed in accordance with the *Explosives Act* (Government of Canada 1985d) and associated regulations.

Administration Buildings, Quality Control Office, Garage and Warehouse

Permanent facilities will be built during site preparation to provide office space for the site management team, maintenance areas for servicing equipment and vehicles used in site preparation and construction activities, and covered warehousing to provide on-site storage of contractor and Project materials and equipment.

Worker Accommodation Camp

A worker accommodation camp is currently planned to provide housing for Project workers during the site preparation, construction and up to 10 years of operations. Early visioning for the accommodation camp is that it could be an approximately 800-bed, modular camp located closer to or on the main Project site. Domestic sewage and grey water for the camp will be managed according to appropriate regulatory requirements. Potable water is anticipated to be purchased from an external supplier and trucked to site until the potable water treatment plant and associated infrastructure is in place.

The proposed accommodation camp will be mobilized to site in a phased approach based on resource loading. Initial mobilization of the accommodation camp is anticipated to include utilities to service each accommodation unit individually, as well as dining and kitchen facilities and recreation facilities. The camp is planned with protocols to ensure that alcohol, cannabis, and other items associated with substance use are not present within the camp boundary. The security measures at the site are commensurate with the Project phase and licence conditions and will be applied in a graded approach to meet the requirements and guidance of the *Nuclear Security Regulations* and *REGDOC-2.2.4, Fitness for Duty, Volume II: Managing Alcohol and Drug Use*.

If required, a temporary facility to provide construction accommodation will be developed to support the initial construction period.

Construction of Helipad and Parking Lots

The surface structures to be built during site preparation are anticipated to include the helicopter landing pad and the parking lots for personal and commercial vehicles.

9.5 Construction

9.5.1 Overview Activities, Infrastructure and Physical Works

This section describes activities needed to complete the development of the remaining facilities planned to support operations. The construction phase will focus on construction and development of nuclear facilities, development of the underground DGR for the emplacement of the used fuel, and completion of the remaining infrastructure at the Project site. These activities are anticipated to be included in the construction licence. All necessary permits and approvals would be obtained prior to physical work being performed at the site.

Construction activities will include construction of remaining surface facilities, including the UFPP, all underground facilities, including the exhaust ventilation shaft, service shaft and main shaft, subsurface ventilation, dewatering infrastructure, the central service area and the Underground Demonstration Facility. The initial placement panel will be constructed as will the panel arms. The UFPP, interim LLW and interim ILW storage facilities are also planned to be constructed during this phase.

9.5.2 Listing of Major Construction Activities

The major activities anticipated in the construction phase are described in Table 9.3.

The subsections that follow provide additional information for key activities and facilities. Further information will be provided in subsequent regulatory submissions as appropriate.

Table 9.3: Activities During Construction

Surface
Ongoing construction of on-site access roads, secondary access road and rail spur
Construct remaining water management infrastructure and system
Develop potable water, natural gas, electrical, sewage, fire water, telecommunications distribution networks and tie-ins
Construct UFPP, interim LLW and ILW storage facility
Construct permanent concrete batch plant
Construct administration building
Construct auxiliary building
Construct emergency response building
Construct weigh scale and auxiliaries
Construct sealing material compaction plant
Construct/install sealing material storage bins building
Construct compressor plant
Construct storage yard
Construct repair garage and warehouse

Surface
Construct/install bus shelters
Construct UFPP and auxiliaries
Active liquid wastewater treatment system
Construct interim LLW and ILW storage buildings
Construct/install security buildings
Construct security gate
Install fencing around the protected area of the site
Traffic along the access roads and rail spur
Construct service shaft complex Construct exhaust ventilation shaft complex Construct main shaft complex
Underground
Excavation of central services area
Excavate road ballast crusher station, waste rock storage, explosive magazine, detonator magazine, collection sumps, emulsion loader and maintenance bay, vent gear storage area.
Mobilize heavy equipment for underground development
Excavate connection tunnel for exhaust ventilation, service and main Shafts
Excavate off-shaft
Excavate central access tunnel to connect exhaust and main shafts
Excavate access tunnels
Excavate placement arms and associated ventilation circuits
Establish first placement arm and associated infrastructure
Construct underground shops, bays, storage areas and remaining infrastructure to support the operations phase
Install underground substations and electrical switch rooms
Establish ventilation circuits for placement arms
Excavate vertical settlers
Excavate filter presses
Excavate and construct Underground Demonstration Facility area and associated access tunnels
Establish placement arms and associated infrastructure
Establish placement rooms to support operations

ILW = intermediate-level waste; LLW = low-level waste; UFPP = Used Fuel Packaging Plant.

Construction of On-site Road Network and Rail Spur

On-site roads will be made available for use during the construction phase of the Project. To facilitate an early transition to permanent roads, their construction is planned in two stages as follows:

- **Stage 1:** Construct and establish a road base, which will be performed as part of site preparation activities.

- **Stage 2**: Complete the road construction for permanent use, including final grading and finishing activities during the construction phase.

A rail spur is being considered to connect the DGR to a Class I rail line for transport of materials and used fuel, and construction of the rail spur would be complete during the construction phase.

Water Management

Development of the water management system continues with the further construction and development of surface facilities and addition of more drainage points such as roof drains from the newly built facilities.

The NWMO proposes to establish an integrated water management system for the site to manage water from the underground and surface facilities. It is planned that precipitation and surface runoff that comes into contact with surface facilities can be collected in ditches and collection ponds. Water from the dewatering of the underground DGR is planned to be collected in sumps and pumped to the surface for management as needed. Water pumped from the underground development activities, such as shaft sinking, is planned to be reused if suitable. If not fit for re-use, it would be directed to a collection pond for treatment prior to release to the environment.

A separate system is planned to collect the runoff water that does not come into contact with the surface facilities. The two systems may potentially be combined at discharge. The NWMO plans to use the best available, and economically achievable, technologies for treatment. Treated discharge to the environment is anticipated to be localized and will be in accordance with regulatory requirements. Receiving locations for treated water discharge are still under evaluation and will be located within a 2 to 10 km radius from the centre of the site.

Long-term storage ponds are planned to be designed to manage storm events without discharge of untreated water to the environment.

Utilities Installation

Leveraging the infrastructure installed during site preparation, connections are planned to be made for water, power and natural gas (for heating) for the facilities built during construction.

The fire protection systems for the surface facilities are planned to be installed during construction and likely will include the fire water system, fire detection and alarm systems, automatic fire extinguishing and fire suppression systems and manual fire extinguishing equipment. The fire water pipeline installed during the site preparation (initial licence) will be progressively connected to the new structures and facilities developed during construction as a part of the Project site-wide fire protection system.

Used Fuel Packaging Plant, Low-Level Waste and Intermediate-Level Waste Storage Facilities

The used nuclear fuel will be received from interim storage sites at the UFPP. The UFPP will incorporate multiple robotic/remote processing systems contained within hot cells (containment structures) to remove the used fuel from the transportation package and repackage it into the UFCs that will be emplaced in the DGR. Hot cells have been used in numerous nuclear facilities worldwide and are recognized for their effectiveness in protecting workers and the environment from radiation exposure (IAEA 2013). They are a key feature of the Posiva facility in Finland, particularly within the Onkalo DGR, which serves as an international reference point for the final disposal of spent nuclear fuel (IAEA 2012). The encapsulation plant at ONKALO includes hot cells for fuel handling, welding, and inspection, enabling part of a multi-barrier safety system designed to isolate radioactive materials for up to 100,000 years (Savolainen 2019).

The UFPP will also have numerous integrated complex support systems including conventional heating, ventilation and air conditioning, the nuclear grade ventilation system for the hot cells,

electrical power distribution, service and potable water, active and inactive drainage systems and active and inactive solid waste management systems.

Radioactive solid waste generated during operations in the UFPP is planned to be stored on site in interim LLW and ILW storage facilities.

Permanent Concrete Batch Plant

The permanent concrete batch plant would be responsible for supplying the site with concrete during the construction and operations phases. The temporary batch plant installed to support the site preparation activities is anticipated to continue operation in parallel with the permanent concrete batch plant to support high concrete demand during construction phase.

Administration Building, Auxiliary Building, Emergency Response Building, Weigh Scale, Compressor Plant, Repair Garage and Warehouse

Buildings that are planned to be constructed within the Protected Area include the administration, auxiliary and emergency response buildings, weigh scales, the compressor plant, the repair garage/warehouse.

The Project site requires a warehouse and storage facilities to receive, store and dispense materials, consumables, and equipment necessary to support operations. The repair garage is anticipated to provide capability to service site vehicles.

Sealing Material Compaction Plant

The sealing material compaction plant will be built during the construction phase and will be located outside of the Protected Area. The sealing material compaction plant is designed to produce bentonite blocks and granular fill. Storage silos would store the bentonite powder transported to the Project site by trucks. The sealing material compaction plant would house presses, mixers, milling/machining systems and roll compaction systems.

Site Security

Security infrastructure would be built to control personnel and vehicle access to and from the Protected Area and Balance of Site areas. The main security monitoring room is planned to house monitoring equipment including cameras and closed-circuit television monitors and would serve as the central command point for security surveillance serving both the Protected Areas and the Balance of Site. Guardhouse(s) would be provided for security personnel for the control, verification and authorization of vehicle and staff movements.

Sinking Exhaust, Service and Main Shafts

The NWMO plans to develop three shafts during the construction phase, the exhaust ventilation shaft, the service shaft and the main shaft. Shaft sinking and related activities typically include the following:

- ground improvement (grouting) around the shafts
- preparation of the shaft collar areas including installation of headframe foundations
- fabrication and installation of the headframes
- installation of shaft sinking hoisting equipment
- shaft sinking
- changeover to permanent hoisting system

The current plan is that the shafts will be sunk and excavated using a controlled drill and blast mining excavation technique. It is anticipated that the use of explosives will be controlled, and grouting will be used as needed to manage groundwater inflows. The NWMO is monitoring developments in mechanical excavation mining techniques and may switch to alternative methods that do not use explosives if they become available, are practically feasible (e.g., suitable for expected geological conditions) and economically achievable.

Excavation and shaft sinking activities for the exhaust ventilation and service shafts will be completed first, before main shaft sinking activities begin. Once the depth of the repository is reached in the exhaust ventilation and service shafts, the off-shaft development will progress to achieve flow-through ventilation between the exhaust ventilation and service shaft.

The exhaust ventilation shaft and service shaft are planned to be constructed utilizing the permanent steel headframes. The exhaust ventilation shaft will use a temporary rock hoisting system using the sinking configuration to support continuation of the lateral development activities until the permanent rock handling system and loading pocket infrastructure is developed in the service shaft. It is planned that the main shaft will be constructed utilizing a temporary sinking headframe. Once the main shaft construction is completed, the temporary sinking headframe will be removed and decommissioned, and the permanent headframe will be installed.

The majority of the equipment used for shaft sinking will be electric/hydraulic and pneumatic powered with some equipment being diesel-powered. Appropriate means to properly ventilate the construction area during shaft sinking are planned to be implemented to ensure provision of safe air quality for workers.

The ventilation system for shaft sinking is temporary and specific to each shaft. Temporary surface fans provide fresh air to the shaft bottom via temporary vent ducting. A temporary fresh air heater system is installed to provide adequate working conditions (above freezing) during the colder months. Once the rock handling and skip hoisting systems are commissioned in the service shaft, the exhaust ventilation shaft will be converted to the permanent configuration.

Underground Services During Lateral Development

Services planned to support underground lateral development (power, communications, water management, compressed air) will utilize the same infrastructure services used during the initial site preparation activities.

Once the service shaft and exhaust ventilation shaft are connected, it establishes the primary ventilation entailing a flow-through system from the service shaft, along the upper fresh air level to the fresh air raises, then through each circuit and finally discharging into the atmosphere at surface passing through the exhaust ventilation shaft.

The controlled drill and blast excavation technique is planned to be used to excavate the above listed underground amenities in the underground central services area. Excavation is followed by installation of rock support, spraying of shotcrete (where required), grading and construction of floors and installation of necessary utilities and safety protection systems.

Underground Demonstration Facility

Establishing the early Underground Demonstration Facility will be a high priority for the off-shaft excavation development. The first early Underground Demonstration Facility will be excavated between the service shaft and exhaust ventilation shaft, followed by a second Underground Demonstration Facility excavated in the area south of the exhaust ventilation shaft. The excavation of the early Underground Demonstration Facility will likely be completed with handheld or alternative equipment due to the progress of equipment mobilization to the DGR level (500 m to 800 m underground). The main Underground Demonstration Facility will be a secondary excavation priority which will completed later in the construction phase with the excavation of the Central Services Area.

Studies that would be conducted in the Underground Demonstration Facility include geoscience verification and testing, demonstration of excavation and construction methods, validation of emplacement procedures for UFCs and sealing materials, long-term studies of engineered barrier materials or processes, and/or monitoring of specially instrumented emplaced containers.

Sumps

Water management during shaft sinking and initial construction at the DGR horizon level would require temporary sumps for the collection and transfer of used service water and underground water inflows from rock formations to surface via the shaft discharge column. This wastewater stream from the shaft sinking equipment is expected to require treatment to remove contaminants prior to re-use in the service water system. If not suitable for re-use, the water would be discharged to the DGR dewatering settling pond. As development progresses, the permanent sump and dewatering systems would be constructed and commissioned, and the temporary sump and dewatering system would be decommissioned and removed.

Once the permanent dewatering system is commissioned, it is anticipated that the used service water and underground water inflow is collected and sent to the main sump and then pumped to surface.

The main sump is likely to be located in the central services area and additional sumps are likely to be located as needed at appropriate locations in the underground repository footprint. Pumps placed in the additional sumps and dewatering lines would direct water to the main sump, for settling, recirculation and/or discharge from the underground to the surface. All sumps are planned to be periodically cleaned to remove settled sediments and debris.

Underground Deep Geological Repository Facility

An extensive underground DGR facility is planned to be constructed to manage the used fuel emplaced in the engineered and natural barriers. A generic proposed underground layout is shown in Figure 9.3. The underground DGR would consist of a series of panels containing multiple dead-ended placement rooms that will be filled with the UFCs surrounded in bentonite. The underground DGR would include all the infrastructure necessary to safely operate and concurrently construct the underground facility.

The placement rooms of the underground repository are constrained by the naturally occurring rock fracture network. The Geoscience Verification Plan and additional characterization work performed during the initial years of the construction phase will ensure that where applicable, the placement arms are sufficiently far from these fractures.

Underground Infrastructure, Central Services Area

The infrastructure that would be excavated and installed as a part of construction activities in the central services area includes:

- dewatering stations
- service shaft loading pocket
- ramp to shaft bottoms
- Underground Demonstration Facility rooms
- excavated ramp
- office, lunchrooms and refuge station
- permanent service water station
- electrical substations

- rock breaker area
- rock raise
- maintenance shop and warehouse
- battery charging station
- underground equipment/material storage areas
- explosives and detonators magazines
- road crusher ballast station
- emulsion loader and ballast station
- vent gear storage

Mobilize Heavy Equipment for Underground Development

Once construction activities associated with the central services area and main shaft are completed, the plan is to mobilize the heavy equipment necessary to extend the lateral development of the DGR by bringing it underground using the main shaft hoist.

An explosives magazine will be located away from the central service area and the panels of placement rooms, but readily accessible for mobile explosives loading trucks.

The magazine is likely to be fitted with shelving for bulk explosives bags and stick powder and equipped with a wall-mounted jib crane.

Excavate Access Tunnels and Placement Arms

The reference excavation technique for construction of underground access tunnels and placement arms is controlled drill and blast.

The primary function of the underground access tunnels is to provide people, vehicles and equipment access to the central service area and the main repository with placement arms and placement rooms.

The central access tunnels are planned to be constructed with concrete floors to provide a smooth driving surface for transfer of loaded buffer box (bentonite blocks with loaded UFCs) and bentonite gap fill material handling and emplacement equipment. As the access tunnels are developed, the support services planned to be installed include compressed air lines, waterlines, drain lines, electrical power distribution cables, communications infrastructure and ventilation ducting**.**

Excavate Ventilation Circuits for Placement Arms

The underground DGR is planned to be excavated to support concurrent operations and construction activities. Independent ventilation circuits are to be established for the emplacement (operations) and excavation (construction) areas of the underground DGR. To the degree possible, the subsurface ventilation system is expected to be set up to ensure that underground work is performed in a fresh air supply stream with the exhaust being directed through unoccupied areas.

It is anticipated that ramps are excavated in the central service area to access the fresh air transfer level and the service and exhaust ventilation shaft bottoms. It is likely that the crosscuts are excavated at appropriate locations to establish ventilation circuits in each placement arm and to avoid the use of ducting to deliver ventilation air.

Placement Rooms

The first panel of placement rooms is planned to be excavated and developed during the construction phase. The placement room dimensions are determined by the loaded buffer box size. The basic arrangement of the underground repository would involve a series of parallel, dead-end placement rooms, organized into panels. The panels of placement rooms are located along repository arms that will extend from the Central Services Area. All underground openings are currently planned to be excavated by controlled drill and blast excavation technique. The placement room floors may have a thin layer of concrete to provide smooth travelling surface for the emplacement equipment.

It will be necessary to excavate new placement rooms concurrently while UFCs are being emplaced in the excavated placement rooms. For safety and logistical reasons, excavation of new placement rooms and emplacement of fully excavated placement rooms with loaded buffer boxes would occur concurrently in separate panels.

Underground Footprint

In the repository arm where loaded buffer box emplacement activities are occurring, non-nuclear equipment traffic and loaded box delivery equipment traffic are expected to follow dedicated and separate travel routes in twin access tunnels. In general, the excavation-related equipment and vehicles carrying various non-nuclear materials (e.g., sealing materials and concrete) would travel in one access tunnel and the equipment carrying the UFCs for emplacement would travel in the other access tunnel.

Equipment Storage and Maintenance

During construction, the main shaft is planned to be used to mobilize large, heavy equipment to support excavation and lateral development of the DGR.

An underground shop is planned to be constructed to perform all maintenance on the mobile equipment such as mining equipment, service vehicles and personnel carriers. This shop is likely to be located relatively close to the exhaust ventilation shaft and would have a main shop area for working on larger equipment and satellite bays to service smaller equipment. It may also include a wash bay, welding shop, parts storage warehouse, electrical room, lunchroom and a supervisor's office. It is anticipated that overhead bridge cranes and an overhead monorail crane are installed in the underground shop to support the maintenance activities.

The special equipment storage area is planned for the storage of special equipment required for either testing or monitoring in the Underground Demonstration Facility or elsewhere in the DGR. The storage area is likely to have a controlled environment (climate control) to protect the special equipment while in storage.

Permanent Refuge Station

A large permanent refuge station would be established in the central service area. The permanent refuge station is planned to be located between two access tunnels which, would allow access from both ends of the station. The refuge station would have two concrete walls with steel doors in the wall at each entrance. The refuge station would include a main area for personnel and an operations supervisor's office at the back end of the room. The refuge station would be equipped with safety and emergency equipment such as a fire extinguisher, eyewash station, first aid kit, emergency food and drink rations, emergency toilets and stretchers. The refuge station would provide a safe location of refuge to workers and visitors during an abnormal event that can be sealed and will be supplied with fresh air via the compressed air system.

In addition, portable refuge stations would be established at suitable locations in each arm of the repository within crosscuts that connect the twin access tunnels of each arm. The portable refuge stations would provide refuge to workers and visitors during an abnormal event when safe passage to

the permanent refuge station in central service area is not possible. Each of the portable refuge stations would contain bottled compressed oxygen for emergency breathing air.

The portable refuge station would also have a stock of bottled drinking water for the occupants to be used during an emergency event.

Service and Potable Water

Supply of service water would be provided in the DGR during both the construction and operation phases for operating mining equipment, dust suppression and support various other services.

Potable water would be sourced at the surface-based water treatment plant and delivered underground via totes.

Excavated Rock Management Area

Excavated rock from construction of the shafts and the underground during construction phase is planned to either be sent to the aggregate crushing and screening plant for use as construction material or be transported by truck for storage in the ERMA.

Geochemical testing to date indicates that the excavated rock is not expected to be acid generating or metal leaching. An overwhelming proportion of recovered core, approximately 97 percent of the total drilled length, consists of biotite granodiorite-tonalite or a slight compositional variation. Lithogeochemical and mineralogical investigations of this predominant rock type only locally identify trace proportions of sulphur-bearing minerals (e.g., sulphides, sulphates). The ERMA will be designed to accommodate these findings to provide appropriate environmental protection as needed.

9.6 Operations

9.6.1 Overview Activities, Infrastructure and Physical Works

This section provides a conceptual description of the activities that are likely to be performed during the operations phase to commensurate with the current conceptual status of the reference design. The activities to be performed in the operations phase will be continuously refined based on design evolution and Project progression.

The primary activities would be in handling and transfer of the used fuel.

For planning purposes, it is assumed that once an operating licence is received, the operations activities in the UFPP and the emplacement activities in the DGR would operate at full capacity to achieve the design throughput. As the design matures, detailed commissioning plans for cold and hot commissioning will be prepared and appropriately implemented. Cold commissioning refers to the initial phase of testing and validation where systems and equipment are operated without the use of radioactive materials or hazardous substances. Hot commissioning involves testing with actual process materials under operational conditions to confirm that the facility performs safely and effectively in real-world scenarios. Together, these phases are critical to verifying system integrity, ensuring regulatory compliance, and facilitating a smooth transition to full-scale operations.

The used fuel is planned to arrive by truck or rail in certified transportation packages and received at the UFPP. The used fuel will be removed from the transportation packages, transferred into the durable corrosion-resistant UFC and emplaced in placement rooms underground. Once a placement room is filled, it needs to be safely closed off from the main tunnel. To do this, a special seal will be built at the entrance of the placement room. This seal is made of two parts: one uses bentonite to stop water from getting through, and the other is a strong concrete barrier to hold everything in place. If water reaches the placement room, the bentonite swells up and blocks the flow. The concrete keeps the bentonite from moving and helps make sure everything stays securely sealed.

Concurrently with the emplacement activities, placement rooms would continue to be excavated in different panels. Excavated rock will be crushed, brought to the surface and transported to the ERMA.

Safeguards procedures and systems are expected to be implemented as required to meet the applicable *General Nuclear Safety and Control Regulations* (Government of Canada 2000b).

LLW and ILW generated would be segregated and stored on site on an interim basis in LLW and ILW storage facilities during the operations phase.

9.6.2 List of Major Activities During Operations

The major activities anticipated in the operations phase are described in Table 9.4. The subsections that follow provide additional information for key activities and facilities. Further information will be provided in subsequent regulatory submissions as appropriate.

Table 9.4: Activities During Operations

General
Hot and Cold commissioning of Systems, Structures and Components
Surface
Manufacturing of cementitious and bentonite sealing materials
Used fuel receipt, transfer and containerization in UFPP
Management and storage of LLW and ILW generated from UFPP operations
Balance of site operations, quality control, safeguards, warehouse, water treatment, air compressor and fuel storage buildings, sewage treatment, guardhouses, storage yard
Management of excavated rock
Demobilization and removal of temporary infrastructure
Traffic along access roads and rail spur
Underground
Emplacement of Loaded Buffer Boxes in DGR placement rooms
Ongoing underground development of placement panels and rooms
Sealing of placement rooms

DGR = Deep Geological Repository; ILW = intermediate-level waste; LLW = low-level waste; UFPP = Used Fuel Packaging Plant.

Packaging of Used Fuel in the Used Fuel Packaging Plant

Operating systems would come online once the Licence to Operate is received from the CNSC. Quality control and performance monitoring systems would be in place to monitor and measure performance of the systems against the established baseline site performance data during the operations phase.

Incoming material, fabricated products and operational activities would be controlled through a formal quality assurance program.

Safeguards measures would be incorporated into the facility design, systems and operations to maintain accountability of all nuclear materials and to detect any diversion.

The operations performed at the Project site can best be summarized as receipt, inspection and repackaging of the used fuel in the UFPP. Once packaged, the UFC is transported to the DGR for emplacement. These activities are completed to isolate the radiological hazard associated with used fuel from humans and the environment.

The engineered barriers required to encapsulate the used fuel would be received either in raw form (e.g., bentonite clay) to be converted into their final state at the sealing material compaction plant or are received in a completed ready-to-use state (e.g., UFCs) requiring final assembly.

The fabrication and/or assembly processes would be performed at the surface facilities, and the emplacement and isolation function would be performed underground in the DGR. Concurrently, lateral development of the DGR to construct placement panels would continue to occur in parallel with the packaging and emplacement activities. Any activities performed in close proximity to the used fuel would be carried out per specific radiation protection plans and pre-job assessments to ensure worker doses remain as low as reasonably achievable. A brief summary of the processes occurring during the operations phase, excluding those needed to develop additional placement rooms, is provided below.

Used fuel currently stored at interim storage facilities would arrive at the Project site in a certified transportation package. The packages would be received at the UFPP, disassembled in a hot cell (exposing the contained used fuel) and the used fuel transferred to the UFC. Empty UFCs would be received at the UFPP from an off-site manufacturing plant. The received UFCs would be substantially completed prior to arriving at the DGR and include an insert, a shell with integral bottom and corrosion barrier and a separate UFC head with its corrosion barrier.

The throughput of Canada Deuterium Uranium used fuel encapsulated in UFCs is expected to be 120,000 fuel bundles per year. Utilizing the current reference UFC design with a capacity of 48 Canada Deuterium Uranium used fuel bundles, the throughput required for both the UFPP, and the underground emplacement is estimated to be 2,500 UFCs per year.

At this time, the decontamination of certified transportation packages, UFPP areas and UFCs is expected to generate both liquid and solid radioactive waste streams. Solid waste is planned to be characterized as LLW or ILW and stored in the interim LLW storage facility or the interim ILW storage facility, respectively. Active liquid waste is planned to be characterized, collected and stored in the interim LLW storage facility or the interim ILW storage facility, respectively, as applicable. Upon completion of the emplacement of all of the used nuclear fuel into the DGR, the activities are planned to focus on the co-emplacement of LLW from the interim LLW storage facilities into the DGR, in dedicated placement rooms or areas that are separate from the used nuclear fuel placement rooms. Design details and operational descriptions of the co-emplacement of LLW will be provided in future licensing applications.

Transfer and Emplacement of the Used Fuel Underground

Once the UFC has been confirmed to meet requirements for movement underground, the UFC would be encased in rectangular, highly compacted bentonite blocks and transferred to the underground in a shielded transfer cask. The highly compacted bentonite blocks would not be contact handleable and would require shielding and remote handling processes, to prevent workers from being exposed to radiation.

The emplacement of the pre-assembled UFC and bentonite engineered barriers is expected to be a material transfer process utilizing custom designed wheeled transfer equipment. Once the transfer cask containing the loaded UFC surrounded in bentonite blocks is brought from the UFPP down the main shaft to the underground, the transfer cask trolley is brought to the entrance of the placement room.

The loaded buffer box assembly is placed into the placement room for permanent storage, and bentonite fill is installed in remaining voids of the placement room.

Once a placement room is filled, an engineered room seal is planned to be installed to permanently seal off the placement room from the access tunnels. Concrete and bentonite are proposed to be used for the sealing of the placement room entrance supplied from the concrete batch plant and the sealing materials compaction plant.

At this time, all underground emplacement related activities are expected to be performed with battery powered vehicles.

Lateral development of the DGR to excavate panels for the placement rooms until all the panels required for the used fuel inventory are constructed is planned to occur concurrently with the emplacement activities. A concrete batch plant on site would provide the necessary concrete for underground flooring, placement room seals and related developmental infrastructure as required. Upon cessation of emplacement activities, the facility is planned to be prepared to go into long-term care and monitoring.

The main access tunnels, shafts and underground infrastructure are expected to remain available for service and maintained accordingly.

Development of Additional Placement Rooms

The activities and physical works needed to develop additional placement rooms are the same as those described in Section 9.5.2 and, hence, will not be repeated in detail again.

As access tunnels are developed, the infrastructure services including compressed air lines, waterlines, drain lines, power cables, lighting and ventilation ducting are expected to be installed.

Geological investigation and verification activities are planned to be carried out concurrently with underground development to obtain the geological data needed to confirm the safety of the repository system and to identify geological nonconformities where seals or other suitable geological fracture management techniques may be needed.

Excavated Rock Management Area

The ERMA is required for both construction and long-term support for the Project. As panels would continue to be excavated and developed during operations, the ERMA is estimated to remain in service for most of the operating life of Project.

Water Management

The site water management systems as described in Section 9.5.2 would manage conventional water streams. Water from the nuclear operations would be directed to the active liquid water management system for further processing. All liquid waste generated as a byproduct of operation activities is planned to be collected, segregated, treated and stored in engineered structures prior to discharge. Contact water will be managed, monitored, and if required, treated, prior to discharge to a suitable receiving waterbody meeting regulatory requirements.

9.7 Decommissioning and Closure

9.7.1 Overview Activities, Infrastructure and Physical Works

This section provides a preliminary, conceptual description of the activities planned to be completed during the extended monitoring, decommissioning and closure phases at the Project site. It is expected that these activities may be modified over the many decades that will occur prior to this work being undertaken.

A period of long-term monitoring is expected to provide further data to demonstrate the long-term safety of the Project. During this phase, limited activity would take place at the Project site beyond

surveillance, co-emplacement of LLW and selective decommissioning of structures, systems, and components.

Decommissioning, final closure and the subsequent institutional control period and eventual release from licensing of the Project site will be governed by the CNSC following all associated regulations and codes and will be informed by ongoing engagement with the public and potentially affected Indigenous peoples. The CNSC requires a preliminary decommissioning plan be developed and revised on a five-year cycle throughout the lifecycle of the Project for approval and that the appropriate financial guarantee is in place to carry out the decommissioning activities. Key activities to be performed in the decommissioning phase are listed in Table 9.5 and further described in the section below. As with all previous phases, all necessary permits and approvals would be obtained prior to physical work being performed at the site.

9.7.2 Listing of Major Activities for Decommissioning and Closure

The major activities anticipated in the extended decommissioning and closure phase are described in Table 9.5.

The subsections that follow provide additional information for key activities and facilities. Further information will be provided in subsequent regulatory submissions as appropriate.

Table 9.5: Activities During Decommissioning

Surface
Ongoing environmental data collection
Ongoing engagement and consultation with the public, interested parties and Indigenous Peoples
Application for, and receipt of environmental related permits
Hiring of individuals and contractors and procurement of materials and equipment
Decommissioning of surface structures, systems and components
Decommissioning of UFPP, Interim LLW and Interim ILW storage facilities
Removal of ILW to a Licenced facility
Sealing of access tunnels and perimeter tunnels
Reclamation of decommissioned site and ERMA
Installation of permanent markers to inform future generations of the presence of the sealed repository
Underground
Co-emplacement of associated LLW from decommissioning in the DGR
Decommissioning of underground DGR structures, systems and components
Sealing of access tunnels, perimeter tunnels and Central Services Area
Sealing of access shafts

DGR = Deep Geological Repository; ERMA = Excavated Rock Management Area; ILW = intermediate-level waste; LLW = low-level waste; UFPP = Used Fuel Packaging Plant.

Long-Term Monitoring and Decommissioning of Surface Structures

Following completion of emplacement of Loaded Buffer Boxes (loaded UFCs with bentonite blocks) in the repository, the Project will enter in an extended monitoring phase where the NWMO will continue to monitor the long-term safety and performance of the repository system. During this period, placement rooms are planned to be backfilled and sealed, but access tunnels and perimeter tunnels are open and maintained to support in situ monitoring activities.

LLW is planned to be transferred from interim surface storage to underground panels/emplacement rooms for permanent storage. Where appropriate, some surface structures may be decommissioned during extended monitoring period. For example, the UFPP, interim LLW storage facilities and interim ILW storage facilities may be decommissioned to allow co-emplacement of LLW. LLW generated during decommissioning these structures is planned to be emplaced underground. ILW is planned to be transported to a Licenced facility or co-emplaced underground with the LLW. Other surface facilities may be decommissioned as permitted by the Decommissioning Plan and Licence.

Underground infrastructure items that are not required for the extended monitoring period or decommissioning post extended monitoring period are likely to be removed and decommissioned, which may include bulk materials such as piping, electrical cables or electrical equipment and shop maintenance equipment. These items will be moved to the surface, thereby preparing the access tunnels and main access area for closure. All removed items will be recycled where possible and the remaining items transported off site to a suitable disposal site.

The NWMO will demonstrate the site's long-term safety during the extended monitoring period. The actual duration of this period will be determined based on society's desire at the time as well as experience from other international DGRs for used nuclear fuel and CNSC oversight.

The extended monitoring phase includes the following activities:

- monitoring of barrier parameters such as rock temperature, rock stress/displacement (response to thermal loading), water ingress, placement room seal performance, ground water quality, ground water radioactivity, humidity and acoustic emissions as required
- monitoring of the long-term experiments in the Underground Demonstration Facility set up during the construction or operations phase
- maintenance of facilities potentially needed for decommissioning and closure
- design, construction and commissioning of any new facilities needed to support decommissioning and closure
- revision of decommissioning and closure plans to reflect experience gained during the extended monitoring phase as well as regulatory or technology updates

Decommissioning Underground Infrastructure

To sustain continuous monitoring activities prior to decommissioning, much of the central services area is planned to remain operational including the main, service and exhaust ventilation shafts. This will allow personnel access to the repository at all times.

In the post monitoring period, the main decommissioning activities would commence. The seals and plugs per current concepts remain similar in physical size and properties to those placed during the operational phase. The systems and techniques previously used can be optimized and applied during execution of the decommissioning activities.

Decommissioning is planned to commence with the access tunnels adjacent to the placement rooms, specifically at the placement room concrete bulkhead. The emplacement of seals and plugs is likely to occur in a retreating manner, one panel at a time from the furthest panel out, towards the central service area. Once all the panels have been sealed and plugged, the area of focus is anticipated to

shift to the central service area. The horizontal opening and rooms are expected to be sealed and plugged similar to the methods used in the access tunnels. At this phase, temporary infrastructure, such as power and water supply will be required to support the decommissioning activities. Finally, the main, service and exhaust ventilation shafts will be decommissioned.

The sealing of the access tunnels will be carried out such that requisite tunnels remain open to provide ventilation to working areas. Therefore, the sequence for tunnel closures is likely to consist of sealing all tunnels in a retreating manner from the exhaust ventilation shaft to the service shaft.

Similar to the access tunnels, the shafts are also anticipated to be prepared prior to the installation of the shaft sealing system. Bulk materials residing along the length of the shaft including the concrete liner are likely to be removed and disposed of. Then the pre-planned seals and plugs for the shafts are be installed in accordance with the intersecting geology exposed along the shaft.

The final underground decommissioning activity anticipated is the sealing and plugging of any remaining boreholes to eliminate any connections from the surface to the DGR placement level. Much like the shafts, specific seals and plugs are planned to be placed to mitigate intersecting features or to provide a fill that is compatible with the neighbouring geology.

Shaft decommissioning activities would begin after sufficient performance monitoring data have been collected to support a decision to decommission and close the repository.

For planning purposes, final decommissioning is expected to occur about 100 years after repository construction using an adaptive and graded approach. It is envisioned that this phase of the Project would end when the repository is sealed, with all surface facilities decontaminated, decommissioned, and removed. For planning purposes, it is assumed the decommissioning and closure phase will require about 30 years.

The main activities undertaken during decommissioning and closure (or several years before) would likely include several steps:

- preparation of a Detailed Decommissioning Plan that complies with all regulatory requirements and application for a Licence to Decommission
- construction of facilities needed for decommissioning and closure of the Project site, such as a concrete batch plant and a sealing material compaction plant (if required)
- decommissioning of underground facilities, i.e., removal of operational systems and furnishings and preparation of exposed rock surfaces for sealing
- sealing of access tunnels, perimeter tunnels and service areas; bentonite seals and concrete bulkheads are planned to be installed near access tunnel intersections and also near intersections with significant zones (as appropriate)
- sealing of shafts, which involves removal of shaft services, instruments and furnishings; reaming of shafts to remove the concrete liner; installation of temporary services; and backfilling with various sealing materials
- decontamination, dismantling and removal of surface infrastructure and facilities, particularly the UFPP, interim LLW storage facilities and interim ILW storage facilities
- surveys of soils and sediments impacted by surface infrastructure to identify contaminants of potential concern (COPCs) for both conventional and radiological contaminants to meet decommissioning plan objectives
- management of all waste streams, including radioactive wastes, generated during decommissioning operations

- sealing of subsurface boreholes and those surface boreholes not required for post-closure monitoring; the preferred sealing approach will depend on the geological features intercepted by each borehole
- closure of any remaining facilities
- installation of permanent markers to inform future generations of the presence of the sealed repository
- environmental monitoring, as needed

10. Estimated Maximum Production Capacity of the Project

The total number of used fuel bundles to be processed in the UFPP over its lifetime of about 50 years, will be approximately 5.9 million bundles of used fuel which is the projected total inventory of used nuclear fuel estimated to be produced in Canada from the current fleet of reactors to end of life, as outlined in the NWMO's 2024 Nuclear Fuel Waste Projections Report (NWMO, 2024). This projection is based on published refurbishment and life-extension plans for the Darlington and Bruce reactors, and the continued operation of Pickering A reactors (until end of 2024) and Pickering B reactors (until end of 2026), and on the NWMO's assumptions used for planning purposes.
The Project is expected to last over 160 years, including site preparation, construction, operation (about 50 years), closure, and post-closure monitoring. The Project would be Licenced by the CNSC for approximately 160 years, from site preparation through decommissioning and closure.

The Project does not include any capacity beyond 5.9 million bundles of fuel. Increases in the proposed inventory would require approval from host communities and applicable regulators, including the CNSC as the lifecycle regulator for the Project.

Over its lifetime, the UFPP is planned to process about 120,000 used fuel bundles per year.
On average, per the current conceptual reference design, 10 UFCs are planned to be processed and placed in the repository each workday, or approximately 2,500 UFCs each year. Alternative used fuel container designs may be examined from design and throughput optimization perspectives.

To achieve this throughput, the UFPP is likely to incorporate multiple processing lines. Based on annual shipping (receipt) assumptions, the maximum number of certified transportation packages received at the UFPP in any given year is estimated to be approximately 625 Used Fuel Transportation Packages (UFTPs) and 260 Basket Transport Packages, respectively (each UFTP holds 192 used fuel bundles whereas the Basket Transport Package holds up to 120 used fuel bundles). The UFPP is designed to receive and process up to three UFTPs and two Basket Transport Packages per day. Used fuel-filled modules and baskets may be placed into temporary dry storage as required, until modules can be accepted for processing inside the UFPP.

10.1 Description of Production Processes

A brief summary of the main production processes is provided in this section. Most processes will be carried out remotely to minimize worker exposure doses.

Used fuel arrives (approximately two trucks per day) at the UFPP from the interim storage sites and is received in the UFTP handling cells. In the UFPP, the used fuel modules would be lifted out of the transportation packages and placed in the UFC Loading Cells. Next, the used fuel bundles are unloaded from the modules and loaded into UFCs.

Multiple used fuel handling systems are planned to be available in the UFPP. Each isolated from one another with airlocks and shielding walls as required. The "hot cell" areas within are expected to be shielded by concrete and/or metallic walls with lead glass windows and closed-circuit television cameras for remote viewing.

Per the current conceptual reference design, the used fuel-filled UFC is loaded into a shielded transfer cask and transferred to a weld cell to undergo the final assembly processes of welding, machining and inspection. Next, the filled and welded UFC enters a copper application and machining cell, where the UFC's machined weld area would receive a copper coating, machined smooth and transferred for copper annealing. The UFC assembly would be considered completed after it is confirmed that the copper coating meets the required acceptance criteria.

The completed UFC is then transferred to the bentonite buffer box storage, handling and dispatch area. There the main process is to assemble the buffer box with the UFC inside. The buffer box

(with UFC inside) is loaded into the dispatch vehicle transfer flask and transferred into the repository via the main shaft on a trolley.

In the repository, the transfer cask (with the loaded buffer box) is transported to a shielding canopy located at the entrance to a placement room where the buffer box is moved onto the transfer system for emplacement. The placement vehicle travels the length of the placement room to the emplacement location and deposits the loaded buffer box. After the emplacement of two loaded buffer boxes, two highly compacted bentonite spacer blocks are emplaced in a similar fashion. Then the bentonite gap fill material emplacement system enters the placement room and augers granular bentonite in the annular spaces around the buffer boxes. Prior to receiving the next loaded buffer boxes, several thick bentonite tiles/tablets are deposited on the placement room concrete floor to be ready for the next buffer box emplacement.

All activities in the placement rooms would be remotely controlled once the first buffer box has been received at the room entrance.

The entire loaded buffer box emplacement process would take approximately four hours per box. Three emplacement operations are expected to be performed in parallel to achieve the required annual 2,500 buffer box transfer rate.

After a placement room is filled, the end of the room would be sealed with bentonite and concrete. The planned cementitious materials (e.g., concrete and grout) are prepared in the concrete batch plant, as needed. The bentonite and other clay-based sealing materials, including the buffer boxes and highly compacted bentonite space blocks, are planned to be manufactured in the sealing material compaction plant.

11. Anticipated Schedule

For purpose of studies, it has been assumed that the Project will start with the activities noted in the site preparation phase in 2030 and extend through the decommissioning and closure period, ending approximately 2193.

The approximate durations for site preparation and construction phase, operations phase, and decommissioning and closure phases are provided in Table 11.1.

Table 11.1: Assumed Project Phases and Planning Timelines

Project Phase	Approximate Timeline (Year)	Phase Duration (Years)
Site Preparation and Construction	**2030-2042**	**13**
Operations	**2043-2092**	**50**
Decommissioning and Closure a. Extended Monitoring b. Decommissioning and Closure	**2093-2192**	**100**
Institutional Control[(a)]	**2193 +**	

(a) The control of residual risks at a site after it has been decommissioned. Institutional controls can include active measures (those requiring activities on the site such as water treatment, monitoring, surveillance and maintenance) and passive measures (those not requiring activities on the site, such as land-use restrictions or markers) (CNSC REGDOC-3.6, Glossary of CNSC Terminology).

CNSC = Canadian Nuclear Safety Commission; REGDOC = regulatory document.

12. Alternatives To and Alternative Means

12.1 Alternatives to the Project

Through enacting the NFWA, the Government of Canada decided on the path forward for the long-term management of used nuclear fuel in Canada. The act established the NWMO as the organization responsible for managing this used nuclear fuel which came with a series of obligations. One obligation on the NWMO was to conduct a comprehensive study on the possible approaches for the safe, long-term management of used nuclear fuel, and to recommend a preferred approach to the Government of Canada. The NFWA required the NWMO's study to include a comprehensive technical description of each waste management option, along with a comparative analysis of their benefits, risks, and costs, and an assessment of ethical, social, and economic considerations, as well as a detailed implementation plan. This assessment of alternatives to the Project was completed over three years and is documented in *Choosing a Way Forward* (NWMO 2005), included in Appendix D. To meet requirements for the IPD, the NWMO has summarized the following content from Appendix D in this section of the IPD:

- the description of alternatives assessed
- the rationale for selecting the preferred approach for used nuclear fuel (the Project)
- the public and Indigenous engagement and consultation which was conducted and how views were considered in selecting the preferred management approach for used nuclear fuel

Since the NWMO's mandate is to design and implement a long-term solution for the management of Canada's used nuclear fuel, a no-action alternative (i.e., proceed without a plan for long-term management of used nuclear fuel) was not considered as part of the previous alternatives to assessment.

12.1.1 Alternatives Assessed

Section 12(2) of the NFWA specified three technical methods to be the basis of approaches considered by the NWMO, with the ability to consider additional options.

For about four decades, various countries have been investigating many possible methods to manage used nuclear fuel over the long term. In the NWMO's first discussion document, *Asking the Right Questions?* (NWMO 2003), the NWMO reviewed 14 different options that have been considered internationally. The NWMO used three categories:

- methods requiring review as specified by the NFWA
- methods receiving international attention
- methods of limited interest

From the NWMOs initial review of 14 options, the NWMO narrowed the choices to four, which became the focus of its study. Further rationale for screening out these methods is provided in Appendix D. As required by the NFWA, the NWMO studied individual approaches based on each of the three technical methods specified for study:

- option 1—deep geological disposal in the Canadian Shield
- option 2—storage at nuclear reactor sites
- option 3—centralized storage, either above or below ground

In addition, the NWMO selected a fourth option, APM, which in part involves many features of the three technical methods listed in the NFWA. Each of these options are described further below.

12.1.1.1 OPTION 1: DEEP GEOLOGICAL DISPOSAL IN THE CANADIAN SHIELD

Option 1 would include long-term management of used nuclear fuel through containment and isolation in a deep geological repository in the crystalline rock of the Canadian Shield. Used nuclear fuel is transported from the nuclear reactor sites to a central location for long-term management. The design of the deep geological repository is based on the concept described by AECL in the 1994 Environmental Impact Statement on the Concept for Disposal of Canada's Nuclear Fuel Waste, and modified to take into account the views of the Seaborn EA panel as reported in February 1998. Following an interim period of monitoring, the repository is closed, without the intent to retrieve the used fuel.

A deep geological repository relies on natural and engineered barriers to isolate the used fuel from the surface environment over its hazardous lifetime. Within the disposal concept, a repository is a facility deep underground where used fuel is placed for final containment and isolation. The features of Option 1 for used nuclear fuel disposal are outlined in Table 12.1.

Table 12.1: Features for Option 1—Deep Geological Disposal in the Canadian Shield

Representative Conceptual Design Activities for Deep Geological Disposal in the Canadian Shield	
Concept	A long-term management approach based on a central DGR located in the Canadian Shield at a nominal depth of 500 to 1,000 m below surface. Used fuel would be transported from existing interim storage facilities at nuclear reactor sites, to a central location. At the central facility, the used fuel would be transferred into corrosion-resistant containers that would be placed in rooms excavated deep in the rock. There would be a need for transportation containers and facilities to produce them; processing facilities to load the fuel into transportation containers; production facilities for deep repository containers; processing facilities to transfer the fuel from transportation to deep repository containers; and production facilities for sealing materials. Once all of the used fuel is transferred to the deep repository, it would be placed in the underground before final backfilling, sealing and closure of the facility. Following closure of the deep repository, maintenance, inspection and security-related operations would be minimal. Such a facility would be designed to be passively safe over the long term and not rely on institutional controls to ensure safety. The current owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transported from the reactor sites to the central facility for long-term management.
Location	The facility would be in the crystalline rock of the Canadian Shield, a vast rock formation stretching across parts of several provinces and territories. A specific location would need to be identified, and licences would be required from the CNSC for the construction and operation of the facility.
Used Fuel Transportation	The operation of the centralized facility would involve moving the fuel from existing reactor site storage facilities in certified transport containers to the central site. Transportation would require an emergency response plan and adherence to security provisions. The mode of transportation (road, rail or water) would depend upon the location of the central facility and other factors.

Representative Conceptual Design Activities for Deep Geological Disposal in the Canadian Shield	
Containers	At the central facility, used nuclear fuel would be placed in durable corrosion-resistant containers. This type of container can be designed to last a minimum of 100,000 years and is capable of withstanding the hydraulic pressures of glaciations. Facilities would exist at the central site for repackaging the used fuel.
Storage Design Life	None. Concept does not include new storage facilities.
Land Requirement	Approximately 600 ha. The surface building dimensions would likely be a small fraction of the total land area. The footprint for the DGR would be approximately 183 ha. The actual size of the DGR would depend on a number of factors such as number of fuel bundles and their heat output, depth of the repository and site-specific factors such as thermal conductivity of the rock mass.
Underground Facility	A network of horizontal tunnels and rooms would be excavated in stable rock about 500 to 1,000 m below the surface. Used nuclear fuel would be packaged in durable containers and placed within the rooms or in boreholes drilled into the floor of the rooms.
Repository Sealing System	Clay-based materials would be used to surround and protect the containers, to fill the void spaces in the repository, to limit the movement of groundwater and dissolved material, and to protect workers during container placement operations. These are referred to as sealing systems and involve materials such as high-performance concrete and swelling bentonite clay.
Geosphere Barrier	The geosphere, or host rock, provides the principal barrier between the used fuel containers and the surface environment. The crystalline rock of the Canadian Shield is a naturally occurring geological formation which has long-term stability, good rock strength, low groundwater flow, and is sufficiently below the surface and lacking in mineral resources that it is very unlikely to be disturbed by erosion or accidental drilling.
Monitoring	The facility would be monitored to confirm the performance and safety of the system prior to final sealing, decommissioning and closure of the repository. Extended monitoring of the used fuel containers, sealing systems, rock around the repository underground water flows and the natural environment would be conducted to confirm the long-term safety and performance of the system. In addition, some preventive maintenance might be required. Extended monitoring at repository depth would occur over approximately 70 years, although it could be shorter or longer.
Retrieval	The technology to retrieve used fuel containers from a DGR would need to be further developed and demonstrated at the site.
Schedule	A government decision in 2006 to develop a DGR would see the new facility ready in 2035, at the earliest. There would be a need to obtain a licence at each phase and demonstrate continuous compliance with the licence (under regulatory oversight).
Decommissioning	Once necessary licences were obtained, decommissioning would commence, and all underground access tunnels and shafts would be backfilled and sealed. Surface facilities would be decontaminated and dismantled. Closure activities include removal of monitoring instruments and returning the site to greenfield conditions.

CNSC = Canadian Nuclear Safety Commission; DGR = Deep Geological Repository; NWMO = Nuclear Waste Management Organization.

12.1.1.2 OPTION 2: STORAGE AT NUCLEAR REACTOR SITES

Option 2 includes the long-term management of used nuclear fuel in storage facilities, at or just below surface, at each nuclear reactor site in Canada. Storage facilities are maintained, rebuilt and operated in perpetuity at each reactor site. This approach requires active management for the hazardous lifetime of the used nuclear fuel. Following removal from a reactor, used fuel is placed in wet storage bays at the reactor site. After a period of about seven to 10 years out-of-reactor, used fuel can be placed in dry storage at the reactor site. This long-term management approach builds on the current dry storage technology at the reactor sites. The features of Option 2 are summarized in Table 12.2.

Table 12.2: Features for Option 2—Storage and Nuclear Reactor Sites

Representative Conceptual Design Activities for Storage at Nuclear Reactor Sites	
Concept	Long-term storage at existing reactor sites would involve the expansion of existing dry storage facilities or the establishment of new, long-term dry storage facilities at each of the seven used fuel storage sites in Canada. In the latter case, used fuel would be transferred from the existing interim storage facilities to newly designed storage containers and storage buildings for long-term management. Storage would require an ongoing program of regular replacement and refurbishing activities, as facilities would be renewed indefinitely. Processing buildings would also be required to load the fuel and provide for its on-site transfer. The storage facilities would require ongoing maintenance, inspections and security systems. The current owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transferred to the long-term storage facilities at the reactor sites.
Location	Long-term storage locations would need to be established at the seven Licenced Canadian reactor sites: • Whiteshell Laboratories, Manitoba • Bruce Nuclear Power Station, Ontario • Pickering Nuclear Power Station, Ontario • Darlington Nuclear Power Station, Ontario • Chalk River Laboratories, Ontario • Gentilly Nuclear Power Station, Québec • Point Lepreau Nuclear Power Station, New Brunswick This would involve identifying specific storage locations at each reactor site and obtaining the necessary licences from the CNSC for the construction and operation of the facility, and potential EAs.
Transportation Requirements	No off-site transportation of used fuel is required for extended storage at nuclear reactor sites.
Containers	There are both surface and below-surface design options for reactor site storage, involving the use of casks, vaults and/or silos. The alternative conceptual designs considered reflect the different methods currently used for interim storage at each location in Canada.

Representative Conceptual Design Activities for Storage at Nuclear Reactor Sites	
Storage Design Life	Eventually the storage containers and buildings would need to be replaced. This would involve construction of new storage buildings, transfer of the used fuel from the long-term storage containers to new packages, and transfer of the containers to the new building. The old buildings and waste storage containers would need to be refurbished or demolished. Based on design assumptions, complete refurbishment of all components of the storage facility would be required every 300 years.
Land Requirement	The land requirement for the surface storage buildings and associated facilities would vary for each reactor site depending upon the number of fuel bundles and the design of the storage facility. The maximum land requirement is expected to be less than about 200 m x 200 m, or about 4 ha (10 acres).
Underground Facility	One of the possible reactor site concepts involves storage slightly below ground, in shallow trenches.
Repository Sealing System	None. There would not be a deep repository to be sealed.
Geosphere Barrier	Geosphere would not be used to provide a significant long-term isolation barrier.
Monitoring	Once all the used fuel from the reactor site was placed in the long-term storage facility, it would require continuous ongoing monitoring to ensure that facility was being safely maintained, and to ensure preventive maintenance and repair is completed as required.
Retrieval	Storage would be designed to allow the safe retrieval of used fuel at any point during the life of the facility.
Schedule	A government decision in 2006 to adopt storage at nuclear reactor sites, followed by immediate implementation would mean facilities at each site would be ready between 2016 and 2020. The long-term storage facilities would likely require complete refurbishment or replacement by the year 2300. While the design of a new long-term storage facility may vary at each reactor site, there would be a need to obtain a licence at each phase and demonstrate continuous compliance with the licence.
Decommissioning	Storage facilities and their components would be decommissioned and replaced, depending on the service lives of the various storage components. The duration of the decommissioning activities is approximately 30 years for each facility repeat event (about every 300 years).

CNSC = Canadian Nuclear Safety Commission; EA = Environmental Assessment; NWMO = Nuclear Waste Management Organization.

12.1.1.3 OPTION 3: CENTRALIZED STORAGE, ABOVE OR BELOW GROUND

Option 3 includes the long-term management of used nuclear fuel in a storage facility, above or below ground, at a central site in Canada. Used nuclear fuel is transported from the nuclear reactor sites to this central location for long-term management. The storage facility is maintained, rebuilt and operated in perpetuity at this central site. The features of Option 3 are summarized in Table 12.3.

Table 12.3: Features for Option 3—Centralized Storage, Above or Below Ground

Representative Conceptual Design Activities for Centralized Storage	
Concept	Centralized extended storage involves creating new, long-term storage facilities at a central location. Used fuel would be transferred from the seven interim storage sites in Canada to a newly designed facility. Conceptual designs have been developed for a central storage facility built above ground, or below ground. There would need to be transportation containers and facilities to produce them; processing facilities to load the fuel into transportation containers; production facilities for storage containers; and processing facilities to transfer the fuel from transportation to storage containers. Storage would require an ongoing program of regular replacement and refurbishing activities, as facilities would be renewed and expanded indefinitely. Once all the used fuel is transferred to the long-term storage facilities, ongoing maintenance, inspections and security systems would be required. The current owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transported from the reactor sites to the central facility for long-term management.
Location	Centralized storage could be built at a nuclear reactor site, but for assessment purposes, it is conservatively assumed that the central storage facility would be located at an undeveloped site, and the facility would be expanded as needed. A specific location would need to be identified, and licence would be required from the CNSC for the construction and operation. This would also involve an EA.
Transportation Requirements	The operation of the centralized facility would involve moving the fuel from existing reactor site storage facilities in certified transport containers to the central site. Transportation would require an emergency response plan and adherence to security provisions. The mode of transportation (road, rail, or water) would depend upon the location of the central facility and other factors.
Containers	Four alternatives have been developed for the Joint Waste Owners as representative of a range of possible designs for the centralized long-term storage facility concept. In all cases the used fuel would be contained in either concrete and steel casks or vaults. Two alternatives would use buildings on the surface. The other two alternatives would be underground. One option would be just below the surface and mounded over, while the other option would be about 50 m below ground in bedrock. There are four design alternatives for centralized storage: • casks and vaults in storage buildings; • surface modular vaults; • casks and vaults in shallow trenches; and • casks in rock caverns. Facilities would exist at the central site for repackaging the used fuel.

Representative Conceptual Design Activities for Centralized Storage	
Storage Design Life	The storage containers and storage facilities are designed to last at least 100 years. Based on current design assumptions, complete refurbishment of all components, and repackaging of the entire fuel storage system is assumed to be repeated every 300 years.
Land Requirement	The land requirement for the storage buildings and associated facilities would vary for each central storage alternative. For the surface storage alternatives, the land requirement would be approximately 93 ha. For the underground storage alternatives, the footprint of the storage caverns would be approximately 23 ha.
Underground Facility	No deep facility. The possibility exists to construct shallow rock caverns below the surface.
Repository Sealing System	None. There would not be a deep repository to be sealed.
Geosphere Barrier	Geosphere would not be used to provide a significant long-term isolation barrier.
Monitoring	The operation would require ongoing preventive maintenance and repair, as well as continuous monitoring to ensure that facility safety was being maintained.
Retrieval	The long-term storage facilities would be designed to allow safe retrieval of used nuclear fuel at any point during the service life of the facility. If the storage systems did not perform as expected, they could be repaired, or the fuel could be transferred to a new storage facility.
Schedule	A government decision in 2006 to adopt centralized storage would see the storage facility ready for operations by 2023. Such facilities would require refurbishment or replacement by about the year 2300. There would be a need to obtain a licence at each phase and demonstrate continuous compliance with the licence.
Decommissioning	Storage facilities and their components would be decommissioned and replaced, depending on the service lives of the various storage components. The duration of the decommissioning activities is approximately 30 years for each facility repeat event (about every 300 years).

CNSC = Canadian Nuclear Safety Commission; EA = Environmental Assessment; NWMO = Nuclear Waste Management Organization.

12.1.1.4 OPTION 4: ADAPTIVE PHASED MANAGEMENT

Option 4 includes the long-term management of used nuclear fuel through an adaptive path. This approach enables the following possibilities:

- centralized containment and isolation of the used fuel in a deep geological repository in a suitable rock formation, such as the crystalline rock of the Canadian Shield or Ordovician sedimentary rock
- flexibility in the pace and manner of implementation through a phased decision-making process supported by a program of continuous learning, research and development
- provision for an optional step in the implementation process in the form of shallow underground storage of used fuel at the central site, prior to final placement in a deep repository
- continuous monitoring of the used fuel to support data collection and confirmation of the safety and performance of the repository
- potential for retrievability of the used fuel for an extended period, until such time as a future society makes a determination on the final closure and the appropriate form and duration of post-closure monitoring

- capacity for nuclear fuel to be transported from the nuclear reactor sites to a central location for long-term management

APM includes features from the other three technical methods. It proposes a path forward toward a determinate end point, the placement of used nuclear fuel in a deep geological repository for safe, secure long-term management. The approach builds on the continued development of the deep geological repository concept and takes into account the 1998 recommendations of the Seaborn Panel, as well as recent geological repository conceptual design experience in Canada and internationally.

The features of Option 4 are summarized in Table 12.4.

Table 12.4: Features for Option 4—Adaptive Phased Management

Representative Conceptual Design Activities for Adaptive Phased Management	
Concept	**Phase 1 – Site Selection:** • Develop with citizens an engagement program for activities such as design of the process for choosing a site, development of technology and key decisions during implementation. • Select a central site that has rock formations suitable an underground characterization facility and a DGR. • Undertake site characterization, safety analyses and an EA for the underground characterization facility and DGR at the central site, and to transport used fuel from the reactor sites. • Develop and certify transportation containers and used fuel handling capabilities. **Phase 2 – Design And Characterization:** • Conduct research and testing at the underground characterization facility to demonstrate and confirm the suitability of the site and technology. • Engage citizens in the process of assessing the site, the technology and the timing for placement of used fuel in the deep repository. • Complete the final design and safety analyses to obtain the required operating licence for the deep repository and associated surface facilities. • Examine the possible need for transportation containers and facilities to produce them; processing facilities to load the fuel into transportation containers; production facilities for storage containers; and processing facilities to transfer the fuel from transportation to storage containers. **Phase 3 – Long-Term Isolation:** • If used fuel is stored at a central shallow underground facility, retrieve and repackage used fuel into long-lived containers. • If used fuel is stored at reactor sites, transport used fuel to the central facility for repackaging. • Place the used fuel containers into the DGR for final containment and isolation. • Continue monitoring and maintain access to the deep repository to assess the performance of the repository system and to allow retrieval of used fuel, if required. • Engage citizens in ongoing monitoring of the facility. • A future generation would decide when to decommission the underground characterization facility and any remaining long-term experiments or demonstrations of technology, and when to close the repository, and the nature of any post-closure monitoring of the system. The current owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transported from the reactor sites to the central facility for long-term management.

Representative Conceptual Design Activities for Adaptive Phased Management	
Location	The central facility for the underground characterization facility and deep repository could be located in a suitable rock formation such as the crystalline rock of the Canadian Shield or in the Ordovician sedimentary rock basins. A specific location would need to be identified, and a licence would be required from the CNSC for the construction and operation of the facility. This would also involve an EA.
Transportation Requirements	The operation of the centralized facility would involve moving the fuel from existing reactor site storage facilities in certified transport containers to the central site. Transportation would require an emergency response plan and adherence to security provisions. The mode of transportation (road, rail or water) would depend upon the location of the central facility and other factors.
Containers	Storage containers at reactor sites would consist of the existing casks, vaults and silos. Containers for long-term isolation in a deep repository are based on a 100,000-year design life. These durable containers are designed to withstand long-term environmental effects such as climate change and glaciation. Facilities would exist at the central site for repackaging the used fuel.
Storage Design Life	Storage containers at the central underground storage facility are based on the existing design of the dry storage container or equivalent with a 100-year design life.
Land Requirement	Approximately 600 ha. The surface building dimensions would likely be a small fraction of the total land area. The footprint for the DGR would be approximately 183 ha. The actual size of the DGR would depend on a number of factors such as number of fuel bundles and their heat output, depth of the repository and site-specific factors such as thermal conductivity of the rock mass.
Underground Facility	During the Phase 3 long-term isolation period, the used fuel would be placed in a network of horizontal access tunnels and rooms excavated in stable rock at a nominal depth of 500 to 1,000 m below surface. Used fuel containers would be placed within the rooms or in boreholes drilled into the floor of the rooms.
Repository Sealing System	Clay-based materials would be used to surround and protect the containers, to fill the void spaces in the repository, to limit the movement of groundwater and dissolved material, and to protect workers during container placement operations. These are referred to as sealing systems and involve materials such as high-performance concrete and swelling bentonite clay.
Geosphere Barrier	The geosphere, or host rock, provides the principal barrier between the used fuel containers and the surface environment. Both the Canadian Shield granite and the Ordovician sedimentary rock basins are examples of naturally occurring geological formations which have long-term stability, good rock strength, and low groundwater flow. Large areas exist with sufficient depth below the surface and lacking in mineral resources that they are very unlikely to be disturbed by erosion or accidental drilling.
Monitoring	During Phase 3, monitoring would require technology since the long-term isolation containers would be backfilled and sealed within the placement rooms. Monitoring would be conducted to confirm the long-term safety and performance of the repository system. Until a decision is made to backfill and seal the access to the deep repository, monitoring would take place in situ at repository depth. After closure of the deep repository, post-closure monitoring of the facility could take place from the surface.
Retrieval	Used fuel would be retrievable at all times. The technology to retrieve used fuel containers from a DGR would need to be further developed and demonstrated at the site.
Schedule	A government decision in 2006 to select this management approach would see an underground characterization facility and possibly a central shallow underground rock cavern storage facility ready by about 2035. The DGR could then be ready by about 2065. There would be a need to obtain a licence at each phase and demonstrate continuous compliance with the licence.

Representative Conceptual Design Activities for Adaptive Phased Management	
Decommissioning	Once a societal decision was made and the necessary licences were obtained, decommissioning would commence, and all underground access tunnels and shafts would be backfilled and sealed. Surface facilities would be decontaminated and dismantled. Closure activities include removal of monitoring instruments and returning the site to greenfield conditions.

CNSC = Canadian Nuclear Safety Commission; DGR = Deep Geological Repository; EA = Environmental Assessment; NWMO = Nuclear Waste Management Organization.

12.1.2 Rationale for Selecting the Preferred Alternative

As required by the NFWA, the NWMO completed a comparative analysis of benefits, risks and costs for each of the four options against eight objectives established for the study. Through this comparative analysis, the NWMO considered economic regions in which that approach might be implemented, as well as ethical, social and economic considerations associated with that approach. The assessment drew upon a wide variety of reports, background papers, dialogues and assessments conducted over the course of the study, all of which are available on the NWMO website.

A description of the objectives is provided below. A summary of the comparative analysis findings is presented in Section 12.1.2.2. The complete comparative analysis is presented in Chapter 8 of Appendix D.

12.1.2.1 OBJECTIVES CONSIDERED IN COMPARATIVE ANALYSIS

Objective 1—Fairness: To ensure fairness (in substance and process) in the distribution of costs, benefits, risks and responsibilities, within this generation and across generations.

The selected approach should produce a fair sharing of costs, benefits, risks and responsibilities, now and in the future. In addition, fairness means providing for the participation of interested citizens in key decisions through full and deliberate public engagement during different phases of decision making and implementation.

In the assessment of fairness, the NWMO considered issues of both substantive and procedural fairness. Substantive fairness focuses on the content or substance of the approach, including how the costs and benefits associated with the approach would be distributed among different people and between humans and other species. It also includes consideration of intergenerational fairness which considers if a balance struck between the current generation taking responsibility for resolving the problem versus the desire not to constrain future generations by the choices the NWMO makes today. Procedural fairness focuses on the processes used and is mainly a function of the degree to which the approach would allow for the participation of concerned citizens in key decisions about how the approach would be implemented.

Objective 2—Public Health and Safety: To ensure public health and safety.

Public health ought not to be threatened due to the risk that people might be exposed to radioactive or other hazardous materials. Similarly, the public should be safe from the threat of injuries or deaths due to accidents during used nuclear fuel transportation or other operations associated with the management of used nuclear fuel.

In assessing the options against public health and safety, the NWMO considered many factors. The NWMO believe that any management system employed will result in direct or indirect risks to the health and safety of affected individuals or communities that must be fully acceptable according to current safety standards. The possibilities of unplanned events that could present unexpected risks or stresses must be considered, and appropriate contingency action provided. There should not be

foreseeable outcomes of the approach that lead to greater risks to the public from the used nuclear fuel facility at any time in the future than is acceptable today.

Objective 3—Worker Health and Safety: To ensure worker health and safety.

Construction, mining and other tasks associated with managing used nuclear fuel can be hazardous. The selected approach should not create undue or large risks to the workers who will be employed to implement it.

In assessing options for impacts on worker health and safety, the NWMO considered a number of factors. The management system and the technologies used, the design, the construction methods and the operational and monitoring procedures should be such that, in addition to complying with good engineering practices and all industrial safety regulations, workers involved with the used nuclear fuel facility should not be subject to risks or harmful exposures, chronic or accidental, greater than those acceptable to Canadian or international authorities at the time of construction. Workers engaged in future monitoring or maintenance activities should not be subject to risks greater than those acceptable today.

Objective 4—Community Well-Being: To ensure community well-being.

Implications for the well-being of all communities with a shared interest (including host community, communities in the surrounding region and on the transportation corridor, and those outside of the vicinity who feel affected) should be considered in the selection and implementation of the management system and related infrastructure. A broad range of implications must be considered, including those relating to economic activity, environmental disruption and social fabric and culture.

The assessments with respect to community well-being considered both the likely economic impacts of the approach, and the potential effects on social and cultural qualities of affected communities. On the economic side, consideration was given to potential effects on property values, jobs and businesses. Potential social and cultural impacts include raising fears and concerns of citizens and the risk of community polarization (e.g., contrasting beliefs between those who support and those who oppose locating a facility near their community). Some residents may see living near a radioactive waste management facility as placing a stigma on their community.

Analysis of Objective 5—Security: To ensure security of facilities, materials and infrastructure.

The selected management approach needs to maintain the security of the nuclear materials and associated facilities. For example, over a very long timeframe, the hazardous materials involved ought to be secure from the threat of theft, despite possibilities of terrorism or war. An approach must provide for the security of both nuclear materials and the facilities that store or use them.

To assess security, the vulnerability of each approach to various risk scenarios was considered. The risk scenarios included terrorism and potential "insider" threats focused on theft, diversion, sabotage, and "seize and hold" strategies. The adequacy of contingency plans and the robustness of the approach under scenarios involving societal breakdown and civil disobedience were also considered.

Objective 6—Environmental Integrity: To ensure environmental integrity.

The selected management approach needs to ensure that environmental integrity is maintained over the long term. Concerns include the possibility of localized or widespread damage to the environment or alteration of environmental characteristics resulting from chronic or unexpected release of radioactive or non-radioactive contaminants. Concerns also include stresses and damage associated with new infrastructure (such as roads and facilities) and operations (e.g., transportation).

Assessing the degree of impact each approach would have on the natural environment required consideration of many factors, including the number and sensitivity of ecosystem elements that would

potentially be affected, the likelihood of impact on each type of resource, and the significance of the potential consequences to affected resources. Many different types of valued and environmentally sensitive resources could be affected, including plants and animals, land, surface water, groundwater and the air (e.g., through air pollution created during the construction of a new facility). Also included in the assessment were various aesthetic impacts, such as noise, and visual changes to the natural scenery. As in the case of other objectives, it is necessary to consider not only the stresses that each approach would produce assuming that the approach performs as expected, but it is also necessary to consider the possibility of risk scenarios which go beyond normal operating parameters.
An important factor to be considered here is the impact of significant changes in environmental conditions associated with climate change and the impact these types of changes may have on the performance of the management system.

Objective 7—Economic Viability: To design and implement a management approach that ensures economic viability of the waste management system, while simultaneously contributing positively to the local economy.

Economic viability refers to the need to ensure that adequate economic resources are available to pay the costs of the selected approach, now and in the future. The cost must be reasonable.
The selected approach ought to provide high confidence that funding shortfalls will not threaten the assured continuity of necessary operations.

Assessing the economic viability of the approaches required considering the likelihood that financial resources would be available to pay the costs, recognizing that these costs are uncertain and, especially in the case of the reactor site and centralized storage approaches would continue over a very long time.

Objective 8—Adaptability: To ensure a capacity to adapt to changing knowledge and conditions over time.

The selected management approach should be robust in the face of new or unforeseen circumstances. The approach should provide flexibility to future generations to change decisions; not place burdens or obligations on future generations that will constrain them. The approach should be able to function satisfactorily in the case of unforeseen events. "Adaptability" is defined as the set of characteristics of an option that are expected to make a management approach robust with respect to the widest range of possible social and environmental scenarios in the long term. To be "adaptable" is to be capable of responding well to changes in environmental and social conditions, over a wide range of such possible changes.

Assessing the adaptability of each approach required consideration of many factors, including whether there are opportunities to adapt to changing knowledge or circumstances during the period when the various stages of the Project are being implemented. It also included consideration of the robustness of the operation of the option to contain and isolate the waste, and/or ease of taking corrective action to ensure continued containment and isolation, in response to a wide variety of expected challenges to system integrity over the very long term. These challenges might include extreme natural events, deficiencies in option performance as designed, and an availability of any institutional controls or systems that may be required.

12.1.2.2 SUMMARY OF FINDINGS AND RECOMMENDED OPTION

Option 4 was the preferred approach for the following reasons:

- This approach is designed to be highly adaptive in the near term, the period in which it is reasonable to believe there will be strong oversight institutions and active management capacity. It entrenches an explicit and planned process of social learning and action. Over this period, new learning and technological innovation is easily incorporated into the management plan.
- This approach also clearly identifies the technology associated with a deep geological repository as the appropriate end point. It does not rely on human institutions and active management for its

safe performance over the long term. The approach plans for and puts in place a safe and secure containment option for the used nuclear fuel at each point in the process. It provides real options and contingency plans should implementation through the phases not proceed as planned.

- This approach is designed to ensure that public and worker health and safety are maintained over the long term. Radiological and non-radiological exposures to the public and to workers are estimated to be very small. The flexibility and adaptability of the approach allows for new and continuous learning to be incorporated. This is expected to improve the safety and performance of the management system through the reduction of uncertainty. It allows confidence to be established in the safety and performance of the technology before proceeding along each step in its implementation.
- Similarly, site selection, engineered barriers and placement at depth in geologic media comprise a robust management design to protect environmental integrity. The extended period over which the site and the facilities can be monitored, tested and refined, prior to final placement of the used fuel are designed to strengthen the environmental performance of the system. The opportunity for active monitoring and study will allow the NWMO to learn, understand and adjust facility designs as may be appropriate over a staged implementation period.
- Over the long term, the approach will keep the waste secure, since it involves strong physical protection of the fuel against unintended security breaches by placing used nuclear fuel deep underground, and ultimately backfilling and sealing all routes to access the fuel.
- The approach is designed to be fair in the distribution of the risks, benefits and uncertainties within this generation and across generations.
- Community well-being is a key consideration in the approach in the sense that the staged and adaptive process will allow the implementation path to be responsive to the expectations of Canadian society today and continued influence of future generations on the subsequent decisions to be taken concerning design and evaluation of program progress.
- Economic viability, and in particular financial surety, is taken into account in requiring the majority of expenditures to be made in the near term (within the first 90 years) ensuring confidence in the funding institutions.
- The approach provides opportunity for future generations to influence the way in which the fuel is managed.
- The approach provides for research and collaborative decision making in the determination of the manner and timing of movement through the phases.
- The approach suggests a process through which confidence in the technology and supporting systems can be developed before moving to the final phase.
- The approach suggests a process for putting multiple options in place should these be required as contingencies throughout the implementation process.

Dialogue with Canadians has highlighted that an optimal balance needs to be found between flexibility in the near term, which allows for new learning, and the implementation of an approach which isolates and contains the used fuel in a way which does not require active care by people over the very long term. Option 4 provides such a balance. Canadians have also said that an optimal balance needs to be struck between moving cautiously, to allow for new learning and social confidence, and sustaining sufficient momentum to carry forward with implementation of the approach to completion. Should the implementation period be too protracted, there is a risk that future generations will lose interest and/or otherwise abandon the approach mid-way through implementation with negative impacts on public health and safety as a result.

A stepwise implementation process, involving potentially impacted communities of interest at each major point of decision making, will result in greater public acceptability. This public acceptance

should expedite the implementation of the deep repository by matching the pace and manner of implementation to that at which society is prepared to proceed. In laying out a process in which key decision points have been mapped along with the means to ensure those involved in the decision have both the capacity and information to make the required decision, and putting contingencies in place should unforeseen events be encountered, implementation should proceed in as efficient a manner as social conditions allow. Through the nature of the decision-making process, and contingencies for multiple decision-making outcomes, the continued safe and secure management of used nuclear fuel is best assured through to completion of implementation.

The NWMO also acknowledges that the DGR/NWMO will likely be designated as a nuclear installation/operator and subject to financial security requirements under the NLCA. In the event of a nuclear incident, compensation from the NWMO via financial security may be sought under the NLCA for preventive measures to evacuate residents and businesses or take other necessary mitigation measures to protect public health and safety.

12.1.2.3 FEDERAL DECISION AND SUPPORT

In 2007, based on the outcomes of the *Choosing a Way Forward* study (Appendix D), the federal government selected the NWMO's recommendation for APM, dismissing all other alternatives and mandating the NWMO to implement APM including the Project. In addition to selecting APM, the Government of Canada via the Minister of Natural Resources has been responsible for overseeing the NWMO's progress of implementing APM by reviewing annual/triennial reports, tabling these reports in both Houses of Parliament and issuing an annual public statement. The first milestone in the implementation of APM, site selection has been satisfied with the NWMO receiving the willingness of the most proximate communities to host the Project. In addition to the Government of Canada's selection and oversight of Canada's Plan under the NFWA, in 2024 the Parliamentary Standing Committee on Environment and Sustainable Development's study, *Canada and Radioactive Waste Management: Important Decisions for the Future*, received strong support, with an overwhelming vote of 324 yeas, 0 nays, and 4 paired votes to accept the report. The committee's recommendations emphasized the construction and operation of a DGR as the safest and most reliable method for managing high-level radioactive waste.

The unanimous backing reflects broad agreement on the importance of prioritizing the Project to safeguard both the environment and human health.

Additionally, while not within the scope of the current IPD for Canada's DGR for used fuel, in 2023, the Government of Canada's acceptance of the Integrated Strategy for Radioactive Waste (the Strategy), including the recommendation that the NWMO implement a DGR for the long-term management of ILW and non-fuel High-Level Waste. The NWMO must continue to implement APM inclusive of the Project as required by the NFWA. With the siting process complete, the NWMO may now proceed with detailed site characterization and licensing of the APM DGR.

12.1.3 Summary of Public Consultation and Indigenous Engagement

Early on the NWMO adopted as its mission "to develop collaboratively with Canadians a management approach for the long-term care of Canada's used nuclear fuel that is socially acceptable, technically sound, environmentally responsible and economically feasible."

The NWMO engaged the Canadian public and Indigenous Peoples in a collaborative process that involved gathering input from both technical experts and a broad range of citizens to ensure that the management approach reflected the best scientific knowledge and societal values. The NWMO facilitated open dialogue, encouraging the Canadian public and Indigenous Peoples to articulate values and objectives, which were then used to assess various management approaches. This inclusive approach aimed to identify the management approach that was most responsive to the

Canadian publics and Indigenous Peoples values and objectives, thereby ensuring the chosen management approach would be regarded as socially acceptable.

A summary of the engagement and consultation process undertaken for the *Choosing a Way Forward* study (Appendix D), as well as details regarding each phase of the process is provided in the following sections. Detailed information on the process, phases and what the NWMO heard through the engagement and consultation process is presented in Chapter 3 of Appendix D. Chapter 3 also outlines past and present engagement efforts implemented by the NWMO, that support the inclusion of Indigenous Peoples perspectives and traditional knowledge in its work.

12.1.3.1 A RESPONSIVE STUDY PROCESS

To satisfy the NWMO's obligations under the NFWA, the three-year NWMO study, which concluded with the submission of the *Choosing a Way Forward* study (Appendix D), was designed as a dialogue conducted over four phases. Each of the four phases focused on a key decision point, and the direction of the Canadian public and Indigenous Peoples was elicited through dialogue before proceeding to the next key decision and phase of work. The four phases were supported by a series of milestone documents to share what was heard from the Canadian public and Indigenous Peoples, how this shaped the NWMO's thinking, and to elicit public feedback to shape and direct subsequent steps in the study. Through these documents, the NWMO sought to make transparent their deliberations, to "think out loud," and to elicit comments and direction.

The dialogue process sought direction from the Canadian public and Indigenous Peoples for each of the following points:

- identifying the questions to be asked and answered in the study, and the key issues to be addressed in the assessment of the management approaches
- confirming the range of technical methods to be considered in the NWMO study
- assessing the risks, costs and benefits of each management approach through the assessment process
- designing the overarching management structure and implementation plans for each management approach considered in the study

The NWMO understood that the Canadian public and Indigenous Peoples were interested in this public policy issue. Recognizing the need for inclusivity, the NWMO engaged a diversity of voices to ensure a range of social and ethical considerations. The NWMO sought societal direction through dialogues with citizens to understand the values and objectives that ought to drive decision making on a waste management approach and the concerns that needed to be addressed.

The dialogue process involved various traditional and innovative techniques to capture social and ethical considerations. These included nationwide surveys, focus groups, workshops, e-dialogues, deliberative surveys, and discussion sessions. Through agreements initiated by the NWMO, 15 national, regional and local Indigenous organizations conducted a range of dialogue initiatives, which they designed to meet the needs and preferences of Indigenous participants. Techniques ensured representative feedback and facilitated discussions among experts. The NWMO website shared all reports publicly for transparency. Additionally, background papers on scientific knowledge related to managing nuclear fuel were commissioned and peer reviewed.

Specialists also prepared illustrative conceptual engineering designs and cost estimates for each of the short-listed management approaches in the study. These conceptual designs formed the basis for much of the broader public discussion. The process through which the NWMO sought to elicit societal direction at each major step was designed to be responsive to what the Canadian public and Indigenous Peoples said an appropriate study process should embody:

- The study process must be grounded in knowledge and expertise.

- The study must solicit and consider a wide range of perspectives.
- The NWMO should "think out loud" and engage citizens in dialogue at multiple points in the process.
- The process must be fair, transparent and trustworthy.
- The process must make information accessible to members of the public who currently know little about this issue.
- The process must use a variety of methods to engage citizens.

12.1.3.2 PROCESS OF COLLABORATIVE DEVELOPMENT WITH THE CANADIAN PUBLIC AND INDIGENOUS PEOPLES

A summary of activities and outcomes of each phase of the consultation process is provided below.

Phase 1—Conversations About Expectations

The NWMO began by listening to the Canadian public and Indigenous Peoples about their expectations and objectives for the study. The NWMO asked several questions:

- How should the study be conducted?
- What questions should be asked and answered in the study?
- Which options should be investigated and included in the study?

As part of this "listening and learning," the NWMO launched a number of initiatives, including a set of early conversations with the Canadian public and Indigenous Peoples, to begin to appreciate expectations both for the process to be used and the issues to be explored in the study. These initiatives included:

- Face-to-face meetings
- Letters and submissions
- Key Concepts exploration
- Traditional Knowledge Workshop
- Technical Methods exploration
- Future Scenarios exploration
- Roundtable on Ethics
- Nuclear Host Community workshop
- Indigenous dialogues
- Sustainable Development workshop
- Science and Technology workshop
- Public attitude research
- Political Representatives briefing

One of the NWMO's major initiatives was a Scenarios Exercise, aimed to anticipate future societies and their interactions with used nuclear fuel over long time frames. In collaboration with Global Business Networks, a team of 26 individuals produced detailed scenarios for 25 years, less detailed ones for 175 years, and sets of conditions for 500 years, along with simple "what-ifs" for 10,000 years. These scenarios became crucial in assessing different management approaches.

The NWMO also commissioned approximately 70 papers by specialists and convened workshops to initiate some focused discussions on specific topics, including:

- Social and Ethical Dimensions
- Health and Safety
- Science and Environment
- Economic Factors
- Technical Methods
- Conceptual Engineering Designs and Cost Estimates for Alternative Management Approaches
- Institutions and Governance

This was the first step in creating an information foundation for the study. Over the course of the study, as information gaps were identified through public dialogue, additional expert papers were commissioned and workshops convened. The NWMO's information base expanded as Indigenous Peoples began to contribute their knowledge, wisdom and insight to the study. Citizens from communities that currently store used nuclear fuel shared their experiences "living" with used nuclear fuel. The information foundation was also augmented by other citizens from the perspective of public values, objectives and experience.

Phase 2—Exploring the Fundamental Issues

The second phase of the study was launched with the release of the NWMO's first discussion document Asking the Right Questions? The NWMO reported back to the Canadian public and Indigenous Peoples what it had heard, and on this basis how it planned to proceed with the study. This discussion document identified the following:

- a list of 10 questions which the NWMO heard that the Canadian public and Indigenous Peoples want asked and answered in the study, and which should set the agenda for the study
- the short list of technical methods that the NWMO heard hold the most promise, drawn from a list of 14 technical methods, representing the range of choices considered internationally for the management of used nuclear fuel

The NWMO launched a number of initiatives (Appendix D, Table 3-3) to engage citizens and specialized groups in discussion on four questions:

- Has the NWMO described the problem correctly?
- Has the NWMO identified appropriate ways to deal with the problem?
- Is the NWMO asking the right questions?
- Is the NWMO's proposed decision-making process understandable and appropriate?

One of the most significant initiatives was the National Citizens Dialogue on Values, where 462 Canadians participated in discussions to identify key characteristics for long-term management approaches. This dialogue led to the identification of one overarching requirement and six fundamental values that formed the basis of the assessment framework. The framework was used for a preliminary analysis of alternative management approaches, conducted by a multi-disciplinary Assessment Team over six months. The team's findings were included in the second discussion document and discussed extensively with the Canadian public and Indigenous Peoples in Phase 3.

Phase 3—Evaluating Management Approaches

The third phase of the study was launched with the release of the NWMO's second discussion document *Understanding the Choices*. Through this document, the NWMO reported to the Canadian

public and Indigenous Peoples what the NWMO heard in the previous phase, and how the NWMO planned to proceed with the assessment of approaches. This discussion document:

- reported on further learning about the values and priorities of the Canadian public and Indigenous Peoples concerning the long-term management of used nuclear fuel, and insights from dialogues convened around the first discussion document
- provided more complete descriptions of the approaches that had become the focus of the study
- outlined a proposed framework to be used for the assessment of management approaches, composed of citizen values, designed to build on the 10 questions that had been identified through conversations with the Canadian public and Indigenous Peoples and largely confirmed through subsequent dialogue
- ethical principles and specific objectives

This framework was designed to build on the 10 questions that had been identified through conversations with the Canadian public and Indigenous Peoples and largely confirmed through subsequent dialogue.

To continue the dialogue, the NWMO organized a series of 120 public information and discussion sessions in 34 locations, including every province and territory, across Canada. These sessions were advertised broadly to invite all interested Canadians to meet with us, learn about the study, and contribute to the assessment of the approaches.

Finally, the NWMO further explored the strengths and limitations of the approaches under study by commissioning a group of specialists to use the framework outlined in the second discussion document, and modified through dialogue, to conduct a rigorous assessment of the management approaches under study. This additional and complementary assessment work extended the assessment to include consideration of illustrative economic regions in which each of the approaches might be sited and more formal quantification of risk.

With the release of the second discussion document, the NWMO asked the Canadian public and Indigenous Peoples the proposed assessment framework sufficiently reflected their values and objectives. The NWMO also asked for the help of the Canadian public and Indigenous Peoples to apply the framework to the approaches and identify the relative strengths and limitations of each of the approaches.

Through dialogue leading up to the second discussion document, the NWMO had begun to hear that the way in which any management approach is implemented is very important, perhaps as important as the approach itself. For this reason, the NWMO also posed the following question to the Canadian public and Indigenous Peoples, "Are there specific elements that you feel must be built into an implementation plan?"

A series of public sessions and workshops with the public and interested parties were held to gather input. Additionally, independent consultants conducted a rigorous assessment of the approaches, considering the potential implementation in different regions and quantifying the associated risks.

Phase 4—Finalizing the Study Report

With the release of the Draft Study Report, the fourth and final phase of the NWMO's study began. In this phase, the NWMO continued dialogue with interested Canadians, specifically to receive comment and suggestions and to hear concerns about the NWMO's proposed recommendation.

This dialogue surfaced issues of both substance and clarification as input to the refinement of the final recommendation and report. Among the significant initiatives in this phase of work was the convening of workshops with interested individuals, citizen groups and organizations who had been involved in earlier phases of the study. These workshops were designed to discuss and hear comment and direction concerning the NWMO's planned recommendation and report.

The release of the Draft Study Report marked the beginning of the fourth and final phase of the study. In this phase, the NWMO continued discussions with the Canadian public and Indigenous Peoples to gather comments, suggestions, and address concerns about the NWMO's proposed recommendation. These exchanges provided valuable input for refining the final recommendation and report. One of the key activities during this phase was organizing workshops with individuals, citizen groups, and organizations who had participated in earlier phases of the study. The purpose of these workshops was to discuss and receive feedback on the NWMO's planned recommendation and report.

12.1.4 Summary of Alternatives to the Project

The selection of APM as Canada's long-term approach for managing used nuclear fuel reflects a rigorous, inclusive, and values-driven process. Through a comprehensive three-year study, guided by eight key objectives and shaped by extensive public consultation and Indigenous engagement across four phases, APM emerged as the most socially acceptable, technically sound, environmentally responsible, and economically feasible option. Its flexibility, emphasis on safety, and capacity for continuous learning and adaptation ensure that it meets the expectations of both current and future Canadians and Indigenous Peoples.

12.2 Potential Alternative Means

A list of alternative means currently being considered by the NWMO for the Project is provided in Table 12.5. Technical and economically feasible options associated with each alternative mean are still being considered through ongoing studies. This list is preliminary and will be subject to revision based on the results of further engineering and study.

Table 12.5: Potential Alternative Means for the Project

No.	Topic	Alternative Means
1	Access road alignments	Options for primary and secondary access road alignments.
2	Energy sources	Options for heating and electricity supply.
3	Transmission line alignments	Variations in alignment and location of transmission line and associated infrastructure.
4	Source of water supply	Options for using surface water or groundwater sources for water supply.
5	Water Discharge	Options for location of the effluent water discharge point(s).
6	Water Treatment	Alternative treatment technologies and techniques to control effluent water quality.
7	ERMA	Variations in configuration and siting of the ERMA.
8	OMA	Variations in configuration and siting of the OMA.
9	Waste management	Options for managing conventional and radioactive waste generated on site.
10	Accommodation camps	Options for the location of permanent and temporary accommodations camps.

ERMA = Excavated Rock Management Area; OMA = Organics Management Area.

C. LOCATION INFORMATION AND CONTEXT

13. Proposed Location

The Project is located within WLON's territory, approximately 21 km southeast of the WLON reserve lands (Band #157), 12 km from the nearest WLON resident, and 43 km northwest of the Township of Ignace (Ignace), Ontario, along Trans-Canada Highway 17. The site is on the Canadian Shield, about 240 km northwest of Lake Superior (Thunder Bay) via a straight line from the approximate Project centroid, as displayed in Figure 14.1. Following consideration of social and cultural perspectives and preferences, technical suitability, transportation safety and First Nation/municipal community willingness, this location was ultimately selected for the Project.

The Project site is within the Wabigoon Forest Management Unit and Dryden Forest Management Unit. While the NWMO does not currently own the lands for which the Project is proposed, they are Crown-owned, under the administration and control of the Province of Ontario as represented by the MNR. An arrangement is planned to be established with MNR for the transfer of the Crown lands that will be needed for the Project to the NWMO. This arrangement with the MNR will provide the NWMO permission to consider these lands for purpose of seeking a licence from the CNSC. The transfer is expected to be completed immediately prior to the issuance of the initial licence.

13.1 Proposed Geographic Coordinates

The centroid of the Project site is approximately 556793E 5485960N, Zone 15 North American Datum 83.

Coordinates for other major Project facilities (Zone 15 North American Datum 83) are tentatively:

- ERMA: 555119E 5485208N
- ERMA Access Road: 554840E 5484773N
- Primary Access Road: 557306E 5485301N to 560199E 5487910N
- Secondary Access Road: 555845E 5486197N to 558842E 5488694N

13.2 Description of the Land and Surrounding Areas

The Project location in relation to regional communities, First Nation reserves and provincial Crown land is displayed in Figure 1.2 publicly available information on land claims from the Ministry of Northern Development and Mines as well as land ownership parcels are provided in Figure 13.1. The entirety of the Project site is located on what is designated as provincial Crown land in the Kenora Mining Division in northwestern Ontario, in proximity to Highway 17 between Dryden and Ignace, Ontario.

On November 20, 2013, pursuant to Section 35 of the *Mining Act* (Government of Ontario 1990e), the NWMO was granted Withdrawal Order No. W-K-98/13 for areas of land situated in the Kenora Mining Division. Four parcels of land were withdrawn from prospecting, staking, sale and lease while the NWMO conducted preliminary field assessment activities to assist in the identification of a suitable site for a DGR. Following these field studies, one of the four parcels included in W-K-98/13 was selected as the preferred site for the Project and is referred to as the temporary withdrawal area ("Revell withdrawal area," approximately 17,600 ha), as shown by the orange rectangle in Figure 13.1. As the NWMO has done with lands in other potential siting areas, land that is not considered suitable will be identified to the provincial government so the land can be released from the withdrawal of prospecting and mining claims.

The following claims and/or land ownership parcels are located within the temporary withdrawal area per the Ministry of Mines Mining Lands Administration System Map Viewer (Government of Ontario 2023c; accessed October 2024):

- mining claim # 868881 (partially within Provincial grid cell 52F09C375)—the portion of this claim within the NWMO's withdrawal area is not included in the claim or available to the claim holder, as the withdrawal takes priority since it was in place prior to the claim being registered
- non-mining land tenure (Bell Canada ownership parcel)—surface and mining rights patent HK11 (partially within Provincial grid cells 52F09B255 and 52F09B235)
- non-mining land tenure (private landowner ownership parcel)—surface and mining rights patent (partially within Provincial grid cells 52F09B196, 52F09B216 and 52F09B217)
- several other features intersect the withdrawal area, including Highway 17, Highway 622, and hydro and rail corridors

Proximity to Residences and Communities

The following distances were measured cross country from the approximate Project site centroid to the nearest extent of the municipality/community boundaries, with the exception of Borups Corners, Dyment and Dinorwic which lacked spatial boundaries. Distances to these three communities were calculated using the approximate community centroids. Below, several of the closest communities to the Project site are listed:

- the community of Borups Corners (approximately 10 km to the northeast)
- the community of Dyment (approximately 13 km to the northwest)
- the community of Dinorwic (approximately 28 km to the northwest)
- the Local Service Board (LSB) of Wabigoon Village (Wabigoon) (approximately 35 km to the northwest)
- the Township of Ignace (Ignace) (approximately 35 km to the southeast)
- the City of Dryden (Dryden) (approximately 40 km to the northwest)
- the municipality of Sioux Lookout (Sioux Lookout) (approximately 50 km to the north)

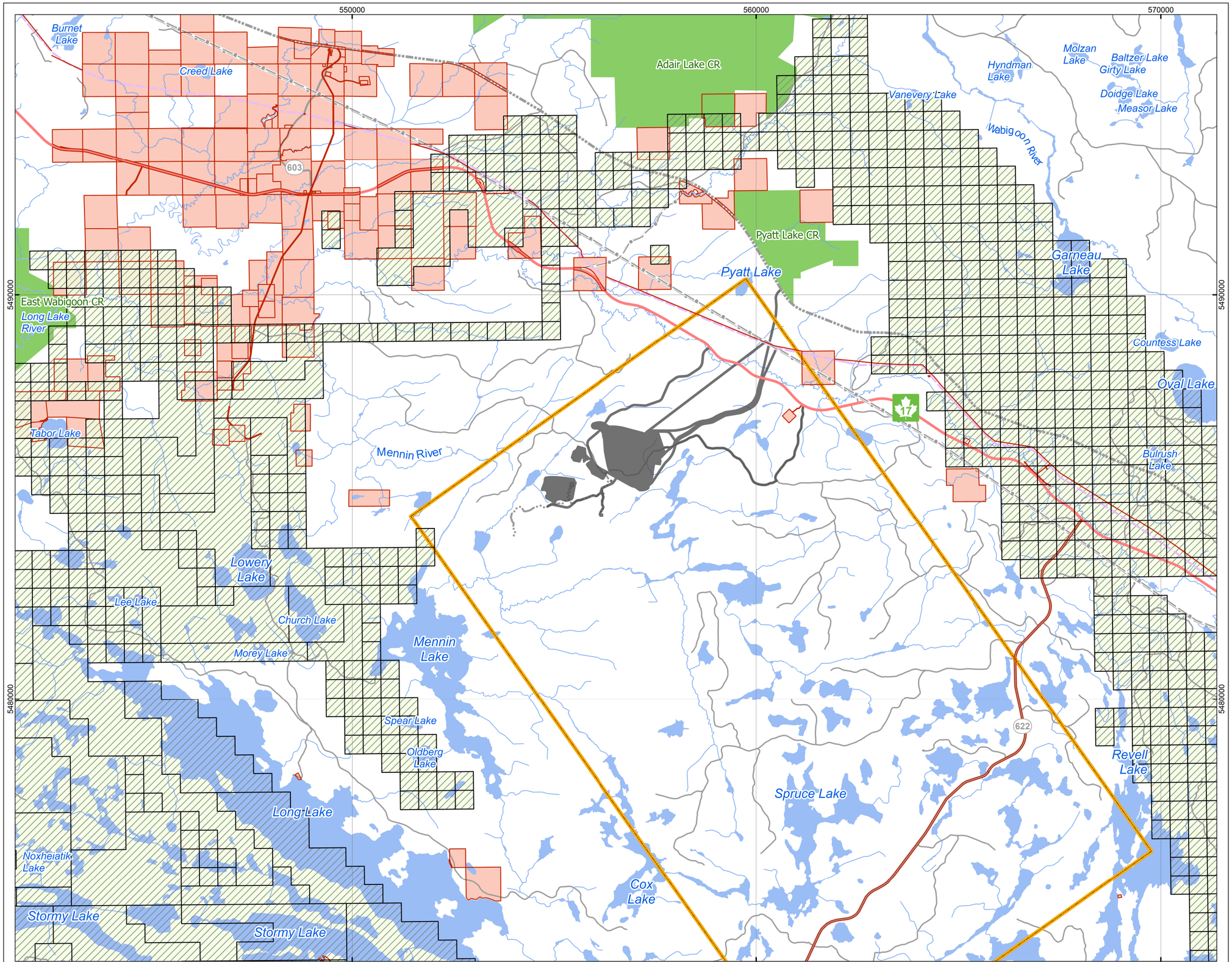
Proximity to Indigenous Lands and Communities

The Project site is located in land covered by Treaty #3 signed with the Anishinaabe peoples and within the territory of WLON. The following distances were measured in a straight line from the approximate Project site centroid to the nearest edge of reserve lands. Distances to First Nation reserve lands in the vicinity of the Project site range approximately 21–107 km:

- WLON (approximately 21 km to the northwest)
- Eagle Lake First Nation (approximately 60 km to the northwest)
- Lac Seul First Nation (approximately 64 km to the north)
- Seine River First Nation (approximately 85 km to the south)
- Lac Des Mille Lacs First Nation (approximately 107 km to the southeast)

Proximity to Federal Lands

There are no federal lands in close proximity to the Project. The Project is located inland with no related marine or port features related to the Project. It is understood that the closest federal lands are the Whiteshell Laboratories, owned by AECL and located approximately 286 km (cross country) from the Project site near Pinawa, Manitoba.



LEGEND

Proposed Project Infrastructure

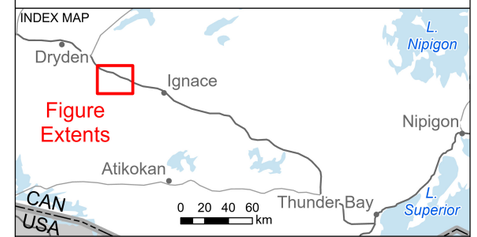
- Proposed DGR Project Footprint

Existing Present Day Infrastructure

- Transmission Line
- Natural Gas Pipeline
- Railway
- Highway 17
- Highway
- Road
- Temporary Access Road

- Temporary Withdrawal Area (current as of June-24-2024)
- Land Ownership Parcel
- Claim - Ministry of Northern Development and Mines (current as of May-08-2024)
- Conservation Reserve (CR)
- Watercourse
- Waterbody

INDEX MAP



REFERENCE

Data: GEO, Government of Ontario, Natural Earth, and MINES
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 15N

OCT-10-2025

0 1 2 3 4 5 km

SCALE 1:90,000

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

TITLE

Land Tenure and Land Use

FIGURE: 13.1

14. Biophysical Environment

The CNSC requires per REGDOC-1.2.1, *Guidance on Deep Geological Repository Site Characterization*, that site characterization information to be collected before and at all times that a nuclear facility is Licenced. This section, Biophysical Environment, summarizes the NWMO's current understanding of the characterization at the Project site, including biophysical environment and geological characteristics that indicate the site can meet the Project's requirements to contain and isolate used nuclear fuel to protect people and the environment.

For many of the environmental components studied, the NWMO has already undertaken extensive and technically rigorous field programs to verify site suitability and to inform the preliminary safety assessment work that supported site selection. Additional work will be completed to further support the initial licence application to the CNSC and the federal IA process. However, the studies completed to date are considered sufficiently advanced to support the screening-level assessment of potential effects presented in Section E of the IPD.

The NWMO has an extensive geoscience program and environmental program, both with the objective of characterizing the biophysical environment for the purposes of licensing the site.

Geoscience Program Overview

The geoscience program focuses on surface bedrock characterization, based on geological mapping, and subsurface bedrock/groundwater characterization, based on seismic investigations and borehole drilling programs. Both surface and subsurface geoscientific characterizations have also benefitted from remote airborne geophysical surveys. The geoscience data collection program is sufficiently complete to satisfy the initial licence application to the CNSC (licence to prepare site) and an Impact Statement.

The NWMO has developed an understanding of the Project site based on the collection, evaluation, and modelling of data during site characterization studies that were initiated in 2010. To date these include the following initiatives:

- **2011**—Initial Screening Desktop Study (Golder 2011)
- **2012-2013**—Phase I Desktop Preliminary Assessment (Golder 2013)
- **2014-2016**—Initial Phase 2 Preliminary Assessment Field Studies, including high-resolution airborne geophysical surveys (SGL 2015) and geological mapping (SRK and Golder 2015)

Between 2017 and 2023, the site investigations have focused primarily on characterizing the Project site and surrounding area using several methods:

- high-resolution airborne LiDAR measurements of the surface topography (ATLIS 2019)
- structural lineament interpretation (DesRoches et al. 2018), 2D bedrock geological map (Parmenter et al. 2020), and 3D geophysical/geological model (SGL 2020) for the Project site and surrounding area
- drilling, coring, and testing, of six deep boreholes, with ongoing long-term monitoring and sampling in four boreholes (Golder 2018, 2020a,b, 2021, 2022a,b)
- field verification of land use at the borehole sites as part of the borehole program by Anishinaabe peoples of WLON

- installation and ongoing monitoring of nine shallow groundwater wells
- 2D seismic reflection survey (Vibrometric 2022), and vertical seismic reflection profiles completed in three deep boreholes (WSP-Golder 2023; WSP 2023a,b)
- installation and ongoing monitoring of nine microseismic stations (Nanometrics 2022), and additional geological mapping

More geoscientific site characterization is required and is planned as part of the NWMO's detailed site characterization program which will continue to support the achievement of the expectations of the CNSC as set out in REGDOC 1.2.1. However, the uncertainties that remain are less about the fundamental suitability of the Project site to safely contain and isolate used nuclear fuel, and more about continuing to develop and document a thorough quantitative understanding of the proposed site (NWMO 2023). Where the NWMO intends to collect additional site characterization data for the initial licence application, they are identified here; otherwise, data will be collected to support future licensing applications to the CNSC.

Environment Program Overview

Desktop studies on the biophysical environment for the Project site began in 2014 and encompassed a very large geographical area, to ensure adequate baseline data collection coverage to support the site selection process. These studies provided a general description of the environment based on readily available sources of information. The intent of the desktop studies was to identify and map known or potential ecological features, including the following:

- ecological land classification ecosites
- candidate significant wildlife habitat (SWH)
- stream reach classification
- Species at Risk (SAR)

There are two types of SWHs: candidate SWHs are areas that have ecological land classification ecosite and/or habitat attributes that meet criteria outlined in the Province of Ontario's SWH Criteria Schedules for Ecoregion 3W (MNRF 2017). Confirmed SWHs are areas that have been field-verified and meet the defining criteria outlined in the SWH Criteria Schedules for Ecoregion 3W (MNRF 2017). This environmental information was used to inform a conceptual site layout in order to safely construct and operate the Project in the area.

More recently, a set of reports was developed outlining the methodology and design for baseline characterization of biodiversity (Zoetica 2022) and the abiotic environment (CanNorth 2020) within and surrounding the Project site. Summary of data collection from the NWMO's ongoing program is presented in the subsections below. The baseline environmental data collection programs initiated in 2020 were designed collaboratively with Anishinaabe peoples of WLON, residents of Ignace and other local community groups and were reviewed by IAAC and members of the federal review team in 2021, to ensure the programs would meet the needs of the regulators. Enhancements to the program designs were made in response. Preliminary data have been collected, and more data are needed in the Project footprint to support site characterization to confirm conclusions and findings made in the environmental baseline section.

The NWMO will for all phases of the Project, continue to characterize the Project site and report the information to the CNSC to satisfy the requirements of the NSCA. These studies will further inform the repository design and long-term safety case using the CNSC's graded approach. Following receipt of a CNSC licence, the NWMO will verify predictions and demonstrate compliance with the implementation of an extensive regulatory monitoring program that meets the requirements of CNSC licences.

This section describes the following aspects of the biophysical environment baseline:

- meteorological environment
- geology and geological hazards
- geochemistry of excavated materials
- topography, soil, and sediment
- atmospheric, acoustic and visual environment
- groundwater and surface water
- vegetation, riparian and wetland environment
- fish and fish habitat
- birds, migratory birds, and their habitat
- terrestrial wildlife and wildlife habitat
- SAR and their habitat
- climate change
- ambient radioactivity

14.1 Meteorological Environment

14.1.1 Currently Available Baseline Data

The Dryden meteorological station is the nearest meteorological station with historical data to the Project site, located approximately 55 km northwest. Climate normals data for the Dryden meteorological station (Dryden A) are displayed in Table 14.1 for the 1981 to 2010 period (ECCC 2020b). There is variability in baseline meteorology conditions (e.g., temperature, wind and precipitation) both over time and across seasons. Recorded extreme temperatures at Dryden can reach highs of 37.5 degrees Celsius (°C) in summer months and lows of - 43°C in winter months. The annual average temperature is 2.4°C, where the average summer temperature is approximately 16°C and the average winter temperature is -12°C (ECCC 2020b).

Precipitation normals data for the Dryden meteorological station are displayed in Table 14.2 for the 1981 to 2010 period (ECCC 2020b). The annual average precipitation in the area of the Project site is 720 mm, where 1 cm of snow is considered to be equal to 1 mm of equivalent rainfall. The region receives an average of 60 to 115 mm of precipitation each month from May to October. Higher amounts are seen through the summer months (June to September). Through the remaining months (November to April), average precipitation is between 20 to 50 mm for each month. The Dryden Station region on average experiences 20 to 115 mm of precipitation per month and about 175 cm of snowfall per year and therefore is unlikely to experience drought conditions that would affect local waterbodies. Local lakes and waterbodies are expected to freeze in the winter months (November to March; ECCC 2020b).

South winds prevail in Dryden, changing to northeast winds in April. Table 14.3 presents the monthly wind data obtained from Environment and Climate Change Canada (ECCC) 1981–2010 climate normals for the Dryden meteorological station (2020b), displayed in kilometres per hour (km/h). Wind speed and direction are an average for each month over the calendar year (ECCC 2020b).

The NWMO also established an on-site meteorological monitoring station to compare site meteorological information with the data from the Dryden Regional station, to ensure that the latter was representative of the site conditions. Data collection began in 2021, and the program includes the following parameters: air temperature, relative humidity, rain, snow depth, wind speed and direction, soil water content, atmospheric pressure, and solar radiation. Results from the second year of data collection for air temperature, rain and snow depth from June 2022 to July 2023 are presented in Table 14.4. Data were compared against measurements from other meteorological stations in the region and found to be similar.

Table 14.1: Climate Normals Data—Dryden (1981 to 2010)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Daily Average (°C)	-16.8	-12.7	-5.8	3.0	10.8	16.2	18.9	17.8	11.7	4.2	-5.2	-13.5
Standard Deviation	3.7	4.2	2.7	2.5	2.1	2.1	1.4	1.9	1.7	1.9	3.4	4.1
Daily Maximum (°C)	-11.6	-7.3	-0.1	8.8	16.9	21.7	24.3	23.1	16.5	8.2	-1.6	-9.1
Daily Minimum (°C)	-21.9	-18.1	-11.5	-2.8	4.7	10.5	13.4	12.4	6.8	0.3	-8.8	-17.8
Extreme Maximum (°C)	6.7	10.4	16.7	28.3	33.8	**37.5**	35.6	35.4	34.4	24.9	20.6	8.0
Date of Extreme Maximum (yyyy/dd)	2003/07	2000/22	2000/ 07+	1980/21	1986/30	**1995/18**	1975/30	2003/18	1976/07	2003/10	1975/05	1982/02
Extreme Minimum (°C)	**-43.3**	-40.8	-34.6	-23.0	-10.9	-1.5	2.0	-0.4	-4.4	-12.4	-33.0	-38.3
Data of Extreme Minimum (yyyy/dd)	**1970/17**	1996/02	2003/02	1979/06	1989/05	1983/07	1983/05	1982/27	1976/25	1996/31	1985/30	1976/02

Note:
Bold indicates all-time extremes for the location.
A + besides an extreme date indicates that this datum is the first occurrence of the extreme value.

Table 14.2: Precipitation Normals Data—Dryden (1981 to 2010)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Rainfall (mm)	0.2	2.1	6.7	24.7	69.2	115.2	103.1	83.5	87.7	49.2	13.0	1.2
Snowfall (cm)	30.1	19.9	25.1	13.9	3.4	0.0	0.0	0.0	1.1	14.6	35.3	31.1
Precipitation (mm)	26.5	20.0	29.9	39.6	73.4	115.2	103.1	83.7	88.9	63.6	46.7	29.1
Average Snow Depth (cm)	30	34	27	5	0	0	0	0	0	1	8	19
Median Snow Depth (cm)	30	34	27	2	0	0	0	0	0	0	7	19
Snow Depth at Month-end (mm)	34	33	15	0	0	0	0	0	0	1	12	24
Extreme Daily Rainfall (mm)	1.0	14.2	19.6	35.6	43.7	67.4	**92.0**	57.0	69.6	47.6	26.8	4.6
Date of Extreme Daily Rainfall (yyyy/dd)	1973/ 18+	1998/ 26	1990/15	1985/21	1972/19	2000/10	**2001/31**	2000/06	1997/28	2004/23	2000/01	2003/27
Extreme Daily Snowfall (cm)	27.9	18.9	24.2	18.6	17.0	0.6	0.0	0.0	8.8	23.6	**30.0**	15.6
Date of Extreme Daily Snowfall (yyyy/dd)	1975/ 10	1977/ 23	2004/13	1996/25	2004/11	1990/03	1970/ 01+	1970/ 01+	1984/24	1988/27	**1988/16**	1984/16
Extreme Daily Precipitation (mm)	35.6	19.0	25.4	35.6	51.4	67.4	**92.0**	57.0	69.6	47.6	30.0	17.8
Date of Extreme Daily Precipitation (yyyy/dd)	1975/ 10	1977/ 23	1975/27	1985/21	2004/11	2000/10	**2001/31**	2000/06	1997/28	2004/23	1988/16	1984/16

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Extreme Snow Depth (cm)	56	60	64	57	10	0	0	0	1	24	49	**80**
Date of Extreme Snow Depth (yyyy/dd)	1989/ 26	1996/ 24	1980/14+	1988/01	2004/12	1980/01+	1979/ 01+	1979/ 01+	2003/30	2001/26	1991/04+	**1994/04**

Note:
Bold indicates all-time extremes for the location.
A + besides an extreme date indicates that this datum is the first occurrence of the extreme value.

Table 14.3: Wind Normals Data—Dryden (1981 to 2010)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Average speed (km/h)	11.5	12.5	13.0	13.3	13.2	12.5	11.3	11.1	12.7	**13.4**	12.8	11.6
Most prevalent direction (from)	S	S	S	NE	S	S	S	S	S	S	S	S
Max. hourly speed (km/h)	46	48	56	52	52	**70**	52	50	48	56	57	56
Date of max. speed observance (yyyy/dd)	1986/12	1971/27	1984/10	1992/20	1992/06	2002/11	2000/25	1984/21	1991/22	1972/16	1991/02	1999/25

Note:
Bold indicates maximum observance of any month.

Table 14.4: Meteorological Observation Station Data (July 2022 to June 2023)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average monthly temp. (°C)	-11.1	-12.2	-7.4	0.3	13.4	18.8	18.5	18.2	12.6	5.5	-3.3	-12.7
Average monthly daily maximum temp. (°C)	-7.8	-6.2	-0.8	6.0	20.3	24.9	24.4	23.9	18.3	10.6	0.1	-9.3
Average monthly daily minimum temp. (°C)	-14.6	-18.5	-14.3	-5.6	6.2	12.5	12.6	12.8	6.8	1.4	-6.9	-17.2
Total snow accumulation (cm)	33.3	11.6	21.7	62.6	7.7	-	-	-	-	17.3	64.9	67.4
Total precipitation (mm)	1.8	12.2	11.7	20.2	15.0	22.3	79.3	30.0	33.3	12.2	16.0	0.0

- = not applicable.

During the quality control process of the site meteorological monitoring station data, some temporal data gaps were observed in the 2021-2022 ambient temperature and total precipitation. There were some missing data points from February 2023 due to a temporary loss of power at the monitoring station which may have slightly affected the daily and monthly averages. However, data were compared against measurements from other meteorological stations in the region and found to be similar and within a reasonable range. The issues with the equipment have since been addressed during maintenance visits and the data recording resumed afterwards.

The temperature data for 2022-2023 generally appear to be of good quality and show expected trends, with average monthly temperatures ranging from -12.7°C in December to 18.8°C in June. Average monthly daily maximum temperatures range from -9.3°C in December to 24.9 °C in June, while average monthly daily minimum temperatures range from -18.5°C in February to 12.8°C in August.

The snowfall data indicate a total of 286.6 cm of snow accumulation in 2022-2023, with measured snow occurring between October and May and the highest accumulation in November 2022, December 2022, and April 2023.

The total precipitation data appear reasonable during the summer but appear to underestimate total precipitation during the winter. For example, zero total precipitation was recorded throughout December 2023, while snow accumulation was estimated at 67.0 cm. This may indicate a general issue with accurately recording snow water equivalent during periods of heavier snow. The total precipitation recorded for 2022-2023 was 254.3 mm, compared to 504.6 mm at the Dryden Regional meteorological station maintained by ECCC. While the on-site precipitation data may be underestimated during the winter (due to the potential issue during periods of higher snowfall), the greatest difference when compared to the Dryden Regional station during 2022-2023 occurred during July 2022, where 215.3 mm of precipitation were recorded at Dryden compared to 79.6 mm on-site. There is no indication of issues with the data from the on-site meteorological monitoring station during this period; the high rainfall accumulation at Dryden during July 2022 was likely more localized. Despite being substantially less than at Dryden, July 2022 was still the month with the highest recorded precipitation on site during 2022-2023.

14.1.2 Planned Work

The NWMO will continue to collect meteorological data to characterize the site area meteorological conditions and consider them in the design of a Project per the requirements of REGDOC-1.2.1.

14.2 Geology and Geological Hazards

14.2.1 Currently Available Baseline Data

Since 2014, the NWMO has completed extensive geological investigations within and surrounding the Project site, located within crystalline rock on the Canadian Shield. This work included remote sensing surveys, geological mapping of the surface, seismic surveys, and drilling and testing of six deep (approximately 1,000 m long) boreholes, to explore the subsurface. Key source reports for the information presented below include Sanders Geophysics Ltd. (2015), which describes the acquisition, processing, and interpretation of the geological character of the region around and including the Project site; Parmenter et al. (2020), which describes the surface bedrock geology for the region surrounding and including the Project site; Sanders Geophysics Ltd. (2020), which presents a 3D model of the bedrock geology for the same region; DesRoches et al. (2021), which presents a 3D model of the bedrock geology and fracture network within and surrounding the Project site; and single-borehole geological integration reports, which summarize the geological characteristics of all six deep boreholes (Parmenter et al. 2022a,b,c; DesRoches et al. 2023;

Markovic and DesRoches 2024; Markovic et al. 2024). Additional supporting results from the geoscientific work program have been documented in more than 60 technical reports that are publicly available on the NWMO website.

The Project site is located in a stable, seismically quiet setting in the Canadian Shield at the heart of the North American continent, away from tectonic plate boundaries. It is considered a craton, which is a large stable block of the earth's crust forming the nucleus of a continent. The Canadian Shield has remained tectonically stable throughout much of northwestern Ontario since approximately one billion years ago, except for localized rifting approximately 600 million years ago in eastern Ontario and related to the opening of the Iapetus Ocean (Percival and Easton, 2007). This area of the Shield was eroded to a nearly flat surface of regional extent prior to the onset of multiple cycles of deposition and erosion of sedimentary rocks, and associated vertical and lateral crustal motion, over the last approximately 500 million years. There is no evidence to suggest that there will be any risk of active tectonism or volcanism at the Project site for the next several million years that would impact the long-term containment and isolation of the used fuel.

The Canadian Hazard Information Service maintains a network of monitoring stations that record the location and magnitude of seismic events across the country. In northwestern Ontario, these have been supplemented by the NWMO with additional stations to improve the data coverage and accuracy. Earthquakes are measured using the Nuttli Scale (mN), which represents a modern refinement of the older Richter scale. To date, in the Canadian Hazard Information Service dataset, there have not been any earthquakes above magnitude 3 mN, a magnitude typically felt by most humans, occurring within 50 km from the Revell Site. The majority of the seismic events recorded in the vicinity of the site were caused by human activity, such as from blasting activities at mines.

A network of nine microseismic monitoring stations was installed by the NWMO around the Project site in 2021. These nine stations provide increased ability to identify and locate smaller earthquakes within a 50 km radius of the site. Microseismic data are measured in local Richter Magnitude (ML), which is the standard reporting datum for micro seismicity and is best used for "Local" earthquakes with epicenters located up to 600 km from seismic stations. To date, the NWMO microseismic dataset has recorded only one earthquake above magnitude 2 ML, measured at 2.11 ML for a seismic event located 43 km northeast of the Project site. The closest recorded was 0.5 ML in the northern part of the Revell batholith.

Microseismic monitoring will continue to record seismic events to aid in identifying the presence of any active faults in the regional area surrounding the Project site. Monitoring of small-magnitude events (magnitude 3 ML and lower) provides information on the overall seismicity and geological structure of the local region surrounding the Project site. Ground vibrations associated with these small-magnitude events are below the threshold considered to be able to cause structural damage to buildings.

As such, the NWMO has extensive understanding of the geoscientific characteristics of the site, including the potential for geological hazards associated with the Project site, including evidence to support its suitability and safety to host a DGR. The below subsections provide further summary.

Surface Bedrock Geology

Studies to date in the region, including history and recent bedrock mapping, provide an initial understanding of the overburden character and have defined and described 11 bedrock units (Parmenter et al., 2020). The Project site has generally good bedrock exposure, at most with a thin veneer of overburden with an average thickness that varies between 0.3 and 1 m. Locally in valleys and wetland areas the overburden is inferred to be several metres thick.

The Project site is within the northern portion of the Revell batholith, a rock unit approximately 40 km in length and 15 km in width, formed by the solidification of a volume of magma that intruded into continental crust about 2.7 billion years ago. Batholiths are common in the Canadian Shield

and are potentially suitable for hosting a deep geological repository as they often are relatively uniform in their composition and show a relatively low degree of deformation and fracturing (NWMO 2023). A bedrock geology map of the region surrounding and including the Project site is presented in Figure 14.1, which also shows the locations of the six deep boreholes drilled in the area (NWMO 2023).

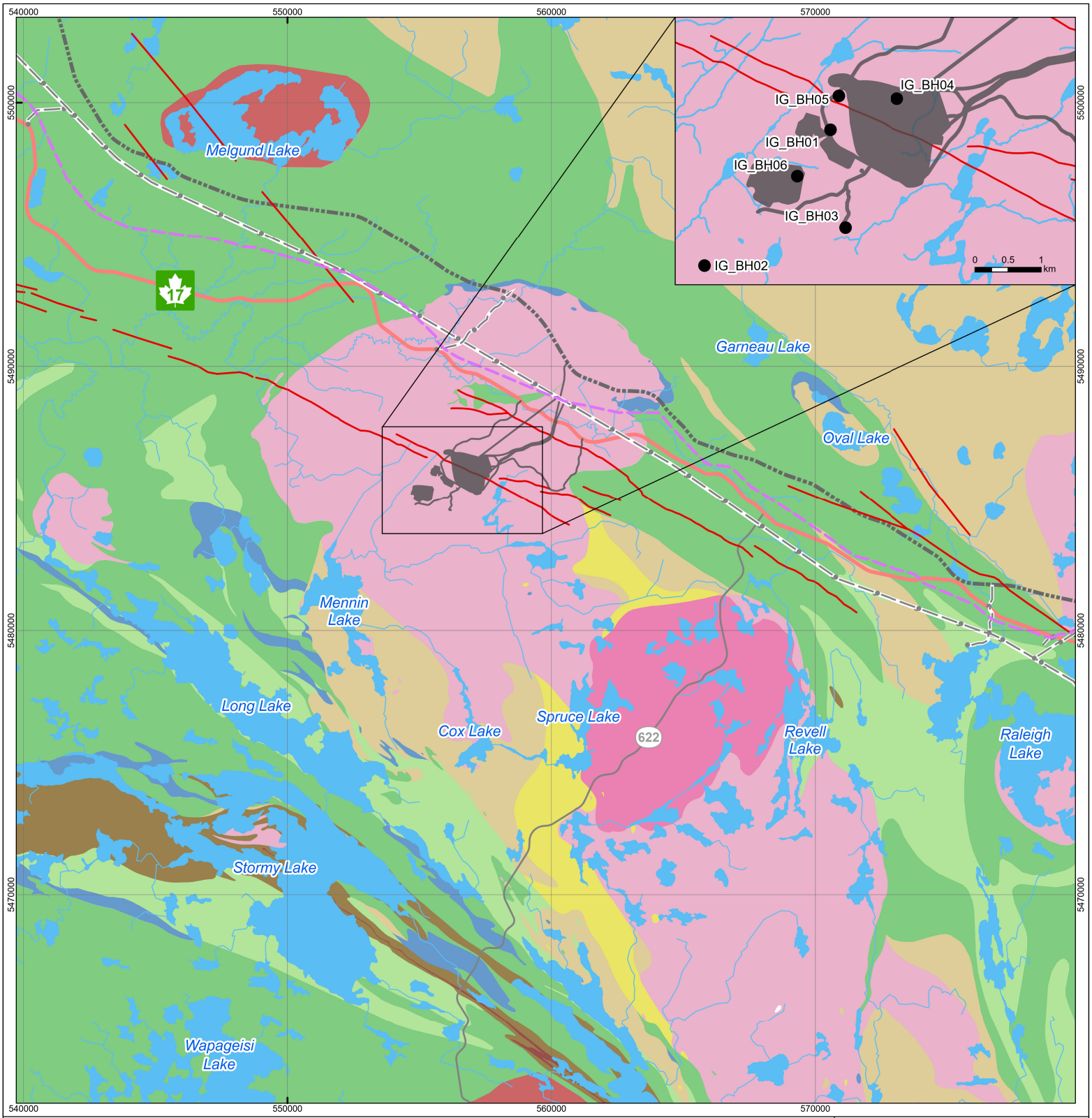
Five greenstone belt bedrock units are assigned to the Archean-aged supracrustal rock group. These include mafic metavolcanic rocks, intermediate to felsic metavolcanic rocks, metasedimentary rocks, including a distinct banded iron formation, and mafic intrusive rocks. Five additional bedrock units are assigned to the Archean-aged plutonic rock group. Four of these Archean-aged units occur within the Revell batholith, including biotite tonalite to granodiorite, hornblende tonalite to granodiorite, biotite granodiorite to granite, and feldspar-megacrystic granite suites. The fifth bedrock unit of the plutonic rock group, which is not identified as a phase of the Revell batholith, is an intermediate to felsic intrusive (sanukitoid) suite located south of the batholith. Proterozoic-aged mafic dykes belonging to the Wabigoon dykes represent the youngest bedrock unit.

Deep Geology

Together, the regional and site-scale studies conducted to date indicate that there is sufficient volume of homogeneous and competent granitoid rock to host a DGR, as the NWMO considers a depth range of 500 m to 800 m as suitable at the Project site and is presently considering a repository situated at a depth of approximately 750 m. Taking into account the identification of structural features in the batholith, a deep geological repository can be positioned between the larger-scale structures presently inferred to be fracture zones (FZs). Additional supporting information is included in the summary below.

A 3D geophysical/geological model for the Revell batholith and surrounding area has been developed based on high-resolution geophysical surveys and surficial geological data. Based on current understanding, the Revell batholith has been modelled with a relatively flat base that extends to a depth of nearly 4 km in some regions. In the northern portion of the Revell batholith where the Project site is located, the potential host rock is estimated to be approximately 3 km thick, which is much deeper than would be needed to host a repository.

Boreholes drilled in the Project site (up to 1 km depth) have provided direct confirmation of the geology at potential repository depth and indicate that the rock encountered to approximately 1 km depth is the same relatively homogeneous granitoid rock identified at surface. Examples of the granodiorite-tonalite, from surface and recovered core, are shown in Figure 14.2.



LEGEND

Proposed Project Infrastructure

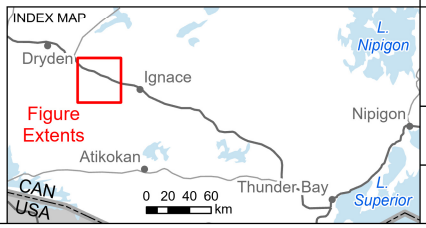
- Proposed DGR Project Footprint

Existing Present Day Infrastructure

- Borehole Surface Location
- Transmission Line
- Natural Gas Pipeline
- Highway 17
- Railway
- Highway
- Waterbody
- Watercourse

Geology

- Diabase (Wabigoon) Dyke
- Intermediate to Felsic Intrusive (Sanukitoid) Rocks
- Biotite Granite to Granodiorite
- Feldspar Megacrystic Granite
- Hornblende Tonalite to Granodiorite
- Biotite Tonalite to Granodiorite
- Mafic Intrusive Rocks
- Metasedimentary Rocks
- Iron Formation
- Intermediate to Felsic Metavolcanic Rocks
- Mafic Metavolcanic Rocks



REFERENCE

Data: Bedrock Geology from: Kresz, 1987; OGS, 2011; Satterly, 1960; Stone et al., 2007; Stone et al., 2011 a, b, c; Thomson, 1933; Parmenter et al., 2020; GEO (obtained 2009-2024)
Projection: Universal Transverse Mercator
Datum: NAD 83
Coordinate System: UTM Zone 15N

OCT-10-2025

0 2 4 km

SCALE 1:200,000

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

TITLE

Surface Bedrock Geology

FIGURE: 14.1

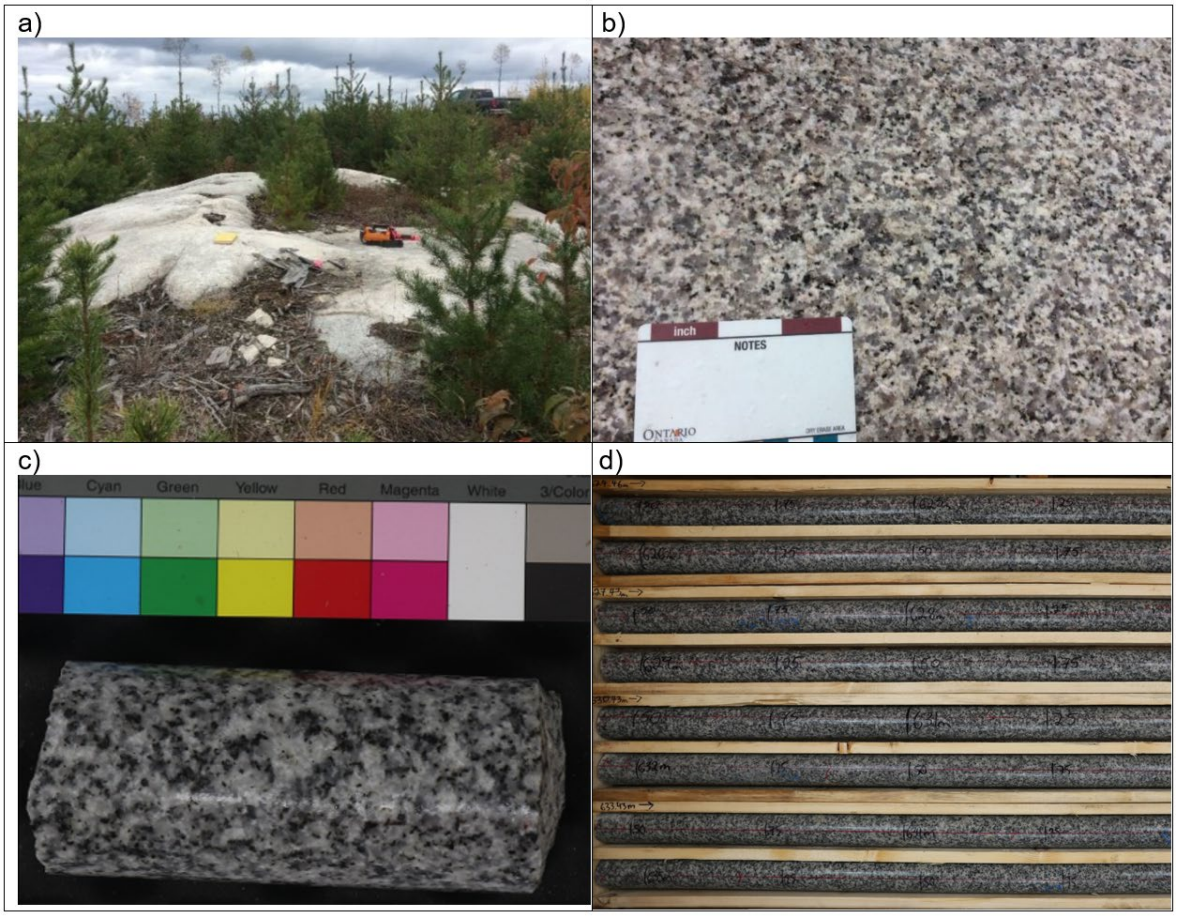


Figure 14.2: Examples of Granodiorite-tonalite at the Project site

(a) at Outcrop Scale with Yellow Notebook for Scale
(b) Close-up of Exposed Bedrock with Scale Card in Inches, and
(c, d) 61 mm Diameter Core Recovered from the Deep Boreholes

14.2.2 Summary

The studies conducted to date indicate that there is sufficient depth and volume of homogeneous and competent granitoid rock within the Project site to host a DGR. The Project site has good bedrock exposure and minimal overburden to aid in learning about the bedrock geology.
The NWMO considers a depth range of 500 m to 800 m as suitable at the Project site and is presently considering a repository situated at a depth of approximately 750 m. Taking into account the identification of structural features in the batholith, a DGR can be positioned between the larger-scale structures presently inferred to be FZs. There is no evidence to suggest that there will be any risk of landslides, slope erosion, unstable ground, or liquefaction during or following Project activities.

14.2.3 Planned Work

Results of the geology and geological hazard baseline study completed to date indicate the need for a limited amount of additional data collection to support the initial licence application and Impact Statement. Additional data will be collected prior to submission of the initial licence application to address this data gap. Additional data collection, as summarized below, will support future licence applications and regulatory approvals/permits.

Integrated results from all site-specific geological characterization activities will be included in Descriptive Geoscientific Site Model report(s). These reports are iterative and will be based on all available geoscientific information to date, initially to support the initial licence application to the CNSC, and the Impact Statement , and then updated as required in support of all future licensing phases.

Surface Bedrock and Deep Geology

The additional planned geological work to support the initial licence application to the CNSC, and the Impact Statement , includes surficial geotechnical data collection, focused on general soil/overburden characterization.

Additional future planned work to be completed as part of ongoing site characterization and in support of future licensing activities will provide enhanced confidence in the geoscientific understanding, which includes surficial geotechnical data collection, additional borehole drilling and associated logging and testing, a 3D seismic survey, and surface characterization activities, such as geological mapping.

The following additional information is required to inform the next phase of site characterization and design activities:

- Geometry and properties of FZs at depth, in particular gently inclined and water-conducting features related to subordinate rock types present in the Revell batholith. This will require additional study to enhance confidence in groundwater flow and radionuclide transport modelling.
- Further site-specific properties are needed to finalize the design. This includes rock properties, as well as details of the surface and near-surface environment, such as hydrology. These will support optimizing the site and design to protect the environment during construction and operations.

It is understood that fractures in the geosphere are the primary potential pathway for radionuclide release into the geosphere. The development of both an updated site-specific geological model and a site-specific discrete fracture network model, using all available geoscientific information, are ongoing and will continue to be updated as additional site-specific information is collected.

Seismicity

Ongoing seismic monitoring is adding to a regional database of geoscientific information. Specifically, the NWMO continues to collect information from the seismic monitoring stations it has installed at the Project site, and within a 50 km radius around the site, as part of its site characterization program. In addition, an initial Probabilistic Seismic Hazard Assessment is ongoing to provide the input needed for developing a safe design for the structures, systems and components of the DGR, including assessing the need for a probabilistic fault displacement model.

Uncertainties remain regarding the likelihood and potential impact of post-glacial faulting. While the Project site is located in a region of low seismic hazard, microseismic monitoring is ongoing to determine if any active faults are present in the region around the site and an investigation of potential recent fault activity will be conducted as part of future detailed site characterization.

Planned Future Surface and Subsurface Characterization

The geoscientific information collected to date will support the initial licence application to the CNSC, and the IA process. Future drilling, logging, and testing of an additional suite of up to 10 deep boreholes and up to 10 shorter-length exploration boreholes are planned for collection of additional geoscientific information. Additional geological mapping and shallow geotechnical investigations will be undertaken.

14.3 Geochemistry of Mined or Excavated Materials

14.3.1 Currently Available Baseline Data

The NWMO has initiated geochemical testing of rock core samples for the purposes of geochemical characterization (i.e., the potential for acid rock drainage and metal leaching) to support preliminary technical studies related to excavated rock management. The program consists of both static and kinetic testing, which are used to determine the general geochemical characteristics and long-term reaction rates of a sample. The program has been designed considering The Mine Environment Neutral Drainage report 1.20.1 (Price 2009). Descriptions of the potential site's geochemistry are also available from Confidence in Safety – Revell Site (NWMO 2023). A summary is provided below Table 14.5.

Rock mineralogy data for the Project site have been gathered through observations and measurements of the surface geology taken during geological mapping, and from laboratory analysis of over 100 core samples collected from the six boreholes drilled to date. Data from the boreholes confirm the overall lithological homogeneity of the bedrock with approximately 95 percent of the drill core recovered classified as granodiorite-tonalite (Table 14.5; Parameter et al. 2022b). The remainder of the recovered core comprises subordinate rock types, including amphibolite and several distinct suites of felsic dykes. Mapping data confirm this homogeneity and lithology at surface. The mineralogy of granitoid rock in general, and of the granodiorite-tonalite encountered in the Project site, is favourable for construction of a repository (NWMO 2023). The lithogeochemistry data to date, and logged mineralogy, do not indicate the presence of sulphur-bearing minerals (e.g., sulphides, sulphates) in any appreciable quantities. These low concentrations of sulphur-bearing minerals at the site are not likely to impact the durability of the copper within the engineered barrier system (NWMO 2023). A summary of the average major oxides in the rock types from one of the boreholes is shown in Table 14.5; the main rock type is biotite granodiorite-tonalite.

Table 14.5: Summary of Average Major Oxides in Rock Types of IG_BH02

Rock Type	Major Oxide Composition (average %)									
	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5
Biotite granodiorite-tonalite	72.48	14.30	1.8	0.03	0.36	1.79	4.75	2.88	0.17	0.04
Biotite tonalite	72.59	14.75	2.59	0.05	0.55	2.63	4.68	1.75	0.25	0.06
Amphibolite	49.06	13.13	8.71	0.15	7.87	10.48	2.73	2.14	0.76	0.33
Aphanitic and Feldspar-phyric tonalite dykes	71.71	14.20	2.68	0.04	0.63	2.59	4.49	1.78	0.28	0.09
Aplite dyke	75.41	13.45	1.2	0.02	0.16	1.11	4.47	3.76	0.08	0.02

The granodiorite-tonalite and amphibolite exhibit low porosity, which is to be expected in these types of igneous rock. The average connected (water-loss) porosity of the granodiorite-tonalite, which represents the porosity within the rock that is connected and filled with fluid, is estimated to be 0.45 volume percent. The average total porosity of the granodiorite-tonalite is 1.32 volume percent, where the total porosity is considered to be an upper bounding value. The average connected and total porosity of the amphibolite are estimated to be 0.15 volume percent and 1.79 volume percent, respectively. Overall, these low porosities will contribute to the retardation of radionuclide movement through the rock (NWMO 2023).

There are no indications from the sample analyses to date that the properties of the rock, once excavated and managed at surface, will have adverse impact on the environment or water quality.

At this time, the geochemical testing program to support preliminary technical studies related to excavated rock management is underway; however, given the existing knowledge of the Revell Batholith geology, the results are not anticipated to demonstrate that the rock is potentially acid generating or possesses metal leaching condition potential (WSP-Golder 2023).

14.3.2 Planned Work

Results of the geochemistry baseline study completed to date indicate that the rock is non-acid generating The NWMO is however planning to undertake additional study. Planned work includes leachate testing to characterize soluble parts of the excavated rock and to see whether the leachate becomes acidic or has high concentrations of metals or salt. The planned work also includes samples from other potentially exposed material, including overburden and materials planned for use during construction.

The comprehensive testing program will be conducted to verify the preliminary findings that the rock at repository horizon is non-potentially acid generating and not toxic. This work will be completed to support the initial licence application to the CNSC, and the IA process.

14.4 Topography, Soil and Sediment

14.4.1 Currently Available Baseline Data

Topography

Land in the Project site and surrounding area is typical of the Canadian Shield. Ground elevations generally range from 400 to 450 m above mean sea level, and the ground surface broadly slopes towards the northwest, as indicated by the flow direction of the main rivers in the area (Revell and Mennin rivers) (Vorauer 2019). Local watercourses within the area tend to flow to the southwest towards Mennin Lake. Long, narrow valleys are located along the western and southern limits of the Project site, which include creeks and small lakes that drain to the southwest and may represent the surface expression of structural features that extend into the bedrock. A broad valley is located along the eastern limits of the Project site and hosts a more continuous, unnamed water body that flows to the south. A high-resolution airborne Light Detection and Ranging (LiDAR) survey was completed to increase understanding of the surface topography for the Project site (ATLIS 2019).

Surficial Soil

Surficial soils in the Project site are generally assumed to consist of the erosional-depositional products of quaternary glacial till. Quaternary units composed largely of glacial till deposits constitute the overburden material in the Project site, which is estimated to be between 0 and 30 m thick and may contain permeable and possibly unconsolidated material. Baseline data collected to date confirm that within the Project site, approximately 70 percent of the land surface consists of

exposed bedrock, or bedrock covered by only a thin mantle of unconsolidated Quaternary sediments (CanNorth 2023).

The NWMO is operating a baseline soil quality data collection program for surface soils <0.3 m below ground surface. Since distinct ecosites have been identified within the Project site, surficial soil quality is evaluated by collecting representative suites of samples from harvested and non-harvested portions of each ecosite. Specific collection areas are ecosite-specific and include multiple locations depending on the distribution and level of harvesting in each ecosite.

Baseline data collected to date range from July to October 2021 (CanNorth 2023). Forty soil samples were obtained from a range of locations, soil types, and habitat types. The program analyzed several COPCs, such as metals; organics and volatiles; general chemistry, ions and nutrients; and glyphosate. Results were compared to applicable guidelines to assess baseline soil quality. The first consideration was given to available federal and provincial guidelines, with priority given to the most conservative value. If federal or provincial guidelines were not available, guidelines from other jurisdictions were adopted (e.g., other provinces or international agencies).

Results were found to vary by soil type and habitat type. Overall, the pH of soil is low (acidic) and the COPC levels are generally below applicable soil quality guidelines, though select COPCs do exceed their corresponding criteria (i.e., aluminum, chromium, iron, lithium, manganese, molybdenum, and titanium). These are components of the soil and reflect the local geology. Hexavalent chromium and sulphur were also identified as exceeding guidelines in a small number of samples, but the majority of soil samples were found to have concentrations of hexavalent chromium and sulphur below detection limits. Hydrocarbons were detected in wetland samples, but the high organic content of the soil is likely influencing the laboratory analysis (CanNorth 2023).

Radionuclides were also measured in soil and are discussed separately in Section 14.13.

Sediment

Sediment samples were collected in September 2022 from 23 sites within and surrounding the Project site, using a dredge sampler (e.g., Ekman) (CanNorth 2024a,b). The most biologically active portion of the sediment was targeted for sample collection (i.e., layer where benthic invertebrates are found), with the depth of each sample varying across sites from 0 to 5 cm. At lakes and ponds, three to five replicates, spaced at least 20 m apart, were collected. At watercourses, three to five replicates, spaced at least three times the bankfull width apart, were collected. Where possible, sediment samples were co-located with benthic invertebrate and water quality sites, though depositional areas where sediments and contaminants may accumulate were targeted (CanNorth 2024a,b).

The sediment program analyzed several COPCs, such as total metals; organics and volatiles; total organic carbon, general chemistry, ions and nutrients; and particle size. Results were compared to applicable guidelines to assess baseline sediment quality. The first consideration was given to available federal and provincial guidelines, with priority given to the most conservative value. If federal or provincial guidelines were not available, guidelines from other jurisdictions were adopted (e.g., other provinces or international agencies).

Sediment particle size was variable in the study area, with silt- and clay-sized particles dominating the composition of ponds and lakes, while watercourses were largely comprised by sands. All samples analyzed for polycyclic aromatic hydrocarbons and semi-volatile organic compounds were below detection limits. Potential exceedances to detection limit guidelines were observed; however, lower laboratory detection limits must be achieved to confirm these findings as the detection limits were higher than or equal to the available sediment quality guideline. Exceedance of sediment quality guidelines for metals (cadmium, chromium, copper, iron, manganese, nickel, selenium, vanadium, zinc) and total organic carbon indicates the study area has naturally elevated concentrations of some parameters (CanNorth 2024b).

Radionuclides were also measured in sediment and are discussed separately in Section 14.13.

14.4.2 Planned Work

Topography

The NWMO considers the topography baseline study sufficiently complete to inform the initial licence application to the CNSC and the Impact Statement and has no planned work to collect additional baseline data. Baseline reports will be included in the integrated submission.

Surficial Soil

Additional studies for the evaluation of soil will be completed during ongoing site characterization and select locations will be sampled as part of an ongoing data collection program. Results will be provided in baseline reports included in the initial licence application to the CNSC and the Impact Statement.

Sediment

Results of the sediment baseline study completed to date indicate the potential need for additional data collection to support the initial licence to prepare site application to the CNSC and the Impact Statement and select sediment locations will be sampled as part of an ongoing data collection program.

14.5 Atmospheric, Acoustic and Visual Environment

14.5.1 Currently Available Baseline Data

Air Quality

The local atmospheric environment is characteristic of a northern Ontario airshed, where local, regional, and national/international sources of COPCs contribute to local air quality. Surrounding the Project site, there are several industrial sources that release COPCs into the airshed, including Domtar Inc.'s Dryden Mill, Produits Forestiers Résolu's Ignace Sawmill, and TransCanada PipeLines Ltd.'s Station 58. These industries contribute to releases of fuel combustion by-products (i.e., carbon monoxide, nitrogen oxides, sulphur dioxide, particulates) and in some cases, releases of volatile organic compounds, polycyclic aromatic hydrocarbons, dioxins and furans, metals, chlorinated hydrocarbons, and sulphides. In addition, the intersecting rail corridor and Trans-Canada highway also contribute to releases of fugitive dust as well as fuel combustion by-products. Off-grid use of diesel-fired power generators (e.g., for camps, cottages and homes) also contributes to releases of fuel combustion by-products. Additionally, intermittent and seasonal sources (i.e., forest fires) will contribute to existing and future air quality within and surrounding the Project site (CanNorth 2020).

Given the remote location, there are no existing air quality monitoring stations in proximity to the Project site. The nearest stations, with publicly available data, that measure the types of chemical parameters typically included in an air quality assessment are in Thunder Bay (approximately 240 km from the Project site) and Winnipeg (approximately 350 km from the Project site).

A baseline air quality data collection program is underway, and results will be presented in the integrated licence application and Impact Statement.

Noise

A baseline noise data collection program will be completed to understand existing noise conditions within the Project site and surrounding area, and results will be presented in the integrated licence application and Impact Statement.

Light

The surrounding area of the Project site is intrinsically dark. There are limited transportation corridors and no discernible development in the immediate area. A baseline light data collection program will be completed to understand existing light conditions within the Project site and surrounding area, and results will be presented in the integrated licence application and Impact Statement.

Visual Environment

Most of the Project site and surrounding area consists of undeveloped upland habitat dominated by jack pine (*Pinus banksiana*) and black spruce (*Picea mariana*). A lesser portion (11 per cent) of the area is classified as wetlands. The land features consist mostly of forest, pasture, wetlands, and open land with trails developed from roads used for tree harvesting operations in the area. There are limited transportation corridors and no discernable development in the immediate area.

Figure 14.3 shows the general existing visual environment (borehole site 4 is visible in the background) (NWMO 2023).

Figure 14.3: Typical Landscape of the Wabigoon Lake Ojibway Nation and Ignace Area

14.5.2 Planned Work

Air Quality

Preliminary air quality data for the baseline program are currently being collected, along with additional data collection to support the initial licence application to the CNSC, and the Impact Statement. Baseline air quality data collection commenced in 2023 and NWMO commits to continue the program to support the integrated impact assessment and initial licence. Data collection will include sample collection and analysis of conventional air quality contaminants such as nitrogen oxides and sulphur oxides, key radiological parameters and select radionuclides to establish background radiation levels.

Noise

The planned work for noise data collection will be on a seasonal basis involving one two-week period in the spring or summer and a second two-week period in the fall or winter. Within each period, the program will be run continuously with sound level data collected on an hourly basis. Monitoring stations will be established to capture noise data within the Project site and surrounding area. The data will be included in the initial licence application to the CNSC, and the Impact Statement=.

Light

The planned work includes campaign-based light data collection of illuminance and sky glow. These will be conducted in the summer, during a period with no considerable light contribution from the moon, and no considerable cloud cover. One location will be used to monitor sky glow, and additional locations will be used to monitor illuminance. All locations are planned to be situated within the Project site and adjacent areas. The NWMO will perform its baseline light data collection and will confirm whether the current baseline requires updating. The data will be included in the initial licence application to the CNSC, and the Impact Statement.

Visual Environment

The NWMO considers the visual environment baseline study sufficiently complete to support the initial licence application to the CNSC, and the Impact Statement. The NWMO has no planned work to collect additional baseline data.

14.6 Groundwater and Surface Water

14.6.1 Currently Available Baseline Data

Hydrogeology and Hydrogeochemistry

The ability of water to move through rock is referred to as the rock's hydraulic conductivity or the related properties permeability or transmissivity. The term transmissivity is used herein as it is more appropriate for the crystalline rock at the Project site. The larger the transmissivity, the more easily water can move through the rock.

Transmissivity was determined through groundwater sampling collected during drilling, downhole hydraulic packer testing and geophysical logging. For groundwater samples to be collected while drilling, appreciable groundwater must be able to flow into the borehole, which is an indirect indication of groundwater velocities of the host rock at subsurface. For the boreholes drilled to date, there were only five instances below 200 m depth where groundwater was able to flow into the borehole at levels sufficient to collect groundwater samples during drilling (NWMO 2023).

The composition of groundwater samples collected from four of the deep boreholes supports the understanding that an increase in salinity with depth is a function of the reduced influence of the overall role of fractures as a connected flow path network at deeper levels in the bedrock beneath the Project site.

Packer testing was conducted in 20 m long intervals in all six boreholes, with up to 30 test intervals completed per borehole and at varying depths. Additional information on groundwater flow was also obtained from other borehole testing (i.e., geophysical logging) and from long-term pressure monitoring at discrete intervals along some of the deep boreholes (NWMO 2023).

Transmissivity results are categorized as rock mass (IG Rockmass) or hydraulically conductive features (IG HCF Figure 14.4). Average rock mass and FZ transmissivity from the University of Waterloo database (modified from Snowdon et al. 2021) are also displayed in Figure 14.4. At the potential repository depth of the Project site, the transmissivity values estimated for the rock mass

from the six deep boreholes have a median value between 10^{-13} and 10^{-10} m^2/s, decreasing with depth (Figure 14.4). These site-specific data are within the expected range of, or slightly lower than, the broader Canadian Shield data in Snowdon et al. (2021). Overall, transmissivity values estimated for the Equivalent Porous Medium rock mass at the Project site indicate the potential for low groundwater velocities. For comparison, the transmissivity of a 20 m thick layer of pure sand, which is the same as the width of the packer testing interval used at the Project site, ranges from 2×10^{-5} to 2×10^{-1} m^2/s. In other words, the estimated rock mass transmissivities at the Project site are about a million times smaller than that of sand (NWMO 2023).

In tested borehole intervals that were interpreted to represent IG HCF, the transmissivity ranged between 10^{-12} and 10^{-5} m^2/s. In these intervals the fracture intensity was usually increased and, commonly, there was presence of at least one broken (non-cohesive), sub-horizontal to gently inclined fracture close to or along the contact between the granodiorite-tonalite and a subordinate rock occurrence, such as amphibolite. These IG HCF structures have been identified as potential pathways for groundwater flow.

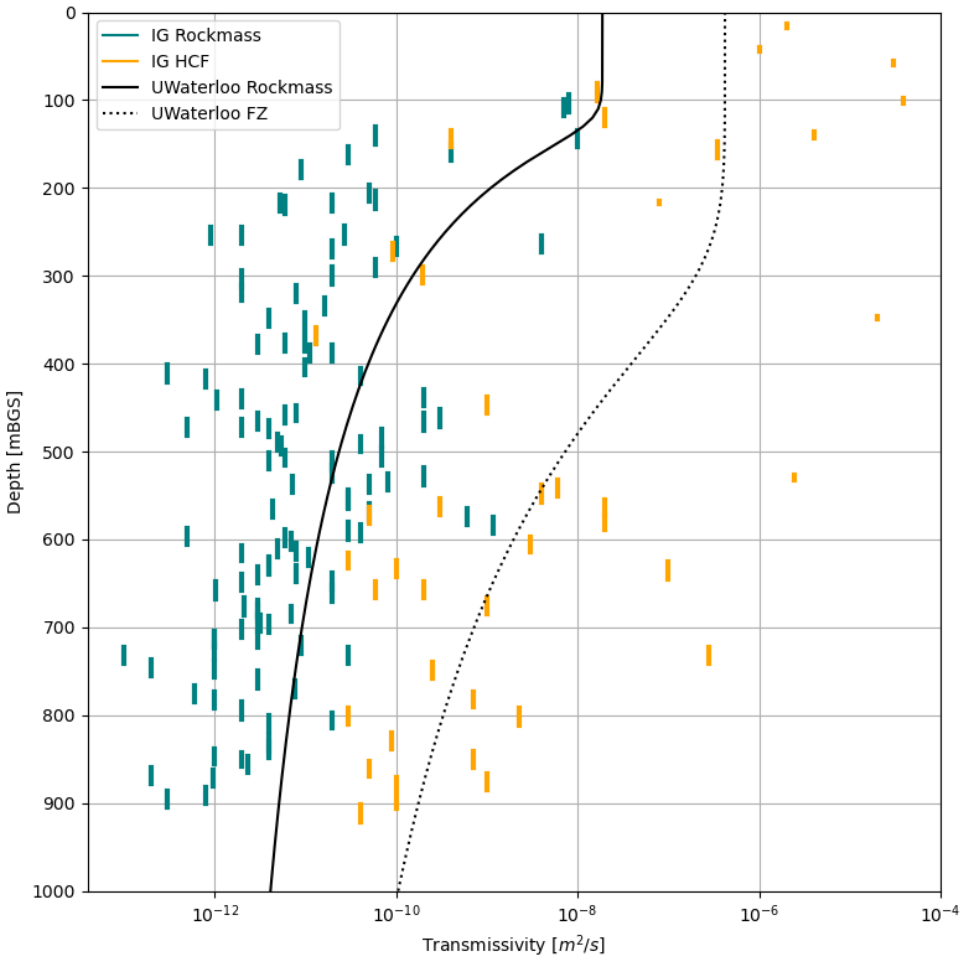


Figure 14.4: Results from Borehole Hydraulic Packer Testing, Reported as Transmissivities (m^2/s)

FZ = fracture zone; IG HCF = hydraulically conductive features; m^2/s = square metre per second; mbgs = metres below ground surface.

Following the completion of drilling and downhole testing in the boreholes, multi-level monitoring systems were installed. These systems permit long-term measurement of pressures and collection

of groundwater samples from intervals in the borehole. Preliminary interpretation of pressure distributions in these two boreholes indicate the presence of increasing groundwater fluid density at depths below approximately 600 m at the Project site, suggesting increasing salinity in the water. The presence of increasing salinity can indicate a stable hydrogeological environment at depth (Park et al. 2009). Multi-level monitoring systems have also been installed in four deep boreholes drilled at the site (NWMO 2023).

The available information provides confidence that the hydrogeological regime at depth at the Project site likely has low rates of mass transport in areas of the rock mass away from potentially flowing FZs (NWMO 2023).

Groundwater Geochemistry

Groundwater samples were collected where possible from water-bearing fractures intersecting boreholes drilled to date. Information on the geochemical composition of water at depth was also obtained from the small volumes of less mobile porewater extracted from core samples collected at different depths. The composition of the groundwater samples, and the porewater from core samples, show trends with depth that are consistent with expectations for a Canadian Shield environment. Fresh (non-saline) water conditions are encountered in a shallow hydrogeochemical zone (i.e., less than about 300 m depth). A deep hydrogeochemical zone, encountered at approximately 600 to 650 m below ground surface and equivalent to an elevation of approximately -150 to -200 m above sea level, is characterized by a higher salinity relative to the shallow hydrogeochemical zone, with increasing salinity observed toward the base of all six boreholes.

To illustrate this stratification, Figure 14.4 includes a summary of salinity (represented by chloride concentrations) from porewater and groundwater samples analyzed to date. The upper boundary of the intervening transition zone varies somewhat in depth, dependent on the borehole locations. However, the increase in salinity marking the transition into the deep hydrogeochemical zone is consistent in depth across all boreholes. This increase in salinity with depth is a function of the reduced influence of fractures as a connected flow path network at deeper levels in the bedrock beneath the Project site. The presence of increasing salinity can indicate a stable hydrogeochemical environment at depth (Park et al. 2009).

The results indicate that the shallow and deep hydrogeochemical zones contain fluids with different major ion chemistry and isotopic composition and have no direct connection. Between the shallow and deep hydrogeochemical zones is a broad transition zone, as displayed in Figure 14.5. The chemistry of the deep hydrogeochemical zone is consistent with very old water. Zone boundaries are approximate.

Although measurements of deep groundwater chemistry are limited, due to the small number of horizons with sufficient flow for groundwater sample collection, there is no evidence to date that glacial meltwater has penetrated the deep hydrogeochemical zone. In addition, from porewater samples analyzed to date for noble gas characterization, helium concentrations and isotopes in the deep hydrogeochemical zone, indicate the waters at such depths are old, with modelled porewater helium residence times in the subsurface of more than one million years.

In addition, the results from the groundwater and porewater samples that have been analyzed to date support the presence of reducing conditions (i.e., dissolved oxygen is not present) at depths below 600 to 650 m (i.e., within the deep hydrogeochemical zone).

For all groundwater samples collected to date, the total dissolved sulphide concentrations were below method detection limit (i.e., very low [NWMO 2023]).

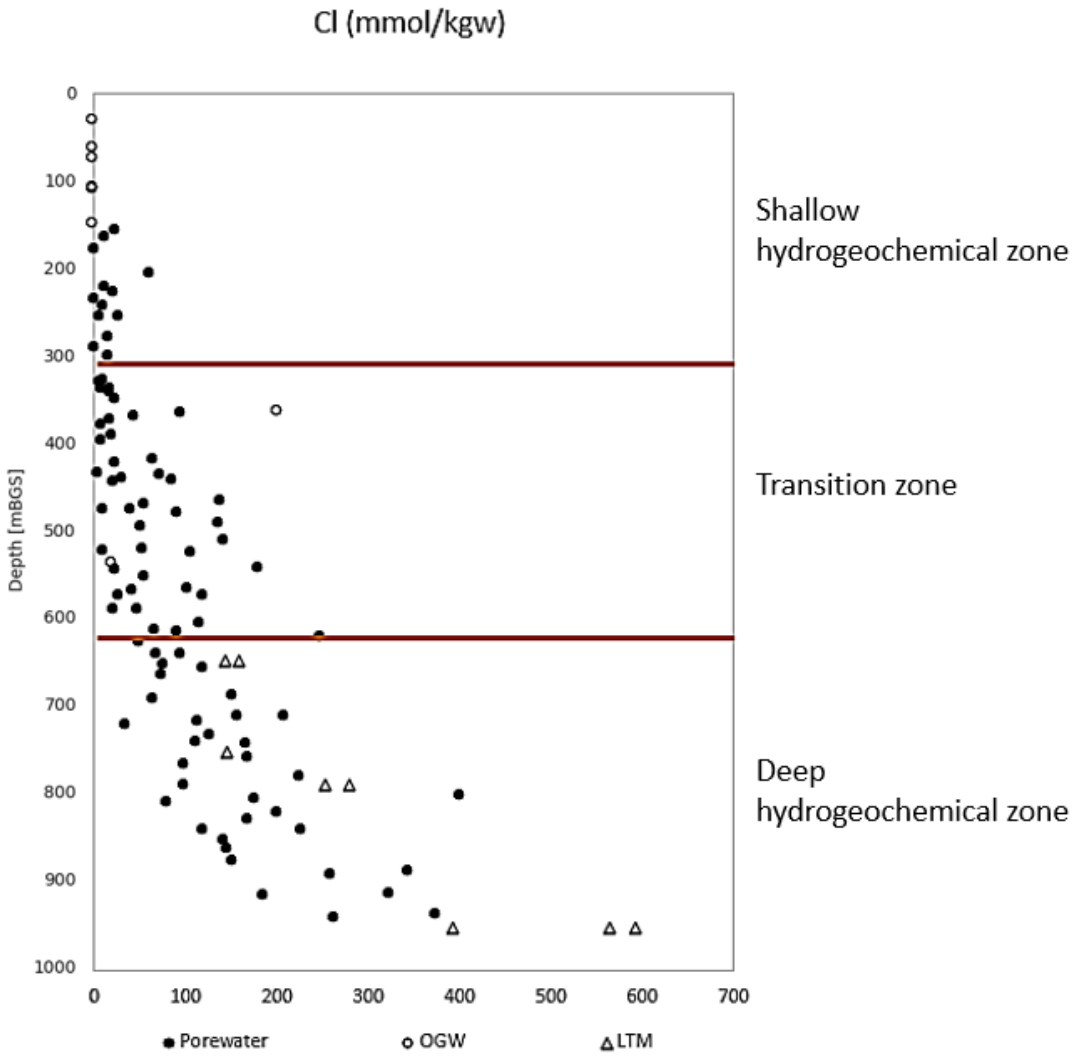


Figure 14.5: Summary of Results from Opportunistic Groundwater, Porewater, and Long-Term Monitoring Groundwater Samples

Cl = chloride; LTM = long-term monitoring; mbgs = metres below ground surface; mmol/kgw = millimoles per kilogram f water; OGW = Opportunistic Groundwater.

Groundwater Quality

A baseline groundwater investigation is in progress to obtain groundwater quality data and will be presented as part of the integrated licence application and Impact Statement.

Hydrology

The Project site lies within the Wabigoon River watershed, which drains from Raleigh Lake northwest to Wabigoon Lake. Wabigoon Lake, in turn, drains towards the Winnipeg River and the Nelson River, which outlets at Hudson Bay (CanNorth 2023). The watersheds and flow directions are displayed in Figure 14.6, and waterbodies and watercourses are displayed in Figure 14.7. The northern portion of the area displayed in Figure 14.6 contains several small, connected waterbodies that are currently unnamed. These unnamed waterbodies collectively drain into Mennin Lake, which is located approximately 2 km southwest of the Project site. Mennin Lake flows

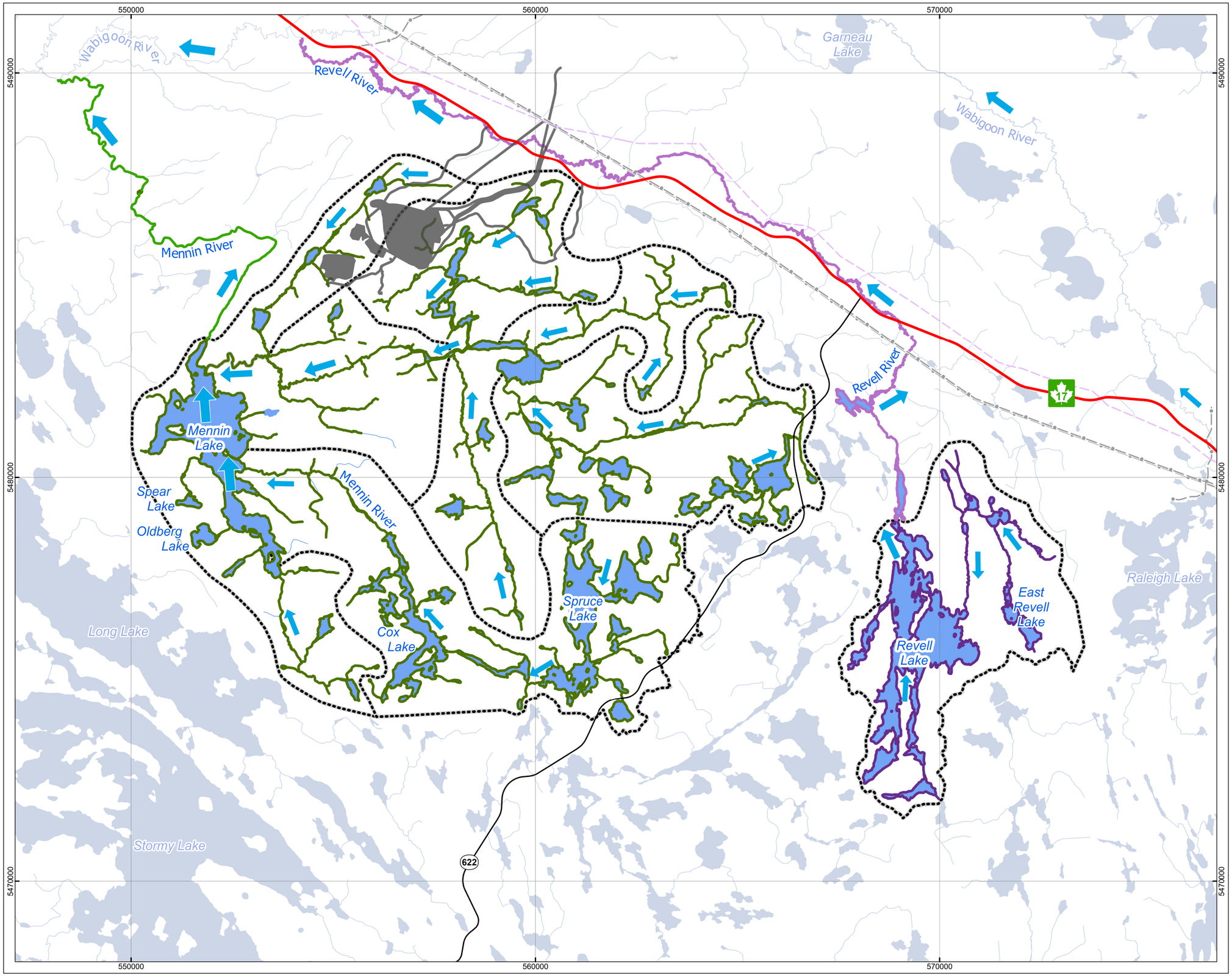
north into the Mennin River, and then northwest into the Wabigoon River. Other streams in the area appear to be intermittent based on exhibited intermittent subterranean flow (CanNorth 2023).

Aerial photos indicate there has been considerable logging within and surrounding the Project site, which will influence the local hydrology, causing more runoff due to a decrease in interception and reduced infiltration. While there is a moderate change in elevation between the lowland areas with wetlands and watercourses, it is unclear whether local flooding occurs within the Project site.

Many of the waterbodies in the Project site and surrounding area are in headwater basins that contribute flow to Mennin Lake, with water flowing generally to the southwest. Additionally, the ridge line between the Revell River and Mennin River basins crosses northwest of the Project site; both basins eventually go into Wabigoon Lake. Close to Mennin Lake, the surface topography appears to be very flat with multiple stream courses and wetlands crisscrossing the landscape. The largest rivers are the Mennin River to the southwest of the Project site and the Revell River (CanNorth 2023).

The NWMO is operating a baseline hydrology data collection program (CanNorth 2023). The program encompasses several hydrological features, including Revell Lake, Mennin Lake, eight smaller waterbodies, two large rivers and five small rivers/streams within the Mennin Lake sub-basin (Figure 14.6). In total, the program includes water level logging, discrete flow measurements, bathymetric surveys, meteorological data collection, and aerial surveys (varying among the waterbodies and features).

Water level data indicate that seasonal variation was within a reasonable range for small lakes and streams. For the Revell River, flow results were obtained and were used to establish stage-flow relationships. For Mennin River, some flow results were obtained but more are needed to establish stage-flow relationships. Bathymetry surveys were completed from July to October 2021, and results indicate that, for example, Mennin Lake and Revell Lake range from 15 to 25 m deep. Aerial surveys were completed, and their data were used to estimate the footprint and flow directions of various waterbodies (CanNorth 2023).



LEGEND

Proposed Project Infrastructure

- Proposed DGR Project Footprint

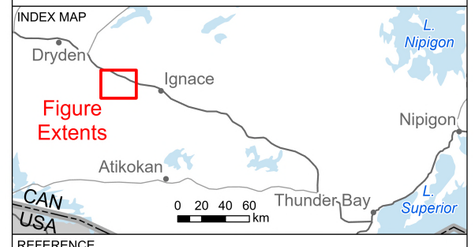
Existing Present Day Infrastructure

- Transmission Line
- Natural Gas Pipeline
- Highway 17
- Highway

- Preliminary Sub-basin
- Watercourse
- Waterbody

Drainage

- Drainage into Mennin Lake
- Drainage into Revell Lake
- Mennin River from Mennin Lake to Wabigoon River
- Revell River from Revell Lake to Wabigoon River
- Waterflow Direction



REFERENCE

Data: GEO, CanVec, CanNorth
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 15N

OCT-22-2025

0 1 2 3 4 5 km

SCALE 1:90,000

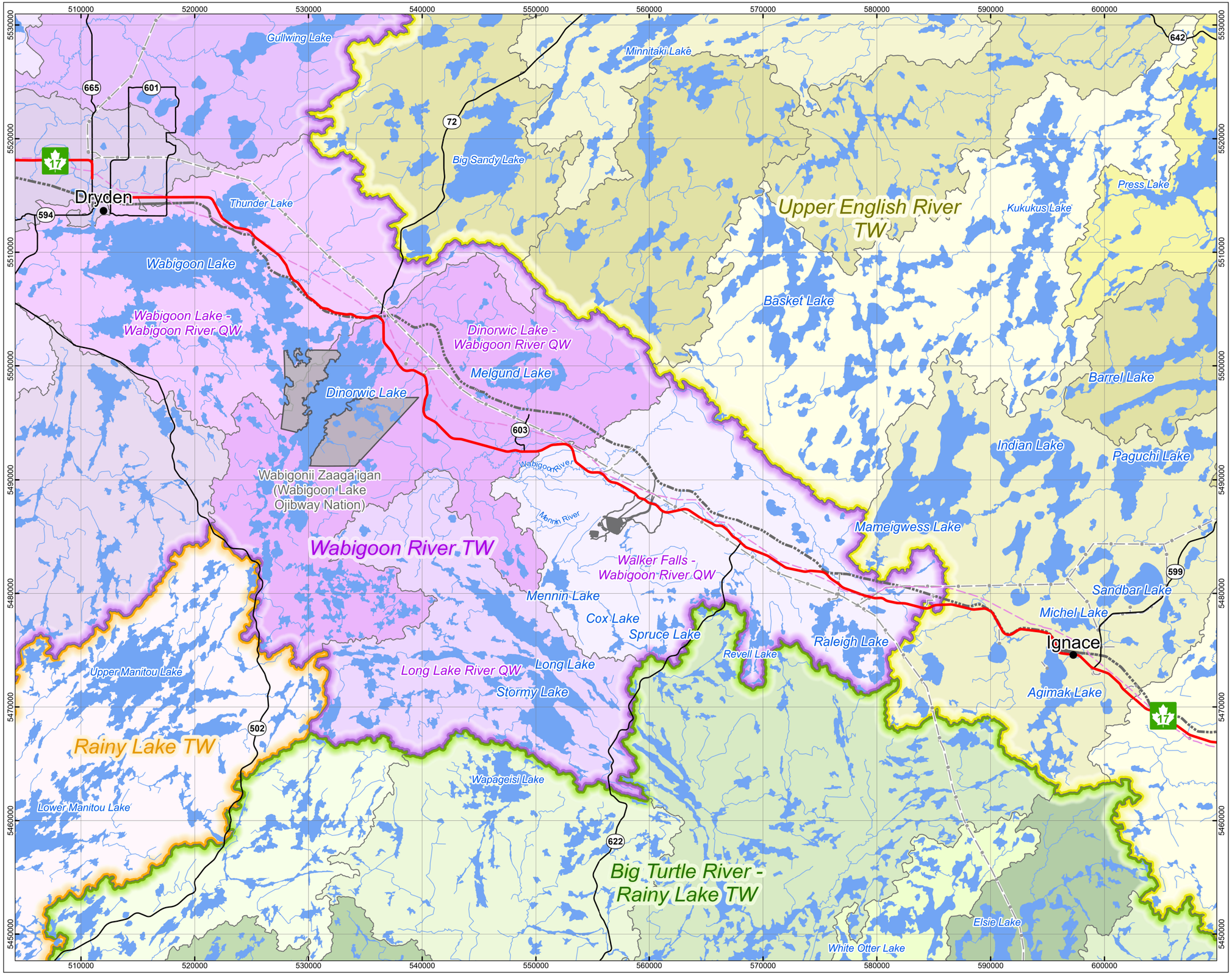
nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

TITLE

Local Watersheds and Water Flow Directions

FIGURE: 14.6



LEGEND

Proposed Project Infrastructure

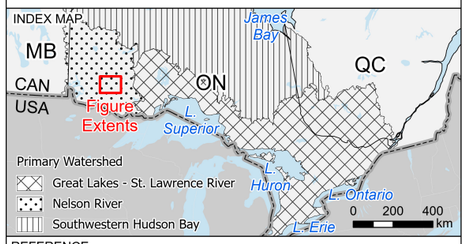
- Proposed DGR Project Footprint

Existing Present Day Infrastructure

- Transmission Line
- Natural Gas Pipeline
- Railway
- Highway 17
- Highway

Tertiary Watersheds (TW) and Quaternary Watersheds (QW)

- Wabigoon River TW
  - Wabigoon River QW
- Upper English River TW
  - Upper English River QW
- Big Turtle River TW
  - Big Turtle River QW
- Rainy Lake TW
  - Rainy Lake QW
- Community
- Wabigoon Lake Ojibway Nation
- Watercourse
- Waterbody



REFERENCE

Data: CanVec, Government of Ontario, Natural Earth, GEO, OWB, NTS
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 15N

OCT-10-2025

0 2 4 6 8 10 km

SCALE 1:320,000

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

TITLE

Watersheds, Waterbodies and Watercourses

FIGURE: 14.7

Surface Water Quality

The NWMO is collecting baseline surface water quality data on an ongoing quarterly basis. The information provided in this report stems from the quarterly data collected from July 2021 to May 2023 (CanNorth 2023). The area within and surrounding the Project site is a typical northern, forested environment with mature, undisturbed forests and few human developments nearby.

Water quality in and surrounding the Project site is normal and indicative of healthy ecosystems. All sampling sites maintained a suitable amount of dissolved oxygen for aquatic life throughout most of the water column, had a slightly acidic pH, and low to moderate water clarity. Concentrations of anions, nutrients, organics, physical properties, and radionuclides were below relevant water quality guidelines throughout the study area. Bacteriological tests for *Escherichia coli* found some samples from the Mennin and Wabigoon rivers and the Unnamed Watercourse contained concentrations that exceeded the guideline (CanNorth 2023).

The program monitored several COPCs, such as metals, organics, limnology parameters (such as dissolved oxygen, pH, conductivity), and nutrients and general chemistry parameters (such as alkalinity, total suspended solids, ammonia). Several waterbodies were sampled, including reference areas. Results indicate that COPC levels in most waterbodies were low, below, or close to the detection limits, and below applicable water quality guidelines, though phosphorus, aluminum, and copper concentrations were elevated above the guideline values in the area. Additionally, there were a few exceedances of manganese and mercury guideline values. Samples analyzed for polycyclic aromatic hydrocarbons, semi-volatile organic compounds, polychlorinated biphenyls, and herbicides and pesticides were below detection limits, with few exceptions. These results illustrate that some parameters are elevated at the p Project site and surrounding area prior to development of the Project (CanNorth 2023).

Radionuclides are discussed separately in Section 14.13.

14.6.2 Planned Work

Hydrogeology and Hydrogeochemistry

Additional baseline studies will be completed in support of the initial licence application to the CNSC and Impact Statement. Initial shallow groundwater data collection includes "nests" of three closely spaced wells to a maximum of 100 m deep at each of three locations and has now been added to the database of information available from drilling, logging, and testing of six deep (1,000 m length) boreholes. All of the shallow wells, and four of the deep boreholes, have equipment installed for long-term monitoring and interval sampling. These long-term monitoring installations will continue to provide information to support characterizing the groundwater system, including at the groundwater-surface water interface to support overall understanding of the surface water-groundwater system in the area.

An initial groundwater model for the Project site and adjacent area, using geological, hydraulic, and hydrogeochemical information from the six deep boreholes and shallow monitoring wells already installed, is planned for development in 2024–2025. Additional groundwater well "nests" will be installed at the site to support ongoing understanding of baseline environment.

Groundwater Quality

The NWMO has planned work to collect additional baseline data as part of ongoing groundwater quality data collection program. The planned work includes continued collection of groundwater quality measurements on a quarterly or monthly frequency, depending on sampling location. COPCs include general water chemistry parameters, nutrients, ions, total and dissolved metals, a suite of radionuclides (including gross alpha and gross beta), and semi-volatile organic compounds in select study areas (CanNorth 2020).

Hydrology

The hydrology baseline program will continue to collect measurements quarterly and, for select locations, monthly. The planned work includes water level measurements as well as stream and river flow measurements. Meteorological data collection relevant to hydrology will continue for the remainder of the baseline period.

Surface Water Quality

Additional planned work includes continued collection of surface water quality measurements on a quarterly or monthly frequency, depending on sampling location. COPCs include general water chemistry parameters, nutrients, ions, total and dissolved metals, parameters related to treated sewage effluent (e.g., total coliforms), a suite of radionuclides (including gross alpha and gross beta), and semi-volatile organic compounds in select study areas (CanNorth 2020).

14.7 Vegetation, Riparian and Wetland Environment

14.7.1 Currently Available Baseline Data

The NWMO is collecting baseline data, which include characterization of vegetation, riparian, and wetland environments within and surrounding the Project site. The first year of baseline results collected in 2022 are desk-based searches of available data studies and field studies conducting aquatic habitat mapping (AHM) (Zoetica 2022). The field studies conducted for AHM collected foundational habitat information relevant to the characterization of habitat for fish and other aquatic and semi-aquatic species. Foundational habitat information was collected in watercourses, waterbodies, and wetlands and included the characterization of riparian and aquatic vegetation. Environmental Deoxyribonucleic Acid (eDNA) studies were also completed in parallel to the AHM field studies to collect aquatic eDNA samples (Zoetica 2022). The eDNA studies provide information about the potential presence of a species based on DNA that is detected in water samples. It is one sampling method used alongside other sources of information to determine species presence.

The baseline results indicate the Project site and surrounding area contain many lakes of various sizes, 27 of which are larger than 10 km^2 and 10 of which are larger than 20 km^2, with about 18 percent (1,115 km^2) of the total surface area occupied by waterbodies. The Revell Batholith contains no lakes larger than approximately 5 km^2; the largest lakes on this batholith are Revell Lake (5.1 km^2) and Mennin Lake (4.9 km^2).

Some discussion of provincially and federally listed at-risk vegetation species is presented here in the context of vegetation, riparian, and wetland environments, but baseline characterization of SAR and their habitat is the focus of Section 14.11. The following paragraphs summarize the baseline results and reporting completed by Zoetica (2023), which outlines the spatial extents of areas where baseline data were collected.

Vegetation

The first year of the baseline studies focused on desk-based analyses of vegetation communities and species of interest observations, and AHM survey results from 2022. For terrestrial plants, results indicate that approximately 77 percent of the land is upland conifer forest, 10 percent is wetland (swamp), and 7 percent is wetland (fen) (other groups are each less than 1 percent of the land area). To date, two vegetation species of conservation concern (including federally and provincially listed SAR and provincially rare species; discussed separately in Section 14.11), eight species of interest to interested parties and/or rights holders, and six weedy/introduced/invasive species have been detected. In addition to habitats for special concern and rare species, candidate SWH have been identified for Sand Dunes, Rare Arctic-Alpine Plant Communities, and Diverse and Sensitive Orchid Communities within and surrounding the Project site.

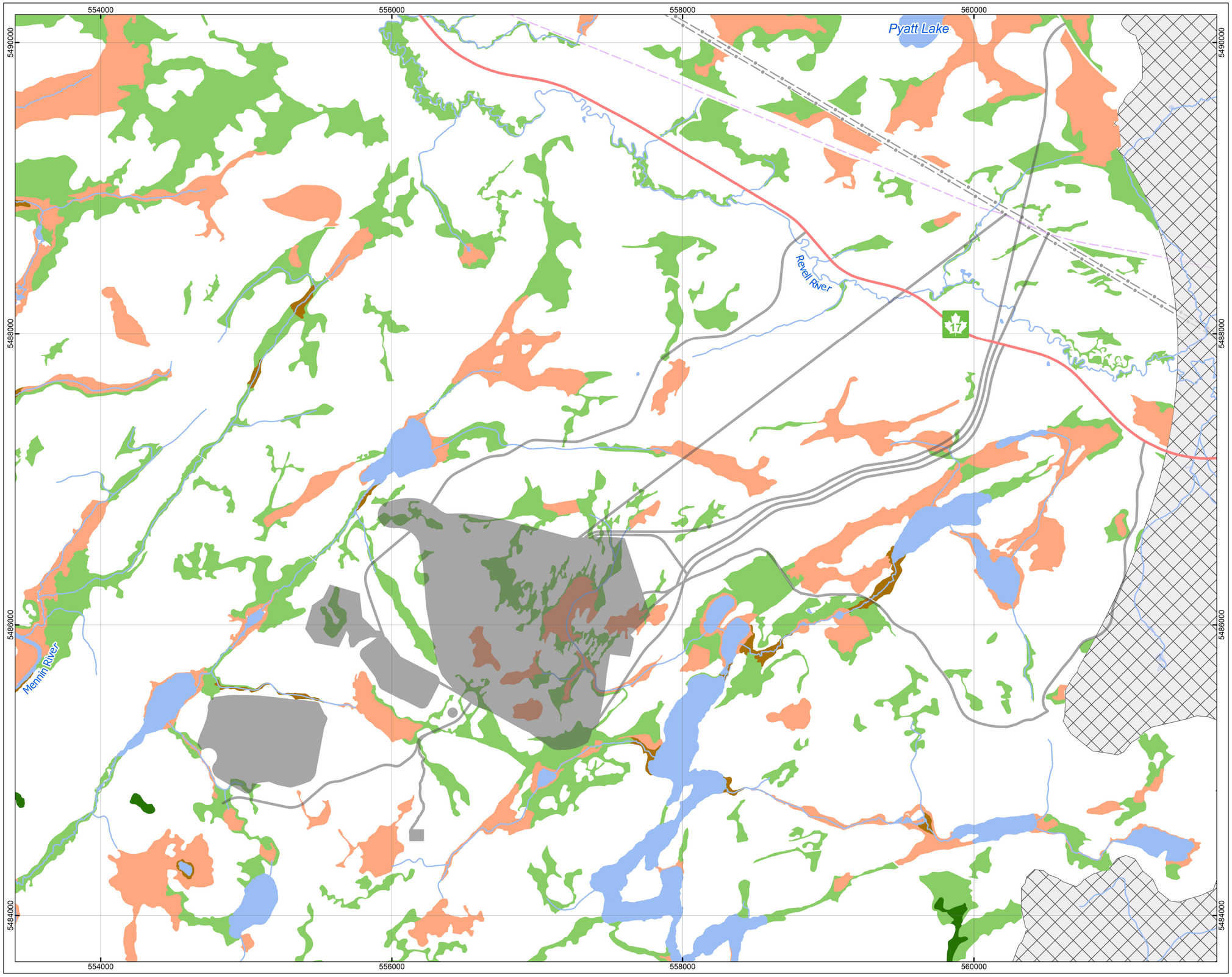
Considering species of interest to rights holders, select stands of wild rice were identified: 1 on the north shore of Mennin Lake and an additional 10 within and surrounding the Project site during AHM studies. Balsam fir and balsam poplar, valued by rights holders for its use as a traditional medicine, were both recorded within or surrounding the Project site.

Riparian and Wetland Environments

Baseline results include a summary of the major wetland types of present (marsh, swamp, fen, bog), as displayed in Figure 14.8. Swamp habitat is the most dominant wetland type and is roughly evenly distributed. Fen is the next most dominant type of wetland. Wetland bogs were rare on the landscape and marsh habitat was relatively rare at the Project site compared to the surrounding region. No provincially significant wetlands were identified within the Project site. One provincially significant wetland (Nabish Creek Wetland Complex) was found to the northeast of Wabigoon Lake. Wetlands are still abundant in the area, even where settlements occur; northern Ontario is not considered a region within Canada where wetland loss or degradation has reached critical levels. With respect to biodiversity, plant species present in the wetlands and riparian environments in the area are characteristic of northern Ontario. Additionally, mammalian aquatic feeding habitat was identified within and surrounding the Project site.

Preliminary baseline results included dominant aquatic plant species recorded through AHM surveys, and, detecting vertebrate and invertebrate wildlife through eDNA metabarcoding studies. Using these methods, 329 species have been detected to date in wetlands within and surrounding the Project site, most through eDNA metabarcoding surveys. A total of 40 vertebrate species and 276 invertebrate species were detected in wetlands during eDNA surveys. Vertebrate species detected included many species expected to use wetland habitats (e.g., moose, beaver, muskrat, northern pike walleye, yellow perch, and smaller bait fish species such as shiner). However, several vertebrate species detected were not anticipated to occur in wetlands in or surrounding the Project site. For example, the American eel (*Anguilla rostrata*), a species listed as Endangered under the Ontario *Endangered Species Act*, 2007 (Government of Ontario 2007) and designated as Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2012), was potentially detected in marsh habitat area surrounding the Project site. This species and several other fish species (e.g., fall fish) was potentially detected outside of their known distribution in Ontario.

A larger number of species were detected in marshes, followed by swamps relative to peatlands (bogs and fen). Marshes naturally contain more open water than other wetland types; thus, they may also naturally contain more aquatic species. A higher relative percent (by area) of marshes was present in the surrounding region relative to the Project site; thus, while AHM and eDNA surveys were not targeted in the surrounding region during 2022 fieldwork, it is likely that wetlands in and surrounding the Project site have lower biodiversity relative to wetland marshes in the greater surrounding region.



LEGEND

Proposed Project Infrastructure

- Proposed DGR Project Footprint

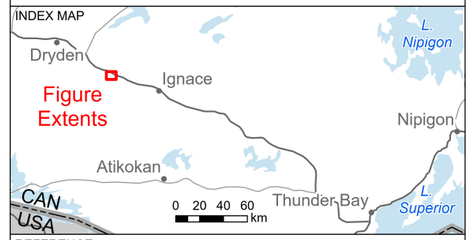
Existing Present Day Infrastructure

- Transmission Line
- Natural Gas Pipeline
- Highway 17
- Highway

Wetland Type

- Bog
- Fen
- Marsh
- Swamp
- Wetland Type Not Mapped
- Watercourse
- Waterbody

INDEX MAP



REFERENCE

Data: GEO, Government of Ontario, Natural Earth, Sumac Geomatics
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 15N

OCT-10-2025

0 0.5 1 km

SCALE 1:25,000

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

TITLE

Wetlands and Low-lying Areas

FIGURE: 14.8

14.7.2 Planned Work

Results of the vegetation, riparian and wetland baseline study completed to date indicate the need for additional data collection to support the initial licence application and IA process; however, are sufficiently advanced to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts presented in Section E of the IPD.

Future field studies planned for vegetation may include a combination of floristic inventory and intuitive meander techniques to detect rare plants, culturally important plants, and weeds, introduced, and invasive species within and surrounding the Project site. Depending on the rarity of candidate SWH ecosites, surveys for potential rare and exemplary plant communities will be conducted.

Further baseline studies will include studies which are aimed at characterizing biodiversity in wetland and riparian environments. Species that were detected through eDNA only will require further investigation (i.e., American eel). Additionally, environmental media components (water, sediment, soil) will be combined with these studies to provide a comprehensive overview of wetland and riparian environments within and surrounding the Project site.

14.8 Fish and Fish Habitat

14.8.1 Currently Available Baseline Data

Some discussion of provincially and federally listed at-risk fish species is presented here in the context of fish and fish habitat, but baseline characterization of SAR and their habitat is the focus of Section 14.11.

Baseline studies for fish and fish habitat completed in 2021 and 2022 consisted of review of desktop data and collection of field data through the AHM studies (previously described in Section 14.7.1). Desk-based research and mapping were then conducted by collating existing data from government, citizen science, and other biodiversity databases. Field studies conducted in 2021 and 2022 focused on collecting Tier 1 foundational habitat data and species detections through eDNA and incidental observations. Important fish habitat was defined as habitat required to fulfill important life history stages, including spawning, rearing, overwintering and migration between seasonally important habitat. The following paragraphs summarize the baseline results and reporting for the Project site and surrounding area completed (Zoetica 2023), which outlines the spatial extents of areas where baseline data were collected. Baseline data were collected from two spatial areas: the local and regional investigation areas. The local investigation area includes Mennin Lake and numerous watercourses and smaller waterbodies proximal to the Project site. The regional investigation area is encompassed within the Wabigoon River tertiary watershed and composed of four quaternary watersheds.

Baseline study to date has found a total of 55 fish species that have been detected in the regional investigation area through desktop review and eDNA metabarcoding studies. A total of 26 species were detected through eDNA metabarcoding studies, though future ground-truthing studies will be required to confirm the eDNA detections. In general, a greater richness of fish species was reported in larger lakes in the regional investigation area compared to the local investigation area and in the smaller lakes. Examples of species include White Sucker *(Catostomus commersonii)*, Bluegill *(Lepomis macrochirus)*, Northern Pike *(Esox lucius)*, Yellow Perch *(Perca flavescens)*, and Walleye *(Sander vitreus)*.

The watercourses and waterbodies in the Wabigoon Tertiary Watershed are displayed in Figure 14.7, where the regional area is located, support a wide variety of fish species and trophic positions requiring differing habitats. Several important fish habitats, including spawning and nursery areas of various species, were documented within the surrounding region. At this time of study, no potentially important fish habitat (i.e., required to fulfill important life stages of fish species) has been documented within or surrounding the Project site.

Watercourse Habitat

Desktop review indicates the presence of walleye spawning areas in smaller tributaries to Dinorwic and Wabigoon Lakes, Peak Lake and on the Wabigoon River at the confluence with Mennin River, as displayed in Figure 14.7. White sucker spawning areas have similarly been documented in several small tributaries of Dinorwic and Wabigoon Lakes and several locations along the Wabigoon River. During AHM surveys conducted in 2022, two additional potential spawning areas were reported. One was a potential spawning site for Northern Pike and perhaps walleye; this site was located at the outlet of an unnamed lake in the local investigation area. The other potential spawning area recorded was noted as a possible spawning site for spring-spawning fish; this site was located at the outlet of Revell Lake.

During desk-based searches of fish habitat a walleye nursery area was noted in the Wabigoon River, within an area surrounded by wetland habitat near the confluence of the Wabigoon River and Dinorwic Lake. No additional rearing habitat was reported during AHM surveys conducted in 2022. However, shoreline and in-water habitat were recorded along reaches of the Mennin, Revell, and Wabigoon rivers, as well as smaller unnamed watercourses in the local investigation area. A search of existing databases revealed no overwintering habitat within watercourses in the local investigation area. During AHM field studies conducted in 2022, two deep pools were identified on the Revell River within the regional investigation area. These pools were deemed to be refuge habitat for fish but may also serve as overwintering habitat for smaller species of fish.

No migratory watercourse habitat has been documented in existing databases or reported during 2021 field studies in the investigation areas. However, barrier identification was conducted. The detection of fish barriers and obstacles can help elucidate potential migratory limitations to fish. A search of existing datasets revealed that many beaver dams have been reported in the regional investigation area and could be potential barriers or obstacles to fish passage. Other types of potential barriers were also reviewed. Two additional potential barriers to fish were identified as river rapids northwest of the Project site on the Mennin River. Additional river rapids were also located further upstream along the Mennin and Revell rivers. Several other barriers to fish passage were identified on the Wabigoon River between the confluence with the Revell River and the confluence with the Mennin River. In addition to natural potential barriers, several man-made dams were noted in the northern portion of the regional investigation area and east of Thunder Lake. During AHM field studies conducted in 2022, a total of 18 potential barriers to fish movement and 38 obstacles were detected in the regional investigation area. Four potential barriers and seven obstacles were detected within and proximal to the Project site. All four barriers were beaver dams located on streams connecting waterbodies, and the majority of the seven obstacles were also primarily beaver dams. However, one obstacle had a large amount of debris potentially obscuring fish passage, and one wetland was deemed a potential obstacle for fish passage during low flow periods. Within the regional and local investigation areas, barriers and obstacles were detected on the Revell and Mennin Rivers and in several smaller waterbodies and wetlands and most were beaver dams.

Lake and Pond Habitat

Desk-based searches of existing datasets revealed no documented lacustrine spawning areas within the local investigation area but several spawning areas in lakes in the regional investigation area. Lake trout spawning areas are located in Long Lake, Stormy Lake, and Washeibemaga Lake, southwest of the Project site in Raleigh Lake, southeast of the Project site. Northern Pike,

Muskellunge and Walleye spawning areas have also been documented primarily in the northwest of the Project site in Dinorwic and Wabigoon Lakes and small lakes connected to these lakes. Walleye spawning areas have also been documented on Peak Lake. Lake whitefish spawning areas have been documented in Thunder Lake, Wabigoon Lake, Long Lake, Washeibemaga Lake, and several small lakes west and southwest of the Project site. A single Smallmouth Bass spawning area was identified in Peak Lake. No additional lacustrine spawning areas were reported during AHM surveys conducted in waterbodies in the investigation areas.

To date, no rearing or overwintering habitat has been identified through desk-based searches of existing information or during AHM surveys in any of the ponds and lakes within the investigation areas. However, during AHM surveys, shoreline and in-water habitat were recorded at sites surveyed in waterbodies in the investigation areas.

Wetland Habitat

To date, no spawning, rearing or overwintering habitat has been identified through desk-based searches of existing information or during AHM surveys in any of the wetlands within the investigation areas. Additional surveys will help determine the potential for spring-spawning fish, such as Northern Pike, to use wetlands for these purposes within and surrounding the Project site.

14.8.2 Planned Work

Results of the fish and fish habitat baseline study completed to date indicate the need for additional data collection to support fisheries authorizations and approvals; however, studies completed to date are considered sufficiently comprehensive to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts presented in Section E of the IPD.

The planned work includes fish community surveys and benthic invertebrate studies. Future fish characterization studies will be required to confirm the presence of important habitat for fish detected through AHM surveys within and proximal to the Project site and could potentially be used to identify additional important habitats. Once more is known about the fish community, information gathered for primary and secondary producers will be used to understand and characterize food web interactions within these study areas. The results of planned work will be submitted in support of the initial licence application to the CNSC and the Impact Statement.

14.9 Birds, Migratory Birds and their Habitat

14.9.1 Currently Available Baseline Data

The NWMO's baseline data collection program includes studying birds and bird habitat within and surrounding the Project site. The 2021-2022 baseline results are based on desktop terrestrial and aquatic ecosystem mapping, habitat suitability modelling, and eDNA sampling. Population trends were also analyzed for select species.

Some discussion of provincially and federally listed at-risk bird species is SAR, and their habitat is the focus of Section 14.11.

The following paragraphs summarize the baseline results and reporting completed, which outlines the spatial extents of areas where baseline data were collected (Zoetica 2023). A list of bird species with ranges that overlap the Project site is displayed in Table 14.6, which signifies species that are protected under the *Migratory Birds Convention Act, 1994* (Government of Canada 1994), *Migratory Bird Regulations* and the provincial *Endangered Species Act* (Government of Ontario 2007) and federal *Species at Risk Act* (SARA).

In the context of bird baseline data, "detected" refers to environmental components identified through multiple sources, including review of existing biodiversity databases, earlier field investigations in the WLON-Ignace siting area, Tier 1 eDNA metabarcoding studies, and observations made during Tier 1 (habitat mapping) field surveys. Therefore, detections were not limited to confirmations from field studies but also included records from background data sources and prior investigations.

Upland Breeding Birds

A total of 64 upland breeding bird species were detected, including 10 SAR species: barn swallow (*Hirundo rustica*), Canada warbler (*Cardellina canadensis*), evening grosbeak (Coccothraustes vespertinus), red-headed woodpecker (*Melanerpes erythrocephalus*), common nighthawk (*Chordeiles minor)*, eastern whip-poor-will (*Antrostomus vociferus*), eastern wood-pewee (*Contopus virens*), olive-sided flycatcher (*Contopus cooperi*). In addition to habitats for three of these SAR upland breeding bird species (olive-sided flycatcher, common nighthawk, eastern wood-pewee), candidate SWH has been identified for colonially nesting bird breeding habitat (tree/shrubs and ground), marsh bird breeding habitat, and seeps and springs (which may be used by grouse species). There are currently no designated protected areas for migratory birds and no critical habitat—i.e., habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species (SARA [Government of Canada 2002b]) for eastern whip-poor-will within and surrounding the Project site. Additionally, 59 of the 64 bird species are protected under the *Migratory Birds Convention Act, 1994* (MBCA), and one of these species is also afforded protection of empty nests under the *Migratory Bird Regulations*: pileated woodpecker (*Dryocopus pileatus*).

Shorebirds

Three shorebird species (spotted sandpiper, Wilson's snipe, lesser yellowlegs) were detected, which are both protected under the MBCA. Candidate SWH has been identified for Marsh Bird Breeding Habitat (which is relevant to spotted sandpiper) within the Project site. The lesser yellowlegs is designated as Threatened in Canada by the Committee on the Status of Endangered Wildlife in Canada as of 2020, and has been listed as a threatened species in Ontario since 2023. Neither of the spotted sandpiper or Wilson's snipe are species at risk or provincially rare; however, both are considered priority species according to ECCC's bird conservation strategy for the region (EC 2014). No shorebird species were detected via eDNA studies to date, though interpretation is difficult due to the limited data available at this time.

Waterbirds

Ten waterbird species, including American bittern (*Botaurus lentiginosus*), Canada goose (*Branta canadensis*), common loon (*Gavia immer*), hooded merganser, mallard (*Anas platyrhynchos*), ring-necked duck (*Aythya collaris*), sandhill crane (*Antigone canadensis*), sora, wood duck, and American white pelican (*Pelecanus erythrorhynchos*) were detected. The American white pelican is not act risk federally but Threatened in Ontario. None of the other species are at risk or provincially rare; however, all are protected under the MBCA, and seven species, including American white pelican, mallard, Canada goose, ring-necked duck, sandhill crane, hooded merganser, and wood duck are considered priority species in ECCC's bird conservation strategy for the region (EC 2014). Candidate SWH has been identified for wild rice stand, waterfowl stopover and staging area (aquatic), waterfowl nesting area, colonially nesting bird breeding habitat (tree/shrubs), and marsh bird breeding. The wild rice stand identified on the north shore of Mennin Lake may be important as a food supply for both waterbirds and local community members. Despite birds not being the focus of eDNA studies completed to date, metabarcoding analyses revealed the presence of three waterbird species within the Project site or surrounding area – hooded merganser, wood duck, and sora – that had not previously been reported.

Raptors

Seven raptor species have been detected, including one SAR, bald eagle (*Haliaeetus leucocephalus*) and two other priority species, American kestrel (*Falco sparverius*), and broad-winged hawk (*Buteo platypterus*), as identified by the ECCC's bird conservation strategy for the region (EC 2014), and by the Ontario Breeding Bird Atlas. Candidate SWH has been identified for eagle and osprey concentration area, bald eagle and osprey nesting habitat (which also includes habitat for a raptor species of Special Concern), and woodland raptor nesting habitat.

A summary of birds detected within and surrounding the Project site is presented in Table 14.6.

Table 14.6: Birds Detected Within and Surrounding the Project Site

Upland Breeding Birds	
Alder flycatcher *(Empidonax alnorum)**	Magnolia warbler *(Setophaga magnolia)**
American crow (*Corvus brachyrhynchos*)	Mourning warbler *(Geothlypis philadelphia)**
American redstart *(Setophaga ruticilla)* *	Nashville warbler *(Leiothlypis ruficapilla)**
American robin *(Turdus migratorius)**	Northern flicker *(Colaptes auratus)**
Barn swallow (*Hirundo rustica*)* ***	Northern parula *(Setophaga americana)**
Black-and-white warbler *(Mniotilta varia)**	Northern waterthrush *(Parkesia noveboracensis)**
Black-capped chickadee *(Poecile atricapillus)**	Olive-sided flycatcher *(Contopus cooperi)**,***
Black-throated green warbler *(Setophaga virens)**	Ovenbird *(Seiurus aurocapilla)**
Blue jay (*Cyanocitta cristata*)	Palm warbler *(Setophaga palmarum)**
Blue-headed vireo *(Vireo solitarius)**	Pileated woodpecker *(Dryocopus pileatus)**,**
Brown creeper *(Certhia americana)**	Pine siskin *(Spinus pinus)**
Canada jay (*Perisoreus canadensis*)	Purple finch *(Haemorhous purpureus)**
Canada warbler (*Cardellina canadensis*)* ***	Red-bellied woodpecker *(Melanerpes carolinus)**
Cedar waxwing *(Bombycilla cedrorum)**	Red-breasted nuthatch *(Sitta canadensis)**
Chestnut-sided warbler *(Setophaga pensylvanica)**	Red-eyed vireo *(Vireo olivaceus)**
Chipping sparrow *(Spizella passerina)**	Red-headed woodpecker (*Melanerpes erythrocephalus*)* ***
Clay-colored sparrow *(Spizella pallida)**	Rose-breasted grosbeak *(Pheucticus ludovicianus)**
Common grackle (*Quiscalus quiscula*)	Ruby-crowned kinglet *(Corthylio calendula)**
Common nighthawk *(Chordeiles minor)** ***	Ruby-throated hummingbird *(Archilochus colubris)**
Common yellowthroat *(Geothlypis trichas)**	Ruffed grouse (*Bonasa umbellus*)
Connecticut warbler *(Oporornis agilis)**	Song sparrow *(Melospiza melodia)**
Dark-eyed junco *(Junco hyemalis)**	Swainson's thrush *(Catharus ustulatus)**
Downy woodpecker *(Dryobates pubescens)**	Swamp sparrow *(Melospiza georgiana)**
Eastern whip-poor-will *(Antrostomus vociferus)** ***	Tennessee warbler *(Leiothlypis peregrina)**
Eastern wood-pewee *(Contopus virens)** ***	Veery *(Catharus fuscescens)**
Evening grosbeak (*Coccothraustes vespertinus*)*	White-throated sparrow *(Zonotrichia albicollis)**
Fox sparrow *(Passerella iliaca)**	White-winged crossbill *(Loxia leucoptera)**
Golden-crowned kinglet *(Regulus satrapa)**	Winter wren *(Troglodytes hiemalis)**
Hairy woodpecker *(Dryobates villosus)**	Yellow-bellied flycatcher *(Empidonax flaviventris)**
Hermit thrush *(Catharus guttatus)**	Yellow-bellied sapsucker *(Sphyrapicus varius)**

Upland Breeding Birds	
Least flycatcher *(Empidonax minimus)**	Yellow-rumped warbler *(Setophaga coronata)**
Lincoln's sparrow *(Melospiza lincolnii)**	
Shore Birds	
Spotted sandpiper (*Actitis macularius*)*	Wilson's snipe (*Gallinago delicata*)*
Lesser yellowlegs (*Tringa flavipes*)* ***	
Waterbirds	
American bittern *(Botaurus lentiginosus)**	Mallard *(Anas platyrhynchos)**
American white pelican (*Pelecanus erythrorhynchos)**	Ring-necked duck *(Aythya collaris)**
Canada goose *(Branta canadensis)**	Sandhill crane *(Antigone canadensis)**
Common loon *(Gavia immer)**	Sora *(Porzana carolina)**
Hooded merganser *(Lophodytes cucullatus)**	Wood duck *(Aix sponsa)**
Raptors	
American kestrel (*Falco sparverius*)	Common raven (*Corvus corax*)
Bald eagle (*Haliaeetus leucocephalus*) ***	Red-tailed hawk (*Buteo jamaicensis*)
Broad-winged hawk (*Buteo platypterus*)	Turkey vulture (*Cathartes aura*)
Golden eagle (*Aquila chrysaetos*)*	

Notes:
* denotes bird species that are protected under the MBCA.
** denotes bird species that are afforded empty nest protection under the *Migratory Bird Regulations.*
*** denotes bird species that are protected under the SARA.

14.9.2 Planned Work

Results of the bird and bird habitat baseline study completed to date indicate the need for additional data collection to support additional work permits and authorizations; however, they are considered sufficiently comprehensive support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts to presented in Section E. Future studies aim to provide a more thorough characterization of migratory bird, upland breeding bird, waterbird, and raptor communities within and surrounding the Project site. Community-level studies will enable estimates of relative abundance and seasonal habitat use (including migratory stop over areas) and provide insight into food webs and tropic linkages. Study methods for upland breeding birds may include point count surveys, nightjar acoustic surveys, autonomous song meters, eastern whip-poor-will surveys (an established SAR protocol; MNRF 2014), and surveys for sharp-tailed grouse leks (dancing grounds for courtship displays), if needed. Waterbird communities study methods may include call playback surveys for secretive marsh birds during the breeding season, and observation stations during spring migration, breeding period, and fall migration. Study methods for raptor communities may include helicopter nest surveys for conspicuous raptors, call playback surveys for woodland raptors, transect surveys for open habitat raptors, and autonomous song meters to detect owls and other species. Based on these initial field studies, call playback for owls and ground nest searches can be conducted to identify breeding territories and/or nests.

14.10 Terrestrial Wildlife and Wildlife Habitat

14.10.1 Currently Available Baseline Data

The NWMO is currently collecting baseline data for the characterization of terrestrial wildlife and habitat. Data from the first year are based on desktop information and select field aspects. Information is presented for the following wildlife groups within and surrounding the Project site:

- ungulates (i.e., moose)
- carnivores
- small terrestrial mammals
- semi-aquatic mammals
- bats
- herpetofauna
- terrestrial invertebrates
- terrestrial vegetation (discussed in Section 14.7)

Some discussion of provincially and federally listed at-risk species is presented here in the context of terrestrial wildlife and habitat, but baseline characterization of SAR and their habitat is the focus of Section 14.11.

The following paragraphs summarize the baseline results and reporting completed (Zoetica, 2023), which outlines the spatial extents of areas where baseline data were collected.

Ungulates

Ungulate species in northwestern Ontario have historically included moose (*Alces alces*), white-tailed deer (*Odocoileus virginianus*), and woodland caribou (*Rangifer tarandus*) (Zoetica 2023). While native to Ontario's northern forests, woodland caribou range has decreased significantly (ECCC 2020a), and the nearest woodland caribou range (Churchill range) is approximately 61 km north of the Project site. Feral hogs (*Sus scrofa*), also known as wild pigs, are an invasive ungulate species, thus are a conservation concern (MNDMNRF 2021a). However, an Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry report from 2021 states that there is no evidence of a self-sustaining feral hog population in mainland Ontario (MNDMNRF 2021b).

Due to their First Nation and community importance, moose are the only ungulate that have been studied further in the baseline studies. Baseline studies to date have focused on the identification of SWH for moose within the Project site and an approximately 30 km radius surrounding it and have confirmed SWHs for moose aquatic feeding area. Candidate SWH has been identified for seeps and springs, and mineral licks. Moose use aquatic feeding areas and mineral licks in different parts of the year—moose aquatic feeding areas are generally used by moose in early summer (mid-June to mid-July) and mineral licks year-round, with more frequent use in late spring and mid-winter (Fraser et al*.,* 1984; Rea et al*.,* 2004). Therefore, SWH for moose are sensitive to disturbance at different times of the year. Long-term moose population trend analyses indicate that estimated moose densities fluctuated widely, there was evidence of a decline in calf:cow ratios, and there was no trend in bull:cow ratios over multi-decadal periods within and surrounding the Project site (Zoetica 2023).

Aerial surveys were also conducted for moose and analysis of these surveys estimated a moderate density of moose (25.7/km^2) within an approximately 30 km area surrounding (and including) the Project site. While the long-term trend analysis did not directly analyze overall moose densities across time, moose densities are in decline across Canada, emphasizing the importance of monitoring their populations and demographics (Ranta and Lankester 2017; Kuzyk et al., 2018; Arsenault et al*.* 2019). In addition to the decline in calf:cow ratios detected in the long-term trend analysis; the aerial survey analysis also calculated a calf:cow ratio that is considered to be low.

The cause for the low ratio cannot be determined from current evidence, but these estimates could indicate low birth rates, high calf mortality, or can be an artifact of small sample size. Over time, a low calf:cow ratio can affect overall population size if fewer moose are being added to the adult age classes.

Carnivores

Based on current range distributions, 14 terrestrial carnivore species potentially occur within the Project site and an approximately 25 km radius surrounding it. These include coyote (*Canis latrans*), northern gray wolf (*Canis lupus occidentalis*), wolverine (*Gulo gulo*), Canada lynx (*Lynx canadensis*), bobcat (*Lynx rufus*), American marten (*Martes americana*), ermine (*Mustela erminea*), long-tailed weasel (*Mustela frenata*), least weasel (*Mustela nivalis*), fisher (*Pekania pennanti*), cougar (*Puma concolor*), American badger (Taxidea taxus), gray fox (*Urocyon cinereoargenteus*), black bear (*Ursus americanus*), and red fox (*Vulpes vulpes*). Of these, three are designated as provincially and federally at risk: wolverine, gray fox, and American badger (northwestern Ontario population). Of these four listed carnivore species, only the cougar was detected to date, and eDNA analysis showed evidence of wolf presence. No species of conservation concern (provincial or federal SAR and provincially rare species) were detected with eDNA.

Candidate SWH has been identified within and surrounding the Project site for mammal denning sites, and seeps and springs. Specific requirements for mammal denning sites vary by species; seeps and springs are areas important for feeding and drinking and are SWH for both moose and black bears.

Small Terrestrial Mammals

Based on current range distributions, 29 small-to-medium-sized terrestrial mammal species could potentially occur within the Project site and an approximately 2 km radius surrounding it. These include, for example, the northern short-tailed shrew (*Blarina brevicauda*), common porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), eastern chipmunk (*Tamias striatus*), and common raccoon (*Procyon lotor*), among others. None of the small terrestrial mammals are provincially or federally listed as SAR. eDNA detected 13 small terrestrial mammal species, some of which have barcode gaps for the primers used, thereby improving confidence in the results. eDNA results suggest the presence of northern flying squirrel (*Glaucomys sabrinus*), a cryptic and nocturnal species that is difficult to detect. The detection of the northern flying squirrel genus adds strength to undertaking habitat suitability modelling for this species.

Semi-Aquatic Mammals

Based on current range distributions, five semi-aquatic mammals could potentially occur within the Project site and an approximately 10 km radius surrounding it. These include American beaver (*Castor canadensis*), northern river otter (*Lontra canadensis*), American mink (*Neovison vison*), muskrat (*Ondatra zibethicus*), and American water shrew (*Sorex palustris*). None of these are provincially or federally listed as SAR. eDNA analysis showed evidence of widespread distribution of beaver and muskrat within and surrounding the Project site, in all types of aquatic habitats.

Bats

Based on current range distributions and preliminary acoustic studies, six bat species occur or potentially occur within the Project site and an approximately 6 km radius surrounding it. These include big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), little brown myotis (*Myotis lucifugus*), and northern myotis (*Myotis septentrionalis*). Of these, all except big brown bat are designated as provincially and/or federally endangered (SAR). Silver-haired bat, eastern red bat, and hoary bat have recently been provincially uplisted, but are not federally listed. eDNA did not detect bat species, but preliminary results from an acoustic study detected several bat species,

including little brown myotis, which is a SAR. Candidate SWH have been identified for Bat Maternity Colony and Bat Hibernaculum.

Herpetofauna—Amphibians

Seven amphibian species have been detected within the Project site and an approximately 2 km radius surrounding it, based on desk and field-based investigations conducted to date. No amphibian species of conservation concern have been observed (nor are they expected). Two species detected via the 2021 field study eDNA analyses had not been previously reported in the Project site. These newly detected species (eastern newt (*Notophthalmus viridescens*) and eastern red-backed salamander (*Plethodon cinereus*) are non-vocal and hence more cryptic in nature. Salamanders, in contrast to frogs and toads, were unlikely to be recorded by song meters used in previous studies to record birds and calling amphibians. These results highlight the complementary nature of using eDNA and metabarcoding early on in the field data collection.

Candidate SWH have been identified for amphibian breeding habitat, and seeps and springs within and surrounding the Project site.

Herpetofauna—Reptiles

To date, no reptile species have been detected within the Project site and an approximately 2 km radius surrounding it. However, candidate SWH has been identified for Turtle Wintering Area, Turtle Nesting Area, and Snake Hibernaculum within this area. Previous NWMO environmental studies carried out within a larger regional investigation area did not directly observe snapping turtles (*Chelydra serpentina*) or "prime nesting habitat"; however, their findings indicate that there is high potential for snapping turtle presence (Tulloch 2018a,b). In addition, no reptiles were detected through eDNA studies performed in the first year of data collection, despite the focus on aquatic and semi-aquatic vertebrates (e.g., fish, amphibians, turtles). Environmental DNA metabarcoding analyses for reptiles may not have been fully optimized in 2021 and more species and/or species detections will likely be identified as the baseline program progresses.

Terrestrial Invertebrates

Information available to date is comprised of desk-based analyses of terrestrial invertebrate-related SWH, species of interest observations, and eDNA sampling results from 2021 within the Project site and an approximately 2 km radius surrounding it. Complete results from desktop and field terrestrial habitat assessments and incidental observations, along with the results of any further studies that may be conducted, will be reported in the future. To date, the only records of terrestrial invertebrate species of conservation concern within or surrounding the Project site are based on Global Biodiversity Information Facility data from the 1980s (GBIF 2021).

Data from Ontario's annual forest health monitoring program show that jack pine budworm (*Choristoneura pinus*) is the major forest disturbance factor in the Dryden District and could be impacting merchantable timber and other ecosystem functions and services within the area (MNDMNRF 2021c).

Community concerns regarding wood ticks were primarily human health-related, as ticks can carry bacterial pathogens (CDC 2019). Analyses of passive tick surveillance data and models of climate change impacts suggest that American dog tick (*Dermacentor variabilis)*, a species detected through eDNA sampling, is expanding its range in Ontario due to changes in suitable climate and habitat for the species, as well as changes in host distribution and abundance (e.g., white-tailed deer) (Minigan et al. 2018; Nelder et al. 2022). Conceptual Project-related effect pathways have not identified a potential link between the Project and tick distribution, abundance, or transmission. Hence, for the baseline data collection program, winter ticks are being considered as one of the existing stressors for ungulates in the region rather than being studied as a biodiversity value.

Monarch butterflies (*Danaus plexippus*) could be present and are listed as federally Endangered.

14.10.2 Planned Work

Results of the terrestrial wildlife and wildlife habitat baseline study completed to date indicate the need for additional data collection to support the initial licence application to the CNSC, and the IA process; however, studies conducted to date are sufficient to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts to presented in Section E.

Future studies for ungulates will aim to provide a more thorough characterization of moose population health within and surrounding the Project site. Additional population-level studies may be designed based on results and needs identified from previous studies. Planned work for any terrestrial SAR is provided in Section 14.11.

Future carnivore studies may include general community surveys for carnivores and on select, regionally important carnivore populations as warranted (e.g., if a SAR carnivore is detected during community surveys, and important/suitable habitat for that species is detected in or proximal to the Project site). Studies proposed will aim to detect a wider variety of carnivores that inhabit areas within the surrounding region to aid in the community characterization.

Future studies for small terrestrial mammals may focus on population-level studies of local snowshoe hares and potentially other small terrestrial mammals and/or key supporting habitat features (e.g., mast trees) for species of interest.

For semi-aquatic mammals, future years of study will focus on determining the numbers and locations of beavers in a biodiversity value-specific study area, and their role in the effects of ecosystem services and function, and possibly additional semi-aquatic mammal species, where warranted. Baseline studies conducted in future years will provide additional characterization of semi-aquatic mammal biodiversity within and surrounding the Project site.

Future years of study aim to provide a more thorough characterization of bat community composition within and surrounding the Project site and may include using techniques such as acoustic surveys, identification of roost and maternity colony trees, exit surveys for hibernacula and roost trees, and incidental observations.

Future studies on herpetofauna aim to provide a more thorough characterization of amphibian and reptile biodiversity within and surrounding the Project site.

Future field studies for terrestrial invertebrates are to be determined. Study methods include targeted surveys for species of interest pending the results of previous studies. Further discussions with local people, Indigenous community members, the regulator, and other provincial and federal agencies are needed to inform the preferred study approach(es) for other studies.

14.11 Species at Risk and their Habitat

14.11.1 Currently Available Baseline Data

The NWMO is currently operating a baseline data collection and characterization program within and surrounding the Project site, an objective of which is to identify species of conservation concern, including federally and provincially listed SAR and provincially rare species. Federally listed SAR are species listed as Special Concern, Endangered or Threatened under Schedule 1 of the SARA (Government of Canada 2002b). Provincially listed SAR are species listed as Special Concern, Endangered or Threatened under the SAR in Ontario list. Research to date has focused on collating existing data on species presence and known important habitats using desktop sources and collecting foundational habitat information through the following field studies: terrestrial ecosystem mapping, AHM, eDNA metabarcoding studies in aquatic habitats, and opportunistic identification of candidate SWH alongside terrestrial ecosystem mapping.

The spatial extents of areas where baseline data were collected are outlined in the 2021-2022 baseline report (Zoetica 2023) and the 2021-2024 baseline report (Zoetica 2025). Based on 2021-2024 baseline results (Zoetica 2022, 2023) and potential for occurrence, SAR were identified within and surrounding the Project site, as follows:

- **Ungulates**—The Project site is located approximately 61 km south of the regulated habitat range boundaries for woodland caribou in the Churchill Range. Therefore, there are currently no regulatory federal or provincial triggers for woodland caribou for this Project, and this species is not included as part of the NWMO environmental baseline studies.
- **Carnivores**—There are four listed carnivore species that previously were determined to potentially occur in the area. These are cougar, American badger, wolverine and gray fox. Although there is the potential for cougar to occur in the area, this species occurs in extremely low densities and is a habitat generalist, using extensive areas in pursuit of prey. It is not listed under the SARA and as of 2022 is not afforded species or habitat protection under the provincial *Endangered Species Act*. Similarly, the wolverine known occurrence range is located approximately 80km north of the Project site, and as such there is very low likelihood that they inhabit areas in and around the Project. Based on ecosite analyses, mammal denning sites and seeps and springs could potentially occur throughout this area.
- **Small mammals**—Of the 29 small-to-medium-sized terrestrial mammals that could potentially occur the area, none are provincially or federally listed as SAR.
- **Semi-aquatic mammals**—Of the five semi-aquatic species potentially occurring in the area, none are provincially or federally listed as SAR.
- **Bats**—Of the six bat species potentially occurring in the area, eDNA studies did not detect any bat species, but a preliminary acoustic study did detect several bat species, including two SAR: Little Brown Myotis and Northern Myotis. Desktop studies indicate a potential presence of three provincial SAR: Silver-hair Bat, Eastern Red Bat and Hoary Bat. Candidate SWH has been identified for Bat Maternity Colony and Bat Hibernaculum.
- **Herpetofauna**—Of the seven herpetofauna species detected in the area, Snapping Turtle was the only SAR species observed.
- **Terrestrial invertebrates**—No terrestrial invertebrate SAR have been observed in the area to date. There is potential for the Yellow-banded Bumble Bee and Monarch butterfly to be found in the area.
- **Terrestrial vegetation**—Black ash was not identified in the Project site but was identified within approximately 10 km of it.
- **Birds**—Eleven SAR bird species were detected in the area. The SAR species include eight upland breeding birds (barn swallow, Canada warbler, evening grosbeak, red-headed woodpecker, olive-sided flycatcher, common nighthawk, eastern wood-pewee, and eastern whip-poor-will), one shorebird (lesser yellowlegs), one waterbird (American white pelican) and one raptor (golden eagle). Bald eagles were also detected and included as Special Concern in studies completed to date but have since been removed from Ontario's list of SAR. Based on desktop studies, Short-eared Owl has the potential to be present during the breeding season (mid-April to late August). Habitats for Olive-sided Flycatcher, Common Nighthawk, and Eastern Wood-pewee, were identified, along with candidate SWH for colonially nesting bird breeding habitat (tree/shrubs and ground), marsh bird breeding habitat, and seeps and springs. Candidate SWH has been identified for eagle concentration area, bald eagle nesting habitat, and woodland raptor nesting habitat. There are currently no designated protected areas for migratory birds and no critical habitat for eastern whip-poor-will within the area. Although not observed to date, there is potential for the Rusty Blackbird, Peregrine Falcon, Harris's Sparrow, Black Tern, and Horned Grebe to be found in the area.

- **Fish**—One SAR, American eel, was detected in the Project site surrounding area through eDNA metabarcoding studies. This is outside the typical range for this species, and there is uncertainty in the results. Additional eDNA sampling and metabarcoding work is being completed to further investigate the validity of the American Eel detection.

14.11.2 Planned Work

SAR studies completed to date indicate the need for additional data collection to support the initial licence application to the CNSC, and the IA process; however, studies completed to date are considered sufficiently advanced to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts presented in Section E of the IPD. Further field studies are needed to verify the presence and distribution of SAR and provincially rare species throughout the Project site and surrounding area, to confirm breeding (or probable breeding) of wildlife species, and to assess the area needed to protect the habitat form and function for the species to define the SWH.

Future studies aim to provide a more thorough characterization of upland breeding bird communities within the Project site and surrounding area. Community-level studies will enable estimates of relative abundance and seasonal habitat use and provide insight into food webs and tropic linkages. Baseline work on habitat suitability modelling for eastern whip-poor-will is ongoing. Because of the uncertainty of some eDNA metabarcoding results and current limitations in methods, detections of species of interest such as American eel should be followed up by barcode gap analyses and/or traditional sampling techniques to verify its presence.

14.12 Climate Change

14.12.1 Currently Available Baseline Data

The NWMO installed a temporary weather station at the Project site in 2021. The data from this station and a description of the current baseline climate are provided in Section 14.1. As discussed in Section 14.1, data from the on-site station were found to be similar to and within a reasonable range of measurements from other meteorological stations in the region.

The NWMO prepared a method development document in 2019 to anticipate the impacts of climate change on the DGR study sites (Wood 2019). Recent climate projections predict a 3°C to 4°C increase in temperature by the 2050s and an approximate increase of 6°C by the 2080s (Wood 2019). In general, this increase in average temperatures is expected to be more substantial during winter months compared to summer months (approximately 1.8°C greater change in winter in the 2050s and 2°C greater change in the 2080s) (Wood 2019).

In the Project site and surrounding area, precipitation is expected to experience an increase of 50 mm/year to 75 mm/year by the 2050s and a 100 mm/year to 125 mm/year increase by the 2080s (Wood, 2019). The projected increases in annual precipitation are mainly driven by an expected increase in winter and spring precipitation. Obtaining strategic baseline meteorology and hydrology data will aid in Project planning for water management in consideration of these predicted climate change effects.

The Strategic Assessment of Climate Change conducted under Section 95 of the IAA is applicable to the Project. An initial strategic assessment of climate change has been conducted for the Project and is provided in Section 22.

14.12.2 Planned Work

An initial Strategic Assessment of Climate Change has been completed for the Project as provided in Section 24 of the IPD. The NWMO will meets the requirements of the Government of Canada's *Strategic Assessment of Climate Change* and that demonstrates how the NWMO is prioritizing the implementation of best available technologies and best environmental practices to reduce direct greenhouse gas emissions between start of site preparation and construction activities.

The NWMO will continue to collect local and regional baseline meteorological data and assess it for weather patterns, seasonal trends and variability. Site-specific data on ground frost, snow cover, evapotranspiration and ice dynamics will also be collected. These data will be reported in the initial licence application to the CNSC, and the Impact Statement.

14.13 Ambient Radioactivity

14.13.1 Currently Available Baseline Data

This section presents information that is currently readily available on baseline radioactivity in the Project site, compiled from a variety of sources. Where possible, information has been selected to best represent this area.

Background Dose Rates

Average background radiation doses in Canada are estimated to be approximately 1.8 millisievert (mSv) per year, which is lower than the worldwide average of 2.4 mSv (CNSC 2020). Baseline radiation levels are spatially variable, depending on location, elevation, and other local geographic influences. Figure 14.9 shows a map of annual outdoor effective dose from cosmic radiation in Canada and United States, expressed in microsievert (μSv) produced by Grasty and LaMarre (2004). As seen in Figure 14.9, the dose varies by a factor of 2-3. In this case, the main factor influencing these variations is elevation.

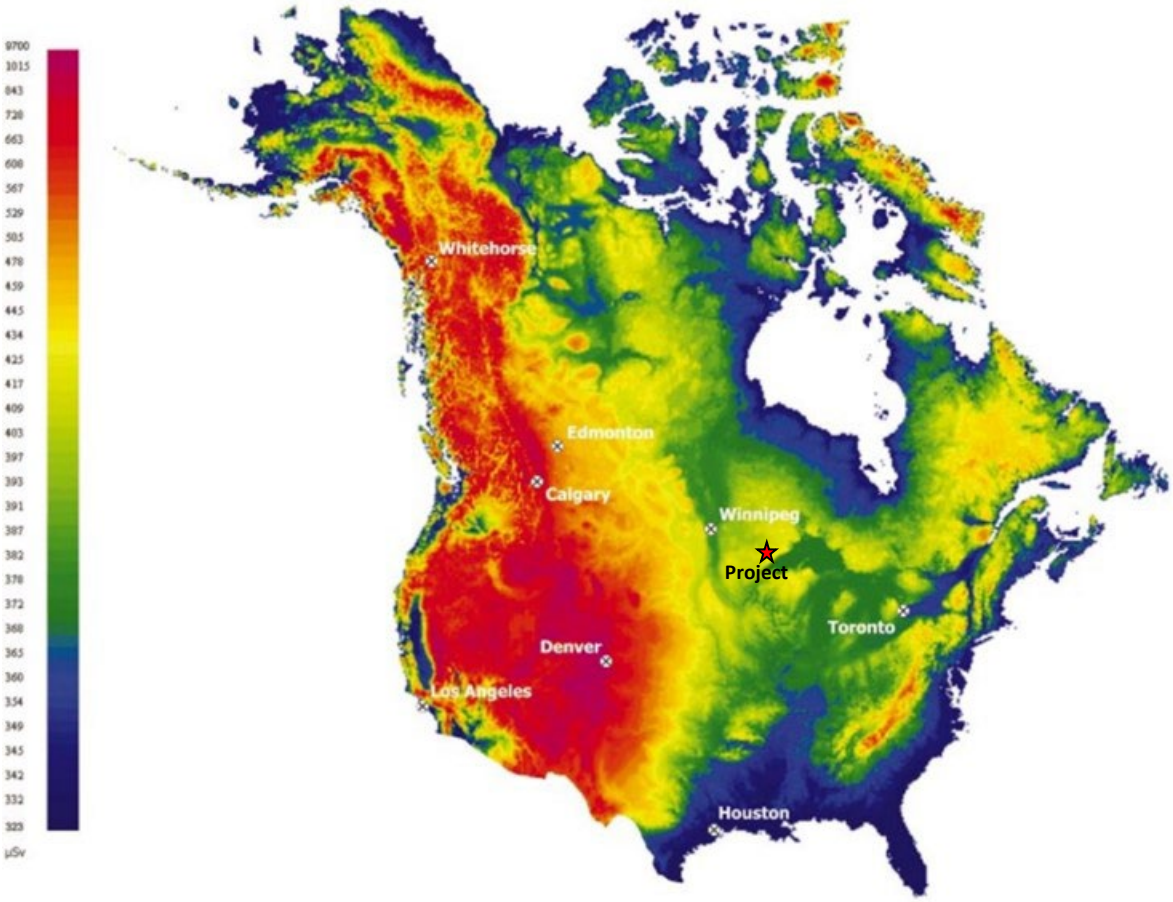


Figure 14.9: The Annual Outdoor Effective Dose (µSv) from Cosmic Radiation for Canada and the United States

µSv = microsievert.

Background Radon Concentrations in Indoor Air

A survey by Health Canada (HC) of radon gas concentrations in Canadian homes shows that 86 percent of residences in the Northwestern Health Unit (NWHU) area, which includes the Project site, were below the national guideline of 200 Becquerel (Bq)/m^3, while 12 percent were between 200 and 600 Bq/m^3 and the remaining 2 percent were above 600 Bq/m^3 (Health Canada 2012).

Baseline Radioactivity Concentrations

In addition to dose estimates, baseline radioactivity concentrations in various environmental media were compiled from the NWMO's baseline data collection program. The baseline program was designed to focus on environmental components that have the potential to be impacted by the Project or have been deemed important for other reasons such as community concern. Some of the components of the baseline program for radiological analysis are listed below (CanNorth 2020):

- surface water and sediment quality
- air quality
- shallow groundwater quality (measured from monitoring wells)
- surface soil quality and gamma radiation
- tissue samples (e.g., wildlife, game, medicinal plants and fish muscle tissue)

With respect to the tissue's samples, the NWMO is currently accepting donated samples of tissues from First Nation and other community members. First Nation and other community members have been invited to donate portions or hunted or harvested items such as berries, fish and game. Recently, moose tissue samples were donated as part of the program.

Surface water data, capturing summer 2021 to spring 2023, are summarized in Section 14.6. The data collection study areas for soil are described in Section 14.4.

The measured data were compared to the values indicated in the Water Quality Guidelines (WQGs). The Environmental Media Baseline Program Design report (CanNorth 2020) identified the following available guidelines:

- **Canadian Council of Ministers of the Environment (CCME 2023)**—Canadian Water Quality Guidelines (CWQGs) for the Protection of Freshwater Aquatic Life, and for the Protection of Agriculture (Irrigation and Livestock)
- **Government of Canada (GC 2021)**—Federal Environmental Quality Guidelines (FEQGs) for surface water quality
- **Ontario Ministry of Environment, Conservation and Parks (MECP)**—Provincial Water Quality Objectives (MOEE 1994)
- **HC (2022a)**—Guidelines for Canadian Drinking Water Quality and Recreational Water Quality

Twenty-two naturally occurring and artificial radionuclides were assessed in surface water. Several waterbodies were sampled, including reference areas. No radionuclides exceeded the available guidelines in surface water. Fourteen radionuclides were assessed in soil. There are no guideline concentrations for these radionuclides in soil, and the majority of radionuclides were below detection limits. Detected radionuclides in a small number of soil samples included Plutonium-238, Plutonium-239 and Strontium-90 at trace detection levels. The detection of Plutonium-238, Plutonium-239 and Strontium in soil was attributed to fallout from historical global nuclear weapons, nuclear weapons testing, and nuclear accidents. Nineteen naturally occurring radionuclides were assessed in groundwater. No radionuclides exceeded the available guidelines in groundwater.

14.13.2 Planned Work

In addition to continuing the participatory tissue sampling program, the NWMO will implement a targeted campaign to ensure that traditional foods consumed by Indigenous groups and other local communities are sampled from a well-distributed area while being mindful of potential socio-economic consequences of this sampling. The planned work also includes continuing to collect baseline data, including measuring radiological parameters in air, soil, and surface water. Planned data collection within each of these environmental mediums was described earlier in Section 14.5 (atmospheric environment), Section 14.4 (soil quality), and Section 14.6 (surface water quality). The work will be submitted in support the initial licence application to the CNSC, and the Impact Statement.

The NWMO is also completing a geochemical analysis of natural occurring radioactive materials in bedrock that may be excavated and exposed through Project activities.

15. Health, Social & Economic Context

Socio-economic reporting, including socio-economic effects of the NWMO's activities on a community's way of life or on its social, cultural or economic aspirations, is a mandatory requirement of the NFWA and the NWMO is required to report on it triennially under Section 18 of the NFWA. The current baseline report (summarized herein) is comprehensive and sufficient to support the initial assessment of impacts presented in Section E, as well as to inform the initial licence application to the CNSC, and the Impact Statement.

The Social, Cultural, Economic, and Health Baseline Studies, Preliminary Report for Engagement, WLON-Ignace Area (InterGroup 2024) forms the basis of the overview of the social, economic and health context in which the Project site is situated. Preparation of the baseline report involved data collection and engagement with close to 500 people, and 70 organizations located in the study area to inform qualitative information gathering and data analysis. In addition, Dryden, Ignace and independent health professionals undertook reviews. The report reflects the undertaking of GBA Plus (Government of Canada 2025) for data gathering and analysis as well as engagement. Due to evolving baseline conditions related to the human environment to enable the writing of the report, May 2023 was generally used as the cut-off for data collection, recognizing that new data sources and changes to existing conditions will continue to persist. Such information will be updated in the future. The design methodology report was reviewed by the IAAC and members of the federal review team to confirm that the baseline social, cultural, economic and health characterization would meet the needs of the reviewers, and enhancements were made in response. Social, cultural baseline characterization components include population and demographics, community and culture, infrastructure and services, land and resource use, and archaeological and heritage resources. Of note, social conditions baseline has been undertaken from a western scientific perspective and focuses primarily on the municipal context.

The communities selected for baseline conditions were intended to capture a sufficiently broad area to characterize the area surrounding the Project site, with the intention for further refinement as the regulatory work progresses. Generally, for reference purposes, the broader study area is the Kenora Census Division (CD) which has a population of 66,000 (Statistics Canada 2022a). Health baseline is the exception as its data catchment area is the administrative boundary of the NWHU which includes some of the Kenora CD and all of the Rainy River District. Baseline information includes Indigenous residents within municipal, District and NWHU areas. Statistics Canada's definition of Indigenous identity refers to whether a person identified with the Indigenous Peoples of Canada and "includes those who identify as First Nations (North American Indian), Métis, and/or Inuk (Inuit), and/or those who report being Registered or Treaty Indians (that is, registered under the federal *Indian Act* [Government of Canada 1985f]), and/or have membership in a First Nation or Indian band" (Statistics Canada 2023). In 2021, over 15 percent of the population identified as Indigenous in Dryden, Ignace, Sioux Lookout and the LSB of Wabigoon (Statistics Canada 2022a). The Social, Cultural, Economic, and Health Baseline Studies, Preliminary Report for Engagement, WLON-Ignace Area Baseline Report has not been verified by First Nation and Métis communities including WLON.

At this time, reporting is limited to Statistics Canada and Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) data, and other publicly available sources. As such, it does not provide a complete representation of the Indigenous identity populations residing within district, municipal, and unincorporated communities, nor does it fully capture the characteristics of on-reserve communities. The NWMO recognizes that data control is a vital aspect of self-determination and cultural preservation for Indigenous communities.

In many cases, particularly for the social, economic, and cultural components studied, additional work will be undertaken to further support the impact assessment process, including the assessment for the Anishinaabe Peoples of WLON and other potentially affected Indigenous groups. Nonetheless, the work completed to date, as documented in the NWMO's *Social, Cultural, Economic, and Health Baseline Studies, Preliminary Report*, which has been reviewed by the IAAC and the Government Review Team, is considered sufficiently advanced to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts presented in Section E of the IPD.

Communities in Proximity to the Project Site

The Project site is located in an area of very low population density. Regional communities, First Nation and Métis communities are displayed in Figure 1.2.

The Project site is located within the territory of the WLON and within the area subject to Treaty #3. Section 13.2 includes the distances to the nearest Treaty #3 First Nations in proximity to the Project site. The Project site is located within the MNR-recognized Lake of the Woods/Lac Seul, Rainy Lake/Rainy River, and the Treaty #3 Halfbreed Adhesion Harvesting Area of the Métis Nation of Ontario Region 1, locally known as the northwestern Ontario Métis Community.

The community of Borups Corners is located approximately 10 km northeast from the Project site and the community of Dyment is approximately 13 km northwest from the site. These two unincorporated communities make up the LSB of Melgund, which is estimated to have approximately 50 full-time residents. In addition to full-time residents, there are about 20 seasonal residents during the summer months. A few seasonal residents are in cabins on Long Lake (Northwestern Ontario Baseline Studies Key Person Interview Program, 2022-2023).

The closest small population centres to the Project site include Dinorwic, approximately 28 km to the northwest, and the LSB of Wabigoon Village (Wabigoon), approximately 35 km to the northwest. Mid-size to larger centres and service areas closest to the Project site are Ignace, approximately 35 km to the southeast; the City of Dryden (Dryden), approximately 40 km to the northwest; and the municipality of Sioux Lookout (Sioux Lookout), approximately 50 km to the north. Distances were measured cross country from the approximate Project site centroid to the nearest extent of the municipality/community boundaries, with the exception of Borups Corners, Dyment and Dinorwic, which lacked spatial boundaries. Distances to these three communities were calculated using the approximate community centroids.

The NWMO had interim reports on census indicators for some First Nations in the northwest prepared using publicly available information. These provide a source of information on population and economic indicators for WLON, Eagle Lake First Nation, Lac Seul First Nation, Lac Des Milles First Nation, and Seine River First Nation. These reports have not yet been verified by individual Indigenous communities but is planned as part of NWMO's engagement program. Once verified, these reports will support the characterization of existing Indigenous Health, Social and Economic conditions in the IA.

15.1 Currently Available Baseline Data for Health Conditions

15.1.1 Currently Available Baseline Data

The following paragraphs summarize the methodology applied in completing the Social, Cultural, Economic, and Health Baseline Studies, Preliminary Report for Engagement, WLON-Ignace Area (InterGroup 2024). Results of the study are discussed in the sections that follow. The Health section of the report included analysis in three areas as follows:

- a Health Outcomes subsection, which documents data and analysis for six topics—Maternal and Child Health, Communicable Disease, Chronic Disease, Mental Health, Injury, and Mortality
- a Social Determinants of Health subsection, which documents data and analysis on seven social determinants—Demographics, Income, Employment and Education, Physical Environment, Social Environment, Health Behaviours, Child Development, and Access to Healthcare
- a Health System subsection, which provides an overview of the healthcare system, followed by data and analysis related to Ignace residents' access to the health system

Data presented below are disaggregated and compared for Ignace, the Dryden Health Hub, and the NWHU. Comparisons to Ontario are included where available. Data are not disaggregated by individual Indigenous community; however, aggregated data incorporate Indigenous individuals accessing the NWHU system. The NWHU is an administrative boundary that includes 19 municipalities; 39 First Nations communities; and 2 unincorporated territories, Kenora Unorganized and Rainy River Unorganized (NWHU 2023a). The Dryden Health Hub is an amalgamation of communities who may use/access services based in Dryden made up of Dryden, Ignace, Eagle Lake First Nation, and WLON. Data for smaller communities were subjected to data suppression.

Community Health Outcomes

Most health indicators do not change dramatically over short time periods, and many outcomes related to exposures or lifestyle can occur over decades. The description of health outcomes goes back far enough to understand past trends and is dependent on the availability of health data. Where data are available, a minimum of 20 years of data are presented. Comparative health outcome data are presented for Ignace, Dryden Health Hub, and the NWHU.

The data include but are not limited to baseline information on the following aspects:

- cancer incidence
- respiratory disease, including asthma and chronic obstructive pulmonary disease (COPD) incidence
- mental health and communicable disease

Maternal and Child Health

In general, between 1996 and 2021, birth rates per 1,000 residents (live birth rate) was highest in the NWHU catchment area, followed by the Dryden Hub and Ignace (IntelliHealth Ontario 2023b). As assessed from 2014 and 2021, health conditions or medical conditions during pregnancy are similar across all three comparison areas (ISCIS 2022).

Communicable Disease

Based on 2021 data, sexually transmitted infection rates are higher within the NWHU, as compared to the rates in Ontario. During the same period of time, rates of reportable infectious diseases

(Campylobacter Enteritis, Hepatitis C, Salmonella) varied between Ignace, Dryden and the NWHU catchment area (iPHIS 2022).

Chronic Disease

Prevalence estimates[1] from 2020 show a comparatively high burden of chronic disease in the NWHU population, notably females with diabetes or chronic obstructive pulmonary disease compared to Ontario (Public Health Ontario 2023m). In 2019/2020, the self-reported rate of arthritis among NWHU residents aged 15 and older was more than 50 percent higher than the province-wide rate. In 2021, the crude rate of hospitalization for asthma was slightly lower at 14.7 persons per 100,000 population in the NWHU compared to 18.8 in Ontario but the difference was not significant (Public Health Ontario 2023p).

The prevalence estimates for cancer show a higher rate of cancer in Ontario (4,647 cases per 100,000 population) compared to the NWHU (4,070 cases per 100,000 population) (Cancer Care Ontario 2021). Prevalence estimates also show females face a higher burden of cancer in both the NWHU (4,503 cases per 100,000 population) and Ontario (4,938 cases per 100,000 population) compared to males (3,647 cases per 100,000 population in the NWHU and 4,348 cases per 100,000 population in Ontario).

From 2001 to 2020 cancer-related physician visits were higher in Ignace than in the NWHU (IntelliHealth Ontario 2023c). Similarly, during 2002 to 2021, cancer-related hospitalization rates were higher in Ignace than in the NWHU. In the case of Ignace, from 2002 to 2021, lung, prostate, and colon cancers accounted for the highest percentage of cancer-related hospitalizations; however, 1 in 2 visits was for other cancers not individually accounted for in leading types (IntelliHealth Ontario 2023a). Between 1986 and 2018, the most common cause of mortality among Ignace residents was neoplasms (cancer), accounting for just over 1 in 3 (34 percent) deaths, followed by diseases of the circulatory system. These two causes of death account for almost two thirds of deaths among Ignace residents and the average age of death (all causes) among Ignace residents was 63.6 years (IntelliHealth Ontario 2023e).

Mental Health and Addictions

From 2002 to 2021, mood disorder or anxiety followed by substance use-related issues were the most common mental health reason why those living in Ignace visited their physician (IntelliHealth Ontario 2023a). NWHU residents self-report higher rates of heavy drinking, when compared to all Ontarians (2015 to 2020) (Statistics Canada 2022b). During 2004 to 2017 emergency department visit rates by youth from the NWHU catchment area for intentional self-harm were dramatically higher than the rates for youth across the province (Public Health Ontario 2019a). Based on data collected between 2002 and 2021, psychiatry and mental health emergency department visit rates were lower among Ignace residents, as compared to both those from the Dryden Health Hub and the NWHU (IntelliHealth Ontario 2023d).

According to the Kenora District Services Board (KDSB) 2022-2026 Strategic Plan, mental health and addictions are a growing issue throughout the region. Existing supports and services are insufficient to address the need, particularly for youth. The demand for mental health and addictions services further strains other services such as emergency medical services and policing (KDSB 2022b).

[1] Rates per 100,000 have been used to illustrate disease prevalence across areas that vary in population size. This approach is a standard means of reporting and typically used by public health organizations. The disease prevalence rates described are the actual number of cases within the population at a point in time.

Injury

While rates are lower in Ignace, between 2002 and 2021 the NWHU shows some of the highest age-standardized rates of emergency department visits for all injuries, among Ontario's health units (IntelliHealth Ontario 2023a). During the same period, rates of intentional injury emergency department visits (assault and self-harm) are lower among Ignace residents than the Dryden Hub; both are significantly lower than the rate for NWHU residents (IntelliHealth Ontario 2023d). Between 1986 and 2018, the percentage of males reporting Potential Years of Life Lost (PYLL) in Ignace was much higher than the percentages found in both the Dryden Hub and NWHU (IntelliHealth Ontario 2023e).

Mortality

Between 1986 and 2018, mortality rates were lowest in Ignace and the NWHU, highest in the Dryden Health Hub. During this period, the mean age at death was lowest for Ignace, followed by the NWHU and the Dryden Health Hub. Overall, men are more likely than women to die prematurely (80 percent of PYLL). The leading cause for PYLL among Ignace residents was external causes (injury), accounting for 1,290 PYLL (but only 70 PYLL were among females, and 1,220 were among males) (IntelliHealth Ontario 2023e). Women live longer, experience greater rates of depression, stress overload, and the consequences of family violence, when compared to men (IntelliHealth Ontario 2023a,d). Compared to all of Ontario and based on data collected between 2011 to 2017, the life expectancy at birth for NWHU residents was significantly lower.

15.1.2 Planned Work

There is no further work planned for health outcomes baseline conditions characterization. The baseline data report, as summarized here, is considered sufficient and comprehensive to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts to non-Indigenous peoples presented in Section E of the IPD.

The NWMO will update or produce additional Social, Cultural, Economic, and Health Baseline studies to meet the need of the regulatory process once it starts working with First Nations and Métis communities as part of the initial licence application and Impact Statement.

The NWMO will continue to work with the Indigenous communities and the public to assess and report on the social, economic impacts of the Project as required by the NFWA.

15.2 Social Determinants of Health

15.2.1 Currently Available Baseline Data

The social determinants of health are the non-medical factors that influence health outcomes (World Health Organization 2023). Income is one of the most influential social determinants of health and is closely linked to many other factors such as education, employment, and housing (CIHI 2018). Health status improves at each step up the income and social hierarchy. Low-income people are known to face greater challenges with their mental health (PHAC 2022a).

There are several key selected social determinants of health findings:

- In 2020, approximately 13.2 percent of Ignace households, 19.7 percent of Kenora district households, and 10.1 percent of Ontario households were considered low income (Statistics Canada 2022e).

- Based on the 2021 census, 20.6 percent of men and 25.5 percent of women aged 15 years and older in Ignace had no certificate, diploma, or degree; compared to 15.8 percent of men and 14.8 percent of women in Ontario (Statistics Canada 2022e).
- Residents of northwestern Ontario are disproportionately affected by poor housing quality. As of 2021, 13.0 percent of dwellings in the Kenora CD (which encompasses the NWHU) needed major repairs, in comparison to only 5.3 percent provincially (Statistics Canada 2022e).
- In 2021, the average monthly shelter cost in Ignace was $760, $1,022 in Dryden, and $1,137 in the Kenora CD. Ignace had higher food costs while Dryden and Thunder Bay have a larger variety of products to choose from (Statistics Canada 2022e).
- Compared to residents of Ontario, those living in the NWHU's catchment area have greater body mass index scores; rates of smoking and heavy drinking (assessed during 2015 and 2020) (Statistics Canada 2022b); and proportions of children scoring high (poorly) on an early development indicator (assessed during 2017 and 2018) (PHAC 2018).
- Between 2013 and 2022, a greater proportion of Ignace mothers reported breastfeeding their children, as compared to those in the NWHU (87.1 percent and 80.3 percent, respectively) (BORN 2023).
- Low-income people and people living with mental health challenges are key vulnerable populations in the area. Mental health is a health priority for health services providers locally and in the NWHU (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).
- Disparities in health outcomes exist between Indigenous Peoples compared to non-Indigenous Peoples in Canada. Compared to white adults, there are large inequalities in racialized adults' contact with dental professionals and regular healthcare providers (PHAC 2022b).

Other social determinants of health that have been investigated for the WLON-Ignace area are outlined in the Baseline Report, and include culture, race, racism, homelessness, and social cohesion.

While this section summarizes available baseline data on social determinants of health, it is important to note that comprehensive, disaggregated baseline data on gender-based violence in the NWHU area are currently not available. This includes data specific to Indigenous women, girls, and 2SLGBTQI+ peoples.

15.2.2 Planned Work

The NWMO considers the public social determinants of health baseline study characterization to be sufficiently advanced to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts to non-Indigenous peoples presented in Section E of the IPD.

The NWMO will update or produce additional Social, Cultural, Economic, and Health Baseline studies to meet the need of the regulatory process once it starts working with First Nations and Métis communities as part of the IA and initial licence application to the CNSC process. This would include the collection of baseline data on gender-based violence.

The NWMO will continue to work with the Indigenous communities and the public to assess and report on the social, economic impacts of the Project as required by the NFWA. Other social determinants of health that have been investigated for the WLON-Ignace area are outlined in the Baseline Report.

15.3 Access to Community Health Care

15.3.1 Currently Available Baseline Data

Health System

Availability of health services is a social determinant of health. Level of access to appropriate and continuous health services affects health status and health outcomes of individuals. People who live in rural communities experience a disparity in access to services which can materially impact early detection of disease, support for disease management, and early access to treatment (Browne 2010).

Ignace

In Ignace, the main healthcare provider is the Mary Berglund Community Health Centre Hub (MBCHCH) which serviced 1,327 individual clients directly over the 2022/2023 fiscal year (MBCHCH Internal Reports 2023). The MBCHCH provides care to Ignace residents and residents of other communities, including Dryden, Thunder Bay, Upsala, and Savant Lake. MBCHCH employs approximately 20 staff, including four to six physicians, a nurse practitioner and two registered nurses. A pharmacy is also located within their building. Mental health services for residents are also available at MBCHCH.

MBCHCH is operating near capacity and does not have space to dedicate to additional service provision. For more specialized services such as surgery and emergency care, residents travel to Dryden, Kenora, Sioux Lookout or Thunder Bay. Gaps identified in available healthcare services are residential addiction treatment, adequate mental health services, senior services, including home care, and crisis response, while common barriers encountered are transportation, long wait times to see specialists, hours of services, and insufficient knowledge on how to navigate the healthcare system (GBA Plus Workshop 2023; Northwestern Ontario Community and Baseline Studies Key Person Interview Program 2022; Northwestern Ontario Baseline Studies Key Person Interview Program 2022).

As required by the province, communities in the area have Community Safety and Well-being (CSWB) plans. The Ignace CSWB plan (Township of Ignace 2021) outlines a course of action for identifying and responding to current and emerging well-being and safety challenges in the community. The goal of this plan is "everyone belongs," and is reflected in the community engagement and collaboration which occurred to identify the local priorities (i.e., support for seniors, employment, mental health, and accessibility).

Dryden

The Dryden Regional Health Centre (DRHC) is a 42-bed hospital serving communities in the area. More than 300 employees at the DRHC provide a range of inpatient, outpatient, specialist, mental health and addictions, and rehabilitative services. The DRHC is integrated with primary care and runs and governs the Dryden Area Family Health Team as a separately funded clinic, as well as operating and governing the Dryden and Area Mental Health and Addictions program. Also found in the city is a medical clinic, dentists, pharmacies, and a range of other healthcare services (e.g., chiropractic, massage, optometry, osteopathy, physiotherapy, podiatry, respite) (DRHC 2023a,b,c; Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

The Dryden and Area CSWB (MNP 2021) is a framework for promoting and maintaining community safety. The three primary goals of the plan are multi-sectoral collaboration enhancing service provision to community members with high risk factors; safe and healthy community members; and community engagement and inclusion that improves CSWB. Four focus areas for the plan are supporting youth, prevention/education, treatment, and social development. Gaps that have been

identified include psychiatric services, a healing lodge, emergency shelters which serve individuals beyond women and children, residential addictions treatment, and a 24/7 warming centre for homeless individuals (WSP 2022b; MNP 2021).

Several social service organizations provide services across the northwest, with branch locations in both Dryden and Sioux Lookout. These agencies include the Ontario Addictions Treatment Centres (methadone treatment only); Firefly (counselling for children and youth, youth justice services); Kenora-Rainy River Districts Child and Family Services; and Community Living Dryden- Sioux Lookout (CATC 2023; CLDSL 2021; Firefly 2022; Kenora-Rainy River Districts Child and Family Services 2023).

Hoshizaki House Dryden District Crisis Shelter and the Sexual Assault and Domestic Violence Care and Treatment Program at the DRHC serve the needs of those in the area who are coping with family violence. Hoshizaki House provides emergency shelter to mothers and their children while the DRHC's program offers contraception, testing and treatment for sexually transmitted infections, and supportive crisis counselling (DRHC 2024; Hoshizaki House 2023).

Patricia Regional Seniors Services assists seniors in maintaining their independence by providing home aids, friendly visits, and transportation (City of Dryden 2024) while the Go Getters Seniors Centre provides a location for those 55 and older to play games, exercise, complete arts and crafts projects, and have meals.

Sioux Lookout

Sioux Lookout's Meno Ya Win Health Centre has a 60-bed hospital and a 20-bed extended care facility. Modern medical methods are utilized, as well as holistic and traditional approaches. Services offered at Sioux Lookouts Meno Ya Win Health Centre include diabetes care, stroke prevention, mental health and addiction services, and inpatient and outpatient programs. Staff at the Hugh Allen Clinic support the hospital, as well as providing primary care, health promotion, and foot care services to residents. Other healthcare services in Sioux Lookout include dental clinics, a pharmacy, an osteopath, and a massage therapist (SLMHC 2023a,b,c,d).

Sioux Lookout's CSWB plan (municipality of Sioux Lookout 2020b) details strategies and actions at four levels of intervention: social development, prevention, risk intervention, and incident response. Through a collaborative process of research, community reports, and community input, the plan identified six priority areas: appropriate and affordable housing, mental wellness, substance misuse and addictions, crisis services' capacity for incidence response and de-escalation, employee recruitment and retention, and community cohesiveness and vibrancy.

Services to support individuals living with mental health and substance use challenges (especially youth) are limited to the Sioux Lookout. William W. Creighton Youth Services, which offers residential and outpatient services to Indigenous and non-Indigenous youth between 12 and 18 years old who have committed an offence (William W. Creighton Youth Services 2023a,b). First Step Women's Shelter is a 14-bed facility in Sioux Lookout providing support and emergency shelter for women and children who have been physically, sexually, and/or emotionally abused (FSWS 2023a,b).

Two venues, Sioux Area Seniors Activity Centre and the Lost Lake Seniors Drop-In Centre regularly offer recreation and educational programs, potluck meals, community events and bus trips (Municipality of Sioux Lookout 2023f).

Indigenous Health Services

Healthcare for Indigenous Peoples in Canada is covered through a range of partnerships, policies, and legislation. Indigenous Peoples are entitled to access insured provincial/territorial healthcare services as they are included in the allocations of federal funding. For Métis, off-reserve First Nations, and non-status First Nations, services and benefits are primarily provided through the province. The Public Health Agency of Canada and HC also fund programs for Indigenous Peoples living in urban and northern areas (Government of Canada 2023b).

For First Nations and Inuit, Indigenous Services Canada (ISC) funds or directly provides services that supplement healthcare services provided by the province. ISC's Non-Insured Health Benefits Program provides eligible First Nations and Inuit coverage for non-insured health benefits, such as dental, vision, mental health counselling, and prescription drugs (Government of Canada 2023a). The First Nations and Inuit Health Branch of ISC works with partners to improve health outcomes on reserves. The First Nations and Inuit Health Branch works to fill gaps in the delivery of provincial health services by funding and/or providing basic primary healthcare services on reserves (ISC 2018a).

Paawidigong First Nations Forum is a not-for-profit organization established in 1996 that provides culturally appropriate health programs and social services to First Nations communities in the area. Programs and services through Paawidigong First Nations Forum focus on Indigenous healing and wellness, fetal alcohol spectrum disorder, community health, home and community care nurse, diabetes nurse and diabetes education program, mental wellness, and mental health and addictions (Paawidigong First Nations Forum 2022a,b).

The Métis Nation of Ontario's Healing and Wellness Branch works with Indigenous and non-Indigenous partners to provide community-based and culturally appropriate programs and services to support the mental, physical, and emotional needs of those in the area. Healing and wellness services offered include mental health and addictions, victim services, justice services, community support, infant well-being, family well-being, cancer care, and diabetes (Métis Nation of Ontario 2022).

Two organizations deliver child protection services to Indigenous families in the area. Tikinagan Child and Family Services and Anishinaabe Abinoojii Family Services are both mandated by the province to provide prevention, fostering and adoption care to those requiring this type of assistance (AAFS 2021; TCFS 2022). Northwest Ontario Métis Child and Family Services provide prevention, family preservation, youth, cultural and repatriation services for Métis citizens in the area (Northwest Ontario Métis Child and Family Services 2023).

Dryden and Sioux Lookout are each home to Friendship Centres serving the broader needs of Indigenous residents in the area. The Dryden Native Friendship Centre employs approximately 40 staff and 90 volunteers. Their focus is on off-reserve, at-risk individuals through the provision of initiatives such as training and education, shelter, transportation, and family assistance (DNFC 2023a,b). Nishnawbe-Gamik Friendship Centre has a similar mandate to serve the needs of all Indigenous community members living in Sioux Lookout, as well as those visiting the community (Nishnawbe-Gamik Native Friendship Centre 2023a,b).

Ambulance Services

The KDSB is responsible for the provision of ambulance services in the region. The Ignace base has two ambulances (one frontline and one backup), and the Dryden base has four (two frontline and two backup).

15.3.2 Planned Work

The NWMO considers the public access to community healthcare baseline study to be sufficiently advanced to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts to non-Indigenous peoples presented in Section E of the IPD.

The NWMO will update or produce additional Social, Cultural, Economic, and Health Baseline studies to meet the need of the regulatory process once it starts working with First Nations and Métis communities as part of the integrated initial licence application and Impact Statement.

The NWMO will continue to work with the Indigenous communities and the public to assess and report on the social, economic impacts of the Project as required by the NFWA.

15.4 Traditional Foods and Medicines

15.4.1 Currently Available Baseline Data

Traditional Diet

It is well known that people in the regional area in northwestern Ontario consume a variety of locally harvested foods. Fishing is understood to be a critical activity year-round, with walleye and pike being popular species but other species are harvested as well. Harvesting and gathering plants is also popular in the regional area including berries (blueberries, raspberries, pin cherries, wild cranberries), mushrooms (chanterelles, morels and others) and wild rice. Low bush cranberries, snowbush berry, Labrador tea, low bush hemlock/ground hemlock are known medicines in the area. The regional area is also popular for hunting a number of species including moose, grouse, duck/waterfowl, and deer. A number of traplines are also present in the broader area and popular trapping species include beaver and marten. Residential sources of drinking water are understood to be predominantly well water, or water from larger lakes including Wabigoon Lake for Dryden, Michel Lake for Ignace and Dinorwic Lake for WLON The presence of artesian wells has also been reported in the Revell Lake watershed.

The First Nations Food, Nutrition and Environment Study presents data on traditional food intake from 18 First Nations in Ontario, with results presented by ecozone (Boreal Shield, Hudson Plains and Mixedwood Plains) (Chan et al. 2014). The most frequently consumed traditional foods in the Boreal Shield ecozone (which includes the Project site) include moose, walleye, blueberries, geese, whitefish, raspberries, duck, northern pike and wild strawberries.

Contaminant Levels in Traditional Foods

Baseline information on chemical and radionuclide levels in foods harvested from the regional area in northwestern Ontario is available from scientific studies and other EAs completed in the area, and from HC guidance (Health Canada 2023). Information from some of these references is presented further below. As indicated in Section 14.3, the NWMO plans to undertake a tissue sampling program which will be used to support the desktop study details presented herein.

The Nokiiwin Tribal Council Country Foods Study (CanNorth 2016) provides concentration data for a number of metals in water, fish, birds, hare, moose and berries, collected from locations around Lake Nipigon. Concentration data were compared to federal and provincial guidelines, regional data and chemical concentrations in supermarket foods that the general Canadian population is exposed to. Overall, metal concentrations in the food samples were found to be similar to or lower than the guidance, HC's total dietary study values and regional data, with two exceptions: (i) mercury levels in fish were above the consumption guideline, and (ii) lead concentrations were high in some samples, likely attributable to the use of lead shot when hunting. The study cites some uncertainties, mainly low sample size (CanNorth 2016).

The First Nations Food, Nutrition and Environment Study (Chan et al. 2014) presents data on contaminant levels in drinking water and traditional food, based on samples collected from 18 participating communities, 10 of which are within the Boreal Shield ecozone where the Project site is located. Contaminants measured included metals, polychlorinated biphenyls and pharmaceuticals. In the Boreal Shield ecozone, levels of most contaminants in drinking water were below guideline values. Uranium levels were above guideline values in 22 households in two communities. To evaluate if there was any health risk of exposure at the levels of the contaminants found in traditional food, contaminant intake was compared to HC guidelines for the protection of health. Based on consumption patterns within the Boreal Shield ecozone that were current at the time of the study, the risk of exposure to contaminants through traditional food was found to be negligible for most adults. However, higher concentrations of mercury were found in predatory fish within the subarctic areas of the Boreal Shield ecozone, indicating an elevated risk of exposure to mercury, particularly for women of child-bearing age (Chan et al. 2014).

Where there are known contaminant issues in traditional foods (such as mercury in fish), tools like restrictions and advisories are used to inform consumers and guide their decision making. As outlined in the MECP's interactive tool, Guide to Eating Ontario Fish (MECP 2023), a fish consumption advisory is in place for a number of lakes in the broader area, including Long Lake (mercury and polychlorinated biphenyls), Stormy Lake (mercury), Wabigoon River- Upstream of Dinorwic Lake (mercury), Rock Lake (mercury), Dinorwic Lake including Stanawan Bay (mercury), Hartman Lake (mercury), Butler Lake (mercury), Wabigoon Lake (mercury and polychlorinated biphenyls) and Thunder Lake (mercury and polychlorinated biphenyls). In these lakes, the most common fish with consumption advisories in place include Black Crappie (*Pomoxis negromaculatus),* Cisco (Lake Herring; *Coregonus artedi*), Lake Whitefish (*Coregonus clupeaformis)*, Muskellunge (*Esox masquinongy*), Northern Pike (*Esox Lucius*), Redhorse Sucker (*Moxostoma spp.)*, Rock Bass (*Ambloplites rupestris*), Sauger (*Sander canadensis*), Smallmouth Bass (*Micropterus dolomieu*), Walleye (*Sander vitreus*), White Sucker (*Catostomos commersonii*), Yellow Perch (*Perca flavescens*) and Lake Trout (*Salvelinus namaycush*). It should be noted that neither mercury nor polychlorinated biphenyls are expected to be released by the Project. However, they are part of the existing baseline.

15.4.2 Planned Work

As discussed in Section 14.13, the NWMO's environmental data collection program includes a participatory tissue sampling program through which local community members can submit relevant foodstuffs for chemical and radiological analysis. This includes fish, wild game, fruits and vegetables, medicinal plants, maple syrup, and honey. In addition to continuing the participatory tissue sampling program, the NWMO will implement a targeted campaign to ensure that traditional foods consumed by Indigenous groups and local communities are sampled from a well-distributed area. These data will be reported in the initial licence application to the CNSC, and the Impact Statement.

The NWMO will continue to work with the Indigenous communities and the public to assess and report on the social, economic impacts of the Project as required by the NFWA.

15.5 Population and Demographics

15.5.1 Currently Available Baseline Data

Population and Demographics
Population and demographics are key to understanding a community's characteristics.
The population in a given region can drive changes to aspects of community life, including demand for infrastructure and services, housing, education, outdoor recreation, and CSWB plans. The following presents existing and historical census and qualitative data on population trends for

communities in proximity to the site. Potential future population trends without the Project are referred to here as the baseline population trend. Projections were completed to reflect three different scenarios to present the possible range of population growth.

This section includes population trends and demographic information for municipalities. Population information includes Indigenous residents within municipalities. Statistics Canada's definition of Indigenous identity refers to whether a person identified with the Indigenous Peoples of Canada and includes those who identify as First Nations, Métis, and/or Inuk (Inuit), and/or those who report being Registered or Treaty Indians (that is, registered under the federal *Indian Act* [Government of Canada 1985f]), and/or have membership in a First Nation or Indian band" (Statistics Canada 2023). Data on First Nations populations or Indigenous residents within municipalities are not intended to represent a full picture of these populations and should not be considered fully representative as it has also not been verified by these communities.

First Nations Communities

Population data for on-reserve and off-reserve First Nations are limited to public Statistics Canada and CIRNAC. Note that the availability of data differs among First Nations on-reserve communities described below. Overall, where subsets of populations are fewer than 100 people, caution is to be taken when interpreting data. There is random rounding to a multiple of 5 or 10 for a small population, and this results in proportions that do not always add up to 100 percent.

Wabigoon Lake Ojibway Nation

Population trend: As of 2021, the total registered population was 886 members (ISC 2022). According to Statistics Canada, 175 members were living on-reserve at that time—90 males and 85 females (Statistics Canada 2022a). ISC reported 189 members living on-reserve. The remaining 697 members were living off reserve (ISC 2022). Between 1991 and 2021, the on-reserve population experienced an average annual growth rate of 1.95 percent (Statistics Canada 1992, 2022a).

Demographic: In 2001 the median age was 27.8 and in 2021 it was 42.4 (Statistics Canada 2002, 2022a). In 2021, in WLON, of the 45 on-reserve families, 22 percent were married-couple families, 56 percent were common-law couple families, and 22 percent were female lone-parent families (Statistics Canada 2022a).

Eagle Lake First Nation

Population trend: In 2021, the total registered population was 645 members (ISC 2022). According to Statistics Canada, there were 257 members living on-reserve – 140 males and 120 females (Statistics Canada 2022a). In contrast, ISC reported 378 members living on-reserve. The remaining 267 members were living off reserve (ISC 2022). Between 1991 and 2021, the on-reserve population experienced an average annual growth rate of 1.59 percent (Statistics Canada 1992, 2022a).

Demographic: In 2001 the median age was 28.9 and in 2021 it was 32.8 (Statistics Canada 2002, 2022a). In 2021, of the 75 families on-reserve in the 2021 Census, 20 percent were married-couple families, 33 percent were common-law couple families, 33 percent were female lone-parent families, and the remaining 20 percent were male lone-parent families (Statistics Canada 2022b).

Lac Seul First Nation

Population trend: In 2021, the entire registered population was 3,640 (ISC 2022). According to Statistics Canada, there were 1,022 members living on-reserve – 535 males and 490 females (Statistics Canada 2022a). In contrast, ISC reported 989 members living on-reserve. The remaining 2,651 members were living off reserve (ISC 2022). Between 1996 and 2021, the on-reserve

population experienced an average annual growth rate of 1.54 percent (Statistics Canada 1992, 2022a).

Demographic: In 2001 the median age was 22.6 and in 2021 it was 25.6 (Statistics Canada 2002, 2022a). In 2021, of the 230 families on-reserve, 26 percent were married-couple families, 35 percent were common-law couple families, 24 percent were female lone-parent families, and the remaining 17 percent were male lone-parent families (Statistics Canada 2022a).

Lac Des Mille Lacs First Nation

Population trend and demographic: In 2021, the entire registered population was 626, and between 2002 and 2021the off-reserve registered population was 626 (ISC 2022). Members of Lac des Mille Lacs First Nation who live off reserve are included in the total population counts of the community where they live (e.g., a Lac des Mille Lacs First Nation member living in Dryden would be counted in Dryden's population). Statistics Canada suppressed all data for the on-reserve population of Lac des Mille Lacs First Nation for each Census period except in 2006 (Statistics Canada 2002, 2007, 2012, 2017, 2022). Each Census of Population, except for 2006, reported a population of 0 residents because Statistics Canada does not report any information when there is a non-response rate higher than 25% and rounds to the nearest five for total populations of 15 or less individuals (Statistics Canada 2012).

Seine River First Nation

Population trend:

In 2021, the entire registered population was 806 (ISC 2022). According to Statistics Canada, there were 270 members living in on-reserve – 135 males and 140 females (Statistics Canada 2022a). In contrast, the ISC reported 372. The remaining 434 members were living off reserve (ISC 2021). Between 2001 and 2021, the on-reserve population experienced an average annual increase of 0.8 percent (Statistics Canada 2022a).

Demographic: In 2001 the median age was 22.8 and in 2021 it was 33.6 (Statistics Canada 2002, 2022a). In 2021, of the 70 on-reserve families, 14 percent were married-couple families, 36 percent were common-law couple families, 43 percent were female lone-parent families, and 14 percent were male lone-parent families (Statistics Canada 2022a). In 2021, there were 434 members living off reserve (INAC 2002, 2007, 2012, 2018; ISC 2022).

Non-Indigenous Communities

Kenora Census Division

Population trend: The population increased from 58,748 in 1991 to 66,000 in 2021 (33,400 males and 32,600 females) for an annual average growth rate of 0.39 percent (Statistics Canada 1992, 2022a). In 2001, the median age was 34 years of age, and in 2021 it was 37.6 years of age (Statistics Canada 2002, 2022a). Some of the communities in the Kenora CD have notable increases in the population during summer months due to seasonal camps, cabins and cottages.

The baseline population trend for the Kenora CD over the next 30 years ranges from 68,849 in 2046 for the conservative growth scenario to 93,541 in 2046 for the optimistic growth scenario. The optimistic growth range uses the Ontario historical annual average growth rate, which was 1.16 percent. The optimistic growth scenario serves as an upper bound to population growth and would require substantial in-migration to reach this level of population (Statistics Canada 2017; InterGroup 2024).

Demographic: Couple families represented 76 percent of families in the 2021 Census (53 percent married couples and 23 percent common-law couples, 24 percent of lone-parent families) (Statistics Canada 2022a). Within the Kenora CD, 49 percent of the population identifies as

Indigenous (Statistics Canada 2022a). There are 47 Indigenous reserves and settlements within the Kenora CD; these Indigenous communities can consist of one or multiple reserve parcels.

Ignace

Population trend: In 2021, Ignace had a population of 1,205 (615 males and 590 females). The population of Ignace has decreased from 1,935 in 1991 to 1,206 in 2021 for an average annual growth rate of -1.56 percent (Statistics Canada 1992,2022a). The population has generally remained unchanged since 2011.

The baseline population trend for Ignace over the next thirty years ranges from a decrease to 866 in 2046 for a conservative growth scenario to an increase to 2,039 in 2046 for an optimistic growth scenario (InterGroup 2024).

Demographics: In 2001, the median age was 37.0 years of age, and in 2021 it was 53.6 years of age (Statistics Canada 2002, 2022a). Ignace experienced a 53 percent decline in the total number of youths (i.e., residents between the ages of 15 to 29) between 1996 to 2021 (Statistics Canada 1998, 2022a).In 2021, of the 385 census families 57 percent were married-couple families, 24 percent were common-law couple families, 11 percent were female lone-parent families, and 5 percent were male lone-parent families. (Statistics Canada 2022a).

The visible minority population in Ignace increased from 0.8 percent in 1996 to 4.1 percent in 2021 (Statistics Canada 1998, 2022a). The Indigenous-identity population in Ignace increased from 5 percent in 1996 to 18 percent in 2021 (Statistics Canada 1998, 2022a).

Dryden

Population trend: In 2021, Dryden had a population of 7,388 (3,590 males and 3,800 females). The population of Dryden has increased from 6,505 in 1991 to 7,388 in 2021 for an average annual growth rate of 0.4 percent (Statistics Canada 1992, 2022a). Dryden saw a notable increase in population from 1996 to 2001 after the amalgamation of Dryden and Barclay formed the City of Dryden.

The baseline population trend for Dryden includes a range of population growth models with a lower bound of 6,466 due to an economic downturn to an upper bound of 8,536 due to a mining project coming online. The upper bound assumes an in-migration of 150 residents due to this mining project (InterGroup 2024).

Demographic: In 2001, the median age was 38.2 years of age, and in 2021 it was 48.0 years of age (Statistics Canada 2002, 2022a). The youth population in Dryden decreased from 20 percent in 1996 to 17 percent in 2021 (Statistics Canada 1998, 2022a). In 2021, of the 2,130 census, families 65 percent were married-couple families, 18 percent were common-law couple families, 12 percent were female lone-parent families and 4 percent were male lone-parent families (Statistics Canada 2022a).

The visible minority population in Dryden increased from 0.9 percent in 1996 to 4.1 percent in 2021 (Statistics Canada 1998, 2022a). The Indigenous-identity population in Dryden increased from 6 percent in 1996 to 19 percent in 2021 (Statistics Canada 1998, 2022a). Key person interviews in Dryden indicated that the Indigenous-identity population in 2021 was undercounted in the Census (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

Sioux Lookout

Population trend: In 2021, Sioux Lookout had a population of 5,839 (2,900 males and 2,940 females). The population in Sioux Lookout increased from 3,311 in 1991 to 5,839 in 2021 for an average annual growth rate of 1.9 percent (Statistics Canada 1992, 2022a).

The 2021 Sioux Lookout Community Profile (municipality of Sioux Lookout 2021) included a population projection to 6,378 residents by 2031. This growth in population would represent an average annual growth of 1.28 percent, which is greater than the historical growth of 1.16 percent for Ontario from 1996 to 2021 (InterGroup 2024).

Demographic: In 2001, the median age was 33.5 years of age, and in 2021 it was 38.0 years of age (Statistics Canada 2002, 2022a). The youth population in Sioux Lookout decreased from 23 percent of the total population in 1996 to 19 percent in 2021. However, the total number of youths increased over the same period. The proportional decrease in youth population was due to a large increase in total population (Statistics Canada 2007, 2022a). In 2021, of the 1,635 census families, 56 percent were married-couple families, 20 percent were common-law couple families, 14 percent were female lone-parent families, and 5 percent were male lone-parent families. (Statistics Canada 2022a).

The visible minority population in Sioux Lookout has increased from 1.9 percent in 1996 to 7.1 percent in 2021 (Statistics Canada 2007, 2022a). The proportion of the population who identifies as Indigenous in Sioux Lookout increased from 28 percent in 1996 to 36 percent in 2021 (Statistics Canada 1998, 2022a).

Sioux Lookout has the largest Indigenous population in comparison to the other communities in proximity to the Project site, which can be attributed to more Indigenous Peoples moving to Sioux Lookout from communities north of Sioux Lookout as it is an important service hub for northern communities (Northwestern Ontario Community and Baseline Studies Key Person Interview Program 2022; Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

Local Service Board of Wabigoon

Population trend: In 2021, the LSB of Wabigoon had a population of 419 (235 males and 185 females). The population of the LSB of Wabigoon in 2006 was 417 and in 2021 it was 419 (Statistics Canada 2007, 2022a). During the summer months it is estimated that the population can increase by 50 to 60 percent due to seasonal residents (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

Demographic: In 2011 the median age was 43.4, and in 2021 it was 49.2 (Statistics Canada 2022a). The youth population in the LSB of Wabigoon has remained around 13 percent since 2011 (Statistics Canada 2022a). In 2021, of the 110 census families, 60 percent were married-couple families, 30 percent were common-law couple families, 18 percent were female lone-parent families, and 4 percent were male lone-parent families. (Statistics Canada 2022a). The Indigenous-identity population in the LSB of Wabigoon was 51 percent in 2016 and 63 percent in 2021 (Statistics Canada 2017, 2022a).

15.5.2 Summary

Municipal population levels in the communities have varied from 1991 to 2021, with Sioux Lookout and Dryden experiencing an increase, Ignace experiencing a decrease, and the LSB of Wabigoon experiencing a relatively flat population. With the exception of Ojibway Nation of Saugeen, on-reserve populations have increased, between 2001 and 2021. From 2001 to 2023, the total registered Indian population of the Lac des Mille Lacs First Nation increased (491 registered members in 2001 and 626 registered members in 2021).

The area population has historically been affected by changes in the resource-based economy, (e.g., mining, forestry) and their associated labour force demands. Baseline population projections in the area in the absence of a major economic driver (e.g., mining) forecast a modest population increase over the next 30 years. Sioux Lookout is a notable exception where the population has not aged to the same extent as other communities and there is a larger proportion of youth.

Municipal communities share demographic trends including an aging population, and a decrease in number of persons per census family. The proportion of the population who identify as Indigenous has increased, which is consistent with national trends. This population is increasing at a faster rate than the non-Indigenous identity population and has a younger age structure. The Kenora CD is forecasted to grow at a higher rate due to a younger age structure compared to other communities in proximity to the Project site. The increase in the proportion and number of people who identify as Indigenous mirrors population trends noted by Statistics Canada, which projects the Indigenous-identity population in Canada will increase at a faster rate than the non-Indigenous identity population through 2041. Reasons include a higher fertility rate, changes in self-reporting, and legislative changes.

15.5.3 Planned Work

The NWMO considers the community and culture baseline study to be sufficiently advanced to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts to non-Indigenous peoples presented in Section E of the IPD There is no additional planned work to collect additional baseline social data on the public data other than an update with 2026 Census data.

The NWMO will update or produce additional Social, Cultural, Economic, and Health Baseline studies to meet the need of the regulatory process once the NWMO starts working with First Nations and Métis communities as part of the integrated initial licence application and Impact Statement.

The NWMO will continue to work with the Indigenous communities and the public to assess and report on the social, economic impacts of the Project as required by the NFWA.

15.6 Community and Culture

15.6.1 Currently Available Baseline Data

The topics described in community and culture are community history, community character, food security, and community well-being. Key themes identified for the communities include the importance of the small-town feel, the accessibility and closeness to nature, and the resource-based economy.

Community well-being can be defined as, "The social, economic, environmental, cultural, and political conditions identified by individuals and their communities as essential for them to fulfill their potential," (Wiseman and Brasher 2008). The Community Well-Being Index measures the socio-economic well-being of Canadian communities over time as an indication of progress made to improve the health and well-being of communities (ISC 2023). The index encompasses four components: education, labour, income, and housing, which are combined to provide each community with a score out of 100. The Community Well-Being Index components are based on and limited to census data, which have not been verified by Indigenous communities, and they do not represent a complete list of dimensions of community well-being, nor do they necessarily reflect community values. Composite Community Well-Being Index data are presented for each of the municipal communities (InterGroup 2024).

Regional Context

Indigenous Peoples have inhabited northwestern Ontario since time immemorial. Petroglyphs (carved rock) and pictographs (painted rock) found on exposed rock surfaces, as well as burial grounds and other cultural sites found throughout northwestern Ontario bear witness to the presence of Indigenous Peoples for thousands of years prior to European colonization and settlement in the late 19th and early 20th centuries (Guertin and Joly 2008). The Anishinaabeg view their relationship with the natural environment as fundamental (Mainville 2007). The Anishinaabeg

practices of kiigookewin (fishing), Manitou Gitigaan (Great Spirit's Garden), kiiose'win (hunting), and onii'igewin (trapping) speak to the intimate relationship between the Anishinaabeg People and the lands of what is now referred to as northwestern Ontario. The Anishinaabeg traded products such as isinglass, a highly valued product from sturgeon bladders and were traditionally adept at Maanchi chi' ga'win, managing game, further displaying the deep relationship with and respect for the land and its resources (Grand Council Treaty #3 2011).

In the 19th century, traditional farming practices and the production of foods like corn, potatoes, and other crops were important to their economy and a major source of food for their growing population as well as for fur traders and settlers. The Anishinaabeg traditionally had comprehensive knowledge of the forest and plants for medicinal, practical, and sacred purposes (Grand Council Treaty #3 2011). On October 3, 1873, Treaty #3 was signed via ceremony and signified the beginning of the involvement of the Crown in the lands already occupied by 28 First Nations (Grand Council Treaty #3 2011).

Community Profiles of First Nations and Métis Communities

Table 15.1 provides the profiles of Indigenous communities that has been validated with the communities listed.

Table 15.1: Community Profiles of First Nations and Métis Communities

Community	Profile
Host First Nation	
WLON	**Population**—Approximately 183 members on-reserve and 998 off reserve (CIRNAC 2025a). **Location**—Located approximately 19 km southeast of Dryden, Ontario. The DGR is located approximately 21 km southeast of the WLON reserve lands. **Governance**—Chief Clayton Wetelainen leads WLON with four councillors. The next election will be held on September 20, 2027. **Website**—https://www.wabigoonlakeon.ca **Other**—In November 2024, the people of WLON via a grassroots demonstration of willingness by community signed the Hosting Agreement confirming that they are a willing and informed First Nation, supportive of hosting the Project within their territory. The NWMO has a confidential Hosting Agreement with WLON. WLON is a signatory to Treaty 3 and a member of the Bimose Tribal Council and Grand Council Treaty #3.
Other First Nations and Métis Communities	
ELFN	**Population**—Approximately 361 members on-reserve and 306 off reserve (CIRNAC 2025b). **Location**—The DGR is located approximately 60 km southeast of the ELFN reserve lands. **Governance**—Chief Bernadette Wabange has led ELFN with three councillors since October 2024. The next election will be held on October 7, 2026. **Website**—https://eaglelakefn.ca **Other**—ELFN is a signatory to Treaty 3 and a member of the Bimose Tribal Council and Grand Council Treaty #3. ELFN is challenging the NWMO's site selection through a Judicial Review, launched in December 2024.

Community	Profile
Lac Seul First Nation	**Population**—Approximately 924 members on-reserve and 2,918 off reserve (CIRNAC 2025c). **Location and Proximity to DGR**—The DGR is located approximately 64 km south of the Lac Seul First Nation reserve lands. **Governance**—Chief Clifford Bull leads the Nation, with councillors representing communities including Frenchman's Head, Kejick Bay, and Whitefish Bay. The next election will be held on November 13, 2026. **Website**—https://lacseulfn.org **Other**—Lac Seul First Nation is made up of the communities of Frenchman's Head, Kejick Bay, and Whitefish Bay. It operates a self-government and manages the day-to-day operations of the Nation. Lac Seul is part of the Independent IFNA and the NAN and is a signatory to Treaty #3.
Wabauskang First Nation	**Population**—Approximately 142 members on-reserve and 251 off reserve (CIRNAC 2025d). **Location**—The DGR is located approximately 115 km southeast of the Wabauskang First Nation reserve lands. **Governance**—Chief William (Bill) Petiquan has led the Wabauskang First Nation with three councillors since June 2024. The next election will be held on June 8, 2027. **Other**—Wabauskang First Nation is a Saulteaux First Nation in northwestern Ontario, and is a member of the Bimose Tribal Council and the Grand Council Treaty #3. Their reserve is located at Wabauskang 21.
Grassy Narrows First Nation	**Population**—Approximately 969 members on-reserve and 610 off reserve (CIRNAC 2025e). **Location**—The DGR is located approximately 145 km southeast of the Grassy Narrows First Nation reserve lands. **Governance**—Chief Sherry Starr Ackabee leads Grassy Narrows First Nation with four councillors since October 2024. The next election will be held on October 22, 2026. **Other**—Asubpeeschoseewagong First Nation (also known as Grassy Narrows First Nation) is an Ojibwe First Nations band government and is a member of the Bimose Tribal Council and Grand Council Treaty #3.
Naotkamegwanning First Nation (Whitefish Bay First Nation)	**Population**—Approximately 718 members on-reserve and 602 off reserve (CIRNAC 2025f). **Location**—The DGR is located approximately 117 km east of the Naotkamegwanning First Nation reserve lands. **Governance**—Gary Tom, with four councillors, has led the Nation since 2023. The next election will be held on December 8, 2025. **Other**—Naotkamegwanning First Nation, formerly known as Whitefish Bay First Nation, is an Ojibwe Nation in the Treaty #3 Territory, located near Sioux Narrows and about 45 minutes from Kenora, Ontario on Lake of the Woods. The Nation has four reserves: Whitefish Bay 32A (1954.3 ha), which is the main reserve; Yellow Girl Bay 32B (1,802.5 ha); Sabaskong Bay 32C (518 ha); and Agency 30 (379 ha), which is shared with 12 other First Nations.
Lac des Mille Lacs First Nation	**Population**—Approximately 7 members on-reserve and 653 off reserve (CIRNAC 2025g). **Location**—The DGR is located approximately 107 km northwest of the Lac des Mille Lacs First Nation reserve lands. **Governance**—Chief Judith Celeste Maunula with five councillors has led the Nation since November 2024. The next election will be held on November 26, 2027. **Website**—https://lacdesmillelacsfirstnation.ca **Other**—Lac des Mille Lacs First Nation, also known as Nizaatikoong, is a Saulteaux Ojibwe band government. The Nation owns two reserves in the Thunder Bay District

Community	Profile
	of Ontario: Lac des Mille Lacs 22A1 on the northeastern shore of Lac des Mille Lacs and Lac des Mille Lacs 22A2 at the junction of the Seine and Firesteel Rivers.
Ojibway Nation of Saugeen	**Population**—Approximately 83 members on-reserve and 147 off reserve (CIRNAC 2025h). **Location**—The DGR is located approximately 144 km southwest of the Ojibway Nation of Saugeen reserve lands. **Governance**—Chief John Machimity has led Ojibway Nation of Saugeen with three councillors since October 2023. It is unknown when the next election is to occur. Website—https://www.ojibwaynationofsaugeen.ca/ **Other**—The Ojibway Nation of Saugeen, nestled in northwestern Ontario within the Thunder Bay District, lies approximately 20 km northwest of Savant Lake.
Seine River First Nation	**Population**—Approximately 360 members on-reserve and 480 off reserve (CIRNAC 2025i). **Location**—The DGR is located approximately 84 km west of the Seine River First Nation reserve lands. **Governance**—Chief Shane Curtis Whitecrow has led the Seine River First Nation with eight councillors since 2024. The next election will be held on February 10, 2026. **Website**—https://seineriverfirstnation.ca **Other**—Seine River First Nation has three Indian Reserve tracts. Their main reserve is Seine River 23A, known in the Ojibwe language as Ashkibwaanikaaning. The second is Seine River 23B, called Mitaawangwe-ziibiing in Ojibwe. The third is Sturgeon Falls 23, referred to as Name-gojijiing in the Ojibwe language.
Northwestern Ontario Métis Community	The NWOMC represents and serves Métis citizens in northwestern Ontario. It is made up of four chartered community councils: the Atikokan Métis Council, Kenora Métis Council, Northwest Métis Council, and Sunset Country Métis Council. The councils are part of the Métis Nation of Ontario and represent citizens at the local level. **Governance**—These councils come together to make up the regional community. The region is also represented by the Regional Consultation Committee (RCC). The RCC is a decision-making body that works to protect of representatives from each Community Council, the Regional Councillor for northwestern Ontario, and the regional Captain of the Hunt. **Website**—https://www.nwomc.ca **Consultation Protocol for Treaty 3**

DGR = Deep Geological Repository; ELFN = Eagle Lake First Nation; IFNA = Independent First Nations Alliance; NAN = Nishnawbe-Aski Nation; NWMO = Nuclear Waste Management Organization; NWOMC = Northwestern Ontario Métis Community; RCC = Regional Consultation Committee; WLON = Wabigoon Lake Ojibway Nation.

Ignace

The history of what is now the Township of Ignace spans back to the presence of First Nations peoples, and red ochre pictographs can be found on the flat surfaces of the Canadian Shield at waterbodies surrounding the Township (Barr 1979). Ignace was established in 1879 when the Canadian Pacific Railway was being built. The Township of Ignace became incorporated in 1908 and remained a railroad town until the 1950s. Ignace's economy has included rail, mining, and forestry. Transportation maintains a key role in Ignace's local economy, as the railway, Trans-Canada Highway (built in the late 1930s), and a pipeline remain. The Township also remains a tourism hub, offering visitors the opportunity for wilderness exploration including popular activities like hunting and fishing (InterGroup 2024).

Residents perceive Ignace as a safe, close-knit community where they take pride in their connection to nature, emphasizing the importance of fresh air, clean lakes, and the area's natural

beauty, which contributes to the community's appeal for both residents and visitors (Local Social, Cultural and Health Workshop 2021). The community values unity, cooperation, integrity, resilience, and environmental preservation (TD Graham & Associates 2019), with a vision to become a livable and vibrant "small-town" (InterGroup 2020).

Between 2006 and 2016, the total average Community Well-Being Index score was 73.6 (ISC 2023). A primary challenge related to the higher cost of foods in Ignace is the lack of market competition. Ignace has a higher unit price across all food basket categories when compared to Dryden and Thunder Bay (InterGroup 2024). This financial barrier is particularly challenging for residents, such as the senior population, who may not have the means to travel to a larger, nearby urban centre, such as Dryden, to purchase groceries at a lower cost (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023). Among communities in proximity to the Project site, Ignace has the largest household and personal income disparity (Statistics Canada 2022q).

Dryden

Of particular importance to Dryden's heritage is Paawidigong, the place of the rapids, which served as the camp and meeting place of the Anishinaabe peoples on the Wabigoon River. Lumber operations and gold prospecting began in the Wabigoon Lake area in the 1880s with construction of the Canadian Pacific Railway (Bray 2012). Dryden was incorporated as a town in 1910 and incorporated as a city in 1998. Pulp and paper have and continues to contribute heavily to the city's economy. Situated on the shores of the Wabigoon and Thunder Lakes in the heart of the Kenora District, Dryden is known for its abundance of outdoor opportunities (MDB Insight 2019). Dryden remains a service hub for surrounding communities, with many of the city's major businesses being located along Highway 17 for greater accessibility for visitors (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

The Dryden , Machin, and Area CSWB plan provides a framework for communities and local interested parties to promote and maintain community safety (MNP 2021). The Plan's mission is to "bring people together to advance inclusion, build upon our resilience and strengthen our community connections for a safer Dryden, Machin, and Area." The CSWB Plan's goals are broken down into actionable items with targeted objectives, outputs/outcomes and responsible parties (MNP 2021).

Between 2006 and 2016, the total average Community Well-Being Index score was 79 (ISC 2023). A significant barrier in the community is an increase in food insecurity. The most recent demographic information from the Dryden Food Bank shows that 63 percent of clients identify as Indigenous, 53 percent are female, and 30 percent are under the age of 18, with the most frequent visitors being individuals between the ages of 19 and 35 (Northwestern Ontario Baseline Studies Key Person Interview Program, 2022-2023). The primary reasons for the number of residents facing food insecurity in Dryden include high food costs in the community and the community's reliance on major employers such as lumber and paper, industries that have seen partial closures and large layoffs (Northwestern Ontario Baseline Studies Key Person Interview Program, 2022–2023).

Sioux Lookout

The name "Sioux Lookout" originates from the area's use of the Sioux Mountain vantage point for guards to see visitors travelling the English River route and is rooted in the battle between the Anishinaabe and Sioux Nations. This area also served as a hub for trading goods, including fur and forestry products. Sioux Lookout was connected to the railway in 1912 and became a railway terminal in the early 1900s before transitioning to a gold and iron mining town and aviation centre (municipality of Sioux Lookout, 2020a).

Sioux Lookout was incorporated in 1912. Formerly known as a rail hub, today Sioux Lookout remains a service hub for northern Ontario, connecting 31 remote northern communities and First Nations and over 30,000 Ontarians to essential services and features one of the busiest airports in the province (MHBC Planning 2013). The Sioux Lookout Canadian National Railway Station, constructed in 1911 is a heritage site. Residents are involved in their community, with the town coming together for annual festivals and events to maintain a lively arts and culture scene. The abundant natural resources that surround the community form the basis of the Sioux Lookout lifestyle, where residents embrace community, diversity, and the great outdoors (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

Between 2006 and 2016, the total average Community Well-Being Index score is 80.3 (ISC 2023). According to the churches operating the local food bank, food insecurity in Sioux Lookout is on the rise due to inflation and rising food costs. The food bank relies on community donations and volunteers to remain operational (Brody 2022). Sioux Lookout has the lowest household and personal income disparity in comparison to the other communities in proximity to the Project site (Statistics Canada 2022e).

Local Services Board of Melgund

The LSB of Melgund includes Dyment and Borups Corners. Dyment, located on Melgund Lake, was established in 1898. The LSB of Melgund is a not-for-profit organization supported by volunteers that holds the authority to provide its communities with arts, culture, and recreation services (InterGroup 2024). Melgund is a quiet community where individuals enjoy spending time in nature and can find outdoor activities to enjoy (Northwestern Ontario Baseline Studies Key Person Interview Program, 2022-2023). Residents of the area feel supported by their community and feel that neighbours are willing to lend a helping hand. Residents enjoy gathering at the local hall to socialize, where events such as playing music together, game nights, and holiday celebrations (e.g., Canada Day) occur. Challenges in Melgund include a lack of space and funding for development, limited resources/services, and a lack of community gathering spaces (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

Local Services Board of Wabigoon

Wabigoon is seen as a community with shared pride where residents choose to live an outdoor lifestyle, taking part in activities such as hunting and fishing and enjoy opportunities to be in nature. The community is considered to be cohesive; residents are largely looking for the same opportunities and development in their community, and when challenges arise, community members unite (Northwestern Ontario Baseline Studies Key Person Interview Program, 2022-2023).

15.6.2 Summary

Key cultural themes identified across communities include the importance of the small-town feel, the accessibility and closeness to nature, and the resource-based economy. Ignace, Dryden, and Sioux Lookout saw a relatively consistent Community Well-Being score from 2006 to 2016. In 2016, Ignace had the lowest Community Well-Being score of 75 and Sioux Lookout had the highest score of 80. Food insecurity is growing across northwestern Ontario, as challenges such as poverty, inflation, addictions, mental health, lack of education and/or employment opportunities, and other social issues continue to affect peoples' ability to obtain an affordable, healthy, and culturally appropriate diet. Cultural food access is a key issue in northwestern Ontario (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023). Rates of food insecurity are often highest amongst individuals of low socio-economic status, Indigenous Peoples, newcomers to Canada, single parent households, and individuals living on social assistance (MNP 2021).

15.6.3 Planned Work

The NWMO considers the community and culture baseline study to be sufficiently advanced to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts to non-Indigenous peoples presented in Section E of the IPD.

The NWMO will update or produce additional Social, Cultural, Economic, and Health Baseline studies to meet the need of the regulatory process once it starts working with First Nations and Métis communities as part of the integrated initial licence application and Impact Statement.

The NWMO will continue to work with the Indigenous communities and the public to assess and report on the social, economic impacts of the Project as required by the NFWA.

15.7 Infrastructure and Services

15.7.1 Currently Available Baseline Data

The Social, Cultural, Economic, and Health Baseline Studies, Preliminary Report for Engagement, WLON-Ignace Area (InterGroup 2024) describes the available built municipal infrastructure and social services. Infrastructure descriptions include consideration of current capacity and the potential to expand capacity in the future, including planned expansions and any barriers for expansion.

Ignace

Ignace's infrastructure was originally built for a larger population than what currently exists. The water treatment and distribution system in Ignace was built in 2009 with a 50-year useful life. It is in good condition with considerable remaining life (WSP 2022a). The treatment plant has a capacity of 2,730 m^3/day and was designed to serve a population of 2,400. Currently, the operational capacity of the facility is limited to serving a population of approximately 1,870 people or approximately 2,000 m^3/day. Michel Lake (located north of the Township) is the community's main water source (WSP 2022a). Built in the 1980s with design capacity for a population of 2,400, the sewage treatment plant is nearing the end of its 50-year lifespan (WSP 2022a). The performance and age of the facility have limited its ability to achieve full design capacity, and it has limited capacity to accommodate future growth. Independent of the Project, it will need upgrades or replacement over the next 10 years. For example, upgrades to its chemical storage and chemical process are currently required. The sewers and manholes are approximately 45 years old, with an expected lifespan of 60 to 80 years. The existing sanitary manholes and sewers will not require replacement until approximately 2036 and appear to be in good working condition despite their age (WSP 2022a).

Ignace manages its own curbside solid waste collection and disposal and operates the landfill site. The landfill site has a remaining capacity of 175,000 m^3. The Township is currently developing a waste management strategic plan that includes recycling and other waste diversion tactics such as aggressive compaction of solid waste which could extend the life expectancy of the landfill past 2056 (WSP 2022a). The site is used by several adjacent unorganized townships in the surrounding area for an estimate of approximately 5,000 resident users served by the landfill (Pinchin 2021).

The Township has stated that its growth plan can support a maximum of 5,000 residents (HSAL et al. 2022). As of 2021, Ignace has a large percentage of two person households at 46 percent compared to the Ontario average of 33 percent (Statistics Canada 2022a). This can be attributed to the large proportion of residents who are 55 years and older and may not have any children living at home (Statistics Canada 2022a). The number of single and semi-detached homes was maintained between 2016 and 2021 at 520. The number of apartments decreased by 30 from

45 to 15. There are currently around 160 vacant lots in Ignace planned for future development (Statistics Canada 2017, 2022a).

The Silver Tops is a key resource for seniors in Ignace, hosting weekly activities (exercise, book club, lunches), community events (birthdays, meetings), and more recently (2023), reconvening a housing committee to help coordinate the construction of a seniors housing complex (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

Service gaps include full-time childcare, services for seniors, and shelters. At the time of the baseline study there was an unmet need for Licenced full-time childcare in Ignace, as well as after school care and services which accommodate shift work (Northwestern Ontario Community and Baseline Studies Key Person Interview Program 2022; Ignace EarlyON Child and Family Centre Parent Focus Group 2023). There is no seniors' housing, long-term care facility, and no shelters for victims of gender-based violence (InterGroup 2024). The Keewatin Patricia District School Board operates the Ignace Public School, and the Conseil Scolaire du District Catholique des Aurores Boréales operates the École Immaculée Conception (InterGroup 2024).

The Dryden Ontario Provincial Police detachment has a satellite office in Ignace. The existing fire station does not meet current building code standards or firefighting standards. The fire department is staffed by volunteers except for the fire clerk, who works part-time. There are currently 14 active members, but it has the capacity for 25 members. In 2021, there were 68 fire emergency response calls (WSP 2022d). The Ignace ambulance base is owned by the KDSB and has two bays. Staffing includes one crew that works 24/7, paramedics (three full-time, one part-time, and three casuals), and one paramedic coordinator. In a year, the Ignace ambulance base receives about 300 calls (WSP 2022d). Burnout among emergency medical services staff is a challenge (Ignace Health and Wellness Focus Group 2023; Ignace EarlyON Child and Family Centre Staff and Parent Focus Group 2023).

Dryden

Dryden has a conventional surface water treatment plant. Water is sourced from Wabigoon Lake, located approximately 2 km from the water treatment plant (Government of Ontario 2021a). The water treatment plant currently runs at 30 percent capacity (Explorer Solutions 2022). Dryden's wastewater treatment plant was built in 2014 and has an expected lifespan of 60 years. To accommodate larger future developments, the water treatment plant would need to be upgraded (PSD 2016).

Dryden operates a full range of waste disposal services including urban and rural garbage collection. The city's landfill site is 9.5 km southwest on Highway 502 and is operated by Dryden staff. The city also provides curbside yard waste collection services every spring and fall (InterGroup 2024).

Currently, there are six childcare centres operating at capacity and with a minimal waitlist (InterGroup 2024; KDSB 2023). Most childcare options are not year-round, which can affect the ability of parents to work full-time. The KDSB office headquarters is in Dryden and residents from surrounding communities travel to Dryden to access a full suite of services offered in the city. Dryden is also a central hub for Indigenous services, so Indigenous on- and off-reserve residents travel to Dryden to access services (NWO Baseline Key Person Interview Program 2022-2023). There are social services for seniors; however, these are constrained by limited hours of operation, limited translation services for Indigenous and newcomer seniors, lack of transportation options, and limited in-home supports (MNP 2021). The Hoshizaki House Dryden District Crisis Shelter serves communities in and around Dryden, Ignace, and Vermillion Bay. It has 10 beds to provide emergency shelter for victims of domestic violence (Hoshizaki House 2023).

There are three school boards operating in Dryden. The Keewatin Patricia District School Board operates the New Prospect Elementary Public School, Open Roads School, and the Dryden High

School; The Conseil Scolaire du District Catholique des Aurores Boréales operates the École Catholique de l'Enfant-Jésus; and The Northwest Catholic District School Board operates the St. Joseph's Catholic School (InterGroup 2024).

According to the 2021 census, the City of Dryden has 3,310 occupied dwellings. There are 2,540 single-detached dwellings, along with 520 apartments, 80 row houses and other single-attached houses, and 45 movable dwellings (Statistics Canada 2022a).

Dryden has the largest Ontario Provincial Police detachment of officers in the region and provides services to Dryden, Ignace, and the unincorporated areas surrounding these municipalities (Ontario Provincial Police, 2022a). The Dryden Fire Service has two fire halls and is a composite fire service with four full-time staff and 37 pay-per-call firefighters (Loomex Group 2022b; Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023). The Dryden ambulance base is owned by the KDSB and has eight bays. Staffing for 911 response includes two crews daily and one crew at night, paramedics (11 full-time, 3 part-time, 4 casual), and one superintendent of operations (KDSB 2023f). Call volumes in Dryden have been increasing. A reason for this includes mental health and substance use issues (WSP 2022d).

Sioux Lookout

The Sioux Lookout water treatment plant was built in 1999. Water is sourced from Pelican Lake (municipality of Sioux Lookout 2021). The water distribution system assets have an average age of 23.9 years with a remaining service life of 39 years (PSD 2020). Booster stations, water tower assets, and water treatment plant assets all have less than 15 years of average service life remaining (PSD 2020). In 2022, average daily demand was measured at 1,892 m^3/day, representing 36 percent of the capacity (Northern Waterworks 2022). Nearly 85 percent of the wastewater treatment plant assets are in poor or worse condition and over 60 percent of manholes and pumping station assets are in poor or worse condition (PSD 2020). The average service life remaining is less than 15 years for manholes, pumping stations, and wastewater treatment plant assets (PSD 2020). The municipality also owns and operates a communal septic field for six residences (PSD 2020). The average condition of water infrastructure is good with a service life remaining of 23 years (PSD 2020).

Sioux Lookout owns and operates the Hidden Lake Landfill Site, located 13 km east of Sioux Lookout. The landfill has an estimated lifespan of 10 to 40 years. Sioux Lookout currently provides pick up of residential waste on a weekly basis (PSD 2020). The municipality also offers residents bi-weekly recycling pick up through a contract with B&M Delivery Services (municipality of Sioux Lookout 2021).

Four Licenced early learning and care facilities operate in Sioux Lookout (KDSB 2023). The Sioux Area Seniors Activity offers recreation and educational programs and services. The Lost Lake Seniors Drop-In Centre is located in Hudson and offers programs and community events (municipality of Sioux Lookout, 2021). First Step Women's Shelter is a 14-bed facility located in Sioux Lookout that provides support, assistance, and emergency shelter for women and children who have been physically, sexually, and/or emotionally abused (FSWS 2023a). Services to support individuals living with mental health and substance use challenges are limited in Sioux Lookout. Youth are considered to be especially at risk of mental health challenges in the community (municipality of Sioux Lookout 2020b). As part of the Ontario Addiction Treatment Centres network, the Sioux Lookout location provides walk-in treatment to individuals living with addictions, including Hepatitis C education and prevention, needle exchange, and naloxone overdose response. There are two Indigenous service providers: Sioux Lookout Meno Ya Win Health Centre and the Nishnawbe-Gamik Friendship Centre (InterGroup 2024).

Sioux Lookout educational facilities include the Sioux Mountain Public School and the Sioux North High School, operated by the Keewatin Patricia District School Board, the Sacred Heart School operated by the Northwest Catholic District School Board, the Pelican Falls First Nation High

School (a private, First Nations operated school), and the Wahsa Distance Education Centre (InterGroup 2024).

In 2021, there were 2,340 occupied dwellings and 307 unoccupied, marginal, and seasonal dwellings. Single and semi-detached housing is the largest category of dwellings, followed by apartments (Statistics Canada 2022a).

The Sioux Lookout Ontario Provincial Police detachment has a large service area. In addition to providing policing services in and around Sioux Lookout, the detachment has agreements with First Nations communities (Wapekeka First Nation, North Caribou Lake First Nation or Weagamow First Nation, and Kitchenuhmaykoosib Inninuwug First Nation or Big Trout Lake First Nation). The detachment also has agreements in place to support the Nishnawbe-Aski Police Service and the Lac Seul Police Service (Ontario Provincial Police 2022b). The Sioux Lookout fire department has two fire halls. The fire department includes a total of 35 members which are all volunteer roles (municipality of Sioux Lookout 2022a). The Sioux Lookout ambulance base is owned by the KDSB and consists of three bays. The ambulance base is staffed with two crews (24/7), paramedics (14 full-time, 6 part-time, and 3 casuals), and one superintendent of operations (KDSB 2023f).

Unincorporated Communities (Wabigoon, Melgund, Dinorwic)

Water and wastewater service for residents of Wabigoon, Melgund and Dinorwic are the responsibility of the homeowner. Service can come in the form of cisterns and water wells for water service and septic tank and field for wastewater service (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023). The Ontario Ministry of Transportation maintains ditches with culverts along the highway right-of-way corridor. Residents are responsible for water management on their own properties (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

There is no curbside garbage or recycling pick up. The MNR operates landfill sites that residents can access. Property owners in Melgund and Dinorwic may also bring their garbage and recycling to the Dryden landfill. The New Wabigoon Waste Disposal Site, located north of the LSB of Wabigoon on Dump Road is the nearest landfill to the LSB of Wabigoon, the LSB of Melgund and Dinorwic. (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

In the LSB of Wabigoon, there are 245 occupied dwellings and 21 unoccupied, marginal, or seasonal dwellings. As of 2021 in the LSB of Wabigoon, 85.3 percent of dwellings are single and semi-detached (Statistics Canada 2022a). Dinorwic has approximately 125 to 130 houses in its community, with most of the housing being single family homes (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023). Melgund has approximately 25 full-time homes (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023).

Oxdrift and Wabigoon both have volunteer fire departments that are part of the provincial Northern Fire Protection Program and managed by the Office of the Fire Marshall (Northwestern Ontario Community and Baseline Studies Key Person Interview Program 2022).

Kenora Census Division

Within the Kenora CD, there are several service providers that serve multiple communities in proximity to the Project site. The KDSB provides integrated social services, including community housing, early years services, employment and financial services, and emergency services. KDSB serves the nine municipalities within the Kenora District: City of Kenora, City of Dryden, municipality of Red Lake, municipality of Sioux Lookout, Township of Ear Falls, Township of Ignace, Township

of Pickle Lake, and Township of Sioux Narrows-Nestor Falls. Below is a list of some of the services available in the Kenora CD:

- The KDSB published a Regional Housing Strategy in 2023, which looks in depth at the existing housing situation in the region and proposed solutions for the District as a whole, as well as each municipality (NWHU, 2023a).
- Kenora-Rainy River Districts Child and Family Services provides services that aim to protect children and youth from abuse and neglect (Kenora-Rainy River Districts Child and Family Services).
- Firefly delivers a variety of programs and services to support children's well-being (Firefly 2023).
- Tikinagan Child and Family Services provides child and family services to 30 First Nations (TCFS 2023).
- Community Living Dryden-Sioux Lookout has been partnering with families and individuals living with intellectual disabilities to support their independent living in the Dryden and Sioux Lookout areas (CLDSL 2022).
- The Canadian Mental Health Association Fort Frances Branch advocates and educates, while providing residents of the Kenora-Rainy River Districts with client-centred, recovery-based services (CMHA 2023).
- Anishinaabe Abinoojii Family Service administers child protection and prevention services to 14 First Nations and five communities in the northern region of Treaty #3 Territory, including the communities of Dryden, Wabigoon and Sioux Lookout (AAFS 2021).
- Paawidigong First Nations Forum provides culturally appropriate health programs and social services to First Nations communities (PFNF 2022).
- The Métis Nation of Ontario Healing and Wellness Branch works with Indigenous and non-Indigenous partners to provide community-based and culturally appropriate programs and services to support the mental, physical, and emotional needs of Métis individuals living in the Dryden area (Métis Nation of Ontario 2022).
- Northwest Ontario Métis Child and Family Services provides prevention services, family preservation, youth services, cultural services, and repatriation services (NWOMCFS 2023).

15.7.2 Summary

Communities have an assortment of infrastructure and services that support residents' basic needs. Service delivery differs between communities. Individual communities may not have all of the services residents need, which may necessitate travel to other communities. Communities in proximity to the Project site are serviced by regional providers who may not be located in the area. Housing is recognized as a challenge by the municipalities and Indigenous Peoples. Temporary and permanent housing operates at or near capacity throughout the region. The majority of housing is single or semi-detached housing, resulting in a need for a diversity of housing in communities. All communities have a higher percentage of single and semi-detached homes as well as movable dwellings than the Ontario average. By comparison the proportion of apartments and row houses and other single-attached houses is lower than the Ontario average, with the highest percentage in Sioux Lookout.

The population in the area is aging, with an increasing proportion of seniors. Sioux Lookout is a notable exception where the population has not aged to the same extent as other communities and there is a larger proportion of youth. As the population ages, the lack of long-term care facilities, and housing and healthcare supports for seniors is a growing concern. Their absence precludes

aging in place. Out migration is a concern not only for seniors, but also for youth as youth leave the area to pursue training, education, and employment, and not return due to limited opportunities.

15.7.3 Planned Work

The NWMO considers the infrastructure baseline study sufficiently complete for the purpose of the initial licence application, and the IA process. The infrastructure section will be updated to reflect any changes in infrastructure services and planning between 2023 – 2027. The NWMO will update or produce additional Social, Cultural, Economic, and Health Baseline studies to meet the need of the regulatory process once it starts working with First Nations and Métis communities as part of the integrated initial licence application and Impact Statement.

The NWMO will continue to work with the Indigenous communities and the public to assess and report on the social, economic impacts of the Project as required by the NFWA.

15.8 Non-Indigenous Land and Resource Use

15.8.1 Currently Available Baseline Data

The NWMO carried out extensive engagement to gain insight into social considerations as well as geological and natural environment features to determine the location of the Project site with minimal important features. Within the Project site, six borehole drilling locations were chosen based on the technical needs of the Project combined with Indigenous and non-Indigenous community and organizational inputs. Potential borehole locations were also screened for cultural sites. A cultural screening examined known archaeological and historical sites using the Ontario Archaeological Sites Database. The cultural screening noted that there were no known archaeological or historical sites in or near the borehole sites. The NWMO published publicly the Natural Resources and Forestry Ignace Borehole Drilling Project, inclusive of the archaeological study, borehole drilling program plans, and Indigenous engagement reports.

The surface area occupied by the Project site, including the ERMA, is approximately 342 hectares. The entirety of the Project site is located on provincial Crown land in the Kenora Mining Division in northwestern Ontario. This region has been disturbed by tree harvesting in the past. There are no active mines, claims, or abandoned mines in the Project site, but there are several mining claims and leases within approximately 5 to 10 km of the site (Government of Ontario 2022, 2023d). The Project site is situated within trapline DR024, and the southeast corner of Bait Harvest Area DR0046. It also overlays with a small portion of the southern tip of trapline IG033. The southeast corner of the Project site overlays a small portion of Bear Management Area IG-09A-040. The Project site is within Ontario Federation of Snowmobile Clubs' District 17, which spans from Kenora to Red Lake to Thunder Bay (NWOSTA 2023). Residents use ATVs and snowmobiles through the Project site as an unofficial trail system (i.e., forestry roads) (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023). Snowmobile trails in this district connect several communities including Fort Frances, Atikokan, Ignace, Sioux Lookout, Red Lake, Dryden, and Kenora (NWOSTA 2023).

Figure 15.1 shows the traplines and bait harvesting blocks transversing or located within the Project site.

In the broader area beyond the Project site, there are a range of other land and resource uses. These include more than 90 landowner parcels (Teranet, 2022); other camps/ cottages; recreational fishing spots; a tourist camp; hiking, and all-terrain vehicle, and snowmobile trails (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023). There are no active mines, active commercial fishing licences, commercial fisheries or navigable waters (as listed in *Canadian Navigable Waters Act* [Government of Canada 1985c] schedule) in the Project site and surrounding area.

Government of Ontario administrative areas in the broader area include two Fisheries Management Zones (4 and 5) (Government of Ontario 2023d); two Wildlife Management Units (Government of Ontario 2015); one Bait Harvest Area (DR0046) (Government of Ontario 2023a); and three traplines (DR024, IG033, IG054) (Government of Ontario 2023e). Further, four Bear Management Areas (IG-05-088, IG-05-090, DR-09A-020, DR-05-071) (Government of Ontario 2023b) are in the broader area. The Project site is predominantly in the Wabigoon Forest Management Unit, but it also extends into the Dryden Forest Management Unit to the north (Government of Ontario 2022). The NWMO understands that these management zones are ministry-regulated resources and not necessarily indicative of traditional land and resource use by Indigenous Peoples.

Outfitting and guiding is a critical part of tourism to the communities in the area around the Project site. Outfitters and guides offer a variety of hunting and fishing experiences by providing direction, assistance, or expertise in hunting and angling. They often organize the services, equipment, and accommodations clients require during their visits. Fishing is the most popular tourism activity, followed by hunting (Northwestern Ontario Baseline Studies Key Person Interview Program 2022-2023). Tourism plays an important role in the local economy.

550000
560000
570000
5490000
5480000

Melgund Lake
Kennabutch Lake
Burnet Lake
Creed Lake
Burning Lake
Long Lake River
Tabor Lake
Lowery Lake
Lee Lake
Church Lake
Morey Lake
Mennin Lake
Spear Lake
Oldberg Lake
Long Lake
Noxheiatik Lake
Stormy Lake
Adair Lake
Amlin Lake
Vanevery Lake
Hyndman Lake
Molzan Lake
Baltzer Lake
Doidge Lake
Measor Lake
Pyatt Lake
Garneau Lake
Countess Lake
Oval Lake
Bulrush Lake
Cox Lake
Spruce Lake
Revell Lake
East Revell Lake

DR0039
DR0046
DR0038
DR0045

IG-05-087
IG-05-088
IG-05-089
IG-05-090
IG-09A-040
IG-09A-042

DR-05-071
DR-09A-017
DR-09A-020
DR-09A-022

IG033
IG034
IG054

DR023
DR024
DR010
DR008

603
622

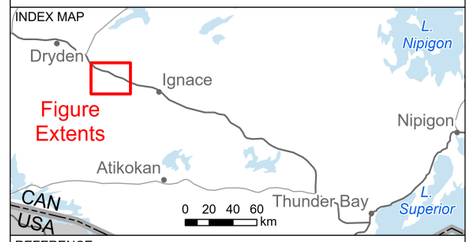
LEGEND

Proposed Project Infrastructure
- Proposed DGR Project Footprint

Existing Present Day Infrastructure
- Transmission Line
- Natural Gas Pipeline
- Railway
- Highway 17
- Highway

- Ontario Trail Network
- Bait Harvest Area
- Registered Trapline Area
- Bear Management Area
- Watercourse
- Waterbody

INDEX MAP



REFERENCE

Data: GEO, Government of Ontario, Natural Earth
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 15N

OCT-10-2025

0 1 2 3 4 5 km

SCALE 1:100,000

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

TITLE

Bait Harvest Areas, Registered Traplines, Bear Management Areas, and Ontario Trail Network

FIGURE: 15.1

15.8.2 Summary

The natural environment is a source of enjoyment and pride for communities, and its integrity is critical to northwestern communities' sense of place and quality of life. The natural beauty of the area and the easy access to land and resource use activities are the biggest draws to the area for residents and visitors. Residents participate in several types of land and resource use activities including fishing, hunting, trapping, gathering, hiking, ATVing, snowmobiling, and boating. Hunting and fishing for residents is both a lifestyle and source of food. Traditional land and resource use, including access to culturally important resources and traditional foods, is present in the area. Outfitting and guiding are important to tourism, and fishing and hunting are popular tourism activities. Within the Project site there is minimal land and resource use activity, and the Project site generally does not interfere with community use. Commercial uses are present in the surrounding area, including, forestry, and trapping and bait harvesting.

15.8.3 Planned Work

The desktop component of a Stage 1 archaeological assessment was completed for the Project site and is considered to be sufficiently advanced to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts to non-Indigenous peoples presented in Section E of the IPD. The NWMO has no planned work to collect additional non-Indigenous land-use baseline data.

The NWMO will update or produce additional Social, Cultural, Economic, and Health Baseline studies to meet the need of the regulatory process once it starts working with First Nations and Métis communities as part of the integrated initial licence application and Impact Statement.

The NWMO will continue to work with the Indigenous communities and the public to assess and report on the social, economic impacts of the Project as required by the NFWA.

15.9 Economic Conditions

15.9.1 Currently Available Baseline Data

Northwestern Ontario is a resource-based economy with a long history of mining and forestry operations. The cyclical nature of forestry and mining has resulted in economic upturns and downturns when these industries grow and contract. Population changes experienced in the communities surrounding the Project site can be attributed to the downturns in the forestry industry and an operational scope change at Domtar (InterGroup 2024).

Other major industries contributing to the economy include healthcare, retail trade, public administration, educational services, and tourism. Healthcare, social assistance and retail trade sectors are among the largest employers. Employment in the largest five industries represents over 60 percent of the labour force, compared to about 50 percent for Ontario. Employment is relatively evenly distributed between males and females across all industries. However, the gender distribution within individual sectors is less balanced. Males tend to work more in transportation, manufacturing, construction, and in agriculture, where the wages are higher compared to educational services, healthcare and social services where females tend to work. As such, the personal income disparity between females and males may be attributed to the types of employment males and females are in (InterGroup 2024).

The local population is aging with an increasing proportion of seniors leaving the workforce. Retaining younger people has been a challenge as youth may not return to the area after completing postsecondary education as there may be better employment opportunities in larger communities. It is anticipated that the labour demand in the region will continue to increase over the next three

decades, while the available labour force may be further challenged in meeting that demand without in-migration (InterGroup 2024).

The Project will create employment and therefore could have effects on labour force characteristics, income, education and training, business opportunities, municipal finances and cost of living. Economic conditions summarized below for each community are based on historical and current census data characterizing labour force, employment, income, and educational attainment. Employment is a primary indicator of economic well-being and a significant contributor to individual health (InterGroup 2024).

Employment information below is focused on labour force trend data for participation, employment, and unemployment rates:

- **Participation rate** is the proportion of people working (employed) or able and available to work (unemployed), from the entire working age population (15 years old and over) (Statistics Canada 2022a).
- **Employment rate** is the number of people employed as a percentage of the working age population (15 years and over), in the specified reference week (Statistics Canada 2022a). Conceptually, the employment rate is the proportion of people working out of all people who could theoretically work.
- **Unemployment rate** refers to the number of people unemployed, expressed as a percentage of the labour force, in the specified reference week (Statistics Canada 2022a). Conceptually, the unemployment rate represents the proportion of people who want to work but do not have work. The definition of unemployment rate relies on the definition of the Labour Force, which includes people who are working (employed) and those who are not working, but able and available to work (unemployed).

Personal and household income is derived from employment income, government transfers and other sources of income. Income statistics are reported for the calendar year prior to the census year (e.g., for the 2021 census, the reference period is the calendar year 2020 for all income variables). An Indigenous household is either 50 percent of members (family or non-family) that self-identify as Indigenous; or in a family household, at least one married spouse or common-law partner is Indigenous; or a lone parent self-identified as Indigenous (Statistics Canada 2023f).

Off-reserve Indigenous-identity populations residing in municipalities are included in census data counts. Economic data for on-reserve First Nations communities are limited to public Statistics Canada and CIRNAC data sources. Related data should not be considered fully representative of the characteristics of Indigenous-identity populations or First Nations communities. Overall, where subsets of populations are fewer than 100 people, caution is to be taken when interpreting data. There is random rounding to a multiple of 5 or 10 for a small population, and this results in proportions that do not always add up to 100 percent. First Nation information is limited to publicly available census data and as such is recognized as an interim characterization of a handful of indicators for individual communities.

The Kenora CD includes people living in municipalities, unincorporated communities, and Indigenous reserves and settlements. This includes Indigenous Peoples living both on and off reserve. Information on the greater Kenora District CD is provided for relevant comparison purposes.

Kenora Census Division

In 2021, there was a total of 50,995 people 15 years of age and over, of which 29,250 were in the labour force (15,300 males,13,950 females) (Statistics Canada 2022a).

Participation rate—Overall, from 2006 to 2021, the participation rate declined from 64.1 percent in 2006 to 57.3 percent in 2021 (Statistics Canada 2007, 2022a). In 2021, the participation rate for

males (59.7 percent) was slightly higher compared to females (55 percent) (Statistics Canada 2022a).

Employment rate—Overall, from 2006 to 2021 Kenora CD experienced a decrease in employment rate from 58.5 percent in 2006 to 52.4 percent in 2021 (Statistics Canada 2007, 2022a). In 2021, males (54 percent) had higher employment rate compared to females (50.7 percent) (Statistics Canada 2022a).

Unemployment rate—Overall, between 2006 and 2021 the unemployment rate stayed relatively stable (8.8 percent in 2006 to 8.7 percent in 2021) (Statistics Canada 2007, 2022a). In 2021, males (9.5 percent) had a higher rate of unemployment compared to females (7.7 percent) (Statistics Canada 2022a).

Average personal income—As of 2020, the total average personal income was $49,360, with the average personal income for males $54,700 and females $44,080 (Statistics Canada 2022a). The average personal income for people who identified as Indigenous was $39,342 as compared to non-Indigenous identity which was $54,325 (Statistics Canada 2022f).

Household income—As of 2020, the average Kenora CD Indigenous household income was $83,000 and the total average household income of $95,400 (Statistics Canada 2022a).

Educational attainment—In 2021, 29 percent of the population had a high school certificate or equivalent, and 40 percent (38 percent men and 46 percent women) had a postsecondary certificate; diploma or degree. In 2021, 22.4 percent had science, technology, engineering and mathematics (STEM)-related qualifications (Statistics Canada 2022a; Manifold 2023b).

Municipal Communities

The NWMO assumes that people in the workforce will primarily reside within communities located within a one-hour drive from the Project site. Municipal information below is focused within this geographical boundary.

Ignace

In 2021, Ignace had a total of 975 people who were 15 years of age or older, of which 500 were people in the labour force (270 males and 225 females) (Statistics Canada 2022a).

Participation rate—Overall, between 2006 and 2021, labour force participation rates declined in in Ignace (66.9 percent in 2006 to 51.3 percent in 2021) and Ontario (67.1 percent in 2006 to 62.8 percent in 2021) (Statistics Canada 2007, 2022a). In Ignace, key drivers of this decline are an aging and declining population (InterGroup 2024). In 2021, males (55.7 percent) had higher rates compared to women (45.9 percent) (Statistics Canada 2022a).

Employment rate—Overall, between 2006 and 2021, employment rate declined in Ignace (60.3 per cent in 2006 to 44.6 percent in 2021) and Ontario (62.8 percent in 2006 to 55.1 percent in 2021) (Statistics Canada 2007, 2022a). In 2021, males (48.5 percent) had higher rates than females (40.8 percent) (Statistics Canada 2022a).

Unemployment rate—Overall, between 2006 and 2021, the unemployment rate in Ignace (10.6 percent in 2006 to 13 percent in 2021) and in Ontario (6.4 percent in 2006 to 12.2 percent in 2021) has increased (Statistics Canada 2022a). In 2021, males (13 percent) had higher rates of unemployment compared to females (11.1 percent) (Statistics Canada 2022a).

Average personal income—As of 2020, the average personal income in Ignace was $53,100. Males in Ignace ($70,400) had a large difference in income compared to females ($35,400), where males had an average personal income that was 98.9 percent greater than females. (Statistics Canada 2022a). In 2020, the average total annual income by Indigenous identity in Ignace was $39,500 as compared to $55,500 for non-Indigenous identity (Statistics Canada 2023f).

Household income—In 2020, Ignace had an average Indigenous household income of $82,000 and a total average household income of $92,000 (Statistics Canada 2022a).

Educational attainment—In 2021, 37 percent of the population had a high school certificate or equivalent, and 39 percent (42.3 percent men and 34.7 percent women) had a postsecondary certificate; diploma or degree. In 2021, 22.7 percent of the population had STEM-related qualifications (Statistics Canada 2022a; Manifold 2023b).

Dryden

In 2021, Dryden had a total of 6,220 people who were 15 years of age or older, of which 3,605 people were in the labour force (1,895 men and 1,715 women) (Statistics Canada 2022a).

Participation rate—Overall, between 2006 and 2021, labour force participation rates declined in Dryden (64.7 percent in 2006 to 58 percent in 2021) and Ontario (67.1 percent in 2006 to 62.8 percent in 2021) (Statistics Canada 2022a). In 2021, males (62.4 percent) had a higher participation rate than females (53.8 percent) (Statistics Canada 2022a).

Employment rate—Overall, between 2006 and 2021, the employment rate decreased in Dryden (60.9 percent in 2006 to 53.1 percent in 2021) and Ontario (62.8 percent in 2006 to 55.1 percent in 2021) (Statistics Canada 2007, 2022a). In 2021, males (58 percent) had higher unemployment rates compared to females (48.4 percent) (Statistics Canada 2022a).

Unemployment rate—Overall, between 2006 and 2021, the unemployment rates have increased in Dryden (5.9 percent in 2006 to 8.3 percent in 2021) and in Ontario (6.4 percent in 2006 to 12.2 percent in 2021) (Statistics Canada 2007, 2022a). In 2021, males (6.9 percent) had lower rates of unemployment compared to females (9.9 percent) (Statistics Canada 2022a).

Average personal income—As of 2020, the average total income in Dryden was $52,850, with the average personal income for males being $62,550 and $43,600 for females (Statistics Canada 2022a). The average personal income for those who identified as Indigenous residing in Dryden was $46,000 as compared to $54,200 for non-Indigenous identity persons (Statistics Canada 2023f).

Household income—In 2020, Dryden had an average Indigenous household income of $99,400 which was similar to a total average household income of $97,500 (Statistics Canada 2022a).

Educational attainment—In 2021, 33 percent of the population had a high school certificate or equivalent, and 47 percent (45 percent males and 48 percent females) had a postsecondary certificate; diploma or degree. In 2021, 28.2 percent of the population had STEM-related qualifications (Statistics Canada 2022a; Manifold 2023b).

Sioux Lookout

In 2021, there was a total of 4,710 people 15 years of age and over, of which 3,325 were in the labour force (1,650 males, 1,680 females) (Statistics Canada 2022a).

Participation rate—Overall, from 2006 to 2021, there was a decrease in the labour force participation rate in Sioux Lookout (78.5 percent in 2006 to 70.6 percent in 2021) and Ontario (67.1 percent in 2006 to 62.8 percent in 2021) (Statistics Canada 2007, 2022a). In 2021, males (79.8 percent) had a higher participation rate than females (77 percent) (Statistics Canada 2022a).

Employment rate—Overall, between 2006 and 2021, there was a decrease in employment rate in Sioux Lookout (75.3 percent in 2006 to 66.7 percent in 2021) and Ontario (62.8 percent in 2006 to 55.1 percent in 2021 (Statistics Canada 2007, 2022a). Of note, overall, Sioux Lookout has a higher employment rate that other communities in the area. In 2021, males (66.9 percent) had a similar rate of employment compared to females (66.5 percent) (Statistics Canada 2022a).

Unemployment rate—Overall, between 2006 and 2021 there was an increase in unemployment in Sioux Lookout (4.2 percent in 2006 to 5.7 percent in 2021) and in Ontario (6.4 percent in 2006 to 12.2 percent in 2021) (Statistics Canada 2007, 2022a). In 2021, males (7.3 percent) had a higher rate of unemployment compared to females (5.7 percent) (Statistics Canada 2022a).

Average personal income—As of 2020, the average personal income in Sioux Lookout was $60,200, representing the highest average income compared to other nearby communities. As a regional health centre, Sioux Lookout has a higher proportion of salaried medical workers, who typically have higher incomes (HSAL et al. 2022). The average personal income for males was $66,200 and $54,500 for females (Statistics Canada 2022a). The average personal income for Indigenous Peoples was $51,040 as compared to $64,500 for non-Indigenous identity persons (Statistics Canada 2023f).

Household income—As of 2020, the average Indigenous household income of $113,200 and a total average household income of $117,700 (Statistics Canada 2022a).

Educational attainment—In 2021, 27 percent of the population had a high school certificate and 52 percent (48 percent males and 57 percent females) had a postsecondary certificate; diploma or degree. In 2021, 31.4 percent of the population had STEM-related qualifications (Statistics Canada 2022a; Manifold 2023b).

Local Service Board of Wabigoon

In 2021, there was a total of 455 people 15 years of age and over, of which 225 were in the labour force (120 males,110 females) (Statistics Canada 2022a). Due to the small population size of the LSB of Wabigoon, income data from 2006 and 2011 are suppressed to protect confidentiality and should be interpreted with caution. Comparability to Ontario and other communities is limited.

Participation rate—Overall, between 2016 and 2021, the participation rate remained relatively stable at from 50 percent in 2016 to 49.5 percent in 2021 and decrease in in Ontario (64.17 percent in 2016 to 62.8 percent in 2021) (Statistics Canada 2017, 2022a). (Statistics Canada 2017, 2022a). In 2021, males (47.1 percent) had a lower rate of participation rates compared to females (55 percent) (Statistics Canada 2022a).

Employment rate—Overall, between 2016 and 2021, the employment rate in Sioux Lookout remained relatively stable (40 percent in 2016 and 40.7 percent in 2021) and increased in Ontario (59.9 percent in 2016 to 55.1 percent in 2021). (Statistics Canada 2017, 2022a). In 2021, males (39.2 percent) had lower rates of employment compared to females (45 percent) (Statistics Canada 2022a).

Unemployment rate—Overall between 2016 and 2021 the unemployment rate in the LSB of Wabigoon was relatively stable (16.7 percent in 2016 to 17.8 percent in 2021) and increased in Ontario (7.4 percent in 2016 to 12.2 percent in 2021) (Statistics Canada 2017, 2022a). In 2021, the males (16.7 percent) had a lower rate of unemployment compared to females (18.2 percent) (Statistics Canada 2022a).

Average personal income—As of 2020, the average personal income in LSB of Wabigoon was $41,000, with the average personal income for males and females being $40,800 (Statistics Canada 2022a). There are no data on average personal income for Indigenous Peoples in LSB of Wabigoon.

Household income—In 2020, the average household income was $76,000. Data are not available for the Indigenous average household income.

Educational attainment—In 2021, 39 percent of the population had a high school certificate, and 29 percent (25 percent male and 32 percent female) had a postsecondary certificate; diploma or

degree. In 2021, 22.4 percent of the population had STEM-related qualifications (Statistics Canada 2022a; Manifold, 2023b).

First Nations

The following information provided for First Nations is limited to public Statistics Canada and CIRNAC for post-2016 data sources and has not been validated by individual communities. Information should not be considered a final representation of these communities.

For some First Nations, subsets of populations are fewer than 100 people, and therefore caution is to be taken when interpreting data. There is random rounding to a multiple of 5 or 10 for such small populations, and this results in proportions that do not always add up to 100 percent could result in a greater than 10 percent difference from the true value that is observed in the First Nation (Statistics Canada 2022a). Statistics Canada economic data availability does differ by First Nation.

Wabigoon Lake Ojibway Nation

In 2021, the on-reserve population in WLON had fewer than 85 males and 80 females who are 15 years of age and older.

Participation rate—Overall, between 2006 and 2021, the participation rates declined for both WLON on-reserve members (58.3 percent in 2006 to 40 percent in 2021) and the Kenora CD (64.1 percent in 2006 to 57.3 percent). In 2021, males (37.5 percent) had lower participation rates compared to females (40 percent) (Statistics Canada 2007, 2022a).

Employment rate—Overall, between 2006 and 2021, the employment rates decreased for both WLON on-reserve members (45.8 percent in 2006 to 36.7 percent in 2021) and the Kenora CD (58.5 percent in 2006 to 52.4 percent in 2021). In 2021, males (31 percent) had lower employment rates compared to females (40 percent) (Statistics Canada 2007, 2022a).

Unemployment rate—Between 2006 and 2016 the unemployment rates decreased for on-reserve members (21.4 percent in 2006 to 16.7 percent in 2016) and stayed relatively stable in the Kenora CD (8.8 percent in 2006 to 11.6 percent in 2016). Due to a small labour force and random rounding, the unemployment rate in 2016 was 25 percent for males and 0 percent for females. The figures may not accurately reflect the true unemployment rate for the on-reserve population of WLON (Statistics Canada 2007, 2017).

Median personal income and household income—Personal income and household income are subjected to data suppression due to the small on-reserve population of WLON to ensure confidentiality of the on-reserve residents and is omitted for this reason (Statistics Canada 2007, 2022a).

Educational attainment—In 2021, 43 percent of the WLON on-reserve population had a high school certificate or equivalent and 23 percent (19 percent male and 20 percent female) had a postsecondary certificate, diploma, or degree (Statistics Canada 2022a).

Eagle Lake First Nation

In 2021, the on-reserve population had fewer than 115 males and 105 females 15 years and older.

Participation rate—Overall, between 2006 to 2021 participation rates were stable for on-reserve members (52.8 percent in 2006 to 52.5 percent in 2021) and declined for Kenora CD (64.1 percent in 2006 to 57.3 percent in 2021). In 2021, males (47.6 percent) had lower participation rates compared to females (57.9 percent) (Statistics Canada 2007, 2022a).

Employment rate—Overall, between 2006 and 2021 the employment rates have decreased for on-reserve members (41.7 percent in 2006 to 40 percent in 2021) and Kenora CD (58.5 percent

in 2006 to 52.4 percent in 2021). In 2021, males (38.1 percent) had lower employment rates than females (42.1 percent) (Statistics Canada 2007, 2022a).

Unemployment rate—Overall, between 2006 to 2021 unemployment rates slightly increased for on-reserve members (21.1 percent in 2006 to 23.8 percent in 2021) and remained stable for Kenora CD (8.8 percent in 2006 to 8.7 percent in 2021). In 2021, males (20 percent) had lower unemployment rates compared to females (27.3 percent) (Statistics Canada 2007, 2022a).

Median personal income—For the total population on-reserve in 2020, the median personal income was $25,400 (Statistics Canada 2022a). A larger proportion of men earned below the median income with about 38 percent of males having earned less than $20,000 in 2020 compared to 32 percent for females. About 21 percent of females earned greater than $50,000 in 2020 compared to 5 percent for males indicating that a larger proportion of females are earning more than double the median income in 2020. However, there were no reported males or females earning above $80,000 in 2020 (Statistics Canada 2022a).

Median household income—Overall, there was a large difference between the median household income for on-reserve Eagle Lake First Nation households compared to the Kenora CD households. For Eagle Lake First Nation, from 2015 to 2020, there was an increasing trend in household median income ($30,016 in 2015 to $46,400 in 2020), similar to the trend for households in the Kenora CD from 2015 to 2020 ($66,198 in 2015 to $78,500 in 2020) (Statistics Canada 2007, 2022a).

Educational attainment—In 2021, 32.5 percent of the on-reserve population had a high school certificate or equivalent, and 42.5 percent (33 percent male and 53 percent female) had a post-secondary certificate diploma or degree (Statistics Canada 2022a).

Lac Seul First Nation

In 2021, The on-reserve population had fewer than 360 males and 325 females aged 15 years and older (Statistics Canada 2022a).

Participation rate—Between 2006 and 2021 the participation rates declined for on-reserve (66.1 percent in 2006 to 50 percent) members for Kenora CD (64.1 in 2006 to 57.3 percent in 2021). In 2021, males and females had the same participation rate (50 percent) (Statistics Canada 2007, 2022a).

Employment rate—Overall, between 2006 and 2021 the employment rates declined for on-reserve members (56.2.5 percent in 2006 to 44 percent in 2021) and Kenora CD (58.5 percent in 2006 to 52.4 percent in 2021). In 2021, males (42.9 percent) had females (45.3 percent) had similar rates of employment (Statistics Canada 2007, 2022a).

Unemployment rate—Overall, between 2006 and 2021 the unemployment rate for on-reserve members (16.2 percent in 2006 to 11.9 percent in 2021) decreased and remained stable for Kenora CD (8.8 percent in 2006 to 8.7 percent in 2021). In 2021, males (14.3 percent) had higher unemployment rates compared to females (9.7 percent) (Statistics Canada 2007, 2022a).

Personal median income—For the total population on-reserve in 2020, the median personal income was $27,200 (Statistics Canada 2022a). There was an increase in the proportion of males who earned between $40,000 to $79,999 from 2010 to 2020 (10 percent in 2010 to 21 percent in 2020) (Statistics Canada 2013, 2022a). There was an increase in the proportion of females who earned between $40,000 to $79,999 from 2010 to 2020 (17 percent in 2010 to 27 percent in 2020) (Statistics Canada 2013, 2022a).

Median household income—Overall, there was a difference between the median household income for on-reserve Lac Seul First Nation households compared to the Kenora CD households, with the Lac Seul First Nation having consistently lower household incomes. For Lac Seul First Nation, from 2005 to 2020, there was an increasing trend in household median income ($34,176 in 2005 to

$46,800 in 2020), similar to the trend for households in the Kenora CD from 2005 to 2020 ($52,750 in 2005 to $78,500 in 2020) (Statistics Canada 2007, 2022a).

Educational attainment—In 2021, 25.9 percent of the on-reserve population had a high school certificate or equivalent and 21.4 percent (21.9 percent for males and females) had a postsecondary diploma or degree (Statistics Canada 2022a).

Lac Des Mille Lacs First Nation

Information on economic base, income, employment, and labour skills for Lac Des Mille Lacs First Nation is not available.

Seine River First Nation

In 2021, The on-reserve population had fewer than 110 males and 110 females 15 years and older (Statistics Canada 2022a).

Participation rate—Overall, between 2006 and 2021 the participation rates declined for on-reserve members (55.6 percent in 2006 and 45 percent in 2021) and for Kenora CD (64.1 in 2006 to 57.3 percent in 2021). In 2021 males (40 percent) had lower rates of participation compared to females (50 percent) (Statistics Canada 2007, 2022a).

Employment rate—Overall, between from 2006 to 2021, employment rates have decreased for on-reserve members (38.9 percent in 2006 to 27.5 percent in 2021) and for Kenora CD (58.5 percent in 2006 to 52.4 percent in 2021). In 2021, males (25 percent) had lower employment rates compared to females (30 percent) (Statistics Canada 2007, 2022a).

Unemployment rate—Overall, between 2006 to 2021, the unemployment rates for on-reserve members (25 percent in 2006 to 38.9 percent in 2021) increased and remained stable in Kenora CD (8.8 percent in 2006 and 8.7 percent in 2021). In 2021, males and females had the same unemployment rate (50 percent) (Statistics Canada 2007, 2022a).

Median personal income—For the total population on-reserve in 2020, the median personal income was $21,400 (Statistics Canada 2022a). There was a decrease for both males and females who earned less than $20,000 from 2015 to 2020 (males 62 percent in 2015 to 40 percent in 2020; females 68 percent in 2015 to 40 percent in 2020) (Statistics Canada 2017, 2022a).

Median household income—Overall, there was a difference between the median household income for on-reserve households in Seine River First Nation compared to the Kenora CD households. In 2005, the household median income was $33,400 compared to $52,750 for Kenora CD. Between 2005 and 2020, there was an increase in median household income. In 2020, the median household income was $40,800 compared to $78,500 for Kenora CD (Statistics Canada 2022a).

Educational attainment—In 2021, 25 percent of the on-reserve population had a high school certificate or equivalent and 27.5 percent (40 percent for males and 15 percent for females) had a postsecondary diploma or degree (Statistics Canada 2022a).

15.9.2 Summary

In 2021, the labour force in municipal communities surrounding the Project site was 8,090 people, with the largest concentrations in Dryden (3,605 people), Sioux Lookout (3,325 people), and Ignace (500 people).

Overall, labour force participation and employment rates declined among the communities and broader area surrounding the Project site from 2006 to 2021 and corresponding unemployment rates increased.

Indigenous Peoples tend to experience higher unemployment rates than non-Indigenous Peoples. The unemployment rates for Indigenous Peoples were higher than for non-Indigenous Peoples in Dryden, Ignace, and Sioux Lookout, the Kenora CD and Ontario in 2021. Factors contributing to the higher unemployment rates include a number of barriers to employment such as systemic discrimination, access to childcare, and a lack of local education and training opportunities (InterGroup 2024).

Among the municipal communities the highest average personal income as of 2020 was in Sioux Lookout ($60,200), followed by Ignace ($53,100), Dryden ($52,850), and the LSB of Wabigoon ($41,000). By comparison, as of 2020, the average personal income in Ontario as a whole was $56,400 and in Kenora CD it was $49,360. Men have a higher average personal income than women, with the exception of the LSB of Wabigoon where personal income is similar. The Kenora CD had a large proportional difference, where those who are non-Indigenous have an average personal income that is 38.1 percent higher (or an income that is $15,000 higher) than those who identify as Indigenous (Statistics Canada 2023f).

Sioux Lookout is a unique community amongst municipal communities given that its major employers are all in the public sector which results in a stable economy. Sioux Lookout is also a hub for the north, connecting people across 29 northern First Nations to their healthcare and social assistance industries (municipality of Sioux Lookout). As a regional health centre, Sioux Lookout has a higher proportion of salaried medical workers, who typically have higher incomes.

The postsecondary completion rate remained relatively flat between 2006 and 2021 in the Kenora CD (Statistics Canada 2007, 2022a). The postsecondary completion rate is lower in all communities surrounding the Project site than in Ontario as a whole. Lower postsecondary completion rates can be attributed in part to the lack of educational institutions in the region, stress from being away from home, limited transportation options, financial constraints from having to live close to campus, and difficulty retaining youth after the completion of their education (InterGroup 2024).

15.9.3 Planned Work

The NWMO considers economic baseline characterization study to be sufficiently advanced to support a risk-informed assessment of potential effects, providing early conclusions regarding the likelihood and significance of potential impacts to non-Indigenous peoples presented in Section E of the IPD. The NWMO has no planned work to collect additional baseline data for the public other than an update with 2026 Census data.

The NWMO will update or produce additional Social, Cultural, Economic, and Health Baseline studies to meet the need of the regulatory process once it starts working with First Nations and Métis communities as part of the integrated initial licence application and Impact Statement.

The NWMO will continue to work with the Indigenous communities and the public to assess and report on the social, economic impacts of the Project as required by the NFWA.

D. INDIGENOUS, FEDERAL, PROVINCIAL, TERRITORIAL, AND MUNICIPAL INVOLVEMENT AND EFFECTS

16. Financial Support from Federal Authorities

No financial support is being provided by federal authorities to the Project.

17. Federal Land that May Be Used

No federal lands are being used for the purpose of carrying out the Project.

18. Indigenous, Federal and Provincial Environmental Approvals

The Project has been selected by the Government of Canada as Canada's plan for the long-term management of used nuclear fuel at the site, and the NWMO is responsible for implementing that plan subject to all applicable Indigenous, federal and provincial approvals and permit processes.

18.1 Wabigoon Lake Ojibway Nation's Regulatory Assessment and Approvals Process

WLON is exercising its jurisdiction through its RAAP. The RAAP is WLON's regulatory process grounded in Anishinaabe law, values, and responsibilities, and reflects WLON's authority to review and decide on development within its territory.

The NWMO is contractually committed, through the Hosting Agreement, to supporting WLON in the implementation of the RAAP with respect to the Project. The language used to define the WLON RAAP in this section has been provided by WLON to define their process in NWMO's IPD, as described in Section ii. NWMO has retained this language to be respectful of WLON's leadership and contributions to the IPD.

18.2 Federal Impact Assessment and Licensing

Impact Assessment Act

Under the current version of the IAA (Government of Canada 2019a), preliminary actions include consideration of whether IAs are required for activities associated with a designated project identified in the *Physical Activities Regulations* (Government of Canada 2019b). Section 28(b) of these regulations include as a designated project: "28. The construction and operation of (b) a new facility for the long-term management or disposal of irradiated nuclear fuel or nuclear waste." The physical activities are set out for the purpose of the definition of a designated project in Section 2 of the IAA.

The Project Description will be prepared in accordance with the *Information and Management of Time Limits Regulations* (SOR/2019-283). This document includes an initial compilation of "project information" consistent with the regulations and the guidance issued by the IAAC.

After the proponent of a designated project provides an IPD of the project, the required engagement occurs, the IAAC provides the proponent with a summary of issues (including based on the engagement), and the proponent's notice addressing such issues and if required, a detailed project description, the IAAC must determine whether an IA of the designated project is required. In making such a determination, the IAAC must take into account, among other factors, whether a means other an IA exists that would address adverse effects within federal jurisdiction and the direct or incidental adverse effects that may be caused by carrying out the designated project.

If the IAAC decides that an IA of the designated project is required and the project includes activities that are regulated under the NSCA, the Minister must refer the IA of a project to a Review Panel under Section 43 of the IAA.

Nuclear Safety and Control Act

In accordance with paragraph 2(g) of the NSCA (Government of Canada 1997) and paragraph 1(e) of the *Class I Nuclear Facilities Regulations* (Government of Canada 2000a), the Project is a Class 1B nuclear facility.

Paragraph 26(e) of the NSCA states that, "Subject to the Regulations, no person shall, except in accordance with a licence to prepare a site, construct, operate, modify, decommission or abandon a nuclear facility."

The detailed requirements to obtain a licence are described in Section 3 of the *General Nuclear Safety and Control Regulations* (Government of Canada 2000b) and in the *Class I Nuclear Facilities*

Regulations (Government of Canada 2000a). Other applicable regulations include the *Nuclear Security Regulations*, *Radiation Protection Regulations* (Government of Canada 2000d), and *Packaging and Transport of Nuclear Substances Regulations*, *2015*, which apply to all nuclear facilities. Appendix A provides supplemental information specific to the nuclear licensing process led by the CNSC, pursuant to the NSCA and its Regulations.

In addition to the regulations, a number of CNSC REGDOCs are also applicable. In particular, REGDOCs for waste management facilities and for assessing the long-term safety of a disposal facility are given in REGDOC-2.11.1 Series.

More generally, the regulatory framework for a licence is organized into 14 Safety and Control Areas. These areas, and examples of regulatory documents that will apply to the Project, are listed in Table 18.1Table .

Table 18.1: Canadian Nuclear Safety Commission Regulatory Documents Applicable to the Project

Document	Topic
Key references related to waste management facilities	
REGDOC-1.2.3	*Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository*
REGDOC-1.2.1	*Guidance on Deep Geological Repository Site Characterization*
REGDOC-2.11	*Framework for Radioactive Waste Management and Decommissioning in Canada*
REGDOC-2.11.1	*Waste Management, Volume I: Management of Radioactive Waste (to be published)*
REGDOC-2.11.1	*Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste*
Other areas relevant to a licence application	
REGDOC-2.1.1	*Management System*
REGDOC-2.1.2	*Safety Culture*
REGDOC-2.2.1	*Human Factors*
REGDOC-2.2.4	*Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical, and Psychological Fitness*
REGDOC-2.3.1	*Conduct of Licenced Activities: Construction and Commissioning Programs*
REGDOC-2.4.3	*Nuclear Criticality Safety*
REGDOC-2.4.4	*Safety Analysis for Class IB Nuclear Facilities*
REGDOC-2.5.1	*General Design Considerations: Human Factors*
REGDOC-2.5.4	*Design of Uranium Mines and Mills: Ventilation Systems*
REGDOC-2.7.1	*Radiation Protection*
REGDOC-2.8.1	*Conventional Health and Safety*
REGDOC-2.9.1	*Environmental Protection: Environmental Principles, Assessments and Protection Measures*
REGDOC-2.9.2	*Environmental Protection: Controlling Releases to the Environment*
REGDOC-2.10.1	*Nuclear Emergency Preparedness and Response*
REGDOC-2.11.2	*Decommissioning*

Document	Topic
Key references related to waste management facilities	
REGDOC-2.12.2	*Site Access Security Clearance*
REGDOC-2.12.3	*Security of Nuclear Substances: Sealed Sources and Category I, II or III Nuclear Material, Version 2*
REGDOC-2.13.1	*Safeguards and Nuclear Material Accountancy*
REGDOC-3.1.2	*Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills*
REGDOC-3.2.1	*Public Information and Disclosure*
REGDOC-3.2.2	*Indigenous Engagement*
REGDOC-3.3.1	*Financial Guarantees for the Decommissioning of Nuclear Facilities and Termination of Licenced Activities*
REGDOC-3.5.3	*Regulatory Fundamentals*
REGDOC-3.6	*Glossary of CNSC Terminology*

Note:
Current versions of the CNSC regulatory documents can be found on the CNSC website (www.cnsc-ccsn.gc.ca/).
CNSC = Canadian Nuclear Safety Commission; REGDOC = regulatory document.

18.3 Other Federal Approvals

In addition to the CNSC licensing and IA, the Project may also be subject to other federal approvals and authorizations including those under the *Fisheries Act* (Government of Canada 1985e), SARA (Government of Canada 2002b), *Aeronautics Act* (Government of Canada 1985a), and *Explosives Act* (Government of Canada 1985d).

Based on current Project understanding, Table 18.2 provides a list of potential federal permits and approvals that the Project may be subject to.

The full and final list of other federal approvals to be required for the site preparation, construction and operations of the Project will be determined based on detailed design requirements and site-specific layouts.

Table 18.2: Other Potential Federal Permits and Approvals for the Project

Potential Permit/Approval	Responsible Authority	Description/Facility
SARA Permits – SARA	ECCC	For wildlife species listed on Schedule 1 of SARA, if any part of their critical habitat or the residences of their individuals is affected by the Project.
Migratory Bird Permits - *Migratory Birds Convention Act, 1994*	ECCC	If birds on Schedule 1 of the *Migratory Birds Convention Act, 1994,* are present, this may require additional work to be completed by the proponent in regard to the nest abandonment notification provisions.
Nest Protections – *Migratory Birds Regulations, 2022*	ECCC	For protection of activities nests containing eggs or young if affected by the Project.
Authorization for Harmful Alteration, Disruption or Destruction of Fish Habitat or	DFO	For direct impacts on fish habitat if needed, and indirect impacts on fish habitat including flow reductions. An

Potential Permit/Approval	Responsible Authority	Description/Facility
Death of Fish by means other than Fishing – *Fisheries Act*		approved fisheries offset plan will be required.
Approval by National Protection Program – *Canadian Navigable Waters Act*	Transport Canada	For work in, on, under, through or across navigable waters.
Aeronautical Obstruction Clearance – *Canadian Aviation Regulations, Aeronautics Act*	Transport Canada	Marking and lighting for structures that could interfere with aeronautical navigation.
ERAP, or Equivalency Certificate – *Transportation of Dangerous Goods Act, 1992*	Transport Canada	An approved emergency response plan for storage of explosives and explosive-related materials.
CoF under the *Canadian Transportation Act*	Transport Canada	Certificate for transport packages and licence for the transport of used nuclear fuel.
Certificate of Transport Packages, and Transport Licences – *Packaging and Transport of Nuclear Substances Regulations, 2015*	CNSC	Transportation of used nuclear fuel along access road and/or rail spur.
Licence for Magazine – *Explosives Act*	NRCan	Licence for explosive magazine to ensure that explosives are appropriately stored.
Land Use Clearance – *Aeronautics Act*	Nav Canada	Construction of tall structures, use of cranes, transmission line towers that may interfere with local airstrips/aerodromes.
ROC – *Railway Safety Act*	Transport Canada	Authorize railway operation in Canada.

CNSC = Canadian Nuclear Safety Commission; CoF = Certificate of Fitness; DFO = Fisheries and Oceans Canada; ECCC = Environment and Climate Change Canada; ERAP = Emergency Response Assistance Plans; NRCan = Natural Resources Canada; ROC = Railway Operating Certificate; SARA = *Species at Risk Act*.

18.4 Potential Provincial Approvals

The Project is a federal undertaking pursuant to the federal government's "peace, order and good government" power and declaratory power under Canada's *Constitution Act, 1982*, which is reflected in the Project being subject to the NFWA, and, via the CNSC, the NSCA for all phases of the Project from site preparation through decommissioning.

Provincial permits may apply to federal undertakings. More specifically, they cannot conflict with federal nuclear laws, and provincial requirements are inoperative to the that they impair the core of federal jurisdiction over nuclear power or essential aspects of nuclear facilities. In practice, unless agreement is reached between the federal government and the provincial government as to which provincial laws apply, will be applied to a federal undertaking, there can be some uncertainty as to which provincial regulatory requirements apply and to what extent. However, as discussions to the applicability of Ontario provincial laws to the Project have not yet occurred and aspects of the Project may be subject to provincial regulatory requirements, the following listing is provided:

- EAs
- certain projects/activities that may trigger Class EA requirements, including:
  - Class EA for Resource Stewardship and Facility Development Projects
  - Class EA for Transmission Facilities (transmission line)

- Class EA for Provincial Transportation Facilities and Municipal Highways (highway turn off)

In addition, some activities may trigger requirements outlined in O. Reg. 50/24, (e.g., emergency diesel generators) if they do not meet the exemption criteria (e.g., Environmental Screening Process for Electricity Projects if <1 megawatt [MW] and < 5 MW; comprehensive EA if ≥ 5 MW):

- provincial permissions related to the following:
  - protected species
  - merchantable timber and aggregates
  - work within waterways
  - work on and transfer of public lands
  - air and noise emissions
  - sewage works including stormwater management works and large subsurface sewage disposal systems if on-site sewage generation is greater than 10,000 L/day
  - water takings over 50,000 L/day

Table 18.3 provides a list of potential provincial authorizations that the Project may be subject to. The jurisdictional boundary between federal and provincial governments will be discussed as part of IAAC's and CNSC's reviews of the IPD.

The full list of provincial approvals and permits that may be required for the site preparation, construction, and operations of the Project will be determined based on detailed design requirements and site-specific layouts.

Table 18.3: Potential Provincial Permits, Approvals or Authorizations for the Project

Potential Permit, Approval or Authorization	Responsible Authority	Description/Facility
ECA - Industrial Sewage Works - *Environmental Protection Act* (Government of Ontario 1990b)	MECP	Approval for the use, operate, establish, alter or replace new or existing sewage works, such as the discharge of treated effluent/contact wastewater, stormwater management works and large treatment facilities (such as package plants discharging to surface water or subsurface disposal). Smaller facilities such as sewage systems with septic tank and tile beds are often approved by local Public Health Units or municipal building code officials.
ECA - Air and Noise - *Environmental Protection Act* (Government of Ontario 1990b)	MECP	Approval for the use, operate, construct, alter, extend or replace any plant, structure, equipment, apparatus, mechanism or thing that may discharge, or from which may be discharged a contaminant into any part of the natural environment other than water such as from the processing facility, crusher, ERMA site (dust) and ventilation facilities.
EASR Registration – *Environmental Protection Act* (Government of Ontario 1990b)	MECP	Required under Part II.2 of the *Environmental Protection Act* for certain activities with air, noise, or odour emissions. Applies to facilities that meet eligibility criteria under Ontario Regulation 1/17.
Permit to Take Water - Ontario *Water Resources Act* (Government of Ontario 1990f)	MECP	Certain water takings, such as for construction site dewatering, may be subject to registration on the Environmental Activity and Sector Registry (Ontario Regulation 63/16, under the *Environmental Protection*

Potential Permit, Approval or Authorization	Responsible Authority	Description/Facility
		Act [Government of Ontario 1990b]). Eligibility restrictions exist for registration of water taking activities, and activities at mines, pits, and quarries are generally excluded from registration. Otherwise, for most other types of water takings, a Permit to Take Water is required for a proponent to take greater than 50,000 L/day from any combination of environmental sources (surface water or groundwater), such as for potable and domestic water supplies.
Permit for SAR - *Endangered Species Act* (Government of Ontario 2007)	MECP	Permission for activities that will kill or harm a protected SAR and/or damage or destroy protected habitat.
Authorization or Registration - *Species Conservation Act*	MECP	Activities that may impact SAR or their habitats will require either a permit or registration. The Act is not yet in force but will be enacted by order of the Lieutenant Governor in Council.
Approval - *Lakes and Rivers Improvement Act* (Government of Ontario 1990d)	MNR	Culvert-related construction below the high-water mark of minor watercourses.
Work Permit - *Public Lands Act* (Government of Ontario 1990g)		Construction on Crown land.
Land Use Permit - *Public Lands Act*	MNR	Tenure for long-term facilities on provincial Crown land, such as for an effluent discharge pipeline if the pipeline leaves the NWMO's owned lands.
Permit to Remove Forest Resources - *Crown Forest Sustainability Act, 1994* (Government of Ontario 1994)	MNR	Cutting of Crown merchantable timber.
Aggregate Permit - *Aggregate Resources Act* (Government of Ontario 1990a)	MNR	Operation and rehabilitation of a dedicated aggregate quarry or pit or extraction of on Crown land or extraction of Crown-owned aggregate or topsoil. Re-use of material excavated for other sources on site is excluded from this permit requirement.
Licence to Collect Fish for Scientific Purposes - *Fish and Wildlife Conservation Act* (Government of Ontario. 1997)	MNR	Conduct baseline fish/wildlife studies and relocate fish from watercourses and waterbodies
Authorization to Interfere With/Destroy a Black Bear or Furbearing Mammal Den, Beaver dam, Black Bear in a Den - *Fish and Wildlife Conservation Act* (Government of Ontario. 1997)	MNR	Destruction of beaver dams, if needed.
Clearance letter (filling of archaeological assessment report) - *Heritage Act*	MCM	Confirms appropriate archaeological and/or cultural heritage studies and mitigation, if required have been completed, for activity at the location to

Potential Permit, Approval or Authorization	Responsible Authority	Description/Facility
(Government of Ontario 1990c)		proceed.
Entrance Permit and Encroachment Permit - *Public Transportation and Highway Improvement Act* (Government of Ontario 1990h)	MTO	For entrances to Highway 17 and potentially for transmission line connection if the transmission line crosses the highway.
Leave to Construct - *Ontario Energy Board Act, 1998* (Government of Ontario 1998)	Ontario Energy Board	Construction of a transmission or distribution system.
Licence to Operate – *Shortline Railways Act*	MTO	Governs the operation of short line railways.

EASR = Environmental Activity and Sector Registry; ECA = Environmental Compliance Approval; ERMA = Excavated Rock Management Area; L/day = litres per day; MCM = Ontario Ministry of Citizenship and Multiculturalism; MECP = Ontario Ministry of the Environment, Conservation, and Parks; MNR = Ontario Ministry of Natural Resources; MTO = Ontario Ministry of Transportation; SAR = Species at Risk.

18.5 Canadian Codes and Standards

A number of Canadian codes and standards apply to the Project. Compliance with these will be demonstrated in the future in support of a licence application. Below is a non-exhaustive list for illustrative purposes of applicable codes and standards in several topic areas for the Project:

- Waste will be managed in accordance with the N292 "General Principals for the Management of Radioactive Waste and Irradiated Fuel" series of standards (as applicable).
- Civil structures will comply with the National Building Code of Canada and the National Fire Code of Canada, while some structures may be considered as nuclear safety-related structures and would be governed by Canadian Standards Association Group (CSA) N291 "Requirements for nuclear safety-related structures."
- Electrical installations and components will be in accordance with the Canadian Electrical Code and associated CSA standards (as applicable).
- The management system will comply with CSA N286 "Management system requirements for nuclear facilities" series of standards as well as International Standards Organization 9001 (ISO 2015).
- The environmental management and monitoring programs will comply with the CSA N288 "Environmental management of nuclear facilities" series of standards.
- The occupational health and safety management programs will comply with the CSA Z45001 standard.
- Workplace relations and collective bargaining between unions and the NWMO will be governed by the Canada Labour Code (Government of Canada 1985b).

18.6 Safeguards

Canada's international safeguards obligations are the result of international treaty commitments (IAEA 1970, 1972, 2000). For nuclear projects, the specific legal requirements to implement these commitments come in the form of licence conditions that are included in a CNSC licence. Compliance with these requirements will be demonstrated in support of a future licence application and safeguards program will be developed.

18.7 International Guidance

A number of technical documents are available that provide guidance on best international practices with respect both to achieving safety, and on the demonstration of safety. Particular international documents relevant to development and safety for a repository are listed in Table 18.4. Canadian guidance and standards have been developed based on international guidance. For clarity, this information is being provided to more fully understand the powers, duties and functions of Canadian regulators and not to suggest that any international jurisdiction have powers, duties and functions over the Project.

Table 18.4: International Guidance Applicable to Safety Assessment

Document Number	Title
IAEA SSR-5	Disposal of Radioactive Waste (IAEA 2011)
IAEA SSG-23	The Safety Case and Safety Assessment for Radioactive Waste Disposal (IAEA 2012)
ICRP 103	The 2007 Recommendations of the International Commission on Radiological Protection (ICRP 2007)

Note:
The latest version of international guidance can be found on the associated agency's website (www.iaea.org, www.icrp.org).
IAEA = International Atomic Energy Agency; ICRP = International Commission on Radiological Protection.

E. POTENTIAL EFFECTS OF THE PROJECT

This section has been developed to address the requirements outlined in Schedule 1, Part E of the *Information and Management of Time Limits Regulations*. This section also aims to offer comprehensive information for the IAAC to support the creation of Tailored Impact Statement Guidelines for the Project. The section is structured as follows:

- A description of any changes that, as a result of the carrying out of the project, may be caused to components of the environment that are within legislative authority of Parliament (Section 19).
- A description of any changes to the environment that, as a result of carrying out the project, may occur on federal lands or lands outside Ontario (Section 20).
- A description of any impact to Indigenous Peoples of Canada as a result of the carrying out of the project (Section 21).
- An estimate of any greenhouse gas emissions associated with the project (Section 22).
- A description of any waste and emissions that are likely to be generated during any phase of the Project and a description of the plan to manage them (Section 23 and 24).
- An overall summary of conclusions and path forward (Section 25).

19. Description of Any Changes to Components of the Environment that Are Within the Legislative Authority of Parliament

The IAA is intended to focus on adverse effects within federal jurisdiction and direct or incidental adverse effects (adverse federal effects).

As described above, the Project is a federal work or undertaking. Section 3(1) of the *Canadian Environmental Protection Act, 1999* provides in part that a "***federal work or undertaking*** means any work or undertaking that is with the legislative authority of Parliament…" As any work or undertaking constructed for the possession or use of a nuclear substance is declared to be to the general advantage of Canada in subsection 71 of the NSCA and Canada's courts have held that the federal government's power related to "peace, order and good government" applies to nuclear facilities, the Project is a federal work or undertaking as defined under the *Canadian Environmental Protection Act,* 1999. Therefore, any potential adverse effects within federal jurisdiction, as defined under the IAA, include the non-negligible adverse effects of the Project. That said, as part of the ultimate decision making for a designated project under the IAA, IAAC may also consider changes to the environment, or to health, social and economic conditions and the positive and negative consequences of those changes that are likely to be caused by the carrying out of the Project in determining whether the Project is justified as being in the public interest.

As described in the *Guide to Preparing an Initial Project Description and a Detailed Project Description* (IAAC 2025), the description of effects provided in this IPD could be reviewed by the IAAC in determining whether an IA is required. Should it be determined that an IA is required, the IAAC will prepare Tailored Impact Statement Guidelines.

This section aims to provide a preliminary assessment of the changes to the environment, or to health, social and economic conditions and the positive and negative consequences of those changes that are likely to be caused by the carrying out of the Project, while also providing sufficient information for the IAAC to develop Tailored Impact Statement Guidelines for the Planning Phase This section is designed to provide the IAAC with sufficient detail to inform the scoping and tailoring

of Tailored Impact Statement Guidelines, as outlined in the IAAC's *Operational Policy Statement* (IAAC 2022).

The section is organized to include the following:

- Section 19.1: This subsection provides an overview of the NWMO's other legislative obligations for the Project to assess potential effects from the Project.
- Section 19.2: This subsection identifies and describes the potential effects from the Project to the environment, or to health, social and economic conditions and the effectiveness of proposed mitigation measures to identify anticipated residual adverse and positive effects from the Project. To support the development of Tailored Impact Statement Guidelines, as outlined in the *Operational Policy Statement*, a preliminary risk screening is presented in this section to describe an anticipated level of risk inherent to residual effects, considering the proposed mitigation measures and other legislative obligations for the Project to assess effects from the Project.
- Section 19.3: This subsection provides the conclusions of the preliminary risk screening.

19.1 Other Legislative Requirements and Application of Precedents

Under the CNSC licensing regime, the NWMO must fulfill all licence conditions and operate within the approved licensing basis, which sets the limits, controls, and conditions for the safe conduct of activities at the site with adequate provision for protecting the environment. The CNSC will conduct ongoing compliance verification activities, including inspections and desktop reviews, to ensure that the NWMO continues to meet all requirements.

In reviewing licence applications, the CNSC applies a graded approach, which is a systematic method that ensures the level of analysis, documentation, and action is commensurate with the following:

- the relative risks to health, safety, security, the environment, and Canada's international obligations
- the specific characteristics of the nuclear facility or activity

At each licensing phase or renewal, the NWMO will be required to update the licensing basis and demonstrate that health, safety, security, and environmental protection are maintained. This includes updating the safety case, site characterization data, pre- and post-closure safety assessments, and Human Health and Ecological Risk Assessment (HHERA). The licensing basis will evolve as new information becomes available to support each phase of the Project.

Indigenous and public participation is an integral part of this process. At each licensing phase, members of Indigenous communities and the public will have opportunities to review and comment through the CNSC's public hearings. In addition, under Section 18(a) of the NFWA the NWMO must assess and report, on a triennial basis, the significant socio-economic effects of its activities on a community's way of life and social, cultural, and economic aspirations. The NWMO will continue to document this engagement through its reports under the NFWA.

Applying lessons learned from the Seaborn Panel and Ontario Power Generation DGR Joint Review Panel reports (CEAA 1998, 2015) on social licence, the NWMO has developed respectful relationships with Indigenous Peoples and the public. Through this process, expressions of willingness to host the Project were received from WLON and the Township of Ignace, culminating in the successful completion of site selection in 2024. Both WLON and the Township of Ignace have entered into Hosting Agreements with the NWMO for the life of the Project. These agreements reflect Canada's commitment to advancing the Project in partnership with informed and willing host communities. While WLON's Hosting Agreement remains confidential and the Township's is publicly available, both provide a framework for participation in the regulatory process.

As the Project transitions to the Impact Statement phase, the NWMO will continue to work collaboratively with WLON and the Township of Ignace to ensure their perspectives are appropriately reflected in ongoing analyses and mitigation planning. With WLON, this collaboration is also anticipated to include, where appropriate, the harmonization of assessments and studies in areas where WLON-specific interests and concerns intersect with the topics and valued components already being examined through the NWMO's Impact Statement. The determination of whether and when such harmonization is appropriate will rest with WLON, in accordance with their own protocols and decision-making processes The environmental protection results presented in Section E will also be subject to review by the CNSC and IAAC. While Section 19 and Section 21 of Section E provide a screening-level assessment of potential effects, further evaluation will occur through established federal and WLON regulatory processes.

Prior to site preparation, the NWMO will collaborate with WLON and the Township of Ignace to confirm the suitability of proposed mitigation measures and develop follow-up and monitoring programs to verify the accuracy of Section E findings. Where monitoring identifies the need for modified or additional measures, the NWMO will develop and implement these as soon as feasible and notify WLON, the Township, and the CNSC within a reasonable timeframe. The NWMO will report annually on the results of these programs to WLON, the Township, and the CNSC in accordance with the Licence Conditions Handbook, confirming the effectiveness of mitigation and verifying that the Project is achieving its intended outcomes.

Understanding that the Project is subject to rigorous legislative requirements and WLON's regulatory assessment and approvals process, the IA plays an important role in ensuring that the federal process adds value and reduces regulatory burden in accordance with the Cabinet Directive on Regulatory and Permitting Efficiency for Clean Growth Projects (Government of Canada 2024). Canada's nuclear power plants have provided, and are expected to continue providing, clean, reliable, and low-carbon energy for decades. Managing the resulting used nuclear fuel responsibly is essential, as it remains radioactive for a long time and requires permanent containment to protect future generations. The Project represents a responsible step toward ensuring the long-term health, safety, and sustainability of Canada's environment and communities. It provides a safe and permanent solution for Canada's used nuclear fuel, supports the continued role of nuclear energy as a reliable and low-carbon power source, and contributes directly to Canada's climate change and net-zero commitments.

19.2 Identification of Potential Effects, Pathways of Change and Risk Screening

As described in the *Operational Policy Statement* (IAAC 2022), the approach to the development of the Guidelines is informed by the anticipated level of risk inherent to a predicted effect, where risk is a function of the likelihood that an adverse effect may happen, following the application of mitigation measures, and the degree of negative impact that may result from its occurrence.

To meet the requirements of Schedule 1, Part E of the *Information and Management of Time Limits Regulations*, and inform the development of Tailored Impact Statement Guidelines, as outlined in the *Operational Policy Statement*, this section presents a systematic consideration of how Project components and activities may interact with the environment and result in changes (i.e., non-negligible effects) to the environment and health, social and economic conditions of non-Indigenous Peoples. There are several objectives for this section:

1. Identify components of the natural, social, health and economic environments that could potentially be impacted by the Project.
2. Identify environmental design features that would be implemented to avoid or reduce potential adverse effects.
3. Identify pathways of changes and potential non-negligible effects on each previously identified component and describes the degree of the adverse or positive effect.

4. Identify mitigation and protection measures that would be implemented to reduce adverse effects or enhance positive effects.
5. Identify the potential for residual effects on previously identified components.
6. Provide a preliminary screening of risk inherent to predicted residual effects, informed by likelihood and degree of impact.

The content presented in Section 19 is focused on changes to the environment or to the health, social and economic conditions of non-Indigenous Peoples. Section 21 describes the anticipated effects on Indigenous Peoples, following a similar approach that is presented in Section 19.

19.2.1 Valued Components, Intermediate Components, Measurement Indicators and Assessment Endpoints

Following Guidance provided by IAAC (2025) the following concepts and definitions are provided according to how they inform the assessment of effects under the IAA, including the extent to which adverse federal effects are significant.

Valued Components (VCs) —consist of environmental, health, social, and economic components of particular importance or concern to potentially affected Indigenous groups, the public, federal authorities or the NWMO, and that may be changed by the Project (IAAC 2025). Selecting appropriate VCs focuses the Impact Statement on the most relevant aspects of the biophysical, cultural, and socio-economic environments and supports effective, transparent decision making.

Intermediate components—include physical attributes or media on which VCs depend such as air quality, hydrology and surface water quality. Intermediate components are identified and assessed using the same process described for VCs; however, they do not have assessment endpoints or significance criteria. The significance of changes in intermediate components can only be evaluated in the context of related influences to VCs, which are the ultimate receptors. For example, changes in surface water quality are interpreted through their effects on fish, vegetation, wildlife, or human health. Assessing intermediate components is therefore fundamental to understanding total effects of the Project.

Measurement indicators—are quantitative attributes of the biophysical, cultural, and socio-economic environments that are used to measure changes to VCs and intermediate components. They provide measurable evidence of change in a VC and intermediate component.

Assessment endpoints—are qualitative expressions of the key properties of VCs that should be protected. They incorporate the concept of sustainability, which refers to maintaining environmental integrity, social and economic well-being, and public health for present and future generations (IAAC 2025). Because endpoints are often not directly measurable, they are supported by one or more measurement indicators that inform conclusions on the ability to maintain or achieve assessment endpoints.

The NWMO has applied these definitions to inform the identification of a preliminary list of potential VCs, including preliminary Indigenous VCs, and intermediate components, their measurement indicators and assessment endpoints (only applicable to VCs) that could be impacted by the Project (Table 19.1). The final list of VCs and intermediate components will be refined through the IA process, informed by feedback from Indigenous groups, the public, and federal authorities.

Table 19.1: Valued Components and Associated Measurement Indicators and Assessment Endpoints

Valued Component or Intermediate Component	Rationale for Selection	Measurement Indicators	Assessment Endpoint
Intermediate Components			
Air Quality	▪ Sensitivity of the environment (e.g., plants, animals) to air quality. ▪ Link to human health. ▪ Influence on lands and resources for traditional purposes by Indigenous Peoples .	▪ Ambient air concentrations of CACs that have applicable provincial or federal ambient air quality criteria and would be emitted directly from the Project.	Not applicable.
Noise, Vibration and Light	▪ Influence on Indigenous physical and cultural heritage and lands and resources for traditional purposes by Indigenous Peoples. ▪ Sensitivity of fish and some wildlife species to noise, vibration and light.	▪ Sound levels for the daytime period and nighttime period, combined day-night sound levels and maximum sound levels. ▪ Peak particle ground vibration velocity, root-mean square ground vibration velocity, air overpressure and water overpressure. ▪ Light trespass. ▪ Sky glow.	Not applicable.
Hydrogeology (groundwater quality and quantity)	▪ Important component in the hydrologic cycle, linked to surface water quantity through exchange with overlying surface water features, important to fish and fish habitat. ▪ Linked to surface water quality through overlying surface water features, which is important for fish and fish habitat, human use (i.e., drinking water or other consumption), and overall ecological integrity.	▪ Groundwater levels and flow rates. ▪ Spatial and temporal distribution of groundwater. ▪ Concentrations of physical analytes (e.g., pH and conductivity). ▪ Concentrations of major ions and nutrients. ▪ Concentrations of dissolved metals and radionuclides.	Not applicable.
Hydrology	▪ Indigenous Peoples may use local waterbodies and watercourses for navigation and recreational or cultural practices. ▪ Key attribute of healthy and functioning aquatic and terrestrial ecosystems. ▪ Link to fish and fish habitat.	▪ Waterbody water surface elevation. ▪ Watercourse flow rates. ▪ Stream channel parameters (e.g., wetted area). ▪ Fluvial sediment transport.	Not applicable.
Surface Water Quality	▪ Key attribute of healthy and functioning aquatic and terrestrial ecosystems.	▪ Water quality constituent concentrations. ▪ Drinking water quality constituent concentrations.	Not applicable.

Valued Component or Intermediate Component	Rationale for Selection	Measurement Indicators	Assessment Endpoint
	▪ Important to Indigenous and non-Indigenous health and well-being. ▪ Land users may use local waterbodies and watercourses for recreational or cultural practices.	▪ Productivity status constituent concentrations.	
Topography, Sediment and Soils	▪ Provide physical structure and foundation for aquatic and terrestrial ecosystems. ▪ Key attribute of healthy and functioning aquatic ecosystems. ▪ Important to Indigenous and non-Indigenous health and well-being. ▪ Indigenous and other land users may use local waterbodies and watercourses for recreational or cultural practices.	▪ Quantity and distribution of terrain units, which includes surficial materials, topography, and slope stability parameters. ▪ Soil quality (i.e., productivity). ▪ Sediment quality constituent concentrations (i.e., risk to aquatic life).	Not applicable.
Valued Components			
Climate Change[(a)]	▪ GHGs contribute to climate change. ▪ Socio-economic/cultural importance. ▪ Federal and provincial plans associated with greenhouse gas emissions reductions and climate change.	▪ Project GHG emissions.	▪ Contribution of Project's GHG emissions to the provincial and federal totals. ▪ Continued ability for Canada to reach climate change commitments in the form of emission reduction targets.
Fish and Fish Habitat	▪ Traditional and/or current food source. ▪ Within legislative authority of the federal government. ▪ Protected with federal and provincial legislation. ▪ Socio-economic/cultural importance. ▪ Ecological importance. ▪ Sensitive to disturbance.	▪ Habitat availability (i.e., habitat quantity and quality). ▪ Habitat distribution (i.e., habitat arrangement and connectivity). ▪ Survival and reproduction	Self-sustaining and ecologically effective fish populations.
Vegetation, Riparian and Wetland Environments	▪ Protected with federal and provincial legislation.	▪ Ecosystem availability (i.e., amount). ▪ Ecosystem distribution (i.e., arrangement and connectivity).	Self-sustaining and ecologically effective ecosystems.

Valued Component or Intermediate Component	Rationale for Selection	Measurement Indicators	Assessment Endpoint
	▪ Ecosystems contain plants that represent both traditional and current food sources. ▪ Ecological importance. ▪ Wetlands provide important hydrological and biochemical functions. ▪ Sensitive to disturbance. ▪ Socio-economic/cultural importance.	▪ Ecosystem condition (i.e., integrity).	
Migratory and SAR Birds	▪ Traditional and/or current food source. ▪ Within legislative authority of the federal government. ▪ Federal and/or provincial migratory birds and/or SAR protected by legislation. ▪ Socio-economic/cultural importance. ▪ Ecological importance.	▪ Habitat availability (i.e., quantity and quality). ▪ Habitat distribution (i.e., arrangement and connectivity). ▪ Survival and reproduction.	Self-sustaining and ecologically effective bird populations.
Terrestrial Wildlife and Wildlife Habitat	▪ Traditional and/or current food source. ▪ Federal and/or provincial SAR protected by legislation. ▪ Socio-economic/cultural importance. ▪ Ecological importance.	▪ Habitat availability (i.e., habitat quantity and quality). ▪ Habitat distribution (i.e., habitat arrangement and connectivity). ▪ Survival and reproduction.	Self-sustaining and ecologically effective terrestrial wildlife populations.
Non-Indigenous Health Conditions	▪ Protection of human health is a requirement for Project acceptance and approval. ▪ Changes to soil quality, water quality and air quality from Project activities could affect human health. ▪ Current food source security. ▪ Socio-economic/cultural importance.	▪ Changes in health conditions.	Protection of human health .

Valued Component or Intermediate Component	Rationale for Selection	Measurement Indicators	Assessment Endpoint
Non-Indigenous Economic Conditions	▪ Changes in employment, business, and income opportunities may affect population in migration and out migration. ▪ Project workforce hiring and contract opportunities may affect employment, income, training opportunities, and opportunities to participate in the traditional economy. ▪ Project expenditures for supplies and services may affect opportunities for existing and new businesses. ▪ Project-related payments to government may affect government revenues.	▪ Change in local population levels, employment, income, procurement, training and education opportunities.	▪ Enhancing the participation of local individuals in employment, income, education, and training opportunities. ▪ Enhancing locally owned businesses opportunities. ▪ Enhancing government revenue.
Non-Indigenous Social Conditions	▪ Job creation, economic influences, and changes to land use resulting from the Project can change the current balance and structure of communities, families, and cultural values, affecting social conditions of both individuals and communities.	▪ Changes in societal, cultural, physical environment, educational and economic well-being.	▪ Maintenance of local non-Indigenous social conditions.
Indigenous Physical and Cultural Heritage, and Structures, Sites or Things of Significance	▪ Within legislative authority of the federal government. ▪ Cultural importance. ▪ Sensitivity to disturbance.	▪ To be defined by each potentially impacted Indigenous Nations and communities.	▪ To be defined by each potentially impacted Indigenous Nations and communities.
Current Use of Lands and Resources for Traditional Purposes by Indigenous Peoples	▪ Within legislative authority of the federal government. ▪ Cultural importance. ▪ Sensitivity to disturbance.	▪ To be defined by each potentially impacted Indigenous Nations and communities.	▪ To be defined by each potentially impacted Indigenous Nations and communities.

Valued Component or Intermediate Component	Rationale for Selection	Measurement Indicators	Assessment Endpoint
Health Conditions of Indigenous Peoples	▪ Within legislative authority of the federal government. ▪ Protection of human health is a requirement for Project acceptance and approval. ▪ Changes to soil quality, water quality and air quality from Project activities could affect human health. ▪ Current food source security. ▪ Socio-economic/cultural importance.	▪ To be defined by each potentially impacted Indigenous Nations and communities.	▪ To be defined by each potentially impacted Indigenous Nations and communities.
Social Conditions of Indigenous Peoples	▪ Within legislative authority of the federal government. ▪ Changes in employment, business, and income opportunities may affect Indigenous population in migration and out migration. ▪ Project workforce hiring and contract opportunities may affect Indigenous employment, income, training opportunities, and opportunities to participate in the traditional economy. ▪ Project expenditures for supplies and services may affect opportunities for existing and new Indigenous businesses.	▪ To be defined by each potentially impacted Indigenous Nations and communities.	▪ To be defined by each potentially impacted Indigenous Nations and communities.
Economic Conditions of Indigenous Peoples	▪ Within legislative authority of the federal government. ▪ Job creation, economic influences, and changes to land use resulting from the Project can change the current balance and structure of Indigenous Nations and communities, families, and cultural values, affecting social conditions of both individuals and communities.	▪ To be defined by each potentially impacted Indigenous Nations and communities.	▪ To be defined by each potentially impacted Indigenous Nations and communities.

(a) GHGs contribute to climate change by absorbing infrared radiation in the atmosphere, leading to increased temperatures and altered weather patterns (Government of Canada 2015b). While it is acknowledged that future climate change may have cumulative effects on other VCs, the linkages presented focus on changes resulting directly from the Project. For example, a change in surface water conditions caused by the Project could influence fish measurement indicators. However, changes in climate change indicators due to the Project do not directly affect other VCs in this context.

CAC = criteria air contaminant; GHG = greenhouse gas; SAR = Species at Risk; VC = Valued Component.

19.2.2 Methods

19.2.2.1 CHARACTERIZATION OF EXISTING CONDITIONS

The existing or current conditions of the biophysical, cultural, and socio-economic environments form the basis to identify and assess potential adverse effects of the Project. Site characterization data and baseline studies, which have involved the collection of desktop and field data (Section 14 and Section 15) were done to support the characterization of the environment before any disturbance from the Project. These studies form the current understanding of existing environmental and social conditions to support the pathway of change screening and risk screening of residual effects.

19.2.2.2 PATHWAYS OF CHANGE SCREENING

The screening of pathways of change identifies how Project activities may interact with intermediate and VCs. The assessment focuses on pathways that could result in residual effects on valued or intermediate components, allowing mitigation to be directed where it is most effective.

Where potential adverse effects are identified, their degree or magnitude is described to provide a preliminary understanding before applying environmental design features or mitigation measures. Feasible design and mitigation practices are then implemented to avoid or minimize effects. Mitigation follows the precautionary principle, which states that lack of full scientific certainty is not a reason to delay measures that prevent environmental degradation. When information is limited, a conservative approach is applied, and effects are assumed to be overestimated.

Project activities and physical works such as site preparation, excavation, surface facility development, underground construction, materials handling, on-site transportation, and water management are evaluated for their potential to affect environmental and social components. Each activity is considered a potential stressor linked to a pathway of change.

This evaluation clarifies how Project components may cause measurable environmental or social changes. By focusing on these linkages, the assessment ensures that analysis and mitigation efforts are targeted toward the most important interactions between the Project and the environment (Figure 19.1).

Figure 19.1: Source – Pathway – Environmental or Social Component

The evaluation follows a structured three-step process (Figure 19.2):

- identifying potential pathways of change to an environmental or social component (Section 19.2.2.2.1)
- identifying environmental design features and mitigation measures to minimize adverse effects or enhance positive effects (Section 19.2.2.2.2)
- determining whether, after mitigation, there remains potential for residual effects (Section 19.2.2.2.3)

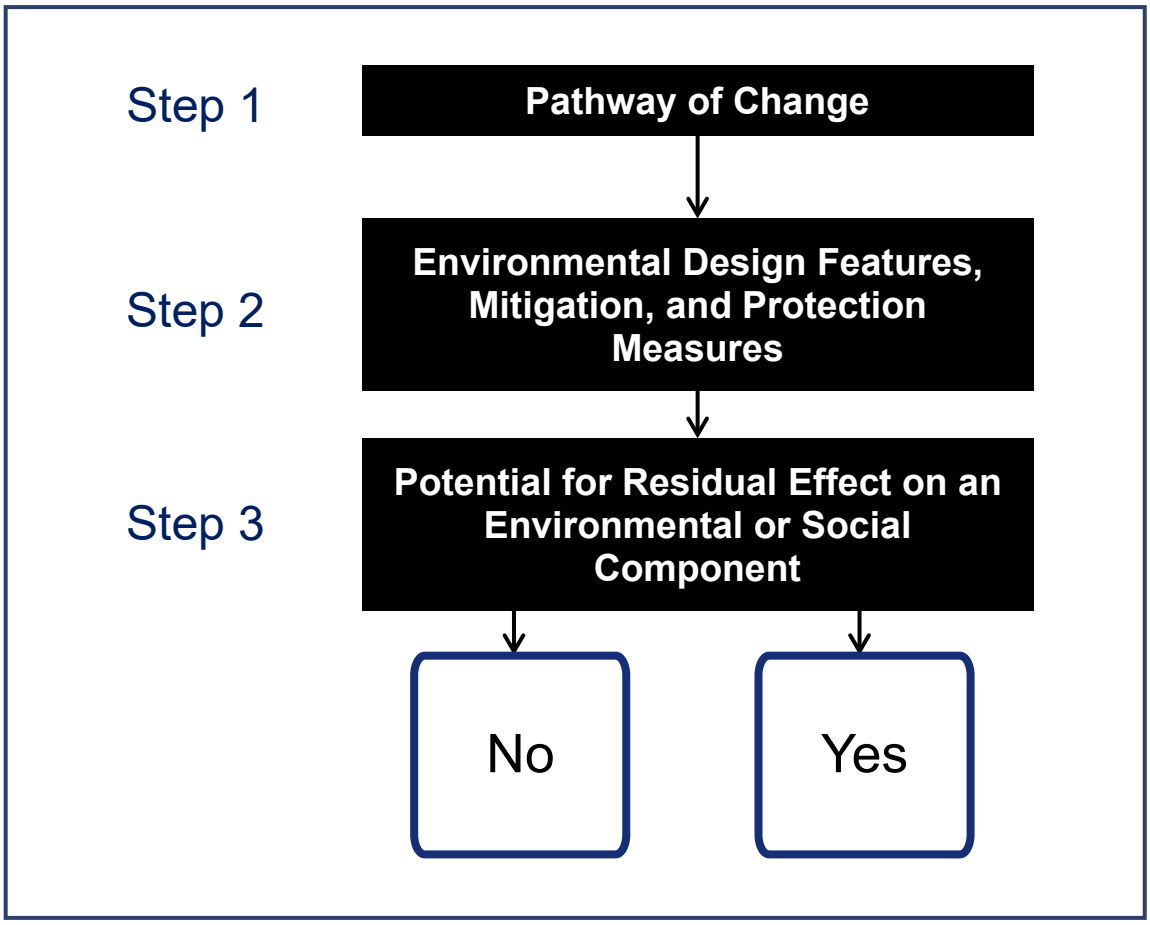


Figure 19.2: Pathway of Change Evaluation Process

19.2.2.2.1 Step 1: Identification of Pathways of Change

The first step in the pathway's evaluation is to identify pathways by which the Project facility or activity could affect the environment. A comprehensive list of pathways of change for all environmental or social intermediate and VCs was developed using the following information:

- review of the description of the Project from Section B
- input from Indigenous, regulatory, and public engagement (Sections 3 and 4)
- results of baseline studies (Section 14 and 15)
- Anishinaabe, Indigenous and Local Knowledge
- scientific knowledge

- experience from comparable projects, already reviewed or approved by IAAC

Following the identification of pathways of change, the degree of the potential effect is described, to provide context to the effectiveness of proposed environmental design features, mitigation and protection measures identified in Step 2.

19.2.2.2.2 Step 2: Environmental Design Features, Mitigation and Protection Measures

After identifying pathways of change and potential effects, the next step is to develop mitigation, protection and enhancement measures that prevent or reduce those effects on environmental and social components or enhance Project benefits. Environmental design features are considered prior to the identification of potential effects and pathways of change, as environmental design features are built into the Project from the outset to limit effects, such as minimizing the Project footprint through centralized infrastructure. These features include best practices, management procedures, and emergency and spill response protocols. In many cases, they provide additional environmental benefits; for example, culverts at watercourse crossings maintain flow, reduce sedimentation, and improve fish passage.

Mitigation and protection measures are actions that reduce effects that cannot be avoided, such as buffer zones protecting wetlands, shorelines, and wildlife habitat. Protection measures include ongoing environmental management practices such as air and water quality monitoring, waste controls, and erosion and sediment management. Together, these measures ensure safe operation of the Project while minimizing potential effects throughout all phases.

The mitigation hierarchy provides a framework to guide effect management by prioritizing actions that are technically and economically feasible (Poulton and Ray 2023):

- **Avoid—**Modify the design to prevent effects, such as siting away from sensitive areas.
- **Minimize—**Limit unavoidable effects using best available technologies and management practices.
- **Reclaim/Rehabilitate—**Restore affected areas to a productive and ecologically stable state.
- **Offset—**Compensate for remaining or temporary losses through ecosystem or community enhancement.

Environmental design features and mitigation measures are developed iteratively by technical experts and will be confirmed acceptable in collaboration with WLON and the Township of Ignace. Measures are selected for effectiveness, feasibility, and relevance to identified pathways. Where analyses indicate unacceptable effects, additional design or mitigation is incorporated to further reduce risk.

Preliminary measures summarized in Table 19.4 reflect industry best practices and regulatory guidelines and standards. Examples include applying in-water construction timing windows to protect fish habitat, scheduling vegetation clearing outside of nesting periods, and revegetating disturbed areas with native species to support ecological resilience.

Selection of mitigation measures are guided by regulatory documents such as CNSC REGDOC-2.9.1 and REGDOC-2.9.2, and CSA standards (e.g., N288.5-11 for effluent monitoring and N288.7-15 for groundwater protection). These standards provide structured methodologies for monitoring and verification. Grounded in regulatory compliance, science, and operational experience, these measures offer a high degree of confidence in their effectiveness.

19.2.2.2.3 Step 3: Pathways of Change Screening

To focus the residual effects analysis on the most important changes as a result of the Project, pathways are screened for each valued and intermediate component. Each potential pathway is

evaluated with the proposed environmental design features, mitigation, and protection measures to determine whether it could result in a residual adverse or positive effect. The effectiveness of mitigation is then assessed to determine whether remaining effects would be negligible.

Screening draws on scientific knowledge, Indigenous and public input, experience from comparable projects, and understanding of mitigation effectiveness. Each pathway is categorized as either of the following:

- **No—**No measurable change occurs in the valued or intermediate component after applying design features or mitigation.
- **Yes—**A measurable change may occur even after applying mitigation.

Pathways identified as having potential measurable changes are carried forward for further risk consideration.

19.2.2.3 PRELIMINARY RESIDUAL EFFECTS RISK SCREENING

The preliminary residual effects risk screening is a qualitative tool used to evaluate the inherent risk of residual environmental effects identified during pathway screening. It helps identify valued and intermediate components that may be more susceptible to adverse effects and therefore require further assessment.

Risk is conceptualized as a function of two dimensions: the likelihood that an adverse effect will occur after mitigation measures are applied, and the degree of negative impact that may result from its occurrence (IAAC 2022). Definitions provided for both "Degree" and "Likelihood" are provided in Table 19.2.

Table 19.2: Definitions for Different Degree and Likelihood Ratings

Rating	Degree	Likelihood
High	▪ Exceeds regulatory guideline thresholds. ▪ Results in a clear, noticeable impact on environmental, social, or economic components. ▪ The change is well beyond natural variation.	The effect is certain to occur.
Moderate	▪ Approaching regulatory guideline thresholds but does not exceed them. ▪ More pronounced than natural variation, and may result in perceptible effects on environmental, social, or economic components.	The effect is probable to occur.
Low	▪ A noticeable change that remains well within regulatory guideline values. ▪ Comparable to natural variation.	The effect is possible to occur.
Negligible	▪ A change that is sufficiently small such that it is unlikely to result in any noticeable effect on environmental, social, or economic components. ▪ Remains well below regulatory guideline thresholds. ▪ Within the bounds of natural variation.	The effect is unlikely to occur.

The accompanying risk matrix (Table 19.3) combines these two dimensions to categorize outcomes from negligible to extreme risk using a colour-coded scale. The matrix, developed in alignment with federal guidance (IAAC 2025), provides an anticipated level of residual risk for consideration in developing the Tailored Impact Statement Guidelines, as described in the *Operational Policy Statement*.

Table 19.3: Risk Matrix

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

In this screening, high or extreme risks indicate potential for significant adverse effects without additional mitigation or controls and require further analysis. For example, continual exceedances of ambient air quality guidelines at sensitive receptors (such as hospitals, schools, or community areas) would pose a high risk to human health.

Moderate risks suggest that additional controls may be needed to prevent significant effects, such as near-exceedances of air quality criteria under certain conditions.

Low or negligible risks indicate that no further mitigation or analysis is required, as effects (for example, concentrations of contaminants of concern in air quality) remain well below applicable guidelines or within natural variation.

19.2.3 Pathways of Change and Preliminary Risk Assessment Screening

During the site preparation and construction phases of the Project, there is no disposal of used nuclear fuel. Effects are therefore limited to those associated with conventional infrastructure construction such as those that occur with mining projects. The Project will be constructed using conventional mining techniques; therefore, mitigation measures suitable for comparable mining projects in the regional area and previously approved by the IAAC (including Hardrock, Goliath, and Hammond Reef Gold Projects) (CEAA 2018a,b, 2019) are appropriate mitigation for effects of carrying out the Project.

Effects during decommissioning and closure are expected to be similar in nature and extent to those during site preparation, construction, and operations, with additional management of LLW.

During operations and closure, the potential for radiation releases, malfunctions, or accidents will be rigorously managed under the CNSC's regulatory oversight and licensing regime. Effects, mitigation measures, and monitoring requirements for these phases are comparable to those assessed for the Ontario Power Generation DGR Project and AECL's Nuclear Fuel Waste Management and Disposal Concept. In both cases, federal EAs concluded that, with mitigation, significant adverse effects were not expected, and deep geological disposal was identified as the preferred method for safely isolating radioactive waste.

While those projects did not proceed, partly due to a lack of social licence and concerns raised by Indigenous groups, the NWMO is committed to a process that includes Indigenous voices, respects Indigenous rights, and builds trust and legitimacy. The NWMO will work collaboratively with the Anishinaabe peoples of WLON and the Township of Ignace to confirm the suitability of precedent mitigation measures before site preparation begins.

Table 19.4 presents the results of the pathway of change evaluation for intermediate and VCs, excluding those related to Indigenous Peoples (Section 21). The table identifies Project

components and activities by phase, environmental design features, pathways of change, affected components, and the degree of potential effect (as defined in Table 19.2). For each pathway, corresponding mitigation, protection and enhancement measures are outlined, following the mitigation hierarchy of avoid, minimize, restore, and offset or compensate (Section 19.2.2.2).

Following application of mitigation, protection and enhancement measures, the residual degree of effect is described, and pathways with potential residual effects are carried forward to the preliminary risk screening. Supporting rationale for these determinations is provided after Table 19.4 for each intermediate and VC identified in Section 19.2.1.

Table 19.4: Pathways of Change Screening for Intermediate and Valued Components

Project Components/Activities	Environmental Design Features	Pathway of Change	Intermediate or Valued Components Potentially Affected from this Pathway of Change	Potential Effect from Pathway of Change Prior to Application of Mitigation and Protection Measures	Mitigation Protection and Enhancement Measures	Predicted Residual Effect from Pathway of Change Following Application of Environmental Design Features, Mitigation and Protection Measures
Site Preparation and Construction: • Land clearing, grubbing, grading and terracing • Construction of on-site access roads and road upgrades • Construction of surface infrastructure • Construction of temporary infrastructure (e.g., laydown areas, concrete batch plant) • Development of underground facilities • Construction of the ERMA and OMA • Management of excavated and organic material • Construction of the transmission line • Construction of raw, fresh and contact water management and treatment systems • Construction and use of accommodation camp • Construction and use of the rail spur **Operations:** • Management of excavated and organic material • Operation of the rail spur • Management of hazardous and non-hazardous waste **Decommissioning and Closure:** • Demolition and removal of surface infrastructure **All Phases:** • Use of heavy equipment and vehicles • Reclamation, restoration and revegetation of disturbed areas no longer required for use • Site traffic	▪ Use fuel-efficient equipment and design infrastructure to reduce fuel use. ▪ Plan haul routes to minimize fuel use and dust emissions. ▪ Use energy-saving lighting like LEDs.	Project activities during all Project phases could generate and emit criteria air contaminants, resulting in direct changes to baseline conditions of air quality, and indirect changes to baseline conditions of other intermediate and valued components.	**Intermediate components:** ▪ Air quality ▪ Surface water quality ▪ Topography, sediment and soils **Valued components:** ▪ Fish and fish habitat ▪ Vegetation, riparian and wetland environments ▪ Migratory and SAR birds ▪ Terrestrial wildlife and wildlife habitat ▪ Non-Indigenous health and well-being ▪ Current use of lands and resources for traditional purposes by Indigenous Peoples ▪ Health and well-being of Indigenous Peoples	CACs may be above regulatory guidelines and standards, resulting in a moderate to high degree of potential adverse effects on air quality and other intermediate and valued components.	▪ Apply water or approved dust suppressants to unpaved roads, as required. ▪ Limit unnecessary engine idling and reduce vehicle speeds on unpaved roads. ▪ Maintain emissions control devices on all equipment. ▪ Regularly service vehicles and heavy equipment. ▪ Monitor and manage energy use for efficiency. ▪ Implement a GHG Management Plan. ▪ In accordance with Licensing requirements, implement: o A project-specific Environmental Protection Program and Effluent and Emissions Plan o A Project-specific Environmental Monitoring Plan that includes monitoring of ambient air quality, as required.	CACs are expected be below regulatory guidelines and standards, but measurable relative to baseline concentrations, resulting in potential low-degree residual effects.
		Project activities during all Project phases could generate and emit GHGs, resulting in direct changes to baseline conditions of the climate change VC.	**Valued components:** ▪ Climate change	GHG emissions from the Project are anticipated to result in a negligible contribution to federal emission totals and would not impede Canada's ability to reach climate change commitments in the form of emission reduction targets.		GHG emissions from the Project are anticipated to result in a negligible contribution to federal emission totals and would not impede Canada's ability to reach climate change commitments in the form of emission reduction targets.
	• Limit the Project footprint to the extent practicable. • Enclose or dampen noisy equipment (>80 dBA) in buildings where feasible.	Project activities during all Project phases could generate noise, vibration and light emissions, resulting in direct changes to baseline conditions of noise, vibration and light, and indirect changes to other intermediate and valued components.	**Intermediate components:** ▪ Noise, vibration and light **Valued components:** ▪ Fish and fish habitat ▪ Migratory and SAR birds ▪ Terrestrial wildlife and wildlife habitat ▪ Non-Indigenous health conditions ▪ Current use of lands and resources for traditional purposes by Indigenous Peoples ▪ Health conditions of Indigenous Peoples	Noise, vibration and light may be above regulatory guidelines and standards, resulting in a moderate to high degree of potential adverse effects on intermediate and valued components.	• Follow NPC-300 for noise control. • Follow NPC-119 and OPSS-120 to limit vibration. • Outfit internal combustion engines with muffler systems. • Maintain roads to reduce noise and vibration. • Follow DFO's Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters. • Implement a project-specific Conventional Health and Safety Program, in accordance with licence requirements.	Noise, vibration and light levels are anticipated to be below regulatory guidelines and standards but measurable relative to baseline concentrations, resulting in low-degree residual effects.

Table 19.4: Pathways of Change Screening for Intermediate and Valued Components

Project Components/Activities	Environmental Design Features	Pathway of Change	Intermediate or Valued Components Potentially Affected from this Pathway of Change	Potential Effect from Pathway of Change Prior to Application of Mitigation and Protection Measures	Mitigation Protection and Enhancement Measures	Predicted Residual Effect from Pathway of Change Following Application of Environmental Design Features, Mitigation and Protection Measures
Site Preparation and Construction: • Development of underground facilities • Construction of the ERMA and OMA **Operations:** • Water management **Decommissioning and Closure:** • Demolition and removal of surface infrastructure **All Phases:** • Reclamation, restoration and revegetation of disturbed areas no longer required for use	▪ Implement the multi-barrier system to eliminate potential radioactive contamination from the storage of used nuclear fuel. ▪ Limit the Project footprint to the extent practicable. ▪ Provide adequate contact water storage capacity to manage groundwater inflows and surface runoff and seepage.	Project activities during all Project phases could change the hydrogeological regime, resulting in direct changes to baseline conditions of hydrogeology, and indirect changes to other intermediate and valued components.	**Intermediate components:** ▪ Hydrogeology ▪ Hydrology ▪ Surface water quality **Valued components:** ▪ Fish and fish habitat ▪ Vegetation, riparian and wetland environments, including SAR ▪ Migratory and SAR birds ▪ Terrestrial wildlife and wildlife habitat, including SAR ▪ Non-Indigenous health conditions ▪ Current use of lands and resources for traditional purposes by Indigenous Peoples ▪ Health conditions of Indigenous Peoples	Changes in hydrological regime may result in a moderate to high degree of potential adverse effects on intermediate and valued components.	▪ Dewatering activities will be completed in accordance with provincial permitting requirements. ▪ Design, maintain, and monitor the underground dewatering system to manage groundwater inflows. ▪ In accordance with Licensing requirements, implement: ○ A Project-specific Environmental Protection Program. ○ A Project-specific Environmental Monitoring Plan that includes monitoring of groundwater quality, as required. ○ A Preliminary Decommissioning and Reclamation Plan.	Changes in groundwater levels are anticipated to be measurable relative to baseline concentrations, resulting in low-degree residual effects. Residual effects on groundwater quality are not anticipated.

Table 19.4: Pathways of Change Screening for Intermediate and Valued Components

Project Components/Activities	Environmental Design Features	Pathway of Change	Intermediate or Valued Components Potentially Affected from this Pathway of Change	Potential Effect from Pathway of Change Prior to Application of Mitigation and Protection Measures	Mitigation Protection and Enhancement Measures	Predicted Residual Effect from Pathway of Change Following Application of Environmental Design Features, Mitigation and Protection Measures
Site Preparation and Construction: • Land clearing, grubbing, grading and terracing • Construction of on-site access roads and road upgrades • Construction of surface infrastructure • Construction of temporary infrastructure (e.g., laydown areas, concrete batch plant) • Development of underground facilities • Construction of the ERMA and OMA • Construction of the transmission line • Construction of raw, fresh and contact water management and treatment systems • Construction and use of accommodation camp • Construction and use of the rail spur **Operations:** • Water management • Effluent treatment plant and treated effluent discharge • Water intake for fresh water and process water • Hazardous and non-hazardous waste management **Decommissioning and Closure:** • Demolition and removal of surface infrastructure **All Phases:** • Reclamation, restoration and revegetation of disturbed areas no longer required for use	▪ Implement the multi-barrier system to eliminate potential radioactive contamination from the storage of used nuclear fuel. ▪ Limit the Project footprint to the extent practicable. ▪ Collect, store, and routinely monitor contact water to confirm discharge water meets water quality criteria appropriate for release. ▪ Provide adequate contact water storage capacity to allow controlled rate of release during both routine and non-routine operation scenarios. ▪ Design and install appropriate site drainage and water containment and conveyance structures on site. ▪ Design new roads such that the alignments minimize water crossings. ▪ Recycle and re-use contact water to reduce fresh water, to the extent practicable.	Project activities during all Project phases could change hydrology and water quality, resulting in direct changes to hydrology and surface water quality baseline conditions and indirect changes to other intermediate and valued components.	**Intermediate components:** ▪ Hydrology ▪ Surface water quality ▪ Topography, terrain and sediment **Valued components:** ▪ Fish and fish habitat ▪ Vegetation, riparian and wetland environments, including SAR ▪ Migratory and SAR birds ▪ Terrestrial wildlife and wildlife habitat, including SAR ▪ Non-Indigenous health conditions ▪ Current use of lands and resources for traditional purposes by Indigenous Peoples ▪ Health conditions of Indigenous Peoples	Changes in hydrology and surface water quality may result in a moderate to high degree of potential adverse effects on intermediate and valued components.	▪ To the extent practicable, work in sensitive areas would be scheduled to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation (e.g., spring freshet). ▪ Install and maintain appropriate erosion and sediment control measures, as required. ▪ Discharge treated effluent to minimize effects from changes in velocity. ▪ Develop appropriate discharge flow rates and monitor treated effluent flow to address erosion concerns. ▪ Monitor treated effluent and treated sewage flow and quality. ▪ Perform routine inspection and maintenance of containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment. ▪ Recycle and re-use contact water to reduce fresh water, to the extent practicable. ▪ Implement progressive reclamation and revegetation of disturbed areas no longer required. ▪ In accordance with Licensing requirements, implement: ○ A Project-specific Environmental Protection Program. ○ A Project-specific Environmental Monitoring Plan that includes monitoring of water levels, surface water quality and sediment quality, as required. ○ A Preliminary Decommissioning and Reclamation Plan.	Changes in hydrology and surface water quality are anticipated to be below regulatory guidelines and standards but measurable relative to baseline concentrations, resulting in low-degree residual effects.

Table 19.4: Pathways of Change Screening for Intermediate and Valued Components

Project Components/Activities	Environmental Design Features	Pathway of Change	Intermediate or Valued Components Potentially Affected from this Pathway of Change	Potential Effect from Pathway of Change Prior to Application of Mitigation and Protection Measures	Mitigation Protection and Enhancement Measures	Predicted Residual Effect from Pathway of Change Following Application of Environmental Design Features, Mitigation and Protection Measures
Site Preparation and Construction: • Land clearing, grubbing, grading and terracing • Construction of on-site access roads and road upgrades • Construction of surface infrastructure • Construction of temporary infrastructure (e.g., laydown areas, concrete batch plant) • Construction of the ERMA and OMA • Construction of the transmission line • Installation of security infrastructure • Construction of raw, fresh and contact water management and treatment systems • Construction and use of accommodation camp • Construction and use of the rail spur • Employment and procurement **Operations:** • Use of heavy equipment and vehicles • Water management • Effluent treatment plant and treated effluent discharge • Water intake for fresh water and process water • Operation of the rail spur • Hazardous and non-hazardous waste management **Decommissioning and Closure:** • Demolition and removal of surface infrastructure **All Phases:** • Reclamation, restoration and revegetation of disturbed areas no longer required for use	▪ Implement the multi-barrier system to eliminate potential radioactive contamination from the storage of used nuclear fuel. ▪ Limit the Project footprint to the extent practicable. ▪ Provide adequate contact water storage capacity to allow controlled rate of release during both routine and non-routine operation scenarios. ▪ Design and install appropriate site drainage and water containment and conveyance structures on site. ▪ Design new roads such that the alignments minimize water crossings.	Project activities during all Project phases could change topography, soils and sediment, resulting in direct changes to baseline conditions of topography, soils and sediment and indirect changes to other intermediate and valued components.	**Intermediate components:** ▪ Topography, soils and sediment **Valued components:** ▪ Fish and fish habitat ▪ Vegetation, riparian and wetland environments, including SAR ▪ Migratory and SAR birds ▪ Terrestrial wildlife and wildlife habitat, including SAR ▪ Non-Indigenous health conditions ▪ Current use of lands and resources for traditional purposes by Indigenous Peoples ▪ Health conditions of Indigenous Peoples	Changes in topography, soils and sediment may result in a moderate to high degree of potential adverse effects on intermediate and valued components.	▪ Implement applicable best management practices for excess soil management included in Province of Ontario Management of Excess Soil Guideline (Province of Ontario 2021). ▪ Collect, store, and routinely monitor contact water to confirm discharge water meets water quality criteria appropriate for release. ▪ To the extent practicable, work in sensitive areas would be scheduled to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation (e.g., spring freshet). ▪ Install and maintain appropriate erosion and sediment control measures, as required. ▪ Develop appropriate discharge flow rates and monitor treated effluent flow to address erosion concerns. ▪ Monitor treated effluent and treated sewage flow and quality. ▪ Minimize areas of vegetation clearing and soil disturbance. ▪ Monitor slope stability during site preparation and construction of facilities. ▪ Monitor site clearing, contouring, and excavation activities for signs of admixing, compaction, and erosion. ▪ Monitor soil transport and stockpiling activities for signs of erosion. ▪ Minimize steepness and length of slopes of disturbed areas and stockpiled soils. ▪ Use clearing equipment that minimizes surface disturbance, soil compaction, and topsoil loss, where feasible. ▪ Implement progressive reclamation and revegetation of disturbed areas no longer required. ▪ Reclaim and revegetate areas where non-permanent Project facilities have been decommissioned. ▪ In accordance with Licensing requirements, implement: ○ A Project-specific Environmental Monitoring Plan that includes monitoring of water levels, surface water quality and sediment quality, as required. ○ A Project-specific Environmental Protection Program. ○ A Preliminary Decommissioning and Reclamation Plan.	Changes in soils and sediment are anticipated to be below regulatory guidelines and standards but measurable relative to baseline concentrations, resulting in low-degree residual effects. Residual effects on topography are not anticipated.

Table 19.4: Pathways of Change Screening for Intermediate and Valued Components

Project Components/Activities	Environmental Design Features	Pathway of Change	Intermediate or Valued Components Potentially Affected from this Pathway of Change	Potential Effect from Pathway of Change Prior to Application of Mitigation and Protection Measures	Mitigation Protection and Enhancement Measures	Predicted Residual Effect from Pathway of Change Following Application of Environmental Design Features, Mitigation and Protection Measures

Site Preparation and Construction:
• Land clearing, grubbing, grading and terracing
• Construction of on-site access roads and road upgrades
• Construction of surface infrastructure
• Construction of temporary infrastructure (e.g., laydown areas, concrete batch plant)
• Construction of the ERMA and OMA
• Construction of the transmission line
• Construction of raw, fresh and contact water management and treatment systems
• Installation of security infrastructure
• Construction and use of accommodation camp
• Construction and use of the rail spur
• Employment and procurement
• Reclamation and revegetation of disturbed areas no longer required for use
Operations:
• Water management
• Effluent treatment plant and treated effluent discharge
• Water intake for fresh water and process water
• Hazardous and non-hazardous waste management
• Reclamation and revegetation of disturbed areas no longer required for use
Decommissioning and Closure:
• Demolition and removal of surface infrastructure
• Restoration and revegetation of facilities and infrastructure
All Phases:
• Site traffic
	▪ Implement the multi-barrier system to eliminate potential radioactive contamination from the storage of used nuclear fuel.
	▪ To the extent practicable, locate in-water developments away from sensitive or unique fish habitats.
	▪ Design in-water developments so that the structures minimize adverse effects on fish and fish habitat and avoid a harmful alteration disruption or destruction of fish habitat, as defined by the federal *Fisheries Act*, to the extent practicable.
	▪ Minimize the physical footprint of in-water developments to the extent practicable.
		Project activities during all Project phases could change fish and fish habitat, resulting in direct changes to baseline conditions of fish and fish habitat, and indirect changes to other VCs.	**Valued components:**
			▪ Fish and fish habitat
			▪ Vegetation, riparian and wetland environments, including SAR
			▪ Migratory and SAR birds
			▪ Terrestrial wildlife and wildlife habitat, including SAR
			▪ Non-Indigenous health conditions
			▪ Current use of lands and resources for traditional purposes by Indigenous Peoples
			▪ Health conditions of Indigenous Peoples
				Project activities have the potential to result in moderate to high degree of adverse effects on fish and fish habitat that could prohibit the maintenance of self-sustaining and ecologically effective fish populations and/or adversely affect other VCs.	▪ Implement progressive reclamation and revegetation of disturbed areas no longer required.
					▪ The NWMO will develop, prior to site preparation and construction, and implement throughout site preparation, construction, and operations, procedures to prohibit non-local NWMO employees and contractor personnel from engaging in recreational hunting, fishing, or the use of all-terrain vehicles or snowmobiles within the Project area or surrounding lands during off-duty hours.
					▪ Where possible, schedule in-water activities to avoid work during DFO's Ontario Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat (DFO 2013).
					▪ Apply DFO's Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act* (DFO 2019) to minimize potential adverse effects on aquatic resources.
					▪ Employ construction methods that avoid or minimize the potential to cause injury or mortality to fish or disturb nearby habitats, to the extent practicable.
					▪ Construct in-water infrastructure in adherence with the conditions of any permits or authorizations from the appropriate regulatory agencies.
					▪ Locate the intake screen above the bottom of the waterbody to prevent entrainment of sediment and aquatic organisms associated with the bottom area.
					▪ Design and install a fish screen on the freshwater intake to avoid or reduce entrainment or impingement of fish, in accordance with DFO's Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995).
					▪ If required, develop a fish habitat offsetting plan consultation with DFO and engagement with WLON and other First Nations and Indigenous groups.
					▪ In accordance with Licensing requirements, implement:
					  ○ A Project-specific Environmental Protection Program
					  ○ A Project-specific Environmental Monitoring Plan that includes monitoring of changes to fish habitat, as required
					  ○ A Preliminary Decommissioning and Reclamation Plan.
						Changes in fish and fish habitat are anticipated to be avoided or offset. Where indirect effects are anticipated (i.e., change in air, hydrology or surface water quality), changes are expected to be well below regulatory guidelines or standards, but measurable. Overall, residual effects of negligible degree are anticipated.

Table 19.4: Pathways of Change Screening for Intermediate and Valued Components

Project Components/Activities	Environmental Design Features	Pathway of Change	Intermediate or Valued Components Potentially Affected from this Pathway of Change	Potential Effect from Pathway of Change Prior to Application of Mitigation and Protection Measures	Mitigation Protection and Enhancement Measures	Predicted Residual Effect from Pathway of Change Following Application of Environmental Design Features, Mitigation and Protection Measures
Site Preparation and Construction: • Land clearing, grubbing, grading and terracing • Construction of on-site access roads and road upgrades • Construction of surface infrastructure • Construction of temporary infrastructure (e.g., laydown areas, concrete batch plant) • Construction of the ERMA and OMA • Construction of the transmission line • Installation of security infrastructure • Construction of raw, fresh and contact water management and treatment systems • Construction and use of accommodation camp • Construction and use of the rail spur • Employment and procurement **Operations:** • Use of heavy equipment and vehicles • Water management • Effluent treatment plant and treated effluent discharge • Water intake for fresh water and process water • Operation of the rail spur • Hazardous and non-hazardous waste management **Decommissioning and Closure:** • Demolition and removal of surface infrastructure **All Phases:** • Reclamation, restoration and revegetation of disturbed areas no longer required for use	• Implement the multi-barrier system to eliminate potential radioactive contamination from the storage of used nuclear fuel. • Avoid wetlands when designing the routes for the site access roads, transmission line and rail spur, to the extent feasible. • Limit the Project footprint to the extent practicable. • Design and locate shoreline developments to minimize riparian vegetation loss and/or disturbance, to the extent practicable.	Project activities during all Project phases could change vegetation, riparian and wetland environments, resulting in direct changes to baseline conditions and indirect changes to other VCs.	**Valued components:** ▪ Vegetation, riparian and wetland environments, including SAR ▪ Migratory and SAR birds ▪ Terrestrial wildlife and wildlife habitat, including SAR ▪ Non-Indigenous health and well-being • Current use of lands and resources for traditional purposes by Indigenous Peoples ▪ Health and well-being of Indigenous Peoples	Project activities have the potential to result in moderate to high degree of adverse effects on vegetation, riparian and wetland environments that could prohibit the maintenance of self-sustaining and ecologically effective ecosystems and/or adversely affect other VCs.	▪ Minimize areas of vegetation clearing and soil disturbance. ▪ Minimize steepness and length of slopes of disturbed areas and stockpiled soils. ▪ Mark clearly with an applicable setback distance and avoid known rare plants, where feasible. Where disturbance to rare plants is unavoidable, compensation would be considered following discussion with WLON and applicable regulators. ▪ Use clearing equipment that minimizes surface disturbance, soil compaction, and topsoil loss, where feasible. ▪ Use native species or non-aggressive, non-native species appropriate for the conditions for revegetation. ▪ Inspect construction equipment prior to arriving at site and clean, if required. ▪ Implement progressive reclamation and revegetation of disturbed areas no longer required. ▪ In accordance with Licensing requirements, implement: o A Project-specific Environmental Protection Program that includes actions to avoid and limit invasive plant species. o A Preliminary Decommissioning and Reclamation Plan.	Changes in vegetation, riparian and wetland environments are anticipated to measurable, and residual effects are anticipated. Overall, following implementation of mitigation measures, residual effects of negligible degree are anticipated.

Table 19.4: Pathways of Change Screening for Intermediate and Valued Components

Project Components/Activities	Environmental Design Features	Pathway of Change	Intermediate or Valued Components Potentially Affected from this Pathway of Change	Potential Effect from Pathway of Change Prior to Application of Mitigation and Protection Measures	Mitigation Protection and Enhancement Measures	Predicted Residual Effect from Pathway of Change Following Application of Environmental Design Features, Mitigation and Protection Measures

Site Preparation and Construction:
• Land clearing, grubbing, grading and terracing
• Construction of on-site access roads and road upgrades
• Use of heavy equipment and vehicles
• Construction of surface infrastructure
• Construction of temporary infrastructure (e.g., laydown areas, concrete batch plant)
• Development of underground facilities
• Construction of the ERMA and OMA
• Management of excavated and organic material
• Construction of the transmission line
• Installation of security infrastructure
• Construction of raw, fresh and contact water management and treatment systems
• Construction and use of accommodation camp
• Construction and use of the rail spur
• Progressive reclamation of disturbed areas no longer required for use
• Site traffic
Operations:
• Use of heavy equipment and vehicles
• Management of excavated and organic material
• Water management
• Effluent treatment plant and treated effluent discharge
• Water intake for fresh water and process water
• Operation of the rail spur
• Management and storage of radioactive waste from UFPP operations
• Hazardous and non-hazardous waste management
• Progressive reclamation of disturbed areas no longer required for use
• Site traffic
Decommissioning and Closure:
• Use of heavy equipment and vehicles
• Demolition and removal of surface infrastructure
• Restoration and revegetation of facilities and infrastructure
• Site traffic
	▪ Implement the multi-barrier system to eliminate potential radioactive contamination from the storage of used nuclear fuel.
	▪ To the extent practicable, locate surface infrastructure and in-water developments away from sensitive migratory bird habitats.
	▪ To the extent practicable design and locate shoreline developments to minimize riparian vegetation loss and/or disturbance.
	▪ Minimize the physical footprint of in-water developments to the extent practicable.
		Project activities during all Project phases could change migratory and SAR bird habitat availability, distribution and survival and reproduction, resulting in direct changes to baseline conditions and indirect changes to other VCs.	**Valued components:**
			▪ Migratory and SAR birds
			▪ Terrestrial wildlife and wildlife habitat, including SAR
			• Current use of lands and resources for traditional purposes by Indigenous Peoples
			• Health and well-being of Indigenous Peoples
				Project activities have the potential to result in moderate to high degree of adverse effects on migratory and SAR birds that could prohibit the maintenance of self-sustaining and ecologically effective populations and/or adversely affect other VCs.	▪ Site preparation and construction activities that might interfere with breeding or nesting migratory birds will avoid the sensitive nesting period of mid-April through late August, to the extent possible.
					▪ If site preparation and construction activities cannot be avoided during the sensitive nesting period, bird nest sweeps will be completed (by a qualified professional) to check for presence of nests and bird mating and/or nesting behaviour.
					▪ During applicable migratory periods, vegetation clearing will be limited. If vegetation clearing is required, nest sweeps will be undertaken to avoid disruption to breeding birds.
					▪ Revegetate temporarily disturbed areas with suitable, native or non-aggressive non-native species after construction activities are complete.
					▪ Employ construction methods that avoid or minimize the potential t cause injury or mortality to migratory birds and/or SAR birds or disturb nearby habitats, to the extent practicable.
					▪ Construct in-water developments in adherence with the conditions of any permits or authorizations that may be issued for the Project from the appropriate regulatory agencies.
					▪ Discharge pumped contact water to minimize effects from changes in velocity.
					▪ Develop appropriate discharge flow rates and monitor treated effluent flow to address erosion concerns.
					▪ In accordance with Licensing requirements, implement:
					  ○ A Project-specific Environmental Protection Program.
					  ○ A Preliminary Decommissioning and Reclamation Plan.
						Changes in migratory and SAR birds are anticipated to measurable, and residual effects are anticipated. Overall, following implementation of mitigation measures, residual effects of negligible degree are anticipated.

Table 19.4: Pathways of Change Screening for Intermediate and Valued Components

Project Components/Activities	Environmental Design Features	Pathway of Change	Intermediate or Valued Components Potentially Affected from this Pathway of Change	Potential Effect from Pathway of Change Prior to Application of Mitigation and Protection Measures	Mitigation Protection and Enhancement Measures	Predicted Residual Effect from Pathway of Change Following Application of Environmental Design Features, Mitigation and Protection Measures
Site Preparation and Construction: • Land clearing, grubbing, grading and terracing • Construction of on-site access roads and road upgrades • Use of heavy equipment and vehicles • Construction of surface infrastructure • Construction of temporary infrastructure (e.g., laydown areas, concrete batch plant) • Development of underground facilities • Construction of the ERMA and OMA • Management of excavated and organic material • Construction of the transmission line • Installation of security infrastructure • Construction of raw, fresh and contact water management and treatment systems • Construction and use of accommodation camp • Construction and use of the rail spur • Progressive reclamation of disturbed areas no longer required for use • Site traffic **Operations:** • Use of heavy equipment and vehicles • Management of excavated and organic material • Water management • Effluent treatment plant and treated effluent discharge • Water intake for fresh water and process water • Operation of the rail spur • Management and storage of radioactive waste from UFPP operations • Hazardous and non-hazardous waste management • Progressive reclamation of disturbed areas no longer required for use • Site traffic **Decommissioning and Closure:** • Use of heavy equipment and vehicles • Demolition and removal of surface infrastructure • Restoration and revegetation of facilities and infrastructure • Site traffic	▪ Implement the multi-barrier system to eliminate potential radioactive contamination from the storage of used nuclear fuel. ▪ Limit the Project footprint to the extent practicable. ▪ Minimize habitat creation and human-wildlife interactions for the Project through design; specifically, by evaluating opportunities to include screening on vents and entranceways.	Project activities during all Project phases could change terrestrial wildlife and wildlife habitat availability, distribution and survival and reproduction, resulting in direct changes to baseline conditions and indirect changes to other VCs.	**Valued components:** ▪ Terrestrial wildlife and wildlife habitat • Current use of lands and resources for traditional purposes by Indigenous Peoples ▪ Health and well-being of Indigenous Peoples	Project activities have the potential to result in moderate to high degree of adverse effects on terrestrial wildlife and wildlife habitat that could prohibit the maintenance of self-sustaining and ecologically effective populations and/or adversely affect other VCs.	▪ Enforce speed limits and reporting procedures for wildlife collisions or observances along the access road and rail spur. ▪ Minimize areas of vegetation clearing and soil disturbance. ▪ Minimize steepness and length of slopes of disturbed areas and stockpiled soils. ▪ Use clearing equipment that minimizes surface disturbance, soil compaction, and topsoil loss (e.g., equipment with low ground pressure tracks or tires, blade shoes and brush), where feasible. ▪ To the extent practicable, work in sensitive areas (i.e., erosive soils, wetland features, and fish habitats) would be scheduled to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation (e.g., spring freshet) ▪ Implement progressive reclamation and revegetation of disturbed areas no longer required. ▪ Reclaim and revegetate areas where non-permanent Project facilities have been decommissioned. ▪ If bats are observed nesting, roosting, or hibernating, do not disturb them, to the extent practicable. Contact the MECP and ECCC to discuss measures for the safe removal/relocation and to identify further measures that could prevent future access. ▪ If SAR are identified, contact the MECP and ECCC to discuss measures for the safe removal/relocation and to identify further measures that could prevent future access. ▪ In accordance with Licensing requirements, implement: ○ A Project-specific Environmental Protection Program. ○ A Preliminary Decommissioning and Reclamation Plan.	Changes in terrestrial wildlife and wildlife habitat are anticipated to measurable, and residual effects are anticipated. Overall, following implementation of mitigation measures, residual effects of negligible degree are anticipated.

Table 19.4: Pathways of Change Screening for Intermediate and Valued Components

Project Components/Activities	Environmental Design Features	Pathway of Change	Intermediate or Valued Components Potentially Affected from this Pathway of Change	Potential Effect from Pathway of Change Prior to Application of Mitigation and Protection Measures	Mitigation Protection and Enhancement Measures	Predicted Residual Effect from Pathway of Change Following Application of Environmental Design Features, Mitigation and Protection Measures
Site Preparation and Construction: • Land clearing, grubbing, grading and terracing • Construction of on-site access roads and road upgrades • Use of heavy equipment and vehicles • Construction of surface infrastructure • Construction of temporary infrastructure (e.g., laydown areas, concrete batch plant) • Development of underground facilities • Construction of the ERMA and OMA • Management of excavated and organic material • Construction of the transmission line • Installation of security infrastructure • Construction of raw, fresh and contact water management and treatment systems • Construction and use of accommodation camp • Construction and use of the rail spur • Progressive reclamation of disturbed areas no longer required for use • Site traffic • Employment and procurement **Operations:** • Use of heavy equipment and vehicles • Management of excavated and organic material • Water management • Effluent treatment plant and treated effluent discharge • Water intake for fresh water and process water • Operation of the rail spur • Management and storage of radioactive waste from UFPP operations • Hazardous and non-hazardous waste management • Progressive reclamation of disturbed areas no longer required for use • Site traffic • Employment and procurement **Decommissioning and Closure:** • Use of heavy equipment and vehicles • Demolition and removal of surface infrastructure • Restoration and revegetation of facilities and infrastructure • Site traffic • Employment and procurement	• Implement the multi-barrier system to eliminate potential radioactive contamination from the storage of used nuclear fuel.	Project components and activities during all Project phases could result in changes to non-Indigenous health, economic and social conditions.	**Valued components**: • Non-Indigenous health conditions • Non-Indigenous economic conditions ▪ Non-Indigenous social conditions	**Health conditions:** Project activities have the potential to result in moderate to high degree of adverse effects on non-Indigenous health conditions and affect non-Indigenous economic and social conditions. **Economic conditions:** Without the implementation of the Project, economic conditions are anticipated to be similar to baseline conditions **Social conditions:** Project activities have the potential to result in moderate to high degree of adverse effects on social conditions and affect non-Indigenous economic and health conditions.	▪ Implement environmental design features, mitigation and protection measures related to the atmospheric environment, surface water quality, fish and fish habitat, vegetation, riparian and wetland environments and terrestrial wildlife and wildlife habitat to mitigate effects on community health and well-being. ▪ Communicate transportation plans with WLON, the Township of Ignace and other local communities. ▪ Develop and implement human resource policies (e.g., EFAP) to assist workers in finding information and referral services for family-related resources, as required. ▪ Implement and enforce the Code of Conduct, provide training to staff and contractors and include confidential reporting and support mechanisms ▪ Establish an Implementation Committee to provide a forum for regular communication and information exchange between the NWMO, host community and Nation for effective management of the Hosting Agreements commitments and for the early resolution of issues and/or disputes that may arise. ▪ Implement benefits and conditions according to the Hosting Agreements.	**Health conditions:** Project activities have the potential to result in negligible degree of adverse effects on non-Indigenous health conditions and/or adversely affect other VCs. **Economic conditions:** Without the implementation of the Project, economic conditions are anticipated to be positive. **Social conditions:** Project activities have the potential to result in a low degree of adverse effects on social conditions and positive effects on social conditions.

CAC = criteria air contaminant; dBA = A weighted decibel; DFO = Fisheries and Oceans Canada; ECCC = Environment and Climate Change Canada; EFAP = Employee and Family Assistance Program; ERMA = Excavated Rock Management Area; GHG = greenhouse gas; LED = light emitting diode; MECP = Ontario Ministry of the Environment, Conservation, and Parks; NWMO = Nuclear Waste Management Organization; OMA = Organics Management Area; SAR = Species at Risk; UFPP = Used Fuel Packaging Plant; VC = Valued Component; WLON = Wabigoon Lake Ojibway Nation.

19.2.3.1 AIR QUALITY

19.2.3.1.1 Pathways of Change Screening

Project activities such as land clearing, grading, blasting for surface and underground facilities, and the construction and use of access roads, the rail spur, the ERMA, OMA and site buildings will generate emissions of criteria air contaminants (CACs). These may include particulate matter (diesel particulate matter, PM_{10} and $PM_{2.5}$, fugitive dust), carbon monoxide, sulphur dioxide, nitrogen oxides, volatile organic compounds, polycyclic aromatic hydrocarbons, ammonia, and trace metals.

Prior to the application of environmental design features, mitigation, and protection measures, these activities could result in measurable changes to air quality, as outlined in Table 19.4.

- Project activities during all phases may generate CACs that contribute to localized changes in baseline air quality conditions for intermediate and VCs.

These activities would be managed through a combination of best management practices and environmental design features, including emission controls and dust suppression techniques. The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance.

Although environmental design features, mitigation and protection measures are anticipated to mitigate criteria air contaminant concentrations below regulatory guidelines and standards, the potential still exists for the Project to elevate predicted concentrations of CACs and fugitive dust compared to baseline conditions at or beyond the Project boundary, which would result in a residual adverse effect on the air quality intermediate component. As residual effects on the air quality intermediate component are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.1.2 Preliminary Risk Screening of Residual Effects

Air quality dispersion modelling has not yet been completed for the Project. The modelling will combine baseline air quality with predicted site-specific emissions to assess potential effects on air quality, contaminant transport, and exposure for humans and ecological receptors. Results will inform additional site-specific mitigation and monitoring requirements, including those under the effluent and emissions control program and the air quality component of the environmental monitoring program. Mitigation measures and monitoring requirements will be shared with WLON, the Township of Ignace, and regulatory agencies.

Model results will also inform the HHERA, required for the NWMO's initial licence application and Impact Statement submission. In accordance with the NSCA and REGDOC-2.9.1, the HHERA will be reviewed by the CNSC to demonstrate that protection measures reduce effects to as low as reasonably achievable (ALARA). The HHERA will identify exposure pathways, assess potential impacts on people and the environment, and confirm that risks remain acceptable throughout the life of the Project. It will be updated at least every five years or when material changes to the Project design occur. The Project is also expected to be subject to provincial permitting requirements under the MECP Environmental Compliance Approval program. In accordance with the requirements of REGDOC-2.9.2, the NWMO would also complete a best available technology and techniques economically achievable assessment for mitigation measures to control environmental releases and develop corresponding environmental action levels for both airborne and liquid effluent releases.

Emissions and dust from similar projects typically settle within 500 m to 1 km of the source due to particle size, low release heights, and limited dispersion (MECP 2017). Terrain, vegetation, and

weather further promote short-range settling. Short-term exceedances may occur but are expected to be infrequent and limited to a few hundred metres of the source, with no material change to baseline conditions or effects beyond the Project boundary.

With effective mitigation, regulatory controls, and the limited dispersion of emissions, residual effects on air quality are expected to have a low degree and low likelihood of occurrence. Therefore, the overall risk of adverse environmental effects is characterized as low. Table 19.5 presents the risk assessment screening for the air quality intermediate component.

Although some uncertainty remains pending completion of the air quality modelling, there is a high level of confidence that proposed mitigation, protection measures, and regulatory oversight under federal and provincial frameworks will effectively manage potential air quality effects.

Table 19.5: Preliminary Residual Effects Risk Screening Associated with the Air Quality Intermediate Component

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

As presented in Table 19.4, changes to air quality may result in pathways of change to other intermediate and VCs, including:

- surface water quality (Section 19.2.3.5)
- topography, soils and sediment (Section 19.2.3.6)
- fish and fish habitat (Section 19.2.3.7)
- vegetation, riparian and wetland environments (Section 19.2.3.8)
- migratory and SAR birds (Section 19.2.3.9)
- terrestrial wildlife and wildlife Habitat (Section 19.2.3.10)
- non-Indigenous health conditions (Section 19.2.3.11)
- current use of lands and resources for traditional purposes by Indigenous Peoples (Section 21.1)
- health conditions of Indigenous Peoples (Section 21.1)

The risk screening for these intermediate and valued components changes to air quality is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the air quality intermediate component are anticipated to be low risk, given the proposed mitigation and environmental protection measures required and regulatory controls in place. Further modelling and assessment of effects on air quality will be completed to meet licensing requirements under the NSCA and inform provincial permitting requirements. Further assessment of effects on air quality

under the IAA is expected to be only applicable to assessment of intermediate or valued components where moderate to extreme risks of non-negligible residual effects are anticipated.

19.2.3.2 CLIMATE CHANGE

19.2.3.2.1 Pathways of Change Screening

Project activities, including power generation, land clearing and operation of equipment and vehicles will generate greenhouse gas (GHG) emissions. With implementation of environmental design features, mitigation and environmental protection measures, these emissions may influence the climate change VC through following pathway of change (Table 19.4):

- Project activities during all Project phases may generate and emit GHGs

Environmental design features and mitigation measures, including use of energy efficient technology and emission control devices on equipment would reduce GHGs emitted from the Project. The environmental design features, mitigation and environmental protection measures proposed are expected to reduce greenhouse gas emissions during all Project phases.

Although environmental design features, mitigation and protection measures would reduce the greenhouse gases emitted from the Project, emissions would still be generated from the Project, resulting in a residual effect relative to baseline conditions. As residual effects on the climate change VC are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.2.2 Preliminary Risk Screening of Residual Effects

Section 22 estimates maximum annual GHG emissions of approximately 14,480 tonnes (Scope 1) and 10,834 tonnes (Scope 2) of CO_2e during construction and operations. Compared to Canada's 2023 national total of 694 Mt CO_2e (ECCC 2025), the Project's CO_2e contribution is negligible (about 0.00002%) while the Project's role in facilitating the use of nuclear power to reduce CO_2e in Canada is considerable. Given that Project emissions represent less than 0.1% of national totals, the degree of effect is considered negligible. The likelihood of greenhouse gas releases from the Project are certain, as the Project will emit greenhouse gases through the Project activities, resulting in a high likelihood.

While GHG emissions are certain to occur, the degree of change is negligible, resulting in a low overall risk to the climate change VC and Canada's ability to meet climate commitments (Table 19.6). The NWMO is committed to implementing a GHG management plan consistent with federal requirements to reduce direct emissions, in collaboration with WLON and regulatory agencies. Further assessment under the IAA is not anticipated to be required.

Table 19.6: Preliminary Residual Effects Risk Screening Associated with the Climate Change Valued Component

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

19.2.3.3 NOISE, VIBRATION AND LIGHT

19.2.3.3.1 Pathways of Change Screening

Project activities including land clearing, grubbing grading and terracing, blasting for surface and underground facilities, construction and use of access roads and the rail spur will generate noise. Vibration sources from the Project are anticipated to be primarily from blasting activities for the construction of surface facilities and underground development. Minor vibration sources are also anticipated during operations from the use of heavy equipment on the access road and operation of the rail spur. Light emissions are anticipated from Project facilities and vehicles during all Project phases.

Without the implementation of environmental design features, mitigation and environmental protection measures, the following pathways of change from these Project activities (Table 19.4) have the potential to result in in a moderate to high degree of adverse effects on the noise, vibration and light intermediate component:

- Project activities during all Project phases could generate noise, vibration and light emissions, resulting in changes to baseline conditions of intermediate and valued components.

These activities would be managed through a combination of best management practices and environmental design features, including minimizing equipment idling, centralized Project facilities together and enclosing or dampening noisy equipment, the application of setback distances from sensitive features, such as fish-bearing watercourses. The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance, including standards and guidelines such as the Ontario Noise Guideline – Stationary and Transportation Sources – Approval and Planning (NPC-300), the HC Noise Guideline, and Fisheries and Oceans Canada's (DFO's) Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters.

Although environmental design features, mitigation and protection measures and other regulatory controls are anticipated to mitigate noise, vibration and light levels below regulatory guidelines and standards, the potential still exists for the Project to change noise, vibration and light levels compared to baseline conditions, which would result in a residual adverse effect on the noise, vibration and light intermediate component. As residual effects on noise, vibration and light are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.3.2 Preliminary Risk Screening of Residual Effects

Noise, vibration, and light modelling have not yet been completed for the Project. Each will incorporate baseline conditions with predicted site-specific emissions to assess potential effects at sensitive receptor locations. Results will inform site-specific mitigation and monitoring requirements within the environmental monitoring program and the NWMO's initial licence application. Any additional measures will be shared with WLON, the Township of Ignace, and regulatory agencies.

For noise, it is anticipated that the NWMO will be required to meet provincial permitting requirements under MECP's Environmental Compliance Approval process and comply with NPC-300 limits for stationary and transportation sources. Given the Project's remote location (about 10 km from the nearest community and 12 km from closest WLON resident), noise levels are expected to remain well below applicable limits, resulting in a low degree and negligible likelihood of residual effects.

Vibration is expected primarily from blasting and underground development. Emissions are anticipated to remain well below limits set by NPC-119 (MOE 1978) and OPSS-120, and the Project will adhere to DFO's Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998) to protect fish and habitat. Accordingly, vibration effects are expected to be low in degree and negligible in likelihood.

Light emissions from vehicles and surface facilities are also expected to be minimal due to the site's remote location, resulting in negligible effects.

Modelling results will also inform the HHERA a requirement under the NSCA and REGDOC-2.9.1. The HHERA will be reviewed by the CNSC to demonstrate that protection measures reduce effects on ALARA. It will identify exposure pathways, assess potential impacts, and confirm risks remain acceptable throughout the life of the Project, with updates at least every five years or as needed.

With proven mitigation, regulatory controls, and the limited extent of noise, vibration, and light emissions, residual effects are expected to present a negligible risk to the environment. Table 19.7 summarizes the risk screening for the noise, vibration, and light intermediate component. Although modelling is pending, there is high confidence in the effectiveness of mitigation and oversight measures under both federal and provincial frameworks.

Table 19.7: Preliminary Residual Effects Risk Screening Associated with the Noise, Vibration and Light Intermediate Component

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

As presented in *Table 19.4*, changes to noise, vibration and light may result in pathways of change to other VCs, including those listed below:

- fish and fish habitat (Section 19.2.3.7)
- migratory and SAR birds (Section 19.2.3.9)
- terrestrial wildlife and wildlife habitat (Section 19.3.2.10)
- non-Indigenous health conditions (Section 19.2.3.11)
- current use of lands and resources for traditional purposes by Indigenous Peoples (Section 21.1)
- health conditions of Indigenous Peoples (Section 21.1)

The risk screening for these VCs is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the noise, vibration and light intermediate component are anticipated to be of negligible risk, given the proposed mitigation and environmental protection measures required and regulatory controls in place. Further modelling and assessment of effects on noise, vibration and light will be completed to meet

licensing requirements under the NSCA and inform provincial permitting requirements. Further assessment of effects on noise, vibration and light under the IAA is expected to be applicable to assessment VCs where moderate to extreme risks of residual effects are anticipated.

19.2.3.4 HYDROGEOLOGY

19.2.3.4.1 Pathways of Change Screening

Project activities including underground development and runoff and seepage from surface facilities have the potential to effect existing groundwater levels and groundwater quality. Without the implementation of environmental design features, mitigation and environmental protection measures, the following pathways of change from these Project activities (Table 19.4) have the potential to result in in a moderate to high degree of adverse effects on the hydrogeology intermediate component:

- Project activities during all Project phases could change the hydrogeological regime, resulting in changes to baseline conditions of intermediate and valued components.

These activities would be managed through a combination of best management practices and environmental design features, including the design and maintenance of an underground dewatering system and ensuring sufficient storage capacity to manage surface runoff and seepage from Project components. These environmental design features will be incorporated into an integrated water management system for the Project. The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance. Additionally, extensive geochemical testing (outlined in Section 14.3.1) has been completed and indicated the excavated rock to be non-acid generating; therefore, residual effects on groundwater quality from seepage or contaminant transport are not anticipated.

Although environmental design features, mitigation and protection measures and other regulatory controls (i.e., provincial permitting and NSCA requirements) are anticipated to mitigate changes to groundwater levels below regulatory thresholds, the potential still exists for groundwater changes from the Project to change when compared to baseline conditions, which would result in a residual adverse effect on the hydrogeology intermediate component. As residual effects on the hydrogeology intermediate component are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.4.2 Preliminary Risk Screening of Residual Effects

A conceptual groundwater model for the Project is planned but not yet completed. This model will use baseline data to define groundwater-surface water interactions, aquifer properties, and flow directions. It will forecast potential changes in groundwater levels, drawdown, and impacts on wells, wetlands, and groundwater-dependent ecosystems due to Project activities. The model will also support contaminant transport analysis, informing direct and indirect effects under both baseline and Project scenarios.

The modelling will be used to inform the site-specific water management strategy for the Project, site-specific mitigation measures and monitoring requirements, including the groundwater protection program and hydrogeological aspects of the environmental monitoring program. Any site-specific mitigation measures and monitoring requirements will be shared with WLON, the Township of Ignace, and applicable regulatory agencies. Modelling results will also inform the HHERA a requirement under the NSCA and REGDOC-2.9.1. The HHERA will be reviewed by the CNSC to demonstrate that protection measures reduce effects on ALARA. It will identify exposure pathways, assess potential impacts, and confirm risks remain acceptable throughout the life of the Project, with updates at least every five years or as needed. The NWMO may also be subject to permitting requirements, including permits to take water.

Changes to groundwater levels may occur but are expected to be mitigated through the site water management strategy implemented for the Project, which would mitigate any changes to surface water levels as a result of drawdown effects due to groundwater inflows from the Project. These drawdown effects are anticipated to spatially limited to within a few hundred metres of underground workings. These exceedances are not anticipated to represent a material departure from baseline conditions and are not expected to result in broader impacts on environmental or health impacts beyond the Project boundary.

With the implementation of proven, effective mitigation measures, the anticipated extent of groundwater level drawdown effects and regulatory controls in place (NSCA and permitting conditions), the likelihood and degree of residual effects on hydrogeology are best characterized as low. With a low degree and low likelihood of residual effects, the Project activities that would result in a pathway of change to the hydrogeology intermediate component are anticipated to result in a low risk of adverse environmental effects. Table 19.8 presents the risk assessment screening for the hydrogeology intermediate component.

Table 19.8: Preliminary Residual Effects Risk Screening Associated with the Hydrogeology Intermediate Component

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

As presented in *Table 19.4*, changes to hydrogeology may result in pathways of change to other intermediate and valued components, including the following:

- hydrology and surface water quality (Section 19.2.3.5)
- fish and fish habitat (Section 19.2.3.7)
- vegetation, riparian and wetland environments (Section 19.2.3.8)
- migratory and SAR birds (Section 19.2.3.9)
- terrestrial wildlife and wildlife habitat (Section 19.2.3.10)
- current use of lands and resources for traditional purposes by Indigenous Peoples (Section 21.1)

The risk screening for these intermediate and valued components is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the hydrogeology intermediate component are anticipated to be low risk, given the proposed mitigation and environmental protection measures required and regulatory controls in place. Further modelling and assessment of effects on hydrogeology will be completed to meet licensing requirements under the NSCA and inform provincial permitting requirements. Further assessment of effects on hydrogeology under the IAA is expected to be applicable to assessment of intermediate or valued components where moderate to extreme risks of residual effects are anticipated.

19.2.3.5 HYDROLOGY AND SURFACE WATER QUALITY

19.2.3.5.1 Pathways of Change Screening

Project activities during site all Project phases, including site clearing, blasting, construction of Project components, altered site drainage, runoff, water withdrawal and discharge of treated effluent have the potential to effect existing hydrology and surface water quality. Without the implementation of environmental design features, mitigation and environmental protection measures, the following pathways of change from these Project activities (Table 19.4) have the potential to result in in a moderate to high degree of adverse effects on the hydrology and water quality intermediate component:

- Project activities during all Project phases could generate and emit criteria air contaminants, resulting in changes to baseline conditions of intermediate and valued components.
- Project activities during all Project phases could change the hydrogeological regime, resulting in changes to baseline conditions of intermediate and valued components.
- Project activities during all Project phases could change existing water quality and hydrology in local waterbodies and watercourses.

These activities would be managed through a combination of best management practices, environmental design features and mitigation measures, including the implementation of a water management system that includes adequate storage capacity to manage, treat and complete controlled release, sediment and erosion control measures and scheduling land disturbance activities to avoid the spring freshet period to reduce the risk of erosion, sedimentation, and contamination of surface water. The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance.

Although environmental design features, mitigation and protection measures are anticipated to mitigate changes in hydrology and surface water quality below regulatory guidelines and standards, the potential still exists for the Project to change hydrology and surface water quality compared to baseline conditions, which would result in a residual adverse effect. As residual effects on the hydrology and surface water quality intermediate components are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects on hydrology and surface water quality.

19.2.3.5.2 Preliminary Risk Screening of Residual Effects

The NWMO will be subject to other regulatory controls, including surface water quality guidelines such as the Canadian Council of Ministers of the Environment Canadian Environmental Quality Guidelines and Provincial Water Quality Objectives, which will inform effluent discharge permitting requirements. As it relates to hydrology, the Project will be required to mitigate changes in surface water levels to avoid the harmful alteration, disruption or destruction of fish habitat or an authorization under the *Fisheries Act* (Government of Canada 1985e) would be required.

Hydrology and water quality modelling, including the completion of an integrated site-wide water balance and water quality modelling, has yet to be completed for the Project. Site-wide water balance and water quality modelling refers to the integrated simulation of water movement, storage, and chemical composition across the Project site throughout all phases. This modelling would incorporate hydrological inputs, geochemical data, and engineered infrastructure to predict water flows and contaminant concentrations under various scenarios, including future climate conditions.

The results of this modelling will inform environmental design features, site-specific mitigation measures and monitoring requirements, including the effluent and emissions control monitoring program and surface water aspects of the environmental monitoring program. Any site-specific

mitigation measures and monitoring requirements will be shared with WLON, the Township of Ignace, and applicable regulatory agencies.

Model results will also inform the HHERA, required for the NWMO's initial licence application and Impact Statement submission. In accordance with the NSCA and REGDOC-2.9.1, the HHERA will be reviewed by the CNSC to demonstrate that protection measures reduce effects on ALARA. The HHERA will identify exposure pathways, assess potential impacts on people and the environment, and confirm that risks remain acceptable throughout the life of the Project. It will be updated at least every five years or when material changes to the Project design occur. The Project is also expected to be subject to provincial permitting requirements under the MECP Environmental Compliance Approval program. In accordance with the requirements of REGDOC-2.9.2, the NWMO would also complete a best available technology and techniques economically achievable assessment for mitigation measures to control environmental releases and develop corresponding environmental action levels for both airborne and liquid effluent releases.

The preliminary risk assessment for hydrology and surface water quality are provided below, in consideration of the environmental design features, mitigation and protections measures presented in Table 19.4 and these additional regulatory controls.

Hydrology

Project activities such as treated effluent discharge, water supply demands, and land-use changes could affect hydrology by altering surface water elevations, flow rates, stream channels, and sediment transport. These potential effects will be managed using best management practices and environmental design features, including site water management infrastructure to maintain baseflows and water levels within their natural range. Short-term changes may occur due to storm events or other water management influences that would require a greater volume of water to be discharged or variations in the receiving environment that would result in greater sensitivity to discharge or water withdrawal (i.e., drought conditions), but these events are expected to be seasonally dependent and considered as part of the site water management strategy. These changes are not anticipated to represent a material departure from baseline conditions and are not expected to result in broader impacts on environmental or human health.

Changes in the hydrogeological regime, particularly groundwater drawdown, can result in an indirect effect on hydrology through a reduction in baseflow contribution to nearby surface water bodies such as streams, wetlands, or lakes. This reduction in groundwater discharge may lead to lower surface water levels and altered flow regimes, resulting in a potentially adverse effect on the hydrology intermediate component. Project activities would be managed through a combination of best management practices and environmental design features, including the implementation of an integrated site water management plan which would manage groundwater inflows to the underground environment and regulate water levels within watersheds potentially impacted by the Project. The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance. As described in Section 19.2.3.4, residual effects on groundwater quantity are anticipated to be low risk.

With the implementation of proven, effective mitigation measures and other regulatory controls, including the NSCA that will require the completion of modelling to inform the site water management approach and monitoring plans and procedures, the degree of residual effects on hydrology are best characterized as low, with a moderate likelihood of occurrence. With a low degree and moderate likelihood of residual effects, the Project activities that would result in direct and indirect pathways of change to hydrology are anticipated to result in a low risk of adverse environmental effects. Table 19.9 presents the risk assessment screening for the hydrology intermediate component.

Although some uncertainty remains pending completion of the water quality modelling, there is a high level of confidence that proposed mitigation, protection measures, and regulatory oversight under federal and provincial frameworks will effectively manage potential water quality effects.

Table 19.9: Preliminary Residual Effects Risk Screening Associated with the Hydrology Intermediate Component

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

Surface Water Quality

Project activities, such as the discharge of treated effluent and changes in land use, may alter surface water quality by changing concentrations of COPCs in the receiving environment. These activities will be managed using best management practices and environmental design features, including site water management infrastructure to control treated effluent release, water treatment to ensure contaminant concentrations remain below regulatory requirements, and sediment and erosion control measures. Short-term changes in surface water quality could occur at the discharge point before dilution and assimilation, but regulatory guidelines are expected to be met within a regulated mixing zone. Storm events or other factors may also temporarily affect water quality by reducing sediment and erosion control effectiveness or altering assimilative capacity; however, any exceedances are not expected to materially differ from baseline conditions or result in broader environmental or human health effects.

As presented in Section 19.2.3.4, residual effects from the Project to groundwater quality are not anticipated.

Fugitive dust emissions from the Project could deposit particulates and trace contaminants in nearby waterbodies, potentially affecting surface water quality. The extent of dust deposition depends on variables such as wind, precipitation, and particle size, but these effects are typically short-lived and spatially limited. Management measures, including dust suppression and Project design to minimize fugitive dust, are supported by industry experience and regulatory guidance. As presented in Section 19.3.2.1, the residual effects on air quality from the Project are anticipated to be low risk.

With the implementation of proven, effective mitigation measures and completion of the required modelling to inform plans and procedures to meet licensing requirements as well as other regulatory controls for the facility, the degree of residual effects on surface water quality are best characterized as low, with a moderate likelihood of occurrence. With a low degree and moderate likelihood of residual effects, the Project activities that would result in direct and indirect pathways of change to surface water quality are anticipated to result in a low risk of adverse environmental effects. Table 19.10 presents the risk assessment screening for the surface water quality intermediate component.

Although some uncertainty remains pending completion of the water quality modelling, there is a high level of confidence that proposed mitigation, protection measures, and regulatory oversight under federal and provincial frameworks will effectively manage potential water quality effects.

Table 19.10: Preliminary Residual Effects Risk Screening Associated with the Surface Water Quality Intermediate Component

Degree					
	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

This risk screening for hydrology and surface water quality acknowledges that, while uncertainty exists in the absence of water quality modelling, there is a high level of confidence in the effectiveness of mitigation and protection measures proposed, and other regulatory controls, including licensing requirements under the NSCA and provincial and federal permitting requirements, reduce the level of uncertainty of these results.

As presented in Table 19.4, changes to hydrology and surface water quality may result in pathways of change to other intermediate components and VCs, including:

- topography, soils and sediment (Section 19.2.3.6)
- fish and fish habitat (Section 19.2.3.7)
- vegetation, riparian and wetland environments (Section 19.2.3.8)
- migratory and SAR birds (Section 19.2.3.9)
- terrestrial wildlife and wildlife habitat (Section 19.2.3.10)
- non-Indigenous health conditions (Section 19.2.3.11)
- current use of lands and resources for traditional purposes by Indigenous Peoples (Section 21.1)
- health conditions of Indigenous Peoples (Section 21.1)

The risk screening for these intermediate and valued components is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the hydrology and surface water quality intermediate components are anticipated to be low risk, given the proposed mitigation and environmental protection measures required and regulatory controls in place. Further modelling and assessment of effects on hydrogeology will be completed to meet licensing requirements under the NSCA and inform provincial permitting requirements and federal guidelines. Further assessment of effects on hydrology and surface water quality under the IAA is expected to be applicable to assessment of VCs where moderate to extreme risks of residual effects are anticipated.

19.2.3.6 TOPOGRAPHY, SOILS AND SEDIMENT

19.2.3.6.1 Pathways of Change Screening

Project activities during site all Project phases, including site clearing, blasting, construction of Project components, altered site drainage, runoff, and discharge of treated effluent have the

potential to effect existing topography, soils and sediment. Without the implementation of environmental design features, mitigation and environmental protection measures, the following pathways of change from these Project activities (Table 19.4) have the potential to result in a moderate to high degree of adverse effects on the topography, soils and sediment intermediate component:

- Project activities during all Project phases could change existing topography, soils and sediment.
- Project activities during all Project phases could generate and emit greenhouse gases and criteria air contaminants, including fugitive dust.
- Project activities during all Project phases could change existing water quality and hydrology in local waterbodies and watercourses.

These activities would be managed through a combination of best management practices, environmental design features and mitigation measures, including the implementation of sediment and erosion control measures, minimizing areas of vegetation clearing and soil disturbance, using equipment to minimize surface disturbance, soil compaction and the implementation of a water management system that includes adequate storage capacity to manage, treat and complete controlled release. The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance.

With the implementation of mitigation measures presented in Table 19.4, residual effects on existing topography are not anticipated. The land in the Project site and surrounding area is typical of the Canadian Shield (Section 14.4.1) and no unique or rare topographical features have been identified in the Project site or surrounding areas.

Although environmental design features, mitigation and protection measures are anticipated to mitigate effects on sediment and soils, the potential still exists for the Project to result in residual effects on sediment and soils compared to baseline conditions. As residual effects on sediment and soils are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.6.2 Preliminary Risk Screening of Residual Effects

Project activities have the potential to affect existing sediment and soils through various mechanisms, including disturbances caused by installing in-water infrastructure, discharge of treated effluent, movement or redistribution of soil and overburden, and vegetation clearing. These activities pose risks of sediment mobilization and alteration but will be managed using a combination of best management practices and environmental design features. Measures such as isolation techniques for in-water works, strategic installation of water supply lines, and controlled effluent discharge are designed to minimize sediment disturbance. The resulting effects are expected to be confined to the immediate vicinity of the in-water infrastructure, and direct effects on sediments locally or regionally are not anticipated.

Project activities that could result in residual effects on soils are primarily linked to compaction and redistribution from heavy equipment use, soil movement, and vegetation clearing. Mitigation strategies include minimizing equipment haul routes, applying environmental design features, and using established controls to limit disturbance. Effects are anticipated to be limited the Project footprint, and effects on soils locally or regionally are not anticipated.

Indirect effects may arise from fugitive dust deposition and changes in contaminant concentrations in sediment due to altered surface water quality.

Fugitive dust emissions may deposit on nearby waterbodies and soils, introducing particulates and trace contaminants (e.g., metals, nutrients), resulting in a potential adverse effect on sediments and soils. However, dust deposition depends on wind, precipitation, and particle size. Effects are

typically short-lived and spatially limited. As presented in Section 19.3.2.1, the residual effects on air quality from the Project are anticipated to be low risk.

Discharge of treated effluent into surface waters could slightly elevate contaminant concentrations in sediments near the point of release. Treated effluent is expected to comply with federal guidelines and permitting requirements, with predicted changes in sediment concentrations remaining within natural variability beyond the immediate discharge point. As presented in Section 19.3.2.1, the residual effects on surface water quality from the Project are anticipated to be low risk.

As presented in Section 19.2.3.1 and 19.2.3.5, the NWMO will complete detailed air quality dispersion modelling and surface water quality modelling to predict potential changes to the ambient air quality concentrations and surface water quality concentrations of COPCs. These models will inform the HHERA, which will assess the journey of contaminants through different environmental media, including soils and sediment. In accordance with requirements under the NSCA and REGDOC 2.9-1, the HHERA will be subject to environmental review from the CNSC to demonstrate that environmental protection measures will be in place to mitigate environmental effects to as low as reasonably achievable, including effects on sediment and soils.

With the implementation of proven, effective mitigation measures, other regulatory requirements that will need to be met (i.e., NSCA, federal guidelines and applicable permitting requirements), the degree of residual effects are best characterized as low. Direct effects are anticipated to be avoided or minimized through the implementation of environmental design features, and environmental protection measures. It is probable that indirect effects, including changes to sediment and soil quality from deposition of dust and treated effluent discharge, could result in changes to soils and sediment quality within and just beyond the Project boundary. The likelihood of residual effects is therefore best characterized as moderate.

With a low degree and moderate likelihood of residual effects, the Project activities that would result in a pathway of change to the topography, soils and sediment intermediate component are anticipated to result in a low risk of adverse environmental effects. Table 19.11 presents the risk assessment screening for the topography, soils and sediment intermediate component.

Table 19.11: Preliminary Residual Effects Risk Screening Associated with the Surface Water Quality Intermediate Component

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

As presented in Table 19.4, changes to topography, soils and sediment may result in pathways of change to other VCs, including those listed below:

- fish and fish habitat (Section 19.2.3.7)
- vegetation, riparian and wetland environments (Section 19.2.3.8)
- migratory and SAR birds (Section 19.2.3.9)
- terrestrial wildlife and wildlife Habitat (Section 19.2.3.10)

- non-Indigenous health conditions (Section 19.2.3.11)
- current use of lands and resources for traditional purposes by Indigenous Peoples (Section 21.1)
- health conditions of Indigenous Peoples (Section 21.1)

The risk screening for these VCs is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the topography, soils and sediment intermediate component are anticipated to be low risk, given the proposed mitigation and environmental protection measures required and regulatory controls in place. Further assessment of effects on topography, soils and sediment will be completed to meet licensing requirements under the NSCA and inform provincial permitting requirements. Further assessment of effects on topography, soils and sediment under the IAA is expected to be applicable to assessment of intermediate or valued components where moderate to extreme risks of residual effects are anticipated.

19.2.3.7 FISH AND FISH HABITAT

19.2.3.7.1 Pathways of Change Screening

Project activities during site all Project phases, including site clearing, blasting, construction of Project components, in-water works, altered site drainage, runoff, water withdrawal and discharge of treated effluent have the potential to directly and indirectly effect fish and fish habitat, aquatic SAR and aquatic life. Without the implementation of environmental design features, mitigation and environmental protection measures, the following pathways of change from these Project activities (Table 19.4) have the potential to result in in a moderate to high degree of adverse effects on the fish and fish habitat VC:

- Project activities during all Project phases could change fish and fish habitat, resulting in direct changes to baseline conditions and indirect changes to other VCs.
- Project activities during all Project phases could generate and emit criteria air contaminants, resulting in direct changes to baseline conditions of air quality, and indirect changes to baseline conditions of other intermediate and VCs.
- Project activities during all Project phases could generate noise, vibration and light emissions, resulting in direct changes to baseline conditions of noise, vibration and light, and indirect changes to other intermediate and VCs.
- Project activities during all Project phases could change the hydrogeological regime, resulting in direct changes to baseline conditions of hydrogeology, and indirect changes to other intermediate and VCs.
- Project activities during all Project phases could change hydrology and water quality, resulting in direct changes to hydrology and surface water quality baseline conditions and indirect changes to other intermediate and VCs.
- Project activities during all Project phases could change topography, soils and sediment, resulting in direct changes to baseline conditions of topography, soils and sediment and indirect changes to other intermediate and valued components.

These activities would be managed through a combination of best management practices, environmental design features and mitigation measures, including scheduling of in-water activities to avoid work during DFO's Ontario Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat (DFO 2013). The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance.

Although environmental design features, mitigation and protection measures are anticipated to mitigate changes in fish and fish habitat availability, distribution and survival and reproduction, the potential still exists for the Project to these measurement indicators compared to baseline conditions, which would result in a residual adverse effect. As residual effects on the fish and fish habitat VC are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.7.2 Preliminary Risk Screening of Residual Effects

Project activities that could result in residual effects on fish and fish habitat include the physical alteration or loss of fish habitat due to Project infrastructure, such as in-water construction, water intakes, effluent diffusers, and road crossings. These activities will be planned and executed in accordance with Fisheries and Oceans Canada's standards and codes of practice, including the use of fish-friendly intake designs to minimize impingement and entrainment, and timing restrictions to avoid sensitive life stages like spawning. In-water works will be conducted using isolation techniques and sediment control measures to prevent habitat degradation and fish mortality. Additionally, the design of culverts and drainage structures will follow best practices to maintain fish passage and habitat connectivity. Public access management, site security and awareness programs will also help mitigate potential pressures from increased human presence. These measures are well-established, routinely applied in similar projects, and supported by regulatory oversight, providing a high level of certainty that changes in habitat availability and distribution are not likely to result in a greater than negligible effect on self-sustaining and ecologically effective fish populations and will support the survival and recovery of viable SAR populations and critical habitat in line with recovery objectives. The NWMO will also coordinate with Fisheries' and Oceans Canada to determine permitting requirements for the Project, including the potential for fish habitat offsetting, should it be determined that the Project will result in permanent loss of viable fish habitat.

Project-related activities, including the generation of air and dust emissions, altered site drainage, runoff, treated discharges, and sediment release, and groundwater seepage could indirectly effect fish and aquatic SAR habitat availability, survival, and reproduction. These activities would be managed through a combination of best management practices and environmental design features, including dust suppression, water quality monitoring, sediment control, and containment systems for contact water and treated effluent. All discharges and water management activities are subject to strict regulatory oversight and permitting, to maintain compliance with federal and provincial water quality standards. Extensive geochemical testing (outlined in Section 14.3.1) has been completed and indicated the excavated rock to be non-acid generating; therefore, seepage and groundwater quality is not anticipated to pose indirect risks to fish health. The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance. Additionally, as presented in Section 19.3.2.1 and 19.3.2.5, environmental protection measures would be in place and effects on air quality and surface water quality would be mitigated to ALARA, and the residual effects on air quality and surface water quality from the Project are anticipated to be low risk.

Altered site drainage, runoff, water withdrawals, and treated effluent discharge could indirectly affect fish habitat availability and distribution. These activities would be managed and mitigated by features such as engineered drainage systems, erosion and sediment control measures, and flow attenuation structures designed to maintain natural hydrology and protect channel and bank stability. Water withdrawals are subject to regulatory limits and permitting, so that flows remain within ecologically protective thresholds. These measures align with best management practices and regulatory standards established by agencies such as Fisheries and Oceans Canada. As a result, there is strong confidence that changes in habitat availability and distribution will be no more than negligible, ensuring the continued health of self-sustaining and ecologically effective fish populations. Furthermore, these measures support the survival and recovery of SAR and the protection of critical habitat, in accordance with recovery objectives.

Blasting activities during site preparation and construction could result in residual effects on fish and fish habitat and aquatic SAR and their habitat. These activities are carefully planned and executed using best management practices, such as timing restrictions to avoid sensitive life stages (e.g., spawning), use of controlled blasting techniques to minimize vibration and underwater noise, and pre-blast surveys to assess fish presence. These measures are consistent with Fisheries and Oceans Canada's standards and codes of practice, which are designed to protect aquatic life. Additionally, environmental design features, such as setback distances from waterbodies and sediment control measures, further reducing the potential for harmful effects.

The HHERA, reviewed by the CNSC under the NSCA and REGDOC-2.9.1, will confirm that mitigation measures reduce effects on ALARA. The HHERA will be updated regularly throughout the Project lifespan. The NWMO's environmental monitoring program will be implemented throughout the lifespan of the Project and would include monitoring activities to verify that mitigation to fish and fish habitat from potential direct or indirect effects is performing as intended and effects are minimized. Should monitoring confirm that effects differ from those predicted, adaptive management measures would be implemented.

Given the effectiveness of mitigation, regulatory controls, and established best practices, residual effects on fish and fish habitat are expected to be negligible in degree and moderate in likelihood, resulting in an overall low risk of adverse environmental effects. Table 19.12 presents the risk screening for the fish and fish habitat valued component.

Table 19.12: Preliminary Residual Effects Risk Screening for the Fish and Fish Habitat Valued Component

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

As presented in *Table 19.4*, changes to fish and fish habitat may result in pathways of change to other VCs, including:

- migratory and SAR birds (Section 19.2.3.9)
- terrestrial wildlife and wildlife Habitat (Section 19.2.3.10)
- non-Indigenous health conditions (Section 19.2.3.11)
- health conditions of Indigenous Peoples (Section 21.1)
- current use of lands and resources for traditional purposes by Indigenous Peoples (Section 21.1)

The risk screening for these VCs is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the fish and fish habitat VC are anticipated to be low risk, given the proposed mitigation and environmental protection measures required and regulatory controls in place. Further assessment of effects on fish and fish habitat will be completed to meet licensing requirements under the NSCA and inform provincial permitting requirements. Further assessment of effects on fish and fish habitat under the

IAA is expected to be applicable to assessment of VCs where moderate to extreme risks of residual effects are anticipated.

19.2.3.8 VEGETATION, RIPARIAN AND WETLAND ENVIRONMENTS

19.2.3.8.1 Pathways of Change Screening

Project activities during site all Project phases, including site clearing, blasting, construction of Project components, in-water works, altered site drainage, runoff, water withdrawal and discharge of treated effluent have the potential to directly and indirectly effect vegetation, riparian and wetland environments. Without the implementation of environmental design features, mitigation and environmental protection measures, the following pathways of change from these Project activities (Table 19.4) have the potential to result in in a moderate to high degree of adverse effects on the vegetation, riparian and wetland environments VC:

- Project activities during all Project phases could change vegetation, riparian and wetland environments, resulting in direct changes to baseline conditions and indirect changes to other VCs.
- Project activities during all Project phases could generate and emit criteria air contaminants, resulting in direct changes to baseline conditions of air quality, and indirect changes to baseline conditions of other intermediate and valued components.
- Project activities during all Project phases could change the hydrogeological regime, resulting in direct changes to baseline conditions of hydrogeology, and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change hydrology and water quality, resulting in direct changes to hydrology and surface water quality baseline conditions and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change topography, soils and sediment, resulting in direct changes to baseline conditions of topography, soils and sediment and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change fish and fish habitat, resulting in direct changes to baseline conditions and indirect changes to other VCs.

Although environmental design features, mitigation and protection measures are anticipated to mitigate changes in vegetation, riparian and wetland environments, the potential still exists for the Project to change vegetation, riparian and wetland environments compared to baseline conditions, which would result in a residual adverse effect. As residual effects on the vegetation, riparian and wetland environments VC are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.8.2 Preliminary Risk Screening of Residual Effects

As presented in Section 14.11, approximately 77 percent of the land is upland conifer forest, 10 percent is wetland (swamp), and seven percent is wetland (fen) (other groups are each less than 1 percent of the land area). Only black ash was identified within 10 km of the Project site; however, black ash has yet to be identified in the proposed site from baseline programs. Select stands of wild rice were identified: one on the north shore of Mennin Lake and an additional 10 within and surrounding the Project site. Balsam fir and balsam poplar, valued by First Nations for its use as a traditional medicine, were both recorded within or surrounding the Project site. As presented in Section 14.7, approximately 17% of the site is composed of wetland swamp or fen habitats (10% swamp, 7% fen). No provincially significant wetlands were identified within the Project site. One provincially significant wetland (Nabish Creek Wetland Complex) is located to the

northeast of Wabigoon Lake. Wetlands are still abundant in the area and northern Ontario is not considered a region within Canada where wetland loss or degradation has reached critical levels.

Project activities that could result in direct residual effects on vegetation, riparian and wetland environments include the physical alteration or loss of vegetation, riparian and wetlands from vegetation clearing and in-water construction. These activities will be planned and executed following industry standard best management practices, including minimizing the areas of clearing, implementing applicable best management practices in the Ontario Management of Excess Soil Guideline (Government of Ontario 2021b), invasive species management and implementation of sediment and erosion control measures. The Project footprint will be minimized to the extent practicable, by centralizing Project infrastructure and using existing disturbances. Identified vegetation species of conservation concern and candidate SWH (Section 14.7) will be identified and avoided, to the extent practicable, including black ash and wild rice. Progressive reclamation will occur in disturbed areas no longer required, using native species or non-aggressive, no-native species appropriate for revegetation conditions. Shoreline developments will be designed to minimize riparian vegetation loss. In-water works will be conducted using isolation techniques and sediment control measures to prevent degradation of wetland quality. Additionally, the design of culverts and drainage structures will follow best practices to maintain wetland hydrology, if required.

The generation of air and dust emissions, altered site drainage, runoff, treated discharges, sediment release, and groundwater seepage could indirectly effect vegetation, riparian and wetland environments habitat availability, survival, and reproduction. These activities would be managed through a combination of best management practices and environmental design features, including dust suppression, water quality monitoring, sediment control, and containment systems for contact water and treated effluent. All discharges and water management activities are subject to strict regulatory oversight and permitting, to maintain compliance with federal and provincial water quality standards. Extensive geochemical testing (outlined in Section 14.3.1) has been completed and indicated the excavated rock to be non-acid generating; therefore, seepage and groundwater quality is not anticipated to pose indirect risks to vegetation, riparian and wetland environments. Additionally, as presented in Section 19.3.2.1 and 19.3.2.5, effects on air quality and surface water quality would be mitigated to ALARA, and the residual effects on air quality and surface water quality from the Project are anticipated to be low risk.

Altered site drainage, runoff, water withdrawals, and treated effluent discharge could indirectly affect vegetation, riparian and wetland habitat availability and distribution. These activities would be managed through well-established environmental design features such as engineered drainage systems, erosion and sediment control measures, and flow attenuation structures that are designed to maintain natural hydrological patterns and protect channel and bank stability. Water withdrawals for potable and process use are subject to regulatory limits and permitting, so that flows remain within ecologically protective thresholds. As presented in Section 19.2.3.5, effects on surface water quality and hydrology are anticipated to be low risk. The NWMO's monitoring program throughout the lifespan on the Project would monitor potential indirect effects from changes in surface water quality and hydrology to vegetation, riparian and wetland ecosystems to validate that mitigation is performing as intended and effects are minimized.

The HHERA, reviewed by the CNSC under the NSCA and REGDOC-2.9.1, will confirm that mitigation measures reduce effects on ALARA. The HHERA will be updated regularly throughout the Project lifespan. The NWMO's environmental monitoring program will be implemented throughout the lifespan of the Project and would include monitoring activities to verify that vegetation from potential direct or indirect effects is performing as intended and effects are minimized. Should monitoring confirm that effects differ from those predicted, adaptive management measures would be implemented. The NWMO will also be required to adhere to permitting requirements under the SARA and Ontario *Endangered Species Act* (Government of Ontario 2007).

With the implementation of proven, effective mitigation measures, other regulatory requirements that will need to be met (i.e., NSCA, federal guidelines and applicable permitting requirements), the degree of residual effects are best characterized as negligible, as the vegetation, wetland and riparian environments are abundant in the surrounding area of the Project, sensitive features will be avoided and indirect effects are expected to be mitigated to ALARA. The likelihood of effects is anticipated to be high, as vegetation removal and clearing is certain. With a negligible degree and high likelihood of residual effects, the Project activities that would result in a pathway of change to the vegetation, riparian and wetland environments VC are anticipated to result in a low risk of adverse environmental effects. Table 19.13 presents the risk assessment screening for the vegetation, riparian and wetland environments valued components.

Table 19.13: Preliminary Residual Effects Risk Screening for the Vegetation, Riparian and Wetland Environments Valued Components

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

As presented in Table 19.4, changes to vegetation, riparian and wetland environments may result in pathways of change to other VCs, including the following:

- migratory and SAR birds (Section 19.2.3.9)
- terrestrial wildlife and wildlife habitat (Section 19.2.3.10)
- non-Indigenous health conditions (Section 19.2.3.11)
- current use of lands and resources for traditional purposes by Indigenous Peoples (Section 21.1)
- health conditions of Indigenous Peoples (Section 21.1)

The risk screening for these VCs is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the vegetation, riparian and wetland environments VC are anticipated to be low risk, given the proposed mitigation and environmental protection measures required and regulatory controls in place. Further assessment of effects on vegetation, riparian and wetland environments will be completed to meet licensing requirements under the NSCA and inform provincial permitting requirements. Further assessment of effects on vegetation, riparian and wetland environments under the IAA is expected to be applicable to assessment of VCs where moderate to extreme risks of residual effects are anticipated.

19.2.3.9 MIGRATORY AND SPECIES AT RISK BIRDS

19.2.3.9.1 Pathways of Change Screening

Migratory and SAR birds detected within baseline surveys where effects could occur (Section 14.9) include:

- **Upland breeding birds—**A total of 64 upland breeding bird species, including eight SAR species (barn swallow, Canada warbler, evening grosbeak, red-headed woodpecker, common nighthawk, eastern whip-poor-will, eastern wood-pewee, olive-sided flycatcher), were observed in the area. Habitat for three species (olive-sided flycatcher, common nighthawk, eastern wood-pewee) was identified, and designated protected areas for migratory birds was not identified. Of the 64 species identified, 59 are protected under the MBCA, and one of these species is also afforded protection of empty nests under the *Migratory Bird Regulations*: pileated woodpecker.
- **Shorebirds—**Three shorebird species (spotted sandpiper, Wilson's snipe, lesser yellowlegs) were detected, which are both protected under the MBCA. Candidate SWH relevant to the spotted sandpiper was also identified within the Project site. The lesser yellow legs are designated as Threatened and afforded protection under the SARA. Neither the spotted sandpiper or Wilson's snipe is at risk or provincially rare; however, both are considered priority species according to ECCC's bird conservation strategy for the region (EC 2014).
- **Waterbirds—**10 waterbird species, including American bittern, American white pelican, Canada goose, common loon, hooded merganser, mallard, ring-necked duck, sandhill crane, sora, and wood duck, were detected. The American white pelican is not act risk federally but Threatened in Ontario. None of the other species are at risk or provincially rare; however, all are protected under the MBCA, and seven species, including American white pelican, mallard, Canada goose, ring-necked duck, sandhill crane, hooded merganser, and wood duck are considered priority species in ECCC's bird conservation strategy for the region (EC 2014).
- **Raptors—**Seven raptor species, including one SAR, bald eagle and two other priority species, American kestrel and broad-winged hawk, have been detected in the area of the Project. Candidate SWH has been identified for eagle and osprey concentration area, bald eagle and osprey nesting habitat (which also includes habitat for a raptor species of Special Concern), and woodland raptor nesting habitat.

Project activities during site all Project phases, including site clearing, blasting, construction of Project components, in-water works, altered site drainage, runoff, water withdrawal and discharge of treated effluent have the potential to directly and indirectly effect migratory and SAR birds and their habitats. Without the implementation of environmental design features, mitigation and environmental protection measures, the following pathways of change from these Project activities (Table 19.4) have the potential to result in in a moderate to high degree of adverse effects on the migratory and SAR bird valued component:

- Project activities during all Project phases could change migratory and SAR bird habitat availability, distribution and survival and reproduction, resulting in direct changes to baseline conditions, and indirect changes to other VCs.
- Project activities during all Project phases could generate and emit criteria air contaminants, resulting in direct changes to baseline conditions of air quality, and indirect changes to baseline conditions of other intermediate and valued components.
- Project activities during all Project phases could generate noise, vibration and light emissions, resulting in direct changes to baseline conditions of noise, vibration and light, and indirect changes to other intermediate and valued components.

- Project activities during all Project phases could change the hydrogeological regime, resulting in direct changes to baseline conditions of hydrogeology, and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change hydrology and water quality, resulting in direct changes to hydrology and surface water quality baseline conditions and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change topography, soils and sediment, resulting in direct changes to baseline conditions of topography, soils and sediment and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change fish and fish habitat, resulting in direct changes to baseline conditions and indirect changes to other VCs.
- Project activities during all Project phases could change vegetation, riparian and wetland environments, resulting in direct changes to baseline conditions and indirect changes to other VCs.

These activities would be managed through a combination of best management practices, environmental design features and mitigation measures, including scheduling of vegetation clearing activities to avoid nesting periods of migratory and SAR birds (ECCC 2025). The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance.

Although environmental design features, mitigation and protection measures are anticipated to mitigate changes in migratory and SAR bird habitat availability, distribution and survival and reproduction, the potential still exists for the Project to change these measurement indicators compared to baseline conditions, which would result in a residual adverse effect. As residual effects on the migratory and SAR bird VC are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.9.2 Preliminary Risk Screening of Residual Effects

Project activities could result in direct residual effects on migratory and SAR birds through the physical loss or alteration of migratory bird and SAR bird habitat include vegetation clearing and construction of Project infrastructure (e.g., wetland and riparian disturbance, in-water construction, land clearing). Habitat disturbance will be minimized through careful site planning, maintaining buffer zones around known nesting areas, and scheduling construction activities outside of critical nesting and breeding periods. Pre-construction surveys will be conducted to identify and avoid sensitive sites. Nests built by any of the species listed in Schedule 1 of the *Migratory Birds Regulations* will either be avoided for the corresponding length of time prescribed in Schedule 1, or written notice will be provided to the Minister per Section 5(2) of the *Migratory Birds Regulations*. In-water infrastructure, such as freshwater intakes and effluent diffusers, will be designed to avoid injury or mortality to birds and reduce habitat disruption. These practices are consistent with federal environmental protection regulations (i.e., the MBCA, federal SARA and provincial *Endangered Species Act*) and best management practices and provide a high level of confidence that changes in habitat availability and distribution, and survival and reproduction are not likely to result in a greater than negligible effect on self-sustaining and ecologically effective migratory bird populations.

Project activities that could generate indirect effects on migratory and SAR birds include emission and generation of air and dust emissions, runoff, seepage, and discharge to affect migratory bird habitat availability, survival, and reproduction. Airborne contaminants such as particulate matter, metals, and radionuclides will be managed through dust suppression techniques, emission controls, and regular air quality monitoring. Runoff and seepage will be controlled using engineered drainage systems, containment structures, and water treatment processes so that surface water quality

remains within protective thresholds. Treated effluent and sewage discharges will comply with applicable water quality standards, and sediment release during in-water construction will be minimized through isolation techniques and erosion control measures. These practices are consistent with federal environmental protection regulations and best management practices and provide a high level of certainty that changes in habitat availability and distribution are not likely to result in a greater than negligible effect on self-sustaining and ecologically effective migratory bird and SAR bird populations. As presented in Section 19.2.3.1 and Section 19.2.3.5, environmental protection measures would be in place and effects on air quality, hydrology and surface water quality would be mitigated to ALARA and are anticipated to be low risk.

Sensory disturbances from Project activities that generate noise, vibration and light during site preparation and construction and operation phases include the operation of mobile and stationary equipment and blasting activities. Sensory disturbances from noise and light from the Project is expected to mostly affect habitat suitability for migratory and SAR birds within the immediate vicinity of the Project/activities. Guidance documents, including *Guidelines to Avoid Harm to Migratory Birds* (ECCC 2023) will be followed to define buffer zones and setback distances to mitigate potential sensory disturbance effects from the Project on migratory birds and SAR, where feasible. Blasting will be scheduled outside of peak breeding and nesting periods. These measures are consistent with federal guidelines under the MBCA, and the *Guidelines to Avoid Harm to Migratory Birds* and reflect industry best practices and mitigation measures previously accepted by the IAAC on other projects for minimizing sensory disturbance. These measures are well-established, routinely applied in similar projects, and supported by regulatory oversight, providing a high level of certainty that changes in survival and reproduction are not likely to result in a greater than negligible effect on self-sustaining and ecologically effective migratory bird and SAR bird populations. As presented in Section 19.2.3.3, environmental protection measures would be in place and effects on noise, vibration and light would be mitigated to ALARA and are anticipated to be low risk.

Changes in fish and fish habitat populations are not anticipated to result in a residual effect on the survival and reproduction of migratory or SAR birds, as effects on fish and fish habitat are anticipated to be negligible in degree and low risk (Section 19.2.3.7) and the regional area includes a considerable amount of fish-bearing lakes, rivers and ponds that could offer potential food sources for migratory and SAR birds.

The HHERA, reviewed by the CNSC under the NSCA and REGDOC-2.9.1, will confirm that mitigation measures reduce effects on ALARA. The HHERA will be updated regularly throughout the Project lifespan. The NWMO's environmental monitoring program will be implemented throughout the lifespan of the Project and would include monitoring activities to verify that bird and bird habitat from potential direct or indirect effects is performing as intended and effects are minimized. Should monitoring confirm that effects differ from those predicted, adaptive management measures would be implemented. The NWMO will also be required to adhere to permitting requirements under the MBCA, SARA, and Ontario *Endangered Species Act*.

The NWMO's environmental monitoring program will be implemented throughout the lifespan of the Project and would include monitoring activities to verify that mitigation to migratory and SAR birds from potential direct or indirect effects is performing as intended and effects are minimized. Should monitoring confirm that effects differ from those predicted, adaptive management measures would be implemented.

The effectiveness of proposed environmental design features, mitigation and protection measures are well-documented and widely accepted across the industry, providing a high level of confidence that the changes in habitat availability, distribution and survival and reproduction on self-sustaining and ecologically effective migratory bird and SAR populations are unlikely. Regulatory controls, including requirements under the NSCA, MBCA, and SARA would also require migratory and SAR to be protected, and effects mitigated to ALARA. To this end, the degree of the residual effect is

anticipated to be negligible. The likelihood of the effect is anticipated to be moderate, as sensory disturbance to migratory and SAR birds is likely to occur to migratory and SAR birds that may be present in the area of the Project.

With a negligible degree and moderate likelihood of residual effects, the Project activities that would result in a pathway of change to the migratory and SAR birds VC are anticipated to result in a low risk of adverse environmental effects. Table 19.14 presents the risk assessment screening for the to the migratory and SAR birds VC.

Table 19.14: Preliminary Residual Effects Risk Screening for the Migratory and Species at Risk Bird Valued Component

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

As presented in *Table 19.4*, changes to migratory and SAR birds may result in pathways of change to other VCs, including:

- terrestrial wildlife and wildlife Habitat (Section 19.2.3.10)
- non-Indigenous health conditions (Section 19.2.3.11)
- current use of lands and resources for traditional purposes by Indigenous Peoples (Section 21.1)
- health conditions of Indigenous Peoples (Section 21.1)

The risk screening for these VCs is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the migratory and SAR birds VC are anticipated to be low risk, given the proposed mitigation and environmental protection measures required and regulatory controls in place. Further assessment of effects on migratory and SAR birds will be completed to meet licensing requirements under the NSCA and inform provincial and federal permitting requirements. Further assessment of effects on migratory and SAR birds under the IAA is expected to be applicable to assessment of VCs where moderate to extreme risks of residual effects are anticipated.

19.2.3.10 TERRESTRIAL WILDLIFE AND WILDLIFE HABITAT

19.2.3.10.1 Pathways of Change Screening

Terrestrial wildlife and wildlife habitat includes species detected within baseline surveys where effects could occur (Section 14.10):

- **Moose**
- **Carnivores**—Fourteen terrestrial carnivores potentially occur within the vicinity of the Project site, including four designated as provincially or federally at risk (i.e., wolverine, gray fox, American badger, cougar). Although there is potential for cougar to occur in the area, this

species occurs in extremely low densities and is a habitat generalist. It is not listed under the SARA and as of 2022 is not afforded species or habitat protection under the provincial *Endangered Species Act*. Similarly, the wolverine known occurrence range is located approximately 80km north of the Project site, and as such there is very low likelihood that they inhabit areas in and around the Project.

- **Small terrestrial mammals**—Twenty-nine small-to-medium-sized species could potentially occur within the vicinity of the Project site; none of them are provincially or federally listed as SAR.
- **Semi-aquatic mammals**—Five semi-aquatic mammals could potentially occur within the vicinity of the Project site.
- **Bats**—Six bat species occur or potentially occur within the Project site; five are designated as provincially endangered and two federally endangered.
- **Herpetofauna**—Seven amphibian species have been detected within the Project site; Snapping Turtle was the only SAR species observed.
- **Terrestrial invertebrates**—No terrestrial invertebrate SAR have been observed in the area to date There is potential for the Yellow-banded Bumble Bee to be found in the area.

Project activities during site all Project phases, including site clearing, blasting, construction of Project components, in-water works, altered site drainage, runoff, water withdrawal and discharge of treated effluent have the potential to directly and indirectly effect terrestrial wildlife species, including SAR and their habitats. Without the implementation of environmental design features, mitigation and environmental protection measures, the following pathways of change from these Project activities (Table 19.4) have the potential to result in in a moderate to high degree of adverse effects on the terrestrial wildlife and wildlife habitat VC:

- Project activities during all Project phases could change terrestrial wildlife and wildlife habitat availability, distribution and survival and reproduction, resulting in direct changes to baseline conditions and indirect changes to other VCs.
- Project activities during all Project phases could generate and emit criteria air contaminants, resulting in direct changes to baseline conditions of air quality, and indirect changes to baseline conditions of other intermediate and valued components.
- Project activities during all Project phases could generate noise, vibration and light emissions, resulting in direct changes to baseline conditions of noise, vibration and light, and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change the hydrogeological regime, resulting in direct changes to baseline conditions of hydrogeology, and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change hydrology and water quality, resulting in direct changes to hydrology and surface water quality baseline conditions and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change topography, soils and sediment, resulting in direct changes to baseline conditions of topography, soils and sediment and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change vegetation, riparian and wetland environments, resulting in direct changes to baseline conditions and indirect changes to other VCs.

- Project activities during all Project phases could change migratory and SAR bird habitat availability, distribution and survival and reproduction, resulting in direct changes to baseline conditions of fish and fish habitat, and indirect changes to other VCs.

These activities would be managed through a combination of best management practices, environmental design features and mitigation measures. The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance.

Although environmental design features, mitigation and protection measures are anticipated to mitigate changes in terrestrial wildlife and wildlife habitat availability, distribution and survival and reproduction, the potential still exists for the Project to change these measurement indicators compared to baseline conditions, which would result in a residual adverse effect. As residual effects on the terrestrial wildlife and wildlife habitat VC are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.10.2 Preliminary Risk Screening of Residual Effects

Project activities, such as vegetation clearing and infrastructure construction, have the potential to directly affect terrestrial wildlife and their habitats, including those of SAR, through physical loss or alteration. To minimize habitat disturbance, the Project will employ careful site planning, maintain buffer zones around SWHs, and schedule construction outside critical breeding periods. Pre-construction surveys will be conducted to identify and avoid sensitive areas, and if any protected species habitats are found under Schedule 1 of the SARA (Government of Canada 2002b), these will either be avoided, or the necessary permitting process will be initiated. In-water infrastructure, like freshwater intakes and effluent diffusers, will be designed to prevent harm to semi-aquatic mammals and herpetofauna. These measures align with federal and provincial environmental protection regulations (i.e., SARA and provincial *Endangered Species Act* [Government of Ontario 2007]) and best management practices, providing strong assurance that any changes to habitat availability, distribution, survival, or reproduction are unlikely to have more than a negligible impact on self-sustaining and ecologically effective terrestrial wildlife populations.

Project activities that could generate indirect effects on terrestrial wildlife and wildlife habitat include emission and generation of air and dust emissions, runoff, seepage, and discharge to affect terrestrial wildlife and wildlife habitat availability, survival, and reproduction. Airborne contaminants will be managed through dust suppression techniques, emission controls, and regular air quality monitoring. Runoff and seepage will be controlled using engineered drainage systems, containment structures, and water treatment processes so that surface water quality remains within protective thresholds. Treated effluent and sewage discharges will comply with applicable water quality standards, and sediment release during in-water construction will be minimized through isolation techniques and erosion control measures. These practices are consistent with federal environmental protection regulations and best management practices and provide a high level of certainty that changes in habitat availability and distribution are not likely to result in a greater than negligible effect on self-sustaining and ecologically effective terrestrial wildlife and wildlife habitat populations. As presented in Sections 19.2.3.1 and 19.2.3.5, air quality, hydrology and surface water quality would be mitigated to ALARA and are anticipated to be low risk.

Sensory disturbances from Project activities that generate noise, light and vibration during site preparation and construction are not anticipated to result in greater than negligible effects on terrestrial wildlife and wildlife habitat, including impacts on reproduction. Sensory disturbances are expected to mostly affect habitat suitability for wildlife within the immediate vicinity of the Project/activities. If required, buffer zones and setback distances to mitigate potential sensory disturbance effects from the Project identified terrestrial wildlife habitat will be implemented. These measures are well-established, routinely applied in similar projects, and supported by regulatory oversight, providing a high level of confidence. As presented in Section 19.2.3.3, noise, vibration and light would be mitigated to ALARA and are anticipated to be negligible risk.

Changes in fish and migratory and SAR bird populations are not anticipated to result in a residual effect on the survival and reproduction of terrestrial wildlife populations, as effects on fish and fish habitat and migratory and SAR birds are anticipated to be negligible in degree and low risk (Section 19.2.3.7 and Section 19.2.3.9).

The HHERA, reviewed by the CNSC under the NSCA and REGDOC-2.9.1, will confirm that mitigation measures reduce effects on ALARA. The HHERA will be updated regularly throughout the Project lifespan. The NWMO's environmental monitoring program will be implemented throughout the lifespan of the Project and would include monitoring activities to verify that terrestrial wildlife and wildlife habitat from potential direct or indirect effects is performing as intended and effects are minimized. Should monitoring confirm that effects differ from those predicted, adaptive management measures would be implemented. The NWMO will also be required to adhere to permitting requirements under the SARA and provincial *Endangered Species Act*.

The effectiveness of proposed environmental design features, mitigation and protection measures are well-documented and widely accepted across the industry, providing a high level of confidence that the changes in habitat availability, distribution and survival and reproduction on self-sustaining and ecologically effective migratory bird and SAR populations are unlikely. Regulatory controls, including requirements under the NSCA, SARA, and provincial *Endangered Species Act* would also require terrestrial wildlife and wildlife habitat, including SAR, to be protected and effects mitigated to ALARA. To this end, the degree of the residual effect is anticipated to negligible. The likelihood of the effect is anticipated to be moderate, as sensory disturbance to terrestrial wildlife and wildlife habitat is likely to occur to wildlife that may be present in the area of the Project.

With a negligible degree and moderate likelihood of residual effects, the Project activities that would result in a pathway of change to the terrestrial wildlife and wildlife habitat VC are anticipated to result in a low risk of adverse environmental effects. Table 19.15 presents the risk assessment screening for the to the terrestrial wildlife and wildlife habitat VC.

Table 19.15: Preliminary Residual Effects Risk Screening for Terrestrial Wildlife and Wildlife Habitat Valued Component

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

As presented in *Table 19.4*, changes to terrestrial wildlife and wildlife habitat may result in pathways of change to other VCs, including:

- non-Indigenous health conditions (Section 19.2.3.11)
- current use of lands and resources for traditional purposes by Indigenous Peoples (Section 21.1)
- health conditions of Indigenous Peoples (Section 21.1)

The risk screening for these VCs is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the terrestrial wildlife and wildlife habitat VC are anticipated to be low risk, given the proposed mitigation and environmental protection measures required and regulatory controls in place. Further assessment of effects on terrestrial wildlife and wildlife habitat will be completed to meet licensing requirements under the NSCA and inform provincial and federal permitting requirements. Further assessment of effects on terrestrial wildlife and wildlife habitat under the IAA is expected to be applicable to assessment of VCs where moderate to extreme risks of residual effects are anticipated.

19.2.3.11 NON-INDIGENOUS HEALTH CONDITIONS

19.2.3.11.1 Pathways of Change Screening

Protection of human health would be comprehensively addressed through the NWMO's licensing requirements under the NSCA. The licensing process mandates rigorous assessments, including the HHERA that evaluate potential exposure pathways, dose modelling, and mitigation strategies aligned with CNSC's Safety and Control Areas (SCAs), such as Radiation Protection, Conventional Health and Safety, and Environmental Protection. The licensing process requires that any direct effects on human health are identified, managed, and mitigated. As such, consideration and additional evaluation of direct health effects through the IAA is not anticipated, as direct health effects area already covered by through the NWMO's licensing requirements subject to the NSCA.

Indirect effects on biophysical health determinants, such as changes in air quality, noise, water quality, fish and fish habitat, vegetation and wildlife may influence human health through environmental pathways, including the consumption of country foods. Additionally, changes in social and economic conditions, such as employment, community cohesion, and access to services may also indirectly affect human health. These indirect pathways of change are considered within this preliminary identification of potential effects.

Project activities during site all Project phases, including emission of air quality contaminants, site clearing, blasting, construction of Project components, in-water works, altered site drainage, runoff, water withdrawal and discharge of treated effluent have the potential to indirectly effect health conditions of local non-Indigenous populations. Without the implementation of environmental design features, mitigation and environmental protection measures, the following pathways of change from these Project activities (Table 19.4) have the potential to result in in a moderate to high degree of adverse effects on the non-Indigenous health conditions VC:

- Project activities during all Project phases could generate and emit criteria air contaminants, resulting in direct changes to baseline conditions of air quality, and indirect changes to baseline conditions of other intermediate and valued components.
- Project activities during all Project phases could generate noise, vibration and light emissions, resulting in direct changes to baseline conditions of noise, vibration and light, and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change the hydrogeological regime, resulting in direct changes to baseline conditions of hydrogeology, and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change hydrology and water quality, resulting in direct changes to hydrology and surface water quality baseline conditions and indirect changes to other intermediate and valued components.
- Project activities during all Project phases could change topography, soils and sediment, resulting in direct changes to baseline conditions of topography, soils and sediment and indirect changes to other intermediate and valued components.

- Project activities during all Project phases could change vegetation, riparian and wetland environments, resulting in direct changes to baseline conditions and indirect changes to other VCs.
- Project activities during all Project phases could change migratory and SAR bird habitat availability, distribution and survival and reproduction, resulting in direct changes to baseline conditions of fish and fish habitat, and indirect changes to other VCs.
- Project activities during all Project phases could change terrestrial wildlife and wildlife habitat availability, distribution and survival and reproduction, resulting in direct changes to baseline conditions and indirect changes to other VCs.
- Project activities during all Project phases could result in changes to non-Indigenous economic conditions and indirect effects on non-Indigenous health and social conditions.
- Project activities during all Project phases could result in changes to non-Indigenous social conditions and indirect effects on non-Indigenous health and economic conditions.

These activities would be managed through a combination of best management practices, environmental design features and mitigation measures. The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance.

Although environmental design features, mitigation and protection measures are anticipated to mitigate changes in non-Indigenous health conditions, the potential still exists for the Project to change non-Indigenous health conditions compared to baseline conditions through indirect pathways of change to biophysical and social determinants of health, which would result in residual effects. As residual effects on the non-Indigenous health conditions VC are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.11.2 Preliminary Risk Screening of Residual Effects

Biophysical Determinants of Health

Direct effects on non-Indigenous health conditions Project activities that could generate effects on biophysical determinants of health include activities described in Sections 19.2.3.1 to 19.2.3.10. As presented in those sections, effects will be managed through environmental design features, mitigation and protection measures that are consistent with federal environmental protection regulations and best management practices and provide a high level of certainty that changes in baseline conditions to those intermediate and valued components are negligible to low risk.

In accordance with requirements under the NSCA and REGDOC 2.9-1, the HHERA will be subject to environmental review from the CNSC to demonstrate that environmental protection measures will be in place to mitigate environmental effects on ALARA, including effects on human receptors. The HHERA will evaluate the potential adverse effects of the Project on both people and the environment by identifying exposure pathways, estimating the likelihood and severity of impacts, and determining whether risks are acceptable under current and future conditions though the lifespan of the Project. The HHERA would also be subject to regular updates throughout the lifespan of the Project.

The effectiveness of proposed environmental design features, mitigation and protection measures are well-documented and widely accepted across the industry, providing a high level of confidence that the changes in biophysical determinants of health are unlikely. Regulatory controls, including requirements under the NSCA, would also require human health to be protected and effects mitigated to ALARA. To this end, the degree and likelihood of residual effect is anticipated to be negligible.

Social Determinants of Health

Increased income for local community members from Project employment may be beneficial, there is also the potential to spend increased disposable income in ways that can amplify social determinants of health, particularly substance abuse, domestic violence, and mental health. The Social, Cultural, Economic, and Health Baseline Studies have already noted that limited substance abuse and addiction services are available in local communities (Section 15.1) and that employment and the associated income in some circumstances may exacerbate them. Potential workers may or may not be prepared for the intense work regime (i.e., a long daily routine and little time off during the work rotation schedule), the separation of living in an accommodation camp away from their home community, and the sudden increase in income. These conditions may result in stress for some potential workers.

The allocation of increased disposable income within local communities is subject to individual choices and behaviours. While sustained higher income is associated with improved health outcomes and enhanced socio-economic status, short-term increases in income do not necessarily yield the same benefits (Scott and Lessard 2002). Although short-term or periodic construction employment may, in some cases, present opportunities for poor spending decisions, income derived from sustained employment over the 13-year site preparation and construction phase, or 50-year operations is more likely to foster lasting improvements in individual health and well-being.

While the potential for adverse effects associated with income is dependent on individual behaviours, the NWMO would implement mitigation measures. The establishment of health and wellness programming on site, including an employee and family assistance program would support workers. The employee and family assistance program would include services such as free assessments, short-term counselling, referrals, and follow-up with employees and their family members who are having personal or work-related problems.

The construction and operation of the accommodation camp and the accommodation of a large, predominantly non-local workforce poses a potential effect on vulnerable populations in the region, particularly with respect to increased risks of gender-based violence, substance abuse, and other social determinants of health. Potential effects from the accommodation camp and workforce would be managed through the enforcement of its Code of Conduct, which includes zero-tolerance policies for harassment and violence. The NWMO would also provide mandatory staff training and accessible, confidential reporting and support mechanisms for potentially affected individuals.

Under the assumption that mitigation opportunities are effectively implemented and received by local community members, the degree and likelihood of residual effects on social determinants of health are anticipated to be negligible, and pathways of change to the non-Indigenous health conditions VC are anticipated to have a negligible risk of adverse effects. Table 19.16 presents the risk assessment screening for the non-Indigenous health conditions valued component.

Table 19.16: Preliminary Residual Effects Screening for Non-Indigenous Health Conditions

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

As presented in *Table 19.4*, changes to non-Indigenous health conditions may result in pathways of change to other VCs, including the following:

- non-Indigenous economic conditions (Section 19.2.3.12)
- non-Indigenous social conditions (Section 19.2.3.13)

The risk screening for these VCs is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the non-Indigenous health conditions VC are anticipated to be negligible, given the proposed mitigation and environmental protection measures required and regulatory controls in place. Further assessment of effects on non-Indigenous health conditions will be completed to meet licensing requirements under the NSCA. Further assessment of effects on non-Indigenous health conditions under the IAA is expected to be applicable to assessment of VCs where moderate to extreme risks of residual effects are anticipated.

19.2.3.12 NON-INDIGENOUS ECONOMIC CONDITIONS

19.2.3.12.1 Pathways of Change Screening

Employment, income and contracting opportunities during all Project phases have the potential to directly and indirectly affect non-Indigenous economic conditions. Without the implementation of the Project, the non-Indigenous economic conditions are anticipated to remain similar to baseline conditions. The following pathways of change from these Project activities (Table 19.4) have the potential to result in a positive effect on non-Indigenous economic conditions:

- Project activities during all Project phases could result in changes to non-Indigenous health, economic and social conditions.

Specific benefits from the Project would include increased employment and income opportunities for non-Indigenous populations. Employment and income opportunities are expected to be greatest during site preparation and construction and continue at a decreased level during operations. The Project would provide a positive benefit through increased business and contracting opportunities through operations. These opportunities are anticipated to result in new revenue sources for existing local and regional businesses and the facilitation of new business start-ups. Specific to the Township of Ignace, benefits are outlined in the Hosting Agreement (NWMO and Ignace 2024), which provides the NWMO's commitments to the community benefits with respect to business opportunities, employment and training opportunities, Project governance, financial benefits to community, and communications and dispute resolutions. The Project would also generate payments to municipal, provincial and federal governments through personal and corporate income taxes and execution of the Hosting Agreement.

The employment, income and contracting opportunities Project, the execution of the Hosting Agreement and generation of revenue for municipal, provincial and federal governments are anticipated to result in positive effects, when compared to existing economic conditions. As the *Operational Policy Statement* and methods presented in Section 19.2.2.3 are intended to focus on the risk of adverse effects, a preliminary risk screening of the risk of the anticipated positive effects on non-Indigenous economic conditions was not completed.

As presented in Table 19.4, changes to non-Indigenous economic conditions may result in pathways of change to other VCs, including the following:

- non-Indigenous health conditions (Section 19.2.3.11)
- non-Indigenous social conditions (Section 19.2.3.13)

The risk screening for these VCs is presented in their applicable subsections.

The pathways of change screening concludes that primarily positive effects are anticipated for the non-Indigenous economic conditions VC, given the proposed employment and procurement opportunities, benefits of the Hosting agreement and payments that would be generated through taxation to municipal, provincial and federal governments.

The NFWA also provides a legislative mechanism for monitoring and reporting on economic conditions in non-Indigenous communities. Under Section 18 of the NFWA, the NWMO is required to report every three years on the socio-economic effects of its activities, including impacts on a community's way of life, culture, and economic aspirations. This statutory obligation supports ongoing oversight and adjustment and complements mitigation and enhancement measures developed in collaboration with host communities. As such, further assessment of effects on non-Indigenous economic conditions under the IAA is only expected to be applicable to assessment of VCs where moderate to extreme risks of residual effects are anticipated.

19.2.3.13 NON-INDIGENOUS SOCIAL CONDITIONS

Project activities during site all Project phases, including site traffic, transportation of materials to and from the site, employment and procurement, use of the worker accommodation camp, hazardous and non-hazardous waste management, management and storage of radioactive waste from UFPP operations have the potential to directly and indirectly affect social conditions of local populations. Without the implementation of environmental design features, mitigation and environmental protection measures, the following pathways of change from these Project activities (Table 19.4) have the potential to result in in a moderate to high degree of adverse effects on the non-Indigenous social conditions VC:

- Project activities during all Project phases could result in changes to non-Indigenous health, economic and social conditions.

These activities would be managed through a combination of best management practices, environmental design features and mitigation measures. The effectiveness of these mitigation strategies is well-established and supported by industry experience and regulatory guidance.

Although environmental design features, mitigation and protection measures are anticipated to mitigate changes in non-Indigenous social conditions, the potential still exists for the Project to change non-Indigenous social conditions compared to baseline, which would result in a residual effect. As residual effects on the non-Indigenous health conditions VC are anticipated, a preliminary risk screening was completed to provide the anticipated level of risk inherent to predicted residual effects.

19.2.3.13.1 Preliminary Risk Screening of Residual Effects

The Project will generate conventional and radioactive waste during operations. Conventional waste will be disposed of at Licenced off-site facilities in coordination with local authorities, while low- and intermediate-level radioactive waste will be stored on site and later co-emplaced in the DGR or transported to another Licenced facility. Both options will meet stringent regulatory requirements, and social effects are expected to be negligible.

Among the Project activities with the greatest potential to influence social and cultural conditions is the operation of the worker accommodation camp. The camp will be a dry facility and subject to security checks and access controls. Mitigation measures common to infrastructure projects with accommodation camps will be implemented to manage potential social effects. These measures include strict behavioural policies and enforcement, local hiring and workforce training programs, on-site recreational amenities, transportation management, and ongoing community liaison and monitoring.

Other residual adverse effects on non-Indigenous social conditions, such as changes in services and infrastructure and increased demand for housing, health care, education, and other community services, are expected due to the scale and nature of the Project. These types of changes are commonly associated with large infrastructure developments and reflect the anticipated transition within local communities. However, these effects are expected to be shaped by the NWMO's ongoing and future engagement and planning efforts, which aim to prepare communities and support positive outcomes. Through the Hosting Agreements, tailored workforce strategies, and collaboration with municipal partners, the NWMO has been identifying potential social impacts and developing mitigation and enhancement measures that reflect local priorities. These efforts are ongoing and supported by the reporting requirements under the NFWA, which provide a statutory mechanism for oversight and adjustment.

Residual effects on non-Indigenous social conditions are anticipated to be low in degree, primarily due to the NWMO's comprehensive coordination with host communities and its statutory obligations under the NFWA. While minor changes from baseline conditions may occur, these are expected to be effectively managed and addressed proactively with the Township of Ignace and other local communities. The implementation of proposed mitigation and enhancement measures, Hosting Agreements, and ongoing engagement with local communities is designed to guide social changes in a manner that minimizes the likelihood of drastic or unexpected impacts. This collaborative and legislatively supported approach helps maintain community cohesion and stability, with any residual social effects being limited in scope and supporting the conclusion of a low degree of change.

While residual effects are likely to occur, the combination of mitigation measures, community coordination, and legislated reporting may mitigate or prevent residual adverse effects from materializing. As a result, the likelihood of residual adverse effects is characterized as moderate, reflecting both the potential for change and the systems in place to manage it.

Positive effects are also anticipated, including employment, income growth, youth retention, and community investment through Hosting Agreement payments. The NFWA requires the NWMO to report every three years on socio-economic effects, providing ongoing monitoring and accountability.

With a low degree and moderate likelihood of residual adverse effects, the Project activities that would result in a pathway of change to the non-Indigenous social conditions VC are anticipated to result in a low risk. Table 19.17 presents the risk assessment screening for the non-Indigenous social conditions VC.

Table 19.17: Preliminary Residual Effects Screening for Non-Indigenous Social Conditions

Degree	High	Low Risk	Moderate Risk	High Risk	Extreme Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Negligible	Negligible Risk	Negligible Risk	Low Risk	Low Risk
		Negligible	Low	Moderate	High
	Likelihood				

As presented in *Table 19.4*, changes to non-Indigenous social conditions may result in pathways of change to other VCs, including those listed below:

- non-Indigenous health conditions (Section 19.2.3.11)

- non-Indigenous economic conditions (Section 19.2.3.12)

The risk screening for these VCs is presented in their applicable subsections.

The preliminary risk assessment screening concludes that residual effects on the non-Indigenous social conditions VC are anticipated to be low risk, given the proposed mitigation and environmental protection measures required and regulatory controls in place, including the NFWA.

The NFWA also provides a legislative mechanism for monitoring and reporting on social conditions Under Section 18 of the NFWA, the NWMO is required to report every three years on the socio-economic effects of its activities, including impacts on a community's way of life, culture, and economic aspirations. This statutory obligation supports ongoing oversight and adjustment and complements mitigation and enhancement measures developed in collaboration with host communities. Further assessment of effects on non-Indigenous social conditions under the IAA is expected to be applicable to assessment of VCs where moderate to extreme risks of residual effects are anticipated.

19.3 Conclusions of Pathways of Change and Preliminary Residual Effects Risk Screening

The information provided in Section 19.2.3 is preliminary and has been developed at a screening level, based on many years of baseline and site characterization data collection, including geochemistry, surface water hydrology and quality, and engagement for the purposes of site selection. The assessment also draws on environmental protection measures drawn from comparable projects in the regional area and the findings of the Joint Review Panel for the Ontario Power Generation DGR, which concluded that, with appropriate mitigation measures in place, the Project was unlikely to result in significant residual adverse effects.

The pathways evaluation and preliminary risk screening of residual adverse effects presented in Section 19.2.3 were undertaken to provide sufficient information to the IAAC to support the development of Tailored Impact Statement Guidelines and to inform the scope of factors to be considered in the IA. This approach aligns with the objectives outlined in the *Operational Policy Statement*, which emphasizes the importance of risk-informed planning during the early phases of the assessment process. Section 19.2.3 specifically aimed to identify potential effects that are material to decision making during the IA, focusing on VCs and intermediate components that may be affected by the Project.

A summary of the conclusions of the preliminary risk screening of residual adverse effects is presented in Table 19.18. The preliminary risk screening concludes that residual adverse effects on identified intermediate and valued components are anticipated to be negligible to low risk, following the implementation of environmental design features, mitigation, and protection measures. The outcomes of Section 19.2.3 serve to focus the scope of the Impact Statement on those components where residual effects may be more pronounced so that the assessment remains targeted, proportionate, and aligned with the principles of the *Operational Policy Statement*.

The NWMO recognizes that these are preliminary conclusions, as the completion of the quantitative modelling to describe anticipated effects has not yet been completed. Nevertheless, there is a high level of confidence in the proposed mitigation and protection measures, which are grounded in proven practices and established regulatory standards. Comprehensive compliance and follow-up monitoring programs will be implemented to confirm that Project activities are undertaken in ways that maintain environmental conditions within or below protective thresholds and to verify the performance of environmental design features and mitigation measures. Monitoring programs would also include adaptive management actions so that mitigation measures are adapted to maintain effectiveness. In reaching these conclusions, the analysis also considered the oversight provided by other legislation and regulatory frameworks, including the NSCA, NFWA, and

applicable federal and provincial permitting requirements. Together, these frameworks provide robust safeguards that reduce residual risk and support the rationale for excluding certain components from further assessment in the Impact Statement under the IAA.

While these intermediate and valued components may not be material to decision making under the IAA due to their negligible to low-risk characterization, they remain important to decision making under the NSCA and possibly, harmonization with WLON's regulatory process. Further assessment, including required studies, modelling, and evaluation, will be undertaken and incorporated into the NWMO's integrated initial licence application and Impact Statement. A list of commitments made in the IPD is presented in Appendix E. This includes commitments to the implementation of environmental design features, mitigation, protection and enhancement measurements and monitoring.

Potential adverse effects on Indigenous Peoples will also consider pathways of change related to the intermediate and valued components described in Section 19. Conclusions on residual adverse effects on environmental, health, social, and economic components relevant to Indigenous Peoples, and their materiality to decision making under the IAA are presented in Section 21.

Table 19.18: Preliminary Residual Effects Risk Screening Results

Intermediate or Valued Component	Degree of Adverse Residual Effects	Likelihood of Adverse Residual Effects	Risk of Adverse Residual Effects
Intermediate Components			
Air Quality	Low	Low	Low Risk
Noise, Vibration and Light	Negligible	Negligible	Negligible Risk
Hydrogeology	Low	Low	Low Risk
Hydrology	Low	Moderate	Low Risk
Surface Water Quality	Low	Moderate	Low Risk
Topography, Soils and Sediment	Low	Moderate	Low Risk
Valued Components			
Climate Change	Negligible	High	Low Risk
Fish and Fish Habitat	Negligible	Moderate	Low Risk
Vegetation, Riparian and Wetland Environments	Negligible	High	Low Risk
Migratory and Species at Risk Birds	Negligible	Moderate	Low Risk
Terrestrial Wildlife and Wildlife Habitat	Negligible	Low	Low Risk
Non-Indigenous Health Conditions	Negligible	Negligible	Negligible Risk
Non-Indigenous Economic Conditions	Not applicable, only positive residual effects anticipated		
Non-Indigenous Social Conditions	Low	Moderate	Low Risk

20. Potential Changes to the Environment on Federal Lands or Lands Outside Ontario

There are no federal lands located near the Project site, and no portion of the proposed development is planned to occur on federal lands. Additionally, although the NWMO is a federally regulated entity by the CNSC, it is not a federal government agency or federal authority but rather a non-profit organization mandated by the federal government under the NFWA to manage Canada's nuclear waste; it is entirely funded by the nuclear industry.

There are no changes to federal lands including Reserve lands that are expected from the Project.

Subject to the outcome of the IA process, the Project lands will be transferred from the provincial Crown and become privately held by the NWMO; however, in so doing, they would still not be classified as federal lands.

The Project will not result in changes to the natural, biophysical or human environment outside of Ontario (and even more distal to other provinces or territories), as will be confirmed through future modelling. The Project is located more than 210 km from the Ontario-Manitoba border.
The Project is not of a scale or location that it could result in changes to the environment outside of Canada. The Project is located more than 140 km from the Ontario-United States border.

21. Potential Effects on Anishinaabe People of Wabigoon Lake Ojibway Nation and Other Indigenous Groups Identified in Section 3

The NWMO recognizes WLON as the most proximate First Nation to the Project, with the nearest community member residing approximately 12 km from the Project site. A foundational principle of the NWMO's site selection process was that the Indigenous community closest to the Project must be an informed and willing host for the Project to proceed into the regulatory process.

As described in Section 3, the NWMO will continue to engage with WLON and other potentially impacted Indigenous groups that may be affected by the Project to understand potential pathways of impact on their environment and well-being. In alignment with Sections 21 and 22 of the *Guide to Preparing an Initial Project Description and a Detailed Project Description*, the NWMO has provided a preliminary assessment of potential non-negligible adverse impacts on Indigenous Peoples, informed by engagement and technical studies completed to date. The assessment approach for Indigenous Peoples follows the same methodology outlined in Section 19.2.

21.1 Valued Components of Interest to Wabigoon Lake Ojibway Nation and Other Indigenous Groups that May Be Affected by the Carrying Out of the Project

The preliminary VCs for WLON and other Indigenous groups that may be affected by the Project are identified in accordance with Schedule 1, Section 21 of the *Information and Management of Time Limits Regulations* (Table 21.1). These VCs are considered preliminary and will be further defined through ongoing engagement with Anishinaabe communities and other potentially affected Indigenous groups. Engagement will focus on understanding how the Project may affect components of importance as defined by each community. The NWMO's approach will be informed by Anishinaabe and Indigenous Knowledge as well as the effects assessment of environmental and social components presented in Section 19.

At this stage, the NWMO's IA approach treats WLON and each of the other potentially affected Indigenous groups as distinct, ensuring that pathways of Project effects are tailored to their specific circumstances and values. Accordingly, engagement and participation programs for WLON and other First Nations identified in Section 3.1 will focus on pathways of change most important and/or applicable to each community. Dialogue with additional Indigenous groups will continue as new information emerges about potential pathways of change relevant to their Rights and interests.

The NWMO recognizes the importance of data sovereignty as an essential aspect of self-determination and cultural preservation. The current draft effects assessment methodology and measurement indicators do not yet fully capture the diversity of Indigenous identities within district, municipal, and unincorporated areas, nor do they comprehensively characterize on-reserve communities. As regulatory engagement progresses, the participation status of Indigenous communities may evolve as new information becomes available through engagement.

Table 21.1 summarizes the preliminary VCs, associated measurement indicators, and assessment endpoints for each of the First Nation communities in Section 3.1, along with the related intermediate and valued components that may influence their assessment.

Table 21.1: First Nations, Preliminary Valued, Components, Measurement Indicators, Assessment Endpoints and Components that Could Influence or Inform Their Assessment

Potentially Affected Indigenous Group	Valued Components	Measurement Indicators and Assessment Endpoints	Intermediate Components and Valued Components that Could Influence Assessment of Indigenous Group Valued Components
• Wabigoon Lake Ojibway Nation • Eagle Lake First Nation • Lac Seul First Nation • Lac des Mille Lacs First Nation • Seine River First Nation	To be defined by each Indigenous group. The preliminary list below reflects the requirements Schedule 1, Section 21 of the *Information and Management of Time Limit Regulations*: ▪ Indigenous physical and cultural heritage, and structures, sites or things of significance (e.g., on both reserve and non-reserve lands, spiritual lands, ceremonial sites. ▪ Current use of lands and resources for traditional purposes (e.g., wild rice, blueberries, moose [plus cumulative effects from forestry and mining], trapping, fish, peat resources, sport fishing, chanterelles, restricted access). ▪ Health and well-being of Indigenous Peoples (e.g., contaminants in fish, wildlife, water, seepage). ▪ Social conditions of Indigenous Peoples (e.g., proximity to the site for First Nation members). ▪ Economic conditions of Indigenous Peoples (e.g., wild rice, cutting wood, baitfishing, benefits to the First Nation, chanterelles).	To be defined by each Indigenous group through engagement	▪ Air Quality ▪ Noise, Vibration and Light ▪ Groundwater ▪ Hydrology ▪ Surface Water Quality ▪ Topography, Sediment and Soils ▪ Fish and fish Habitat, Including Aquatic SAR ▪ Vegetation, Riparian and Wetland Environments ▪ Migratory and SAR Birds ▪ Terrestrial Wildlife and SAR

SAR = Species at Risk.

21.2 Initial Project Description Conclusions for Potential Effects on Wabigoon Lake Ojibway Nation's Anishinaabe People and Other Indigenous Peoples

A pathway of change and risk assessment screening cannot be completed for potentially affected Indigenous groups at this stage, as future engagement will define VCs, measurement indicators and assessment endpoints to inform the scope of the assessment.

Although engagement specific to the regulatory process has only recently been formally initiated with WLON and other potentially affected Indigenous Peoples, the NWMO acknowledges that many years of relationship-building and collaboration have already provided valuable insights. Drawing on this foundation, the NWMO has identified preliminary understandings of potential Project impacts on the Anishinaabe Peoples of WLON, and potentially on other Indigenous Peoples who may be

affected by the Project. These understandings will continue to evolve through ongoing engagement during the nuclear licensing and IA processes.

Physical and Cultural Heritage

- Site selection and the borehole drilling program were informed by technical studies and cultural verification work. A cultural heritage screening was conducted using the Ontario Archaeological Sites Database, which found no known sites near the initial borehole drilling program locations.
- WLON undertook a cultural verification study with the NWMO to confirm the absence of artifacts before site establishment, helping identify borehole IG-BH01 as having the least potential impact. This collaborative process reduced potential impacts on archaeological, historical, and cultural heritage values.
- As part of engagement and participation work with the Anishinaabe Peoples of WLON described in Section 3.2, the NWMO also plans to work with WLON Indigenous Knowledge holders and land users, including Anishinaabe trappers, hunters, and harvesters, to support a shared understanding of land and resource use in the Project area. The NWMO is committed to working in partnership with the community and in accordance with appropriate data governance protocols to ensure that Indigenous Knowledge and Indigenous subject matter expertise inform the planning and implementation of the Project.
- For all phases of the Project, the NWMO will work collaboratively with the host First Nation WLON to understand and uphold appropriate cultural and environmental monitoring practices, including any ceremonial requirements prior to the commencement of activities. WLON ceremony and cultural protocols will be respected, with specific practices to be confirmed in dialogue with the community.
- Physical and cultural heritage of other potentially affected Indigenous groups if they have historically exercised Rights within WLON's territory, although to a lesser extent.

Land and Resource Use for Traditional Purposes

- The Project will result in adverse changes to land access and use for operational, safety, and security purposes. This may impact on the ability of Anishinaabe peoples of WLON and other Indigenous Peoples to access lands for current and traditional use.
- Perceptions of risk associated with radioactive materials may also influence traditional practices in the area, even with the presence of direct physical barriers.
- As the Project is located within the territory of WLON, Anishinaabe peoples of WLON are expected to experience these effects and the other Indigenous Peoples referred to in Chapter 3 may also be impacted.

Indigenous Economic Conditions

- The overall impact on economic conditions from the Project is expected to be positive.
- The Hosting Agreement between the NWMO and WLON, which remains confidential at the request of the community, covers a broad range of themes. These include, but are not limited to, topics like business opportunities, employment and training, and environmental and regulatory program requirements.
- Members of other Indigenous Peoples may also benefit, including through job creation, local investment, and improved regional infrastructure.

Indigenous Health Conditions

- The NWMO will conduct detailed HHERAs to demonstrate that the Project does not pose adverse effects on Indigenous health conditions.
- These studies form part of the Safety Case required under the NSCA (Government of Canada 1997), which will:
  - include both quantitative dose assessments and qualitative lines of evidence
  - be reviewed at each licensing phase by the CNSC
  - be available for review and input by Indigenous Peoples, including participation in public hearings
- The Safety Case will serve as a key platform for ongoing dialogue with interested Indigenous Peoples.

Indigenous Social Conditions

- The NWMO will work collaboratively with WLON and other potentially affected Indigenous groups to understand and address social determinants of health related to the Project, which could include non-negligible adverse effects on mental and physical health and effects on vulnerable Indigenous populations.
- Under the NFWA, the NWMO must report every three years on the socio-economic effects of Project activities on an Indigenous Peoples' way of life, culture, and aspirations.
- The combined requirements of the NSCA and NFWA provide alternative regulatory means to assess and address health, social, and economic impacts on Indigenous Peoples, in combination with the IA process.

Collaborative Implementation and Monitoring

- The NWMO is committed to validating mitigation and enhancement measures with WLON.
- Regulatory monitoring and follow-up programs will be co-developed and implemented collaboratively with WLON to ensure that Project activities align with community expectations and protect Indigenous Rights and values of WLON.

22. Estimate of Greenhouse Gas Emissions

Canada's nuclear power plants have provided clean, reliable, and low-carbon energy for decades. However, used nuclear fuel remains radioactive for a very long time and requires careful, permanent management. The Project is also a critical component of Canada's nuclear fuel cycle, providing the permanent solution required to address the final stage of managing used fuel responsibly. By securing long-term management of used fuel, it supports the continued role of nuclear energy as a reliable, low-carbon power source and contributes directly to Canada's commitments on climate change and achieving net-zero emissions.

The Project will emit GHGs throughout all phases of the Project and the NWMO has completed a preliminary assessment of these emissions. This analysis has been conducted for scope 1 (direct GHG emissions) and scope 2 (electricity indirect energy GHG emissions). Scope 1 (direct GHG emissions) and scope 2 (indirect energy) emissions from the following emissions categories were considered: mobile fleet (note that the underground mobile fleet in the operations phase is expected to be battery powered), heating plant (combustion of propane in the construction phase and natural gas in the operations phase), backup generator (combustion of fossil fuels), blasting (combustion of explosives in construction phase only), land clearing (removal of carbon sinks in construction phase), electricity consumption (via electricity purchases), and used nuclear fuel transport (combustion of fossil fuels) at the Project site along the access roads after turn off from Highway 17, as shown in Figure 9.1. Emissions of each greenhouse gas (i.e., carbon dioxide, methane, and nitrous oxide) were converted into units of carbon dioxide equivalent. Other GHGs (i.e., sulphur hexafluoride, nitrogen trifluoride, hydrofluorocarbons, and perfluorochemicals), published in Schedule 3 of the *Greenhouse Gas Pollution Pricing Act* (Government of Canada 2018) are not currently considered relevant to this Project.

An estimate of net greenhouse gas emissions that will be expected to result from construction and operation of the Project has been conducted. This analysis used *Canada's Greenhouse Gas Quantification Assessment of Climate Change* (ECCC 2022), *Draft Technical Guide Related to the Strategic Assessment of Climate Change* (Government of Canada 2021) and 2006 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories (IPCC 2006) to inform the identification of GHG sources, quantification methods, and emission factors. The maximum annual scope 1 and 2 emissions are estimated to be 14,480 and 10,834 tonnes of carbon dioxide equivalent for the construction and operations phase, respectively. In both cases, the majority of these emissions are expected to arise from the use of the heating plant which contributes to 88 percent and 95 percent of the total emissions calculated for the construction and operations phases, respectively.

The NWMO will meet the requirements of the Government of Canada's *Strategic Assessment of Climate Change* and demonstrate the implementation of best available technologies and best environmental practices to reduce direct greenhouse gas emissions between start of site preparation and construction activities.

23. List of Potential Waste and Emissions

The potential release of wastes and emissions due to implementation of the Project is shown in Table 23.1 for all phases.

Table 23.1: List of Potential Waste and Emissions

Potential Wastes and Emissions	Project Phase			
	Site Preparation	Construction	Operations	Decommissioning
Non-radioactive Waste				
Atmospheric emissions including:				
Drilling and blasting of rock	x	x	x	
Loading and offloading of excavated rock and overburden	x	x	x	
Vehicle and heavy equipment travel	x	x	x	x
Wind entrainment from exposed earth and mineral waste such as within overburden stockpiles and ERMA	x	x	x	x
Greenhouse gas emissions will derive from heavy equipment operation and fuel combustion	x	x	x	x
Noise from the operation of heavy equipment for construction and handling of excavated materials (trucks, shovels, loaders) and potentially from underground development and ventilation	x	x	x	x
Blasting noise from underground (although blasts will be a very limited duration)		x	x	x
Air contaminant emissions from the operation of construction and mining vehicles and equipment	x	x	x	x
Loading and offloading of concrete rubble				x
Liquid emissions including:				
Contact water and surface contact water, including groundwater intercepted by the subsurface drainage and dewatering system. Contact water will contain suspended solids from shaft construction activities and earthmoving activities, ammonia residuals from ammonia-based explosives, and residual hydrocarbons from heavy equipment operation	x	x	x	x
Precipitation and groundwater that comes into contact with surface facilities will be collected using ditches and sumps and will be directed to the water management systems. Runoff from the stockpiles (waste rock and overburden) may contain suspended solids, salts and dissolved metals. A comprehensive geochemistry testing program is underway to support a prediction of water quality,	x	x	x	x

Potential Wastes and Emissions	Project Phase			
	Site Preparation	Construction	Operations	Decommissioning
including for residual metals arising from the natural bedrock that become exposed through underground development-related activities				
Domestic sewage and conventional wastewater (sewage/showers)	x	x	x	x
Excess site water	x	x	x	x
Cementitious solid wastes (e.g., wastes from concrete batch plant)	x	x	x	x
Excess water from the water management and treatment system that meets regulatory requirements for water quality and quantity, will be discharged to the environment	x	x	x	x
Solid wastes including:				
Domestic waste including food scraps, refuse, clothing, metal tins, scrap metal, glass, plastic, wood, paper	x	x	x	x
Conventional construction waste including machinery, equipment and other materials	x	x	x	x
Other waste including hazardous wastes:				
Used machine oils, solvents, lube oils and other designated substance waste	x	x	x	x
Used batteries and other electronic/electrical waste	x	x	x	x
Soil and sediment waste from excavation activities	x	x	x	x
Radioactive Waste				
Atmospheric emissions including:				
Air contaminant emissions of radioactive particulates and gases due to used fuel handling			x	
Liquid emissions including:				
Radioactive wastewater (from washing down UFTPs, UFCs and other equipment) which is captured and sent to the radioactive liquid waste handling facility			x	

Potential Wastes and Emissions	Project Phase			
	Site Preparation	Construction	Operations	Decommissioning
Spills from equipment and machinery	x	x	x	x
Solid wastes including:				
Solid radioactive wastes arising from maintenance of the used fuel transfer systems			x	
Conventional solid wastes from operations (e.g., wastes from cement batch plant and sealing material plant, scraps from installation of services in underground repository)			x	
Spent filters and ion exchange media from treatment processes			x	
Spent equipment/tools from maintenance of hot cell equipment			x	
UFPP and LLW storage building nuclear ventilation system used air filters			x	
Used HEPA filters and typical HVAC filters			x	x
UFPP and nuclear structures, systems and components radioactive wastes				x
UFTPs				x

ERMA = Excavated Rock Management Area; HEPA = high efficiency particulate air; HVAC = heating, ventilation, and air conditioning; LLW = low-level waste; UFC = Used Fuel Container; UFPP = Used Fuel Packaging Plant; UFTP = Used Fuel Transportation Package.

24. Environmental Management System

A key component of the NWMO's company-wide management system is the environmental management system governance created to minimize environmental effects related to the Project and to implement the NWMO's future environmental protection programs that will meet CNSC licensing requirements as well as implement all environmental mitigation measures and follow-up monitoring committed to during the IA process.

Follow-up and regulatory monitoring are essential tools for ensuring that a project is implemented as planned, that mitigation measures are effective, and potential adverse effects are avoided or minimized. It is through monitoring that any unanticipated potential effects can be discovered and prevented through adaptive management.

Adaptive management will be used throughout the life of the Project. This is a planned and systematic process for continuously improving environmental management practices by learning about their outcomes. Adaptive management provides flexibility to identify and implement new mitigation measures or to modify existing ones during the life of a project.

The mitigation measures incorporated in the Project are based on best management practices and are expected to avoid, prevent, or minimize adverse effects under Federal Jurisdiction. If any unforeseen adverse effects occur during the life of the Project, correction measures will be taken.

The NWMO's environmental protection program, which includes an adaptive management component, will comply with several CNSC regulatory documents and CSA standards and implement the required monitoring programs. Specifically, CNSC REGDOC 1.2.3 requires the applicant to implement an effluent and emissions control and monitoring program, environmental monitoring program, and groundwater protection and monitoring program that meet all requirements applicable to site preparation activities in REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures.* The environmental protection program would also comply with requirements outlined in REGDOC-2.9.2: *Environmental Protection – Controlling Releases to the Environment*, which outlines expectations for controlling atmospheric and liquid releases through the application of best available technology and techniques economically achievable, the establishment of Licenced release limits and action levels, commissioning and performance confirmation of treatment systems, and the implementation of adaptive management where required. These programs will also comply with the following CSA standards, as applicable:

- **CSA N288.4—**environmental monitoring programs at Class I nuclear facilities and uranium mines and mills
- **CSA N288.5—**effluent monitoring programs at Class I nuclear facilities and uranium mines and mills
- **CSA N288.7—**groundwater protection programs at Class I nuclear facilities and uranium mines and mills
- **CSA N288.8-17—**establishing and Implementing Action Levels for Releases to the Environment from Nuclear Facilities

International best practices from IAEA *Specific Safety Guide-31 Monitoring and Surveillance of Radioactive Waste Disposal Facilities* will also be used to guide development and implementation of the environmental protection program and environmental monitoring throughout all Project phases, as applicable.

25. Overall Conclusions and Path Forward

The Project represents Canada's plan for the safe, long-term management of used nuclear fuel. It provides a permanent and responsible solution for future generations, grounded in decades of scientific research, sustained community engagement, and alignment with international best practices.

The Project will result in some unavoidable changes to land use and access for operational, safety, and security purposes. Perceptions of potential radioactive contamination from the disposal of used nuclear fuel may also influence traditional land use. The extent, nature, and appropriate mitigation measures for these effects will be further defined through the licensing and IA processes. As the Project is located within the territory of WLON and WLON is the most proximate Indigenous community, the Anishinaabe Peoples of WLON are anticipated to experience these changes most directly.

Engagement with WLON, the Township of Ignace, and other potentially affected Indigenous communities will continue to play a central role in identifying pathways of change, understanding land and resource use, and characterizing potential impacts on Indigenous rights and interests. These perspectives will inform the assessment of significance and the development of mitigation measures to ensure Indigenous knowledge, values, and laws are appropriately reflected in Project implementation.

The preliminary pathways of change and risk screening indicate that, with the application of environmental design features, mitigation, and protection measures, residual effects on biophysical, health, social, and economic VCs are anticipated to be negligible to low risk. These findings help focus the forthcoming Impact Statement on components where residual effects may be more pronounced, including potential impacts on Indigenous Peoples. This screening also provides sufficient information for the IAAC and CNSC to develop Tailored Integrated Impact Statement Guidelines, ensuring that the assessment remains focused, proportionate, and consistent with the principles of the *Operational Policy Statement*.

Additional modelling and analysis will be completed to support both the Impact Statement and the initial licence application to the CNSC under the NSCA. Within the IA process, further effects analysis under the IAA will focus on components that may interact with Indigenous Peoples, including their health, land use, Rights, governance and cultural relationships with the environment.

A complete list of commitments made in the IPD is presented in Appendix E. This includes commitments related to additional baseline data collection, the implementation of environmental design features, mitigation, protection and enhancement measures, monitoring, reconciliation and engagement and climate change commitments.

The Project is expected to deliver lasting socio-economic and cultural benefits for Indigenous and non-Indigenous communities in the local and regional areas, including employment, training, and business opportunities, as well as improved infrastructure and services. The Project also contributes directly to Canada's climate change and net-zero goals by providing the final step in the nuclear fuel cycle, a safe and permanent solution that enables continued use of low-carbon nuclear energy.

The NWMO has confidence, based on extensive investigations completed since 2010, that the selected site meets the technical requirements to safely contain and isolate used nuclear fuel. The NWMO will apply the CNSC's graded approach to licensing to confirm this conclusion and will continue to advance detailed design, geoscience, and environmental programs to support the licensing and Impact Statement phases.

The NWMO will continue to engage collaboratively with WLON and the Township of Ignace, as well as other potentially affected Indigenous groups; to confirm the suitability of mitigation measures and ensure they reflect community priorities, knowledge systems, and pathways of change important to Indigenous Peoples. Follow-up and regulatory monitoring programs will be conducted jointly with the Project's host communities, WLON and the Township of Ignace, and in accordance with their respective agreements to verify the accuracy of predictions and the effectiveness of mitigation measures. Where monitoring identifies the need for additional or modified measures, the NWMO will work collaboratively with WLON, the Township of Ignace, and the CNSC, the lifecycle regulator, to implement improvements as soon as feasible. The Project is expected to have relatively low GHG emissions. The NWMO is committed to meeting the Government of Canada's Strategic Assessment of Climate Change, demonstrating how best available technologies and practices will be used to reduce direct emissions.

Overall, the Project will protect the health of present and future generations and contribute to the environmental, social, and economic sustainability of Canada's communities. It represents a responsible and science-based step toward managing used nuclear fuel in a manner that upholds Canada's commitments to safety, reconciliation, and climate leadership.

F. SUMMARY

A plain-language summary of the information contained in parts A to E is provided under separate cover in English and in French.

References

Contains information Licenced under the Open Government Licence – Ontario and Open Government Licence – Canada.

AAFS (Anishinaabe Abinoojii Family Services). 2021. 2020–2021 Annual Report.

Arsenault, A. A., A. R. Rodgers, and K. Whaley. 2019. Demographic Status of Moose Populations in the Boreal Plain Ecozone of Canada. *Alces* 55:43–60.

ATLIS Geomatics Inc. (ATLIS.) 2019. Final Report, 1674 - Ignace Revell Batholith LiDAR survey. Nuclear Waste Management Organization Report APM-REP-01332-0239. Calgary, Canada. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0239-IGNACE-REVELL-BATHOLITH-LiDAR-SURVEY-2019-04.ashx.

Barr, E. 1979. Ignace, a saga of the shield. Prairie Publishing Company.

BORN (Better Outcomes Registry Network Ontario). 2023. Maternal health data extraction via Northwestern Health Unit. [Retrieved February 7, 2023].

Bray, M. 2012. Dryden. Available from: https://www.thecanadianencyclopedia.ca/en/article/dryden [Accessed March 13, 2023].

Brody, T. 2022. The Sioux Lookout Bulletin - Pelican Falls First Nations High School Celebrates Graduates. Available from: https://www.siouxbulletin.com/pelican-falls-first-nations-high-school-celebrates-graduates [Accessed June 21, 2023].

Browne, A. (2010). Issues affecting access to health services in northern, rural and remote regions of Canada. Northern Article Series. Prince George, BC: University of Northern British Columbia.

Canada Gazette. 2007. Order Selecting an Approach for the Long-term Management of Nuclear Fuel Waste. Part II, Vol. 141, No. 13, pp. 1683. Ottawa, ON. Available from: https://gazette.gc.ca/rp-pr/p2/2007/2007-06-27/pdf/g2-14113.pdf [Accessed September 26, 2025].

Canada Energy Regulators. 2022. Market Snapshot: The Potential Role of Nuclear in Canada's Energy Future. Available from: https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2022/market-snapshot-potential-role-nuclear-canada-energy-future.html

CanNorth (Canada North Environmental Services). 2016. Nokiiwin Tribal Council Country Foods Study. Prepared for Nokiwiin Tribal Council. Available from: https://www.nokiiwin.com/upload/documents/1807-ntc-country-foods-study-revised-fin.pdf.

CanNorth. 2020. Environment Media Baseline Design – Northwestern Region. Canada North Environmental Services Limited Partnership. Nuclear Waste Management Organization Report, APM-REP-07000-0214.

CanNorth. 2023. Nuclear Waste Management Organization Adaptive Phased Management Project – Wabigoon Lake Ojibway Nation-Ignace Area Environment Media Baseline Program – Year 1 Baseline Report. Canada North Environmental Services Limited Partnerships. Nuclear Waste Management Organization Report, APM-REP-07000-0223.

CanNorth. 2024a. Nuclear Waste Management Organization Adaptive Phased Management Project – Wabigoon Lake Ojibway Nation-Ignace Area Environmental Baseline Program Design Revised Draft Report. Prepared in association with Zoetica Environmental Consulting Services and Geosyntec Independent Environmental Consulting Services.

CanNorth. 2024b. Nuclear Waste Management Organization Adaptive Phased Management Project – Wabigoon Lake Ojibway Nation-Ignace Area Environmental Media Baseline Program – Year 2 Baseline Report. Canada North Environmental Services Limited Partnerships. Nuclear Waste Management Organization Report, APM-REP-07000-0241.

CATC (Canadian Addiction Treatment Centre). 2023. Available from: https://canatc.ca/ [Accessed June 27, 2023].

CCME (Canadian Council of Ministers of the Environment). 2023. Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life. Available from: https://ccme.ca/en/current-activities/canadian-environmental-quality-guidelines.

CEAA (Canadian Environmental Assessment Agency). 1998. Nuclear Fuel Waste Management and Disposal Concept: Report of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel. Ottawa, Canada. Available from: https://publications.gc.ca/site/eng/74537/publication.html.

CEAA. 2015. Joint Review Panel Environment Assessment Report: OPG's Deep Geologic Repository for Low and Intermediate Level Radioactive Waste Project. Ottawa, Canada. Available from: https://publications.gc.ca/site/eng/9.800039/publication.html.

CEAA. 2018a. Hardrock Gold Mine Project Environmental Assessment Report. Available from: https://iaac-aeic.gc.ca/050/evaluations/document/129183.

CEAA. 2018b. Hammond Reef Gold Project Comprehensive Study Report. Available from: https://iaac-aeic.gc.ca/050/evaluations/document/124396.

CEAA. 2019. Goliath Gold Project Environmental Assessment Report. Available from: https://iaac-aeic.gc.ca/050/evaluations/document/132189.

CIHI (Canadian Institute for Health Information). 2018. In Pursuit of Health Equity: Defining Stratifiers for Measuring Health Inequality. A Focus on Age, Sex, Gender, Income, Education and Geographic Location. Ottawa, ON: CIHI. Available from: https://www.cihi.ca/sites/default/files/document/defining-stratifiers-measuring-health-inequalities-2018-en-web.pdf.

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC). 2025a. Wabigoon Lake Ojibway Nation - First Nation Profiles. Available from: https://fnp-ppn.aadnc-aandc.gc.ca/fnp/main/search/FNMain.aspx?BAND_NUMBER=157&lang=eng

CIRNAC. 2025b. Eagle Lake - First Nation Profiles. Available from: https://fnp-ppn.aadnc-aandc.gc.ca/fnp/main/search/FNMain.aspx?BAND_NUMBER=148&lang=eng

CIRNAC. 2025c. Lac Seul - First Nation Profiles. Available from: https://fnp-ppn.aadnc-aandc.gc.ca/fnp/Main/Search/FNMain.aspx?BAND_NUMBER=205&lang=eng

CIRNAC. 2025d. Wabauskang - First Nation Profiles. Available from: https://fnp-ppn.aadnc-aandc.gc.ca/fnp/main/search/FNMain.aspx?BAND_NUMBER=156&lang=eng

CIRNAC. 2025e. Grassy Narows - First Nation Profiles. Available from: https://fnp-ppn.aadnc-aandc.gc.ca/fnp/main/search/FNMain.aspx?BAND_NUMBER=156&lang=eng

CIRNAC. 2025f. Naotkamegwanning – First Nation Detail. Available from: https://fnp-ppn.aadnc-aandc.gc.ca/fnp/Main/Search/FNMain.aspx?BAND_NUMBER=158&lang=eng

CIRNAC. 2025g. 189 – First Nation Profiles. Available from: https://fnp-ppn.aadnc-aandc.gc.ca/fnp/main/search/FNMain.aspx?BAND_NUMBER=189&lang=eng

CIRNAC. 2025h. Ojibway Nation of Saugeen - First Nation Profiles. Available from: https://fnp-ppn.aadnc-aandc.gc.ca/fnp/Main/Search/FNMain.aspx?BAND_NUMBER=258&lang=eng

CIRNAC. 2025i. Siene River – First Nation Profiles. Available from: https://fnp-ppn.aadnc-aandc.gc.ca/fnp/Main/Search/FNMain.aspx?BAND_NUMBER=132&lang=eng

CMHA (Canadian Mental Health Association). 2023. Available from: https://fortfrances.cmha.ca [Accessed June 27, 2023].

CNSC (Canadian Nuclear Safety Commission). 2011. Radon and Health. CNSC Report no. INFO-0813. February 2011. Available from: https://api.cnsc-ccsn.gc.ca/dms/digital-medias/February-2011-Info-0813-Radon-and-Health-INFO-0813_e.pdf/object?subscription-key=3ff0910c6c54489abc34bc5b7d773be0.

CNSC. 2020. Fact Sheet: Natural Background Radiation. Available from: https://api.cnsc-ccsn.gc.ca/dms/digital-medias/Fact-Sheet-Background-Radiation-eng.pdf/object.

CNSC. 2022. REGDOC-3.6, Glossary of CNSC Terminology.

CNSC. REGDOC-1.2.1, Guidance on Deep Geological Repository Site Characterization. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc1-2-1/

CNSC. REGDOC-1.2.3, Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc1-2-3/

CNSC. REGDOC-2.1.1, Management System. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/history/regdoc2-1-1/

CNSC. REGDOC-2.1.2, Safety Culture. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-1-2/

CNSC. REGDOC-2.10.1, Nuclear Emergency Preparedness and Response, Version 2. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-10-1v2/

CNSC. REGDOC-2.11, Framework for Radioactive Waste Management and Decommissioning in Canada. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-11-v2/

CNSC. REGDOC-2.11.1, Waste Management, Volume III: Assessing the Long-Term Safety of Radioactive Waste Management. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-11-1-vol3-ver2/

CNSC. REGDOC-2.11.1, Waste Management, Volume 1: Management of Radioactive Waste. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-11-1-vol1/

CNSC. REGDOC-2.11.2, Decommissioning. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-11-2/

CNSC. REGDOC-2.12.2, Site Access Security Clearance. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-12-2/

CNSC. REGDOC-2.12.3, Security of Nuclear Substances: Sealed Sources and Category I, II or III Nuclear Material, Version 2. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-12-3-v2-1/

CNSC. REGDOC-2.13.1, Safeguards and Nuclear Material Accountancy. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-13-1/

CNSC. REGDOC-2.2.4, Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical and Psychological Fitness. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-2-4-v3/

CNSC. REGDOC-2.3.1, Conduct of Licences Activities: Construction and Commissioning Programs. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-3-1/

CNSC. REGDOC-2.4.3, Nuclear Criticality Safety. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-4-3-v1-1/

CNSC. REGDOC-2.4.4, Safety Analysis for Class IB Nuclear Facilities. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-4-4/

CNSC. REGDOC-2.5.1, General Design Considerations: Human Factors. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-5-1/

CNSC. REGDOC-2.5.4, Design of Uranium Mines and Mills: Ventilation Systems. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-5-4-v1-1/

CNSC. REGDOC-2.7.1, Radiation Protection. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-7-1v1-1/

CNSC. REGDOC-2.8.1, Conventional Health and Safety. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-8-1/

CNSC. REGDOC-2.9.1, Environmental Protection: Environmental Principles, Assessments and Protection Measures. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-9-1-vol1-2/

CNSC. REGDOC-2.9.2, Environmental Protection: Controlling Releases to the Environment. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-9-2/

CNSC. REGDOC-3.1.2, Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc3-1-2-v1-1/

CNSC. REGDOC-3.2.1: Public Information and Disclosure. 2018. Available from: Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/history/regdoc3-2-1/.

CNSC. REGDOC-3.2.2: Indigenous Engagement. 2022. Available from : Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/history/regdoc3-2-2/.

CNSC. REGDOC-3.3.1, Financial Guarantees for the Decommissioning of Nuclear Facilities and Termination of Licences Activities. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc3-3-1/

CNSC. REGDOC-3.5.3, Regulatory Fundamentals. Available from: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc3-5-3-v3/

Cancer Care Ontario. 2021. Ontario Cancer Profiles: Cancer Prevalence. Retrieved from: https://profiles.cancercare.on.ca/prevalence/atlas.html [Accessed January 10, 2024].

Centers for Disease Control and Prevention (CDC). 2019. Tickborne Diseases of the United States. Available from: https://www.cdc.gov/ticks/about/?CDC_AAref_Val=https://www.cdc.gov/ticks/diseases/index.html.

Chan L, Receuver o, Batal M, David W, Schwartz H, Ing A, et al. 2014. First Nations Food, Nutrition and Environment Study (FNFES) Results from Ontario (2011/2012). University of Ottawa, print. Ottawa, Canada.

City of Dryden. 2024. Seniors Services. Available from: https://www.dryden.ca/en/community/seniors-services.aspx [Accessed August 2, 2024].

CLDSL (Community Living Dryden-Sioux Lookout). 2021. Annual Report Fiscal Year 2021-2022. Available from: https://www.cldsl.ca/wp-content/uploads/2023/02/2022-Annual-Report.pdf [Accessed September 12, 2023].

CLDSL. 2022. Annual Report Fiscal Year 2021-2022. Available from: https://www.cldsl.ca/wp-content/uploads/2023/02/2022-Annual-Report.pdf [Accessed September 12, 2023].

COSEWIC. 2012. COSEWIC Assessment and Status Report on the American Eel Anguilla rostrata in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Canada. Available from: https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/american-eel-2012.html#_docInfo.

Canadian Standards Association Group (CSA). N291:19. Requirements for nuclear safety-related structures. Canadian Standards Association, 2019. Reaffirmed 2024.

CSA N286:12. Management system requirements for nuclear facilities. Canadian Standards Association, 2012. Reaffirmed 2022.

CSA N288 Series. Environmental management of nuclear facilities. Canadian Standards Association

CSA N288.4-10. Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills.

CSA N288.5-11. Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills.

CSA N288.7-15. Groundwater protection programs at Class I nuclear facilities and uranium mines and mills.

CSA N288.8-17. Establishing and implementing action levels for releases to the environment from nuclear facilities.

CSA Z45001. Occupational health and safety management systems — Requirements with guidance for use. Canadian Standards Association.

DesRoches A, Sykes M, Parmenter A, Sykes E. 2018. Lineament Interpretation of the Revell Batholith and surrounding Greenstone Belts. Nuclear Waste Management Organization Report NWMO-TR-2018-19. Toronto, Canada. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/NWMO-TR-2018-19-Lineament-Interpretation-of-the-Revell-2018-12.ashx?sc_lang=en.

DesRoches, A., Waffle, L., and A. Parmenter. 2021. 3D Site-Scale Geological Model in the Revell Batholith: Model Version 1.0. Nuclear Waste Management Organization Report, NWMO-TR-2021-12. Toronto, Canada.

DesRoches, A., A. Parmenter and S. Markovic. 2023. Phase 2 Initial Borehole Drilling and Testing, Ignace Area WP10 - Geological Integration Report for Borehole IG_BH04. Nuclear Waste Management Organization Report APM-REP-01332-0372. Toronto. Canada.

DFO (Fisheries and Oceans Canada). 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline. Available from: https://publications.gc.ca/collections/Collection/Fs23-270-2004E.pdf.

DFO. 2013. Ontario Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat. Available from: https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/on-eng.html.

DFO. 2019. Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act. Available from: https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40939698.pdf.

DNFC (Dryden Native Friendship Centre). 2023a. Programs. Available from: https://www.dnfconline.org/programs [Accessed on June 4, 2023].

DNFC. 2023b. Catchment Area. Available from: https://www.dnfconline.org/gathering-place [Accessed on June 3, 2023].

DRHC (Dryden Regional Health Centre). 2023. Inpatient Services. https://www.drhc.on.ca/programs-services/inpatient-services/ [Accessed March 10, 2022].

DRHC. 2023a. Physician Opportunities. https://www.drhc.on.ca/careers/physician-recruitment/ [Accessed March 11, 2022].

DRHC. 2023b. Rehabilitation Services. https://www.drhc.on.ca/programs-services/rehabilitation-services/ [Accessed March 11, 2022].

DRHC. 2024. Sexual Assault/Domestic Violence Care and Treatment. https://www.drhc.on.ca/sexual-assault-domestic-violence-care-and-treatment [Accessed October 08, 2024].

EC (Environment Canada). 2014. Bird Conservation Strategy for Bird Conservation Region 12 in Ontario and Manitoba: Boreal Hardwood Transition. Abridged Version. Environment Canada. Available from: https://www.canada.ca/content/dam/eccc/migration/main/mbc-com/5d31bdee-3236-4f5a-8cec-b1347753be9b/bcr-2012_on_final_abridged_june2014.pdf.

ECCC (Environment and Climate Change Canada). 2020a. Amended Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada. Available from: https://publications.gc.ca/site/eng/9.888497/publication.html.

ECCC. 2020b. Canadian Climate Normals & Averages. Environment and Climate Change Canada. [Retrieved August 26, 2024, from https://climate.weather.gc.ca/climate_normals/index_e.html].

ECCC. 2022. Canada's Greenhouse Gas Quantification Assessment of Climate Change. Ottawa: Environment and Climate Change Canada.

ECCC. 2023. Guidelines to Avoid Harm to Migratory Birds. Last modified 2023-07-26. Available from: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html.

ECCC. 2025. Nesting Periods. Available from: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html [Accessed October 2025]

Explorer Solutions. 2022. City of Dryden Community Capacity Study. June 2022.

Firefly. 2022. Firefly Annual Report for 2021-2022.

Firefly. 2023. About us. Available from: https://www.fireflynw.ca/about-us-firefly/ [Accessed June 26, 2023].

FSWS (First Step Women's Shelter). 2023a. Overview. Available from: http://www.fsws.ca/article/aboutfirst-step-womens-shelter-3.asp [Accessed on June 5, 2023].

FSWS. 2023b. Programs. Available from: http://www.fsws.ca/article/programs-4.asp [Accessed on June 5, 2023].

Fraser, D., E. R. Chavez, and J. E. Paloheimo. 1984. Aquatic Feeding by Moose: Selection of Plant Species and Feeding Areas in Relation to Plant Chemical Composition and Characteristics of Lakes. Canadian Journal of Zoology 62:80–87.

GBA Plus Workshop. 2023. Northwestern Ontario (NWO) Baseline Studies GBA Plus Workshop, May 12, 2023.

GBIF (Global Biodiversity Information Facility). 2021. Species Occurrences. Global Biodiversity Information Facility. Available from: https://www.gbif.org [Accessed September 2021].

Golder Associates Ltd. (Golder). 2011. Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel. The Corporation of the Township of Ignace, Ontario. Golder Associates Report 10-1152-0110 (2000); Nuclear Waste Management Organization Report NWMO APM-REP-06143-32404. Mississauga, Canada. Available from: https://www.nwmo.ca/-/media/Reports---Reports/1764_ignace-summaryreport.ashx?sc_lang=en.

Golder. 2013. Phase I Desktop Geoscientific Preliminary Assessment of Potential Suitability for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel. Township of Ignace, Ontario. Golder Associates Report 12-1152-0026 (3000); Nuclear Waste Management Organization Report APM-REP-06144-0011. Mississauga, Ontario. Available from: https://www.nwmo.ca/-/media/Reports---Reports/2214_apmrep061440011_ignace_geoscience_mainreport_we.ashx?sc_lang=en.

Golder. 2018. Phase 2 Initial Borehole Drilling and Testing, Ignace Area. WP02 Data Report – Borehole Drilling and Coring for IG_BH01. Nuclear Waste Management Organization Report APM-REP-01332-0229. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0229-WP02-Data-Report---Borehole-Drilling-and-Coring-for-IG_BH01-2018-11.ashx

Golder. 2020a. Phase 2 Borehole Drilling and Testing, Ignace Area. WP02 Data Report – Borehole Drilling and Coring for IG_BH02. Nuclear Waste Management Organization Report APM-REP-01332-0240. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0240-WP02-Data-Report---Borehole-Drilling-and-Coring-for-IG_BH02-2020-11.ashx

Golder. 2020b. Phase 2 Initial Borehole Drilling and Testing, Ignace Area. WP02 Data Report – Borehole Drilling and Coring for IG_BH03. Nuclear Waste Management Organization Report APM-REP-01332-0241. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0241-WP02-Data-Report---Borehole-Drilling-and-Coring-for-IG_BH03-2020-11.ashx

Golder. 2021. Phase 2 Initial Borehole Drilling and Testing, Ignace Area. WP02 Dat Report – Drilling and Coring for IG_BH04. Nuclear Waste Management Organization Report APM-REP-01332-0242. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0242-PHASE-2-INITIAL-BOREHOLE-DRILLING-AND-TESTING-IGNACE-AREA-WP02-Data-2021-12.ashx?sc_lang=en

Golder. 2022a. Phase 2 Initial Borehole Drilling and Testing, Ignace Area. WP02 Dat Report – Drilling and Coring for IG_BH05. Nuclear Waste Management Organization Report APM-REP-01332-0243. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0243-WP02-Data-Report---Drilling-and-Coring-for-IG_BH05-2022-11.ashx?la=en

Golder. 2022b. Phase 2 Initial Borehole Drilling and Testing, Ignace Area. WP02 Dat Report – Drilling and Coring for IG_BH06. Nuclear Waste Management Organization Report APM-REP-01332-0244. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0244-WP02-Data-Report---Drilling-and-Coring-for-IG_BH06-2022-11.ashx

Government of Canada. Constitution Act*, 1982*. 1982. Section 35, Rights of the Aboriginal Peoples of Canada. https://laws-lois.justice.gc.ca/eng/const/index.html.

Government of Canada. 1985a. Aeronautics Act. RSC 1985, c A-2. Last amended December 18, 2018; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/acts/a-2/index.html.

Government of Canada. 1985b. Canada Labour Code. RSC 1985, c L-2. Last amended June 20, 2025; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/acts/L-2.

Government of Canada. 1985c. Canadian Navigable Waters Act. RSC 1985, c N-22. Last amended November 27, 2024; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/acts/n-22.

Government of Canada. 1985d. Explosives Act. RSC 1985, c E-17. https://laws-lois.justice.gc.ca/eng/acts/E-17.

Government of Canada. 1985e. Fisheries Act. RSC 1985, c F-14. Last amended November 27, 2024; current to September 29, 2025. https://laws.justice.gc.ca/eng/acts/f-14/index.html.

Government of Canada. 1985f. Indian Act. RSC 1985, c I-5. Last amended August 15, 2019; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/acts/i-5.

Government of Canada. 1994. Migratory Birds Convention Act, 1994. SC 1994, c 22. Last amended November 27, 2024; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/acts/m-7.01.

Government of Canada. Nuclear Safety and Control Act. SC 1997, c 9. Last amended January 1, 2017; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/acts/N-28.3.

Government of Canada. 1999. First Nations Land Management Act. SC 1999, c 24. Last amended December 15, 2022; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/acts/f-11.8.

Government of Canada. 2000a. Class I Nuclear Facilities Regulations. SOR/2000-204. Last amended September 22, 2017; current to September 29, 2025. https://laws.justice.gc.ca/eng/regulations/SOR-2000-204/page-1.html.

Government of Canada. 2000b General Nuclear Safety and Control Regulations. SOR/2000-202. Last amended June 12, 2015; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/regulations/sor-2000-202/index.html.

Government of Canada. 2000c. Nuclear Security Regulations. SOR/2000-209. Last amended June 12, 2015; current to September 29, 2025. https://laws.justice.gc.ca/eng/regulations/sor-2000-209/page-1.html.

Government of Canada. 2000d. Radiation Protection Regulations. SOR/2000-203. Last amended January 1, 2021; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/regulations/sor-2000-203/index.html.

Government of Canada. 2002a. Nuclear Fuel Waste Act. SC 2002, c 23. Current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/acts/N-27.7.

Government of Canada. 2002b. Species at Risk Act. SC 2002, c 29. Last amended July 30, 2025; current to September 29, 2025. https://laws.justice.gc.ca/eng/acts/s-15.3.

Government of Canada. 2012a. Canadian Environmental Assessment Act. RSC 2012, c 19, s 52; repealed 2019, c 28, s 9. Last amended August 28, 2019; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/acts/c-15.21.

Government of Canada. 2015a. Packaging and Transport of Nuclear Substances Regulations, 2015. SOR/2015-145. Current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/regulations/SOR-2015-145/index.html.

Government of Canada. 2015b. Causes of Climate Change. Available from: https://www.canada.ca/en/environment-climate-change/services/climate-change/causes.html. [Accessed October 2025].

Government of Canada. 2018. Greenhouse Gas Pollution Pricing Act. SC 2018, c 12, s 186. Last amended June 2, 2025; current to September 29, 2025. https://laws-lois.justice.gc.ca/eng/acts/g-11.55.

Government of Canada. 2019a. Impact Assessment Act. SC 2019, c 28, s 1. Last amended June 2, 2025; current to September 29, 2025. https://www.laws-lois.justice.gc.ca/eng/acts/I-2.75/page-1.html.

Government of Canada. 2019b. Physical Activities and Regulations. SOR/2019-285. Last amended March 27, 2023; current to September 29, 2025. https://laws.justice.gc.ca/eng/regulations/SOR-2019-285/index.html.

Government of Canada. 2020. Strategic Assessment of Climate Change, October 2020. Available from: https://www.canada.ca/en/services/environment/conservation/assessments/strategic-assessments/climate-change.html.

Government of Canada. 2021. Draft Technical Guide Related to the Strategic Assessment of Climate Change. https://www.canada.ca/en/environment-climate-change/corporate/transparency/consultations/draft-technical-guide-strategic-assessment-climate-change.html.

Government of Canada. 2023a. Contact the Non-Insured Health Benefits program. Available from: https://www.sac-isc.gc.ca/eng/1579274812116/1579708265237#on [Accessed October 23, 2023].

Government of Canada. 2023b. Indigenous health care in Canada. Available from: https://www.sac-isc.gc.ca/eng/1626810177053/1626810219482 [Accessed October 6, 2023].

Government of Canada. 2023c. Licensing process. Available from: https://www.cnsc-ccsn.gc.ca/eng/nuclear-substances/licensing-nuclear-substances-and-radiation-devices/licensing-process/#CNSCLicensingandComplianceTools [Accessed September 25, 2025].

Government of Canada. 2024. Cabinet Directive on Regulatory and Permitting Efficiency for Clean Growth Projects. Available from: Cabinet Directive on Regulatory and Permitting Efficiency for Clean Growth Projects – Privy Council Office – Canada.ca.

Government of Canada. 2025. Gender-based Analysis Plus (GBA Plus). https://www.canada.ca/en/women-gender-equality/gender-based-analysis-plus.html. [Accessed September 24, 2025].

Government of Ontario. 1990a. Aggregate Resources Act. RSO 1990, c A8. Last amended 2021; current as of October 21, 2025. https://www.ontario.ca/laws/statute/90a08.

Government of Ontario. 1990b. Environmental Protection Act. RSO 1990, c E19. Last amended 2025; current as of October 21, 2025. https://www.ontario.ca/laws/statute/90e19.

Government of Ontario. 1990c. Heritage Act. RSO 1990, c O18. Last amended 2025; current as of October 21, 2025. https://www.ontario.ca/laws/statute/90o18.

Government of Ontario. 1990d. Lakes and Rivers Improvement Act. RSO 1990, c L3. Last amended 2019; current as of October 21, 2025. https://www.ontario.ca/laws/statute/90l03.

Government of Ontario. 1990e. Mining Act. RSO 1990, c M14. Last amended 2019; current as of October 21, 2025. https://www.ontario.ca/laws/statute/90m14.

Government of Ontario. 1990f. Ontario Water Resources Act. RSO 1990, c O40. Last amended 2021; current as of October 21, 2025. https://www.ontario.ca/laws/statute/90o40.

Government of Ontario. 1990g. Public Lands Act. RSO 1990, c P43. Current as of October 21, 2025. https://www.ontario.ca/laws/statute/90p43.

Government of Ontario. 1990h. Public Transportation and Highway Improvement Act. RSO 1990, c P50. Last amended 2024; current as of October 21, 2025. https://www.ontario.ca/laws/statute/90p50.

Government of Ontario. 1994. Crown Forest Sustainability Act, 1994. SO 1994, c 25. Last amended 2021; current as of October 21, 2025. https://www.ontario.ca/laws/statute/94c25.

Government of Ontario. 1997. Fish and Wildlife Conservation Act, 1997. SO 1997, c 41. Last amended 2023; current as of October 21, 2025. https://www.ontario.ca/laws/statute/97f41.

Government of Ontario. Ontario Energy Board Act, 1998. SO 1998, c 15, Sched. B. Last amended 2017; current as of October 21, 2025. https://www.ontario.ca/laws/statute/98o15/v49.

Government of Ontario. 2007. Endangered Species Act, 2007. SO 2007, c 6. Last amended 2025; current as of October 21, 2025. https://www.ontario.ca/laws/statute/07e06.

Government of Ontario. 2015. Wildlife Management Units. Available from: https://data.ontario.ca/dataset/wildlife-management-units. [Accessed May 15, 2023].

Government of Ontario. 2021. Drinking-Water Systems Regulation O. Reg. 170/03. City of Dryden Water Treatment 2021. Available from: https://www.dryden.ca/media/fi5pxyap/2024-wtp-moe-annual-report-final.pdf [Accessed October 2025].

Government of Ontario. 2021b. Management of Excess Soil - A Guide for Best Management Practices. Available from: https://www.ontario.ca/page/management-excess-soil-guide-best-management-practices [Accessed October 2025].

Government of Ontario. 2022. Management Units and Forest Management Plan Renewal Schedules. Available from: https://www.ontario.ca/page/management-units-and-forest-management-plan-renewal-schedules#foot-** [Accessed February 22, 2023].

Government of Ontario. 2023a. Bait Harvest Area. Available from: https://geohub.lio.gov.on.ca/datasets/lio::bait-harvest-area/explore [Accessed June 13, 2023].

Government of Ontario. 2023b. Bear management area. Available from: https://geohub.lio.gov.on.ca/datasets/lio::bear-management-area/explore?location=49.456120%2C-92.280667%2C9.92 [Accessed June 13, 2023].

Government of Ontario. 2023c. Mining Lands Administration System (MLAS). Available from: https://www.lioapplications.lrc.gov.on.ca/MLAS/Index.html?viewer=MLAS.MLAS&locale=en-CA [Accessed September 21, 2023, and October 11, 2024].

Government of Ontario. 2023d. Recreational Fishing Regulations Summary. Available from: https://wabigoonlakeoutfitters.com/fishing-regulations.pdf

Government of Ontario. 2023e. Trapline Area. Available from: https://geohub.lio.gov.on.ca/datasets/lio::trapline-area/explore?filters=eyJPR0ZfSUQiOls1MDgwNjc3MCwxMzAwODQ2MzM1XX0%3D&location=49.517943%2C-91.604098%2C8.00&showTable=true [Accessed May 15, 2023].

Grand Council Treaty #3. 2011. We Have Kept Our Part of the Treaty: The Anishinaabe Understanding of Treaty #3.

Grasty, R.L. and J.R. LaMarre. 2004. The Annual Effective Dose from Natural Sources of Ionising Radiation in Canada. *Radiation Protection Dosimetry* 108(3), 215-226.

Guertin, N., and Joly, A. 2008. Northern Ontario: An Authentic Heritage. Heritage Matters. Available from: https://www.heritage-matters.ca/articles/northern-ontario-an-authentic-heritage [Accessed April 14, 2023].

HSAL (Hardy Stevenson and Associated Limited), Avaanz Limited and Keir Corp. 2022. Ignace and Area Community Studies: Economics and Finance. Labour Baseline. June 17, 2022.

Health Canada. 2012. Cross Canada Survey of Radon Concentrations in Homes Final Report. Available from: https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/radiation/radon/survey-sondage-eng.pdf.

Health Canada. 2023. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Country Foods. Available from: https://publications.gc.ca/collections/collection_2024/sc-hc/H129-54-5-2023-eng.pdf.

Hoshizaki House. 2023. Overview. Available from: http://www.hoshizakihouse.ca/ [Accessed on June 4, 2023].

Ignace EarlyOn Child and Family Centre Staff and Parent Focus Group. 2023. Northwest Ontario (NWO) Baseline Studies Ignace EarlyOn Child and Family Centre Staff and Parent Focus Group, April 4, 2023.

Impact Assessment Agency of Canada (IAAC). 2022. Operational Policy Statement: Development of Tailored Impact Statement Guidelines. March 30, 2022. Available at: https://www.canada.ca/content/dam/iaac-acei/documents/policy-guidance/operational-policy-statement.pdf

IAAC. 2025. Practitioner's Guide to Federal Impact Assessments. Available from: https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/practitioners-guide-impact-assessment-act.html [Accessed October 2025].

Ignace Health and Wellness Focus Group. 2023. Northwest Ontario (NWO) Baseline Studies Ignace Health and Wellness Focus Group, April 5, 2023.

INAC (Indigenous and Northern Affairs Canada). 2002. Registered Indian Population by Sex and Residence 2001.

INAC. 2007. Registered Indian Population by Sex and Residence 2006.

INAC. 2012. Registered Indian Population by Sex and Residence 2011

INAC. 2018. Registered Indian Population by Sex and Residence 2016.

iPHIS (Integrated Public Health Information System). 2022. Communicable disease data extraction. Analysis by Northwestern Health Unit. [Retrieved May 30, 2022].

ISCIS (Integrated Services for Children Information System). 2022. Maternal health data extraction. Analysis by Northwestern Health Unit. [Retrieved April 21, 2022].

IntelliHealth Ontario. 2023a. Inpatient Discharges Package. Ministry of Health and Long-Term Care. Raw data extract; all analysis by EPI Research Inc. [Retrieved April 19, 2023].

IntelliHealth Ontario. 2023b. Vital Statistics Births Package. Ministry of Health and Long-Term Care. Raw data extract; all analysis by EPI Research Inc. [Retrieved April 10, 2023].

IntelliHealth Ontario. 2023c. Medical Services Package. Ministry of Health and Long-Term Care. Raw data extract; all analysis by EPI Research Inc. [Retrieved March 10, 2023].

IntelliHealth Ontario. 2023d. Ambulatory Visits Package. National Ambulatory Care Reporting System. Ministry of Health and Long-Term Care. Raw data extract; all analysis by EPI Research Inc. [Retrieved April 18, 2023].

IntelliHealth Ontario. 2023e. Vital Statistics Deaths Package. Ministry of Health and Long-Term Care. Raw data extract; all analysis by EPI Research Inc. [Retrieved April 28, 2023].

InterGroup (InterGroup Consultants). 2020. Ignace Project Visioning Community Conversations. Prepared for the Nuclear Waste Management Organization. Prepared by InterGroup Consultants.

InterGroup. 2024. Nuclear Waste Management Organization. 2024. Social, Cultural, Economic, and Health Baseline Studies: Preliminary Report for Engagement. Wabigoon Lake Ojibway Nation – Ignace Area. APM-REP-06300-0264.

ISO (International Standards Organization. 2015. ISO 9001: 2015, Quality Management Systems — Requirements. https://www.iso.org/standard/62085.html.

IAEA (International Atomic Energy Agency). 1970. Treaty on the Non-Proliferation of Nuclear Weapons (NPT). IAEA Information Circular No. INFCIRC/140. Vienna, Austria.

IAEA. 1972. Agreement Between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons. IAEA Information Circular No. INFCIRC/164. Vienna, Austria.

IAEA. 2000. Protocol Additional to the Agreement Between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-proliferation of Nuclear Weapons. IAEA Information Circular No. INFCIRC/164/Add. 1. Vienna, Austria.

IAEA. 2011. Disposal of Radioactive Waste. IAEA Safety Standards Series No. SSR-5. Vienna, Austria.

IAEA. 2012. The Safety Case and Safety Assessment for the Disposal of Radioactive Waste. IAEA Safety Standards and Series No. SSG-23. Vienna, Austria.

IAEA. 2013. Hot Cell Post-irradiation Examination and Poolside Inspection of Nuclear Fuel. IAEA-TECDOC-CD-1693. Vienna: International Atomic Energy Agency. www.iaea.org.

International Commission on Radiological Protection (ICRP). 2007. ICRP 103: The 2007 Recommendations of the International Commission on Radiological Protection.

IPCC (Intergovernmental Panel on Climate Change). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Hayama, Japan: Institute for Global Environmental Strategies, 2006.

ISC (Indigenous Services Canada). 2021. Registered Indian Population by Sex and Residence 2020.

ISC. 2022. Registered Indian Population by Sex and Residence 2021.

ISC. 2023. Community Well-Being Index Scores. Updated May 9, 2023. Available from: https://open.canada.ca/data/en/dataset/56578f58-a775-44ea-9cc5-9bf7c78410e6 [Accessed July 20, 2023].

Joint Review Panel for Deep Geologic Repository for Low and Intermediate Level Radioactive Waste Project. 2015. *Environmental Assessment Report: Deep Geologic Repository for Low and Intermediate Level Radioactive Waste Project*. CEAA Reference No. 17520. Retrieved from https://iaac-aeic.gc.ca/050/documents/p17520/101595E.pdf [accessed 21 January 2025].

Joint Review Panel for the Atomic Energy of Canada's Nuclear Fuel Waste Management and Disposal Concept. 1998. *Environmental Assessment Report for the Atomic Energy of Canada's Nuclear Fuel Waste Management and Disposal Concept*. Canadian Environmental Assessment Agency. Retrieved from https://iaac-aeic.gc.ca/archives/evaluations/431C8844-1/default_lang=En_n=0B83BD43-1.html [accessed 21 January 2025].Kenora District Services Board (KDSB). 2022b. 2022-2026 Strategic Plan. Available from: https://kdsb.on.ca/wp-content/uploads/2022/09/KDSB-2022-2026-Strategic-Plan-FINAL-APPROVED.pdf [Accessed September 12, 2023].

Kenora District Services Board (KDSB). 2023. Childcare Services. Available from: https://kdsb.on.ca/our-services/early-years-services/[Accessed on June 1, 2023].

Kenora District Services Board (KDSB). 2023f. Emergency Medical Services. Available from: https://kdsb.on.ca/our-services/emergency-medical-services/ [Accessed June 12, 2023].

Kenora-Rainy River Districts Child and Family Services. Overview. Available from: https://www.krrcfs.ca/ [Accessed on June 3, 2023].

Kuzyk, G., I. Hatter, S. Marshall, C. Procter, B. Cadsand, D. Lirette, H. Schindler, M. Bridger, P. Stent, A. Walker, and M. Klaczek. 2018. Moose Population Dynamics During 20 Years of Declining Harvest in British Columbia. *Alces* 54:101-119.

Local Social, Cultural and Health Workshop. 2021. Northwest Ontario (NWO) Baseline Studies Local Social, Cultural and Health Workshop, September 15, 2021.

Mainville, S. J. 2007. Manidoo Mazina'igan: An Anishinaabe Perspective of Treaty 3.

Manifold Data Mining (Manifold). 2023. Retrieved May 30, 2023. Household Spending Patterns. Available from: https://manifolddatamining.com/data/spending-data/ [Accessed June 15, 2023].

Markovic, S. and A. DesRoches. 2024. Phase 2 Initial Borehole Drilling and Testing, Ignace Area WP10 - Geological Integration Report for Borehole IG_BH05. Nuclear Waste Management Organization Report APM-REP-01332-0397. Toronto, Canada.

Markovic, S., A. DesRoches and L. Debono. 2024. Phase 2 Initial Borehole Drilling and Testing, Ignace Area WP10 - Geological Integration Report for Borehole IG_BH06. Nuclear Waste Management Organization Report APM-REP-01332-0399. Toronto, Canada.

Mary Berglund Community Health Centre Hub (MBCHCH). 2023. Internal Reports.

MDB Insight. 2019. City of Dryden 2020-2025 Community Strategic Plan. Prepared for the City of Dryden. Prepared by MDB Insight.

Métis Nation of Ontario (MNO). 2022. Métis Nation of Ontario Annual Report 2021-2022. Available from: https://www.metisnation.org/wp-content/uploads/2022/08/MNO-Annual-Report-2022a.pdf [Accessed September 12, 2023].

MHBC Planning. 2013. Community Improvement Plan. Prepared for the Municipality of Sioux Lookout. Prepared by MHBC Planning.

Minigan, J. N., H. A. Hager, A. S. Peregrine, and J. A. Newman. 2018. Current and Potential Future Distribution of the American Dog Tick (Dermacentor variabilis, Say) in North America. *Ticks and Tickborne Diseases* 9:354–362.

Minister of Environment. Information and Management of Time Limits Regulations (SOR/2019-283). Available from: https://laws.justice.gc.ca/eng/regulations/SOR-2019-283/FullText.html#:~:text=PDF%20Full%20Document:%20Information%20and%20Management.

Ministry of Environment and Energy (MOEE). 1994. Provincial Water Quality Objectives. Available from: https://www.ontario.ca/page/water-management-policies-guidelines-provincial-water-quality-objectives#section-2

Ministry of Environment (MOE). 1978. Model Municipal Noise Control By-Law - Final Report. August 1978. Ontario Ministry of the Environment.

Ministry of Natural Resource and Forestry (MNRF). 2018. Aquatic Resource Area Polygon Segment. Available from: https://geohub.lio.gov.on.ca/datasets/aquatic-resource-area-polygon-segment-/explore. Last updated June 20, 2023.

Ministry of Natural Resources and Forestry (MNRF). 2014. Survey Protocol for Eastern Whip-poor-will (Caprimulgus vociferus) in Ontario (DRAFT). Ontario Ministry of Natural Resources and Forestry Peterborough, Canada.

Ministry of Natural Resources and Forestry (MNRF). 2017. Significant Wildlife Habitat Criteria Schedules for Ecoregion 3W.

MNP. 2021. City of Dryden, Machin and Area Community Safety and Well-Being Plan.

Municipality of Sioux Lookout 2023f. Community Centres. Available from: https://www.siouxlookout.ca/en/explore-the-hub/community-centres.aspx [Accessed September 8, 2023].

Municipality of Sioux Lookout. 2020b. The Municipality of Sioux Lookout Community Safety and Well-Being Plan 2021-2025.

Municipality of Sioux Lookout. 2021. The Municipality of Sioux Lookout 2021 Community Profile.

Municipality of Sioux Lookout. 2022a. Fire and Emergency Services. Available from: https://www.siouxlookout.ca/en/our-community/fire-and-emergency-services.aspx [Accessed on: June 22, 2023].

Nanometrics. 2022. Ignace Area Microseismic Monitoring Project Annual Event Summary Report (November 2020 – December 2021). Nuclear Waste Management Organization Report APM-REP-01332-0340. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0244-WP02-Data-Report---Drilling-and-Coring-for-IG_BH06-2022-11.ashx

Nanometrics. 2023. Revell Site Microseismic Monitoring Project Annual Event Summary Report (January 1, 2022 - December 31, 2022). Nuclear Waste Management Organization Report, APM-REP-01332-0422. Toronto, Canada.

National Inquiry into Missing and Murdered Indigenous Women and Girls. 2019. Reclaiming Power and Place: The Final Report of the National Inquiry into Missing and Murdered Indigenous Women and Girls, Vol. Available from: https://www.mmiwg-ffada.ca/wp-content/uploads/2019/06/Calls_for_Justice.pdf.

National Research Council of Canada. National Building Code of Canada 2020. Available from: https://nrc.canada.ca/en/certifications-evaluations-standards/codes-canada/codes-canada-publications/national-building-code-canada-2020.

National Research Council of Canada. National Fire Code of Canada 2020. Available from: https://nrc.canada.ca/en/certifications-evaluations-standards/codes-canada/codes-canada-publications/national-fire-code-canada-2020.

Natural Resources Canada (NRCan). 2024. *Federal oversight: Nuclear Fuel Waste Act.* 2024. Available from: https://natural-resources.canada.ca/our-natural-resources/energy-sources-distribution/nuclear-energy-uranium/radioactive-waste/federal-oversight/7745.

Naylor, S., A. Wickert, D. Edmonds and B. Yanites. 2021. Landscape Evolution Under the Laurentide Icesheet. *Science Advances* 7(48).

MNDMNRF (Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry). 2021a. Ontario's Strategy to Address the Threat of Invasive Wild Pigs. Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry. Available from: https://files.ontario.ca/ndmnrf-wild-pig-management-plan-2021-en-v1-2021-10-19.pdf.

MNDMNRF. 2021b. Annual Report on Invasive Wild Pig Sightings: 2020-2021. Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry. Available from: https://files.ontario.ca/ndmnrf-annual-report-invasive-wild-pig-sightings-2020-2021-en-v1-2021-10-19.pdf.

MNDMNRF. 2021c. Forest Health Conditions in Ontario 2020. Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry. Available from: https://files.ontario.ca/ndmnrf-forest-health-conditions-2020-en-2021-07-30.pdf.

Nelder, M. P., C. B. Russell, S. Johnson, Y. Li, K. Cronin, T. Cawston, and S. N. Patel. 2022. American Dog Ticks Along their Expanding Range Edge in Ontario, Canada. Scientific Reports 12:1–9.

Nishnawbe-Gamik Native Friendship Centre. 2023a. Programs. Available from: http://ngfc.net/programs.html [Accessed on June 5, 2023].

Nishnawbe-Gamik Native Friendship Centre. 2023b. Services. Available from: http://ngfc.net/index-2.html [Accessed on June 5, 2023].

Northern Waterworks. 2022. Sioux Lookout Urban Drinking Water System 2022 Annual Report.

Northwest Behavioural Supports Ontario.2024. Seniors Centre. Available from: https://northwest.behaviouralsupportsontario.ca/Services/Display/140664/Seniors_Centre. [Accessed September 19, 2024].

NorthWest Healthline. 2022. Municipal Office-Public Works. Available from: https://www.northwesthealthline.ca/displayService.aspx?id=171794 [Accessed June 13, 2023].

Northwest Ontario Métis Child and Family Services (NWOMCFS). 2023. Our Vision & Mission. Available from: https://www.nwomcfs.ca/vision-and-mission/ [Accessed September 11, 2023].

Northwestern Health Unit (NWHU). 2023a. About Us. Retrieved from: https://www.nwhu.on.ca/about-us/ [Accessed October 23, 2023].

Northwestern Ontario (NWO) Baseline Studies Key Person Interview Program. 2022-2023.

Northwestern Ontario (NWO) Baseline Studies Key Person Interview Program. 2022-2023.

Northwestern Ontario (NWO) Community and Baseline Studies Key Person Interview Program. 2022.

Nuclear Waste Management Organization (NWMO) and the Corporation of the Township of Ignace (Ignace). 2024. Hosting Agreement. March 18, 2024.

NWMO (Nuclear Waste Management Organization). 2005. Choosing a Way Forward – The Future Management of Canada's Used Nuclear Fuel (Final Study). Nuclear Waste Management Organization Report, APM-REF-00680-23833. Toronto, Canada. Available from: https://www.nwmo.ca/-/media/Reports---Reports/APM-REF-00680-23833-Choosing-a-Way-Forward---Final-Study-11-2005.ashx?rev=43b78ba1aff94da493e2f85a329072be&sc_lang=en&hash=79B894B9D9EDB95D36C7E57E8555A9FC#:~:text=The%20NWMO%20is%20recommending%20that%20Canada%20proceed%20in,would%20be%20monitored%20and%20remain%20retrievable%20over%20time.

NWMO. 2010. Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Corporate-reports/2010-Moving-Forward-Together_Process-for-Selecting-a-Site.ashx?sc_lang=en.

NWMO. 2011. Moving Forward Together - Triennial Report 2008 to 2010. Nuclear Waste Management Organization document, NWMO-REP-08551-25952. March 2011. Available from: https://www.nwmo.ca/-/media/Reports---Reports/1721_triennialreport2008to2010.ashx?sc_lang=en. Toronto, Canada.

NWMO. 2014. Learning More Together - Triennial Report 2011 to 2013. Nuclear Waste Management Organization document, NWMO-REP-08551-36581. March 2014. Available from: https://www.nwmo.ca/-/media/Reports---Reports/2345_learning_more_together_-_triennial_report_2011_to_.ashx?sc_lang=en. Toronto, Canada.

NWMO. 2017a. Progress Through Collaboration Triennial Report 2014 to 2016. Nuclear Waste Management Organization document, NWMO-REP-08551-43587. March 2017. Available from: https://www.nwmo.ca/-/media/Reports---Reports/TR2016_EN_web.ashx?sc_lang=en. Toronto, Canada.

NWMO. 2017b. Triennial Report, Engagement Activities, 2014 to 2016. Nuclear Waste Management Organization document, NWMO-REP-08551-58665. March 2017. Available from: https://www.nwmo.ca/-/media/Reports---Reports/TR-Engagement-Appendix_EN.ashx?sc_lang=en. Toronto, Canada.

NWMO. 2020a. People, Science, Indigenous Knowledge, Moving Towards Partnership Triennial Report 2017 to 2019. Nuclear Waste Management Organization document, NWMO-REP-08551-58663. March 2020. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Corporate-reports/Annual-and-triennial-reports/NWMO-Triennial-report-2017-to-2019.ashx?sc_lang=en Toronto, Canada.

NWMO. 2020b. Triennial Report Community Engagement Activities 2017 to 2019. Nuclear Waste Management Organization document, NWMO-REP-08551-58666. March 2020. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Social-reports/Triennial-report--Community-engagement-activities-2017-to-2019.ashx?sc_lang=en. Toronto, Canada.

NWMO. 2022. 2021 Annual Evaluation Report - Executive Summary. February 2022. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Reconciliation/2021-Annual-Evaluation-Report---Executive-Summary--02-2022.ashx?rev=3933ebac5a374163888929f6d442231b&hash=43A8EDAD91D19DF98F7E9AEB009DDBB6.

NWMO. 2023. Confidence in Safety – Revell Site – 2023 Update. Nuclear Waste Management Organization document, NWMO-TR-2023-07. Toronto, Canada.

NWMO. 2023a. Guided By science. Grounded in Knowledge. Committed to Partnership. Triennial Report 2022-22. Nuclear Waste Management Organization document, NWMO-REP-08551-54258. March 2023. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Corporate-reports/Annual-and-triennial-reports/NWMO-REP-08551-54258-Guided-by-science-Grounded-in-Knowledge-Committed-to-partnership-2023-03.ashx?sc_lang=en. Toronto, Canada.

NWMO. 2023b. Triennial Report: Community Engagement Activities 2020-22. Nuclear Waste Management Organization document, NWMO-REP-08551-55942. March 2023. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Social-reports/Triennial-Report_Community-Engagement-Activities-2020-22.ashx?sc_lang=en. Toronto, Canada.

NWMO. 2023c. Water Statement. Toronto, Canada. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Policy-documents/2023-10-Water-Statement.ashx?sc_lang=en&rev=9fe360fdc5274f948fefefb2f40053bb&hash=1A1F3E80991F61EE205735710DA48F60.

NWMO. 2024. Reconciliation. Available from: https://www.nwmo.ca/Reconciliation.

NWMO. 2024a. Advisory Council Overview. Available from: https://www.nwmo.ca/who-we-are/how-were-governed/advisory-council. Nuclear Waste Management Organization. Activities in the Wabigoon Lake Ojibway Nation-Ignace Area. [Accessed on October 11, 2024]. Available from: https://www.nwmo.ca/Site-selection/Wabigoon-Lake-Ojibway-Nation-Ignace-area/Activities-in-the-Wabigoon-Lake-Ojibway-Nation-Ignace-area.

NWMO. 2024b. Nuclear Fuel Waste Projections in Canada – 2024 Update. Nuclear Waste Management Organization Report, NWMO-TR-2024-09. Toronto, Canada. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/NWMO-TR-2024-09-Nuclear-Fuel-Waste-Projections-in-Canada---2024-Update.ashx?rev=d99d89329cea4c9c98d59884d9b35f36&sc_lang=en

NWMO. Indigenous Knowledge Policy. 2016. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Policy-documents/2020-07-Indigenous-Knowledge-Policy.ashx?sc_lang=en&rev=c23bb3d7bd5f4794b326cc75de6e5b38&hash=88163B1F344EAE8FEA2A56733FD6D331

NWMO. Reconciliation Policy. 2019. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Policy-documents/2019-10-Reconciliation-Policy.ashx?rev=d8a14587ef904a818aad7d3e2a2d6d11&sc_lang=en&hash=80B7C0B8CB8662EA18592727258BB77C.

NWOSTA (North-West Ontario Snowmobile Trail Association). 2023. About Us. Available from: http://nwosta.ca/about/ [Accessed May 15, 2023].

Ontario Ministry of the Environment, Conservation and Parks (MECP). 2023. Guide to eating Ontario Fish. Available from: https://www.ontario.ca/page/guide-eating-ontario-fish#section-1.

Ontario Provincial Police (OPP). 2022a. 2020-2022 Action Plan OPP Dryden Detachment Report.

Ontario Provincial Police (OPP). 2022b. 2020-2022 Action Plan OPP Sioux Lookout Detachment Report.

Paawidigong First Nations Forum (PFNF). 2022a. Community Health & Home and Community Care Nurse. https://www.pfnf.ca/programs-and-services/community-health-home-and-community-care-nurse/ [Accessed March 10, 2022].

Paawidigong First Nations Forum. 2022b. Mental Health and Addictions. https://www.pfnf.ca/programs-and-services/mental-health-and-addictions/ [Accessed March 10, 2022].

Park, Y-J., E.A. Sudicky and J.F. Sykes. 2009. Effects of shield brine on the safe disposal of waste in deep geologic environments. *Advances in Water Resources 32*, 1352–1358.

Parmenter, A., L. Waffle and A. DesRoches. 2020. Bedrock Geology of the Revell Batholith and Surrounding Greenstone Belts. Nuclear Waste Management Organization Report NWMO-TR-2020-08. Toronto, Canada.

Parmenter, A., A. DesRoches, L. Waffle and Golder Associates Ltd. 2022a. Phase 2 Initial Borehole Drilling and Testing, Ignace Area WP10 - Geological Integration Report for Borehole IG_BH01. Nuclear Waste Management Organization Report APM-REP-01332-0260. Toronto.

Parmenter, A., A. DesRoches and L. Waffle. 2022b. Phase 2 Initial Borehole Drilling and Testing, Ignace Area WP10 - Geological Integration Report for Borehole IG_BH02. Nuclear Waste Management Organization Report APM-REP-01332-0266. Toronto, Canada.

Parmenter, A., A. DesRoches and L. Waffle. 2022c. Phase 2 Initial Borehole Drilling and Testing, Ignace Area WP10 - Geological Integration Report for Borehole IG_BH03. Nuclear Waste Management Organization Report APM-REP-01332-0266. Toronto, Canada.

Percival, J.A. and R.M. Easton. 2007. Geology of the Canadian Shield in Ontario: AN Update. Ontario Geological Survey Report Open File Report 6916. Ontario, Canada.

Pinchin 2021. Draft Design and Operations Plan, Ignace Waste Disposal Site.

Price, W.A. Mend Report 1.20.1: Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. CANMET – Mining and Mineral Sciences Laboratories, Natural Resources Canada. Smithers, British Columbia. Available from: https://mend-nedem.org/wp-content/uploads/1.20.1_PredictionManual.pdf.

PSD. 2016. The 2016 Asset Management Plan for the City of Dryden.

PSD. 2020. Township of Ignace Asset Management Plan. Available from: https://www.ignace.ca/images/Asset_Management_Plan_-_May_2020.pdf

PHAC (Public Health Agency of Canada). 2018. Pan-Canadian Health Inequalities Reporting Initiative. Key Health Inequalities in Canada: A National Portrait. Ottawa. Retrieved from: https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/science-research/key-health-inequalities-canada-national-portrait-executive-summary/key_health_inequalities_full_report-eng.pdf [Accessed November 15, 2022].

PHAC. 2022a. Mental health inequalities by income in Canada. Pan-Canadian Health Inequalities Reporting Initiative. Government of Canada. Retrieved from: https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/science-

research-data/health-inequalities-inforgraphics/mental-health-inequalities-by-income-en.pdf [Accessed May 5, 2023].

PHAC. 2022b. Inequalities in Health of Racialized Adults in Canada. Infographic. Available from: https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/science-research-data/health-inequalities-inforgraphics/health-inequalities-racialized-adults-en.pdf

Public Health Ontario. 2019a. Injuries Related to Self-Harm among Youth Emergency Department Visits Health Equity Snapshot [interactive data table]. Retrieved from: https://www.publichealthontario.ca/en/Data-and-Analysis/Health-Equity/Youth-Self-Harm [Accessed May 4, 2023].

Public Health Ontario. 2023m. Chronic Disease Incidence and Prevalence Snapshot. [interactive data table] Retrieved from: https://www.publichealthontario.ca/en/Data-and-Analysis/Chronic-Disease/Chronic-Disease-Incidence-Prevalence.

Public Health Ontario. 2023p. Chronic Disease Hospitalization Snapshot [updated interactive data table]. Retrieved from: https://www.publichealthontario.ca/en/Data-and-Analysis/Chronic-Disease/Chronic-Disease-Hospitalization [Accessed January 10, 2024].

Ranta, B., and M. Lankester. 2017. Moose and Deer Population Trends in Northwestern Ontario: A Case History. Alces 53:159–179.

Rea, R. V, D. P. Hodder, and K. N. Child. 2004. Considerations for Natural Mineral Licks Used By Moose in Land Use Planning and Development. Alces 40:161–167.

Reily, T. 2024b. Nuclear Fuel Waste Projections in Canada – 2024 Update. Nuclear Waste Management Organization document, NWMO-TR-2024-09. November 2024. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/NWMO-TR-2024-09-Nuclear-Fuel-Waste-Projections-in-Canada---2024-Update.ashx?sc_lang=en.

Robin, C.M.I., M. Craymer, R. Ferland, T.S. James, E. Lapelle, M. Piraszewski and Y. Zhao. 2020. NAD83v70VG: *A New National Crustal Velocity Model for Canada*. Geomatics Canada Open File 0062.

Sander Geophysics Limited (SGL). 2020. 3D Geophysical Forward and Inversion Modelling of the Revell Batholith and Surrounding Greenstone Belt. Nuclear Waste Management Organization Report APM-REP-01332-0270. Toronto, Canada. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0270-3D-Geophysical-Forward-and-Inversion-Modelling-of-the-2020-10.ashx?sc_lang=en.

Sander Geophysics Ltd. (SGL). 2015. Phase 2 Geoscientific Preliminary Assessment, Acquisition, Processing and Interpretation of High-Resolution Airborne Geophysical Data, Township of Ignace, Ontario. Nuclear Waste Management Organization Report. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-06145-0002-Phase-2-Geoscientific-Preliminary-Assessment-Acquisition-Processing---Ignace-2015.ashx?sc_lang=en.

Savolainen, P. 2019. Spent Nuclear Fuel Characterisation in Finland. Posiva presentation at IAEA Technical Meeting, Vienna. Available from: https://nucleus.iaea.org/sites/connect/SFMpublic/TM%20on%20Spent%20Fuel%20Characterization%20for%20the%20Manageme/Salvolainen_Posiva.pdf

Sella G., S. Stein, T. Dixon, M. Craymer, T. James, S. Mazzotti and R. Dokka. 2007. Observation of Glacial Isostatic Adjustment in "Stable" North America with GPS. *Geophysical Research Letters* 34(2).

SGL (Sander Geophysics Ltd.). 2015. Phase 2 Geoscientific Preliminary Assessment, Acquisition, Processing and Interpretation of High-Resolution Airborne Geophysical Data, Township of Ignace, Ontario. Nuclear Waste Management Organization Report APM-REP-06145-0002. Toronto, Canada.

SGL. 2020. 3D Geophysical Forward and Inversion Modelling of the Revell Batholith and Surrounding Greenstone Belt. Sander Geophysics Limited. Nuclear Waste Management Organization Report, APM-REP-01332-0270. Toronto, Canada.

Sioux Lookout First Nations Health Authority. 2023a. Client Services. Available from: https://www.slfnha.com/client-services/ [Accessed on June 5, 2023].

Sioux Lookout First Nations Health Authority. 2023b. Health Services. Available from: https://www.slfnha.com/health-services/ [Accessed on June 4, 2023].

Sioux Lookout Meno Ya Win Health Centre. 2023c. Mental Health and Addictions Counselling. Available from: https://slmhc.on.ca/departments-and-services/mental-health-and-addictions-counselling/ [Accessed on June 5, 2023].

Sioux Lookout Meno Ya Win Health Centre. 2023d. Mental Health Services. Available from: https://slmhc.on.ca/departments-and-services/mental-health-and-addictions-counselling/ [Accessed on June 5, 2023].

Snowdon, A., S. Normani and J. Sykes. 2021. Analysis of Crystalline Rock Permeability Versus Depth in a Canadian Precambrian Rock Setting. *Journal of Geophysical Research: Solid Earth* 126(5).

SRK Consulting Inc. (SRK) and Golder Associates Ltd. (Golder). 2015. Phase 2 Geoscientific Preliminary Assessment, Observation of General Geological Features, Township of Ignace, Ontario. Nuclear Waste Management Organization Report APM-REP-06145-0004. Toronto, Canada. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-06145-0004-Phase-2-Geoscientific-Preliminary-Assessment-Observation-of-General-Ignace-2015-2.ashx?sc_lang=en.

Statistics Canada. 1992. 1991 Census. Statistics Canada Catalogue Number 95F0168X. Ottawa. Release date September 15, 1992.

Statistics Canada. 1998. 1996 Electronic Area Profiles. 1996 Census. Statistics Canada Catalogue no. 95F0181XDB96001. Ottawa. Release date October 29, 1998.

Statistics Canada. 2002. 2001 Community Profiles. 2001 Census. Statistics Canada Catalogue no. 93F0053XIE. Ottawa. Release date June 27, 2002.

Statistics Canada. 2007. 2006 Community Profiles. 2006 Census. Statistics Canada Catalogue no. 92-591-XWE. Ottawa. Released March 13, 2007.

Statistics Canada. 2012. Census Profile. 2011 National Household Survey (NHS). Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Release date June 27, 2012.

Statistics Canada. 2013. National Household Survey Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released June 26, 2013.

Statistics Canada. 2017. Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Release date November 29, 2017.

Statistics Canada. 2022a. Census Profile. 2021 Census. Statistics Canada Catalogue no. 98-316-X2021001. Ottawa. Released November 30, 2022.

Statistics Canada. 2022b. Table 13-10-0113-01. Health Characteristics, two-year period estimates from Canadian Community Health Survey. [interactive data table] Retrieved from: https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1310011301. [Retrieved February 2, 2023].

Statistics Canada. 2022e. Census Profile. 2021 Census. Statistics Canada Catalogue no. 98-316-X2021001. Ottawa. Released October 26, 2022. Available from: https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?Lang=E&SearchText=Ignace&DGUIDlist=2021A00053560001&GENDERlist=1,2,3&STATISTIClist=1&HEADERlist=0.

Statistics Canada. 2022q. Pay gap, 1998 to 2021. Available from: https://www150.statcan.gc.ca/n1/pub/14-28-0001/2020001/article/00003-eng.htm [Accessed June 16, 2023].

Statistics Canada. 2023. Indigenous identity of person. Available from: https://www23.statcan.gc.ca/imdb/p3Var.pl?Function=DEC&Id=42927 [Retrieved October 8, 2024].

Statistics Canada. 2023f. Indigenous Population Profile. 2021 Census of Population. Statistics Canada Catalogue no. 98-510-X2021001. Ottawa. Released June 21, 2023. Available from: https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/ipp-ppa/index.cfm?Lang=E [Accessed November 27, 2023].

Scott K, Lessard R. 2002. Income inequality as a determinate of health.

TD Graham & Associates. 2019. Township of Ignace Community Strategy. Exploring Our Possibilities, 2019-2024. Prepared for the Township of Ignace. Prepared by TD Graham & Associates.

Teranet. 2022. Owner Parcel. Shapefile. [Accessed November 23, 2023].

The Loomex Group. 2022b. City of Dryden Fire Master Plan.

Tikinagan Child and Family Services (TCFS). 2023. Overview. Available from https://www.tikinagan.org/about-us/ [Accessed on June 5, 2023].

Tikinagen Child and Family Services (TCFS). 2022. 2021-202 Annual Report.

Township of Ignace. 2021. Ignace Community Safety and Well-Being Plan.

Tulloch. 2018a. Adaptive Phased Management - Phase 2 Environmental Work, Technical Memorandum 1, Ignace, ON. Tulloch Engineering. Nuclear Waste Management Organization Report, APM-REP-07000-0207.

Tulloch. 2018b. Phase 2: Preliminary Environmental Studies, Township of Ignace and Area, Ontario. Summary Report. Nuclear Waste Management Organization Report, APM-REP-07000-0206.

Vibrometric. 2022. Phase 2 - 2D Seismic Investigations, Ignace Area, Report. Nuclear Waste Management Organization Report APM-REP-01332-0308. Toronto, Canada. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0308-Phase-2---2D-Seismic-Investigation-Ignace-Area-Report-2022-07.ashx?sc_lang=en.

Vorauer, A. 2019. Revell Site - Geoscientific Site Characterization Plan. Nuclear Waste Management Organization Report, APM-PLAN-01913-0353.

William W. Creighton Youth Services. 2023a. Overview. Available from: https://www.creightonyouth.com/about/ [Accessed on June 6, 2023].

William W. Creighton Youth Services. 2023b. Services. Available from: https://www.creightonyouth.com/services/ [Accessed on June 6, 2023].

Wiseman, J., & Brasher, K. 2008. Community wellbeing in an unwell world: Trends, challenges, and possibilities. Journal of public health policy, 29, 353-366.

Wood. 2019. Climate Change Impacts Review and Method Development. Nuclear Waste Management Organization Report, NWMO-TR-2019-05. March 2019. Authors: Jonas Robert, Tristan Hauser and Edmundo Fausto.

World Health Organization. 2023. Social determinants of health. Available from: https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1 [Accessed October 10, 2023].

World Nuclear Association. 2024. Country Profiles: Nuclear Power in Canada. Available from: https://world-nuclear.org/information-library/country-profiles/countries-a-f/canada-nuclear-power#notes-amp-references. Last updated March 5, 2024. [Accessed September 16, 2024].

Wright and Hopky. 1998. Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters. Department of Fisheries an Oceans. Ottawa, Ontario. Available from: https://www.publications.gc.ca/site/eng/82558/publication.html.

WSP (WSP Canada Inc.). 2022a. Ignace Area Infrastructure: Municipal Infrastructure Study. September 2022.

WSP. 2022b. Ignace Area Infrastructure: Social Services Facilities Study. October 2022.

WSP. 2023a. Phase 2 Initial Borehole Drilling and Testing at IG_BH04/05/06, Ignace Area. WP12 Data Report – Vertical Seismic Profiling for IG_BH05. Nuclear Waste Management Organization Report APM-REP-01332-0368. Toronto, Canada. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0368-WP12-Data-Report---Vertical-Seismic-Profiling-for-IG-BH05-2023-11.ashx.

WSP. 2023b. Phase 2 Initial Borehole Drilling and Testing at IG_BH04/05/06, Ignace Area. WP12 Data Report – Vertical Seismic Profiling for IG_BH06. Nuclear Waste Management Organization Report APM-REP-01332-0369. Toronto, Canada. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0369-WP12-Data-Report---Vertical-Seismic-Profiling-for-IG-BH06-2023-11.ashx.

WSP-Golder Associates Ltd (WSP-Golder). 2023. Geochemical Characterization of Excavated Rock Management Area – South Bruce and Ignace (Revell) Boreholes. Nuclear Waste Management Organization Report, APM-PLAN-21110-0202. Mississauga, Canada.

WSP-Golder Associates Ltd. (WSP-Golder). 2022. Phase 2 Initial Borehole Drilling and Testing at IG_BH04/05/06, Ignace Area. WP12 Data Report – Vertical Seismic Profiling for IG_BH04. Nuclear Waste Management Organization Report APM-REP-01332-0284.Toronto, Canada. Available from: https://www.nwmo.ca/-/media/Reports-MASTER/Technical-reports/APM-REP-01332-0284-WP12-Data-Report---Vertical-Seismic-Profiling-for-IG-BH04-2022-12.ashx

Zoetica. 2022. Biodiversity Impact Studies – Northwestern Ontario Region: 2022 Baseline Program Design. Zoetica Environmental Consulting Services.

Zoetica. 2023. Biodiversity Impact Studies – Northwestern Ontario Region: 2022 Baseline Report. Zoetica Environmental Consulting Services. Nuclear Waste Management Organization document, APM-REP-07000-0228.

Appendix A: Licensing Appendix

Licensing Appendix

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project

December 2025

APM-REP-05000-0218-R000

Prepared by: Nuclear Waste Management Organization (NWMO)

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

1. Purpose and Scope

The level of detail provided in the Initial Project Description (IPD) is intended to sufficiently meet the information required in an IPD, as indicated in Schedule 1 of the *Information and Management of Time Limit Regulations under the Impact Assessment Act* (IAA).

The purpose of this Nuclear Licensing Appendix is to provide supplemental information specific to the nuclear licensing process led by the Canadian Nuclear Safety Commission (CNSC), pursuant to the *Nuclear Safety and Control Act* (NSCA) and its Regulations.

This Appendix presents and describes the breadth of technical work, programs, and deliverables required for submission in support of the initial licence application.

This Appendix primarily discusses submissions required by the CNSC and does contain detailed discussion about submissions uniquely required under the Impact Assessment Act or any other regulatory agency.

2. The Integrated Assessment

The CNSC is the lifecycle regulator for nuclear facilities in Canada, including the proposed Deep Geological Repository (DGR) for Canada's Used Fuel.

When an impact assessment is required for projects that have a lifecycle regulator, the Impact Assessment Agency of Canada (IAAC) conducts an "integrated assessment" with that regulator. These assessments integrate the regulatory requirements of the lifecycle regulator into the impact assessment process.

The Minister of Environment and Climate Change must refer projects involving the CNSC to an integrated review panel.

2.1 The Integrated Submission

The Integrated Impact Statement and Licence Application is being prepared as a single suite of documents to satisfy all regulatory requirements, in anticipation of the Integrated Tailored Impact Statement Guidelines, in accordance with the Government of Canada's objective of "one project, one review".

The Integrated Impact Statement and Licence Application is expected to contain the following Volumes presented in Table 1, in addition to a Plain Language Summary. The names, organization, and content of the Volumes are subject to change as the project evolves, and as feedback is received from regulatory bodies, the public, and Indigenous peoples.

Table 1: Integrated Impact Statement and Licence Application

Vol.	Name	Primary Content (Subject to Change)
1	Main Volume	Project Summary Licence Annex (Entire suite of documents required under the NSCA and its Regulations. See Section 6 for key submissions)
2	Project Description	Project Overview Need and Purpose Project Activities & Components Project Schedule Alternatives to the Project Alternative Means
3	Engagement	Engagement Summary Indigenous Engagement Public Engagement Regulatory Engagement
4	Effects Assessment	Effects Assessment Methodology Effects Assessments Effects to Indigenous Peoples Baseline Reports and supporting technical and modelling reports.
5	Other Matters	Malfunctions and Accidents Effects of the Environment on the Project Sustainability and Climate Change Follow-up Monitoring Programs (including adaptive management reports)

3. CNSC, the lifecycle regulator

The purpose and mandate of the CNSC is fully described in section 9 of the *Nuclear Safety and Control Act*, and summarized in REGDOC-3.5.3 *Regulatory Fundamentals* as follows:

"The CNSC is the federal organization responsible for regulating the use of nuclear energy and materials in Canada. It regulates to protect health, safety, security and the environment, and to implement Canada's international commitments on the peaceful use of nuclear energy. The CNSC also disseminates objective scientific, technical, and regulatory information to the public."

As the lifecycle regulator, the CNSC continues to perform regulatory, licensing, and enforcement activities for the duration of the entire DGR lifecycle. These activities include, but are not limited to:

- Reviewing licence applications (evaluating designs of nuclear facilities, assessing safety analyses and assessments, reviewing environmental monitoring plans and results, etc.)
- Conducting expert research and analysis
- Verifying licensee compliance with regulatory requirements, i.e., audits and inspections
- Conducting activities to enforce licensee compliance
- Co-ordinating with other regulatory agencies where appropriate.

The suite of assessments and analysis required in support of the licensing process through the CNSC must be comprehensive and detailed enough to allow for the Commission to determine whether the applicant:

(a) is qualified to carry on the activity to be licenced; or

(b) will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

The submissions and assessments required by the CNSC typically focus on:

- Determining risk (radiological and non-radiological) to the environment; including air quality, surface water, ground water, sediment, non-human biota, and species at risk.
- Determining risk (radiological and non-radiological) to humans; including the closest receptors to the facility, members of nearby Indigenous nations, and receptors that are likely to be the most impacted.
- Baseline characterization of the environment, both surface and underground, as applicable.
- Demonstrating that the applicant is capable of performing the licenced activities, including evaluation of the applicant's Management System.
- Demonstrating that the proponent can meet the requirements established by the CNSC with respect to national security.
- Other engineering and safety assessments, including Fire Hazard Analyses, Seismic Analysis, Criticality Assessments, etc.

3.1 The graded approach to licensing

The CNSC applies the graded approach to licensing and compliance activities. The graded approach is a systematic method or process by which elements such as the level of analysis, the depth of documentation and the scope of actions necessary to comply with requirements are commensurate with:

- The relative risks to health, safety, security, the environment, and the implementation of international obligations to which Canada has agreed.
- The particular characteristics of a nuclear facility or licenced activity.

Following the principles of the graded approach, the maturity of the design, safety assessments, and Management System required for the Initial Licence are directly proportional to the activities being licenced. For example, the construction of the Used Fuel Packaging Facility (UFPP) is not included in the scope of the Initial Licence. Therefore, detailed designs and analysis of the UFPP are not required for the Initial Licence. However, the NWMO is still required to prepare and submit a description of the entire facility, and all assessments and analysis required by the applicable Regulations and REGDOCs, further described in Section 5. **Error! Reference source not found.**

Another example is the Safety Case, which is included as part of the Initial Licence, as per REGDOC-1.2.3. The Safety Case relates to all hazards and is the main tool used to document and demonstrate that a facility will adequately protect people and the environment during its entire lifecycle (site preparation, construction, operation and decommissioning) and in the post-closure period. The scope and level of technical detail in the Safety Case will depend on the stage of development of the facility. Data used in the safety case can be obtained from a variety of sources, including site-specific sampling, regional field investigations, scientific literature and analogous examples. Updates to the safety case consider comments from technical and regulatory reviews, increased knowledge, and operational experience, as well as results from monitoring programs and research activities. The lifecycle approach to the development of the safety case enables ongoing engagement with the public and Indigenous groups and the incorporation of stakeholder feedback. At closure of the disposal facility, the safety case will contain information that future generations may require (e.g., institutional control plans, long-term monitoring plan).

The graded approach to licensing also applies to the Management System and applicable programs and procedures. Some programs, policies, and procedures are required to be fully developed for the activities planned under the Initial Licence, while others will be in a preliminary stage because they are not fully applicable yet, e.g., the Radiation Protection Program and the Safeguards Program. More information on the Management System is presented in Section 0.

3.2 Opportunities for public and Indigenous involvement

CNSC licensing decisions for Class I nuclear facilities typically include a public hearing process. The Commission may decide to allow interventions at public hearings. If interventions are allowed the Commission decides whether to allow written interventions only or also oral interventions. For an oral intervention, the intervenor is given a scheduled timeslot in the public hearing agenda in which they can present their information and viewpoints directly in front of the Commission members for consideration.

Licences issued by the Commission are valid for specified durations, after which a licence renewal process is required to extend the licence duration. The duration of the licence is requested by the applicant, but ultimately decided by the Commission.

Licence renewals are also performed via the public hearing process, where public and Indigenous persons are able to make their voices heard via both written and oral submissions and interventions.

4. Licences under the Nuclear Safety and Control Act

Section 26 of the *Nuclear Safety and Control Act* specifies that "Subject to the regulations, no person shall, except in accordance with a licence, prepare a site for, construct, operate, modify, decommission, or abandon a nuclear facility"

In accordance with the Interpretation section of the *Class I Nuclear Facilities Regulations,* the DGR Project is considered a Class IB nuclear facility:

> *"Class IB nuclear facility means … a facility for the disposal of a nuclear substance generated at another nuclear facility".*

There are five general types of licences for Class I nuclear facilities described in the *Class I Nuclear Facilities Regulations*:

- Licence to Prepare a Site
- Licence to Construct
- Licence to Operate
- Licence to Decommission
- Licence to Abandon

The information and level of detail required in a licence application is commensurate with the activities being requested for approval and therefore differs for each type of licence.

A proponent may choose to apply for a combination of licences. For example, many nuclear facilities in Canada, including uranium mines and mills, have applied for a Licence to Prepare a Site and Construct. That application would include all of the necessary information required for both licences, although only a single, combined licence would be granted. The NWMO is not seeking a combined licence; it is seeking approvals that include some construction activities – but not the construction of any nuclear facilities.

Through early engagement with the CNSC staff, the NWMO received direction to refer to the first licence as the "Initial Licence". This Initial Licence will request approvals to perform activities traditionally associated with site preparation. Development of the nuclear facilities, the ventilation exhaust shaft, service shaft and main shaft, the Underground Demonstration Facility and the repository itself will require the Licence to Construct, and therefore an additional and entirely separate licensing process.

5. Licence Application Requirements

The *General Nuclear Safety and Control Regulations* lists General Application Requirements for all licence applications.

The *Class I Nuclear Facilities Regulations* lists General Requirements for Class I licence applications, as well as specifics for each of the five general licence types. These requirements are generic to all Class I nuclear facilities.

REGDOC-3.5.1 *Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills* provides guidance on the level of detail required for a licence authorizing site preparation activities, **emphasis added**:

"*The objective of the site preparation stage is to assess whether the site is suitable for the construction and operation of a nuclear facility.* ***An application for a licence to prepare site does not require detailed design information or specifications of a facility design*** *but must provide enough information to demonstrate that releases of radioactive and hazardous substances are within limits claimed in the Environmental Assessment, and meet all applicable regulatory requirements*."

REGDOC-1.2.3 *Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository* contains more detailed guidance specific to DGRs and site preparation activities.

The following subsections present many of the primary requirements of the initial licence application.

5.1 General Nuclear Safety and Control Regulations - General Application Requirements

As per the *General Nuclear Safety and Control Regulations*, an application for a licence shall contain the following information:

(a) the applicant's name and business address;
(b) the activity to be licensed and its purpose;
(c) the name, maximum quantity and form of any nuclear substance to be encompassed by the licence;
(d) a description of any nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence;
(e) the proposed measures to ensure compliance with the *Radiation Protection Regulations*, the *Nuclear Security Regulations* and the *Packaging and Transport of Nuclear Substances Regulations*, 2015;
(f) any proposed action level for the purpose of section 6 of the *Radiation Protection Regulations*;
(g) the proposed measures to control access to the site of the activity to be licensed and the nuclear substance, prescribed equipment or prescribed information;
(h) the proposed measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information
(i) a description and the results of any test, analysis or calculation performed to substantiate the information included in the application;
(j) the name, quantity, form, origin and volume of any radioactive waste or hazardous waste that may result from the activity to be licensed, including waste that may be stored, managed, processed or disposed of at the site of the activity to be licensed, and the proposed method for managing and disposing of that waste;

(k) the applicant's organizational management structure insofar as it may bear on the applicant's compliance with the Act and the regulations made under the Act, including the internal allocation of functions, responsibilities and authority;

(l) a description of any proposed financial guarantee relating to the activity to be licensed; and

(m) any other information required by the Act or the regulations made under the Act for the activity to be licensed and the nuclear substance, nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence.

5.2 Class I Nuclear Facilities Regulations - General Requirements

As per the *Class I Nuclear Facilities Regulations*, an application for a licence shall contain the following information:

(a) a description of the site of the activity to be licensed, including the location of any exclusion zone and any structures within that zone;

(b) plans showing the location, perimeter, areas, structures and systems of the nuclear facility;

(c) evidence that the applicant is the owner of the site or has authority from the owner of the site to carry on the activity to be licensed

(d) the proposed management system for the activity to be licensed, including measures to promote and support safety culture

(d.1) the proposed human performance program for the activity to be licensed, including measures to ensure workers' fitness for duty

(e) the name, form, characteristics and quantity of any hazardous substances that may be on the site while the activity to be licensed is carried on

(f) the proposed worker health and safety policies and procedures

(g) the proposed environmental protection policies and procedures

(h) the proposed effluent and environmental monitoring programs

(i) if the application is in respect of a nuclear facility referred to in paragraph 2(b) of the *Nuclear Security Regulations*, the information required by section 3 of those Regulations

(j) the proposed program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the activity to be licensed; and

(k) the proposed plan for the decommissioning of the nuclear facility or of the site

5.3 *Class I Nuclear Facilities Regulations* - Licence to Prepare a Site requirements

As per the *Class I Nuclear Facilities Regulations* an application for a licence to prepare a site for a Class I nuclear facility shall contain the following information:

(a) a description of the site evaluation process and of the investigations and preparatory work that have been and will be done on the site and in the surrounding area;

(b) a description of the site's susceptibility to human activity and natural phenomena, including seismic events, tornadoes and floods;

(c) the proposed program to determine the environmental baseline characteristics of the site and the surrounding area;

(d) the proposed quality assurance program for the design of the nuclear facility; and

(e) the effects on the environment and the health and safety of persons that may result from the activity to be licensed, and the measures that will be taken to prevent or mitigate those effects.

5.4 REGDOC-1.2.3 Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository guidance

REGDOC-1.2.3 *Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository* provides detailed guidance on how to meet the requirements of the NSCA and Regulations in the initial licence application. A summary of the primary guidance statements are presented here, noting that there is additional guidance present in the REGDOC.

- The applicant must describe the planned activities and provide data about the site characteristics in their application for a licence to prepare site for a DGR facility.
- The applicant must provide a plan for monitoring the effects of site preparation activities on the environment as part of the application for a licence to prepare site.
- For activities that take place during the site preparation stage for the development of a future nuclear facility, the applicant must clearly demonstrate what measures will be taken to protect health, safety, security and the environment.
- The application must describe the management system programs, processes and procedures that have been or will be defined and implemented to protect health, safety, security and the environment, as well as provide a description of the organizational management structure for the application's site preparation work activities, in accordance with CSA N286, *Management system requirements for nuclear facilities*.
- The application must include:
  - a pre-closure safety analysis that is in accordance with REGDOC-2.4.4, Safety Analysis for Class IB Nuclear Facilities, including a deterministic safety analysis focusing on activities under this licence
  - a hazard analysis focusing on activities under this licence, including:
    - the analysis of external hazards at the site evaluation stage to confirm that the facility will withstand events as described in Appendix C of REGCOD-2.4.4
    - considerations for both design-basis events and beyond-design basis events for the operational phase in accordance with section 4.1 of REGDOC-2.4.4
  - a post-closure safety assessment that is in accordance with REGDOC-2.11.1, *Waste Management, Volume III*
- The application must include:
  - a description of the overall physical design of the facility, the design practices and the safety concepts commensurate with the activities being proposed in the licence.
  - a description of the approach followed for the general design and the performance of the Structures, Systems and Components (SSCs), including the means for preparing equipment maintenance and the monitoring of SSCs to confirm that they will continue to operate during site preparation, as required by the design.
  - the principles, policies, programs, processes and procedures for carrying out site preparation activities.
  - a description of the design considerations related to human factors as outlined in REGDOC-2.5.1, *General Design Considerations: Human Factors.*

    - information on the frequency and severity derived from the characterization of the hazards resulting from external events in establishing the design basis hazard level, including uncertainties in the design basis hazard level.

- The application must include an aging management plan, listing all SSCs important to safety, to provide for the timely detection and mitigation of the aging effects to ensure integrity and functional capacity of the SSCs throughout the pre-closure period.
- The application must describe the approaches for meeting the requirements of the Radiation Protection Regulations for activities conducted under the licence to prepare site.
- The application must describe a radiation protection program and should demonstrate how the design of that program is commensurate with any radiological hazards associated with, or encountered during, the licensed activity.
- The application must also describe how radiological hazards will be monitored and controlled during any site preparation activities, as applicable.
- The application must describe the program and implementation of policies to minimize risk to the health and safety of workers posed by conventional (non-radiological) hazards in the workplace, including the management of workplace safety hazards and the protection of workers.
- The application must provide information detailing compliance to all applicable requirements under the Canada Labour Code, including all occupational exposure limits for all chemical compounds listed under its regulations.
- The application must include a comprehensive set of applicable environmental protection measures, including an environmental risk assessment, environmental management systems, effluent and emissions control and monitoring program, environmental monitoring program and groundwater protection and monitoring program that meet all requirements applicable to site preparation activities in REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures*.
- The applicant must provide the proposed environmental protection policies, programs and procedures needed for the licensing phase.
- The application must describe an emergency preparedness program that meets the requirements associated with REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*.
- The applicant must provide details of the site emergency response organizations and other applicable organizations, including the numbers and positions of all site staff who are assigned to emergency response duties for site preparation activities
- For site preparation activities, applicants must demonstrate that they have:
    - included information on arrangements with first responders, provisions for mutual support or aid, and interagency communication requirements (if a memorandum of understanding is established with a first responders' agency, the same must be provided as part of the application)
    - an emergency response plan to ensure that adequate and timely emergency assistance is available to protect workers, the public and the integrity of site security, while mitigating adverse environmental effects during project activities
    - an emergency preparedness program that maintains an adequate response capability to respond to and mitigate the emergency situations that could occur at the site, including malevolent acts, medical emergencies, accidents and malfunctions for the site preparation phase.

- The application must describe a fire protection program to ensure adequate protection against fires.
- The applicant must address:
  - quantities and physical characteristics, including hazards posed to health and safety, of each substance or waste, including by-products for each substance or by-product to be regulated or controlled, and the relevant list of regulations governing their control
  - transport, storage and use of hazardous substances
  - processing and disposal of hazardous wastes
- As part of the application to prepare site, the applicant must:
  - demonstrate that the site evaluation process has appropriately considered future decommissioning in the planning for the nuclear facility and has adequately considered end-of-life decommissioning
  - prepare a preliminary decommissioning plan in accordance with REGDOC-2.11.2
- The security program must include an inventory change control process for prescribed information.
- The security measures must provide oversight, management and control, with documented policies and procedures for prescribed information.
- For site preparation activities, the applicant should include in their security measures:
  - a description of the site security policy, which demonstrates that the security quality assurance criteria are integrated into overall quality assurance
  - the applicable quality assurance criteria referenced in ISO/IEC 27002:2022, Information security, cybersecurity and privacy protection — Information security controls
  - a description of procedures and processes that ensure that the required quality is defined and consistently achieved within the applicant's security policy
  - documentation of how site personnel will be trained in security
  - information on the security system and subsystem availability program, which accounts for documentation and archiving, and maintaining records of functional testing and routine field testing
- The application must describe the cyber security program, processes and procedures that have been or will be defined and implemented to comply with CSA N290.7, Cyber security for nuclear facilities.
- The applicant's cyber security program must describe each element of the program specified in section 4.2 of CSA N290.7, with sufficient detail to show that the cyber threats, vulnerabilities and risks identified in the Site Selection Threat and Risk Assessment are properly considered.
- The applicant must provide a description of the arrangements, as applicable to site preparation, that will permit the CNSC to discharge Canada's obligations and provide information to the IAEA, in accordance with REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*.
- With respect to site preparation, the applicant must describe how they will meet the requirements of REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills*.
- The applicant must provide the CNSC with information about its public and Indigenous engagement activities as part of its licence application.

- The applicant must also describe how their proposed public information and disclosure program meets the requirements in REGDOC-3.2.1, *Public Information and Disclosure*.

5.5 Comparison of Class I Licence Requirements for each major licensing stage

Reflecting the graded approach to licensing, the level of design detail, assessment robustness, and management system program maturity increases for each licensing stage, from Site Preparation (Initial Licence), Construction, and to Operations.

Table 2 identifies some key differences between requirements needed at each major licensing stage, focusing on the *Class I Nuclear Facilities Regulations.* Note that the information presented in Sections 5.1, 5.2, and 5.3 is required for all licence applications, in addition to what is presented in Table 2.

Table 2: Comparing Class I licence requirements across Site Preparation, Construction, and Operations

Type of information	Initial Licence (Licence to Prepare a Site)	Licence to Construct	Licence to Operate
Site evaluation and facility design	a description of the site evaluation process and of the investigations and preparatory work that have been and will be done on the site and in the surrounding area	a description of the proposed design of the nuclear facility, including the manner in which the physical and environmental characteristics of the site are taken into account in the design	a description of the structures at the nuclear facility, including their design and their design operating conditions
		a description of the structures proposed to be built as part of the nuclear facility, including their design and their design characteristics	
		a description of the systems and equipment proposed to be installed at the nuclear facility, including their design and their design operating conditions	a description of the systems and equipment at the nuclear facility, including their design and their design operating conditions
Effects assessment	the effects on the environment and the health and safety of persons that may result from the activity to be licensed, and the measures that will be taken to prevent or mitigate those effects	the effects on the environment and the health and safety of persons that may result from the construction, operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects	the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects
Construction of nuclear facilities	n/a	the proposed construction program, including its schedule	n/a
Environmental Baseline Characteristics	the proposed program to determine the environmental baseline characteristics of the site and the surrounding area	a description of the environmental baseline characteristics of the site and the surrounding area	n/a
Quality Assurance Program	the proposed quality assurance program for the design of the nuclear facility	the proposed quality assurance program for the design of the nuclear facility	n/a
Safety Assessment	a description of the site's susceptibility to human activity and natural phenomena, including	a preliminary safety analysis report demonstrating the adequacy of the design of the nuclear facility	a final safety analysis report demonstrating the adequacy of the design of the nuclear facility

Type of information	Initial Licence (Licence to Prepare a Site)	Licence to Construct	Licence to Operate
	seismic events, tornadoes and floods		
Safeguards	n/a	the proposed measures to facilitate Canada's compliance with any applicable safeguards agreement;	the proposed measures to facilitate Canada's compliance with any applicable safeguards agreement
Potentially hazardous releases to the environment	n/a	the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics;	the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics;
		the proposed measures to control releases of nuclear substances and hazardous substances into the environment	the proposed measures to control releases of nuclear substances and hazardous substances into the environment
Training and Qualification	n/a	the proposed program and schedule for recruiting, training and qualifying workers in respect of the operation and maintenance of the nuclear facility;	the proposed responsibilities of and qualification requirements and training program for workers, including the procedures for the requalification of workers;
		a description of any proposed full-scope training simulator for the nuclear facility	the results that have been achieved in implementing the program for recruiting, training and qualifying workers in respect of the operation and maintenance of the nuclear facility
Conduct of Operations	n/a	n/a	the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility
Handling of radioactive and hazardous substances	n/a	n/a	the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances
Commissioning	n/a	n/a	the proposed commissioning program

Type of information	Initial Licence (Licence to Prepare a Site)	Licence to Construct	Licence to Operate
			for the systems and equipment that will be used at the nuclear facility
Accidental releases of nuclear and hazardous substances to the environment	n/a	n/a	the proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of national security, including measures to (i) assist off-site authorities in planning and preparing to limit the effects of an accidental release, (ii) notify off-site authorities of an accidental release or the imminence of an accidental release, (iii) report information to off-site authorities during and after an accidental release, (iv) assist off-site authorities in dealing with the effects of an accidental release, and (v) test the implementation of the measures to prevent or mitigate the effects of an accidental release
Acts of sabotage	n/a	n/a	the proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility, including measures to alert the licensee to such acts

5.6 Assessments and data collection at every licensing stage

The Impact Assessment process occurs at the beginning of a project, and it identifies and assesses impacts associated with the entire lifecycle. This is in contrast to the CNSC's licensing and approval process, which is split into discrete licenses and approvals, as described in Section 4.

The graduated approval process with the CNSC means that many aspects of the assessment are repeated and updated, multiple times over the lifecycle of the facility. Several examples of this are presented below.

5.6.1 Environmental Risk Assessments

The CNSC requires that the environmental effects of all licensed activities be evaluated and considered when licensing decisions are made. This is explicitly expressed in the *Class I Nuclear Facilities Regulations,* where each licence application is required to contain the following information:

> Licence to Prepare a Site: the effects on the environment and the health and safety of persons that may result from the activity to be licensed, and the measures that will be taken to prevent or mitigate those effects.
>
> Licence to Construct: the effects on the environment and the health and safety of persons that may result from the construction, operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects.
>
> Licence to Operate: the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects.

REGDOC-2.9.1 Environmental Principles, Assessments and Protection Measures describes the need for an environmental risk assessment (ERA), where an ERA is:
"a systematic process that identifies, quantifies and characterizes the risk posed by contaminants (nuclear or hazardous substances) and physical stressors in the environment. It is a practice or methodology that provides science-based information to support decision-making and to prioritize the implementation of mitigation measures."

In accordance with *REGDOC-2.9.1,* the ERA must include both an ecological risk assessment for the environment and a human health risk assessment for humans. When these studies are performed together, they are referred to as a Human Health and Ecological Risk Assessment (HHERA).

For Class I facilities (like the DGR), it is expected that the licensee conducts an ERA in accordance with *CSA N288.6, Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*. The initial ERA is primarily predictive, as it involves assessing the potential effects of a hypothetical facility. As a facility moves through its lifecycle, the ERA is periodically reviewed (typically at least once every 5 years) and revised using the accumulated site knowledge derived from operational experience, monitoring, special investigations, incorporation of advance in scientific knowledge and Indigenous traditional knowledge.

5.6.2 Safety case

The safety case is the integrated collection of arguments in support of the safety of the proposed DGR during both operations and post-closure. It integrates evidence from the pre-closure and post-closure DGR safety assessments as well as information from the site characterization and performance of the engineered barriers system to synthesize evidence that the DGR Facility will meet or exceed all safety criteria. The safety case is a key deliverable for the initial license, and all subsequent licenses.

The safety case is required to be updated and submitted for every subsequent Licence application. These updates capture the latest developments and revisions in both the pre- and post-closure safety analyses and assessments, as well a description of the repository system as it continues to evolve. The safety case also presents the results of any new or significant site characterization data.

5.6.3 Site characterization

Initial site characterization activities support the site selection process, help gather baseline data about the environment, inform the site layout and design of the facility, and supports the safety case for a DGR project.

Site characterization data is gathered continuously during the site preparation activities and are used as inputs into updated environmental effects assessments required for the Licence to Construct. As per *REGDOC-1.2.1 Guidance on Deep Geological Repository Site Characterization* the types of data collected include:

- Geological environment
    - Geological setting
    - Hydrogeological setting
    - Geochemistry
    - Geological stability
    - Geomechanical characteristics
- Surface environment
    - Climate
    - Aquatic and terrestrial environment
    - Surface water hydrology
    - Geomorphology characterization
    - Geotechnical characterization of surficial deposits
- Human activity and land use

As per *REGDOC-1.2.1 Guidance on Deep Geological Repository Site Characterization*, ongoing characterization activities are expected to continue until closure as part of a geoscience verification plan. These activities would serve to gather additional geoscientific information to confirm sub-surface conditions originally understood from surface based studies.

5.6.4 Summary

The assessment of safety to the environment and humans is embedded into the CNSC licensing process at every licensing stage. Risk to the environment continues to be evaluated through ERAs. The safety case is updated to reflect updates to the safety assessments and evolution of the repository system. Site characteristics continue to be measured and collected to support future licence applications, but also to satisfy the environmental monitoring requirements at a licenced nuclear facility.

6. Key Submissions

The Integrated Impact Statement and initial licence application contains a multitude of individual reports, studies, and assessment documents. Some of these submissions are intended to satisfy the requirements of IAAC and the Impact Assessment, some of them satisfy requirements of the NSCA for licensing, and some will support both sets of requirements. The following table provides a summary of the key deliverables contained within the Integrated Impact Statement and initial licence application and identifies if the submission primarily supports the Impact Assessment, the Initial Licence, or contains information required for both.

Table 3: Key submissions of the Integrated Impact Statement and Initial Licence application

Submission name	Description	Primarily Supports Initial Licence, Impact Statement, or both	How licensing information may be used in the Impact Statement
Management System	Collection of governance documents.	Initial Licence	Primarily supports the Initial Licence. Specific Management Sytem Programs, including the Environmental Monitoring Program, are likely to be referenced in the "Follow-up Monitoring" section of the Impact Statement.
Safety Case	Integrated collection of arguments in support of the safety of the proposed DGR during both operations and post-closure.	Initial Licence	
Post-Closure Safety Assessment	Technical summary of the work undertaken and results obtained for the assessment of the post-closure radiological and non-radiological safety of the DGR.	Initial Licence	Data inputs required for "Accidents and Malfunctions".
Pre-Closure Safety Assessment	Technical summary of the work undertaken and results obtained for the assessment of the pre-closure safety of the DGR.	Initial Licence	Data inputs required for "Accidents and Malfunctions".
Geosynthesis	Interpretation and description of an integrated understanding of the geosphere and the suitability of the site to host a DGR.	Initial Licence / Impact Statement	Serves as the primary input for baseline data reporting and component assessments used to develop the Impact Statement
Descriptive Geosphere Site Model	Geoscientific site description and site model incorporating geologic, geophysical, geomechanical, thermal, hydrogeological and hydrogeochemical data.	Initial Licence	

Submission name	Description	Primarily Supports Initial Licence, Impact Statement, or both	How licensing information may be used in the Impact Statement
Geoscience Verification Plan	Describes the activities intended for gathering additional geoscientific information.	Initial Licence	
Probabilistic Seismic Hazard Assessment	Characterizes natural hazards related to seismicity.	Initial Licence / Impact Statement	The full probabilistic seismic hazard assessment is required under the NSCA and Regulations. A subset of the assessment serves as input for baseline and component assessments used to develop the Impact Statement
Environmental Baseline Reports (Site Characterization)	May include: • Atmospheric • Noise • Groundwater • Surface water & hydrology • Topography • Soil & sediment • Radiation • Climate & Meteorology • Vegetation • Fish & Habitat • Birds • Terrestrial wildlife • Geology • Geochemistry • Social, Cultural, Economic	Initial Licence / Impact Statement	Serves as the primary input for baseline data reporting and component assessments used to develop the Impact Statement
Environmental Protection assessments	May include: • Ambient radioactivity effects • Social, economic and health effects • Geology and geological hazards • Geochemistry or excavated material • Topography, soil and sediment • Surface and groundwater • Fish and fish habitat • Birds and migratory birds • Climate change • Air and water quality • Species at risk • Terrestrial wildlife	Initial Licence / Impact Statement	Serves as the primary input for baseline data reporting and component assessments used to develop the Impact Statement

Submission name	Description	Primarily Supports Initial Licence, Impact Statement, or both	How licensing information may be used in the Impact Statement
Indigenous and Public Engagement Reports	Records documenting engagement with the public and Indigenous peoples.		Indigneous Engagement and Public Engagement Reports are requirements of the IAA and the NSCA. Reports will support Enaggement Sections of Impact Statement
Facility Description	An overall description of the structures, systems and components of the DGR facility. It also describes the development/ construction, operation, post-closure, monitoring and decommissioning.		Supports "Project Description".
Site Preparation Plan	Describes the requirements to be met and activities to be implemented to prepare the proposed Site for future construction and demonstrates that the proposed Site will also be suitable for the full life cycle of the proposed nuclear facility.		Supports identification of other permits and approvals required for the Project.
Determination of Exclusion Zone	Planned exclusion zone around the DGR and surface facilities.		
Engineered Barrier System Design Summary	Technical summary of the work undertaken and results obtained in the design-development of the engineered components comprising the multi-barrier system (Used Fuel Container, Bentonite Buffer, Backfill Material).		Supports the "Project Description".
Aging Management Plan	Oversees the aging of the structures, systems, and components to ensure their integrity and safety throughout the pre-closure period and confirm that they are as described in the pre- and post-closure safety assessments.		

Submission name	Description	Primarily Supports Initial Licence, Impact Statement, or both	How licensing information may be used in the Impact Statement
Conventional Safety Report	Summarizes the hazards to workers and the public and identify mitigation of these hazards at a high level, either by design or by procedural control.	Initial Licence / Impact Statement	The full Conventional Safety Report is required under the NSCA and Regulations. A subset of the report serves as input for Accidents and Malfunctions Assessment in the Impact Statement
Environmental Management System	Management of an organization's environmental policies, measures and procedures in a comprehensive, systematic, planned and documented manner.	Initial Licence / Impact Statement	Serves as the primary input for baseline data reporting and component assessments used to develop the Impact Statement
Human Health and Ecological Risk Assessment	Estimate the nature and probability of adverse health effects in humans and assesses potential risks to the ecological health from contaminated environmental media.	Initial Licence / Impact Statement	Iterative feedback loop between HHERA and component assessment and modelling reports. Supports signficance assessment in Impact Statement
Environmental Monitoring Plans	Includes an effluent and emissions control and monitoring program, environmental monitoring program and groundwater protection and monitoring program.	Initial Licence / Impact Statement	Serves as input to support the development of the "Follow-Up Monitoring Program".
Preliminary Decommissioning Plan	A plan for the decommissioning of the DGR Facility, specifically for the Initial Licence activities.	Initial Licence / Impact Statement	Supports the "Project Description".
Financial Guarantee	Financial guarantee needed to cover the cost to bring the site to the acceptable end state condition, applicable to the Initial Licence activities.	Initial Licence	
Waste Management Plans	Waste management plan for the Initial Licence portion of the project for both conventional and hazardous waste.	Initial Licence	
Preliminary Reference Inventory Report	Description of the used nuclear fuel and facility generated Low and Intermediate Level Radioactive Waste (L&ILW).	Initial Licence / Impact Statement	Supports the "Project Description".

Submission name	Description	Primarily Supports Initial Licence, Impact Statement, or both	How licensing information may be used in the Impact Statement
Emergency Planning Report	Analysis of the risks and hazards that the Emergency Preparedness Program will address emergency response plans and procedures.		The full Emergency Planning Report is required under the NSCA and Regulations. A subset of the report may serve as input for Accidents and Malfunctions Assessment in the Impact Statement.
Security Measures Report	Principal security requirements for major nuclear facilities in compliance the amended Nuclear Security Regulations, as applicable to Initial Licence activities.		The full Security Measures Report is required under the NSCA and Regulations. A subset of the report may serve as input for Effects Assessment (mitigation measures) and Accidents and Malfunctions Assessment in the Impact Statement.

7. Management System

The NWMO currently operates under a suite of governance documents, programs, and procedures collectively known as the Management System. As the NWMO transitions into the role of a nuclear licensee, its Management System is being further developed to meet the requirements of REGDOC-1.2.3, *Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository*, *REGDOC-2.1.1 Management System*, and CSA N286-12 *Management system requirements for nuclear facilities*.

The following management system programs are planned for development. The level of detail required in each program is commensurate with the activities being licenced. For example, the activities performed during the Initial Licence do not involve radiological materials, therefore, the Radiation Protection Program in place during the Initial Licence may not need to be fully developed. The Radiation Protection Program will need to meet all requirements before a Licence to Operate is granted, which would allow the receipt and handling of used nuclear fuel and radioactive materials.

The programs are likely to include, but are not limited to, the following:

- Human Performance Program
- Training Program
- Operating Program
- Safety Analysis Program
- Criticality Safety Program
- Design Program
- Fitness for Service Program
- Radiation Protection Program
- Conventional Health and Safety Program
- Public Information and Disclosure Program
- Environmental Protection Program
- Emergency Preparedness Program
- Fire Protection Program
- Waste Management Program
- Security Program
- Safeguards Program
- Packaging and Transport Program
- Research and Development Program
- Geoscience Program

The Licence Conditions Handbook is expected to list the programs that are required as a condition of the licence, including the requirements and guidance for each (e.g., REGDOCs, CSA standards).

8. Summary

The Initial Project Description fulfils a specific purpose under the *Impact Assessment Act* and is not intended to discuss the licensing requirements of a nuclear facility in great detail.

Through the Integrated Assessment, IAAC works with the lifecycle regulator, the CNSC, to integrate the nuclear licensing requirements into the Impact Assessment process. Upon the completion of the IA process, the CNSC remains the primary authority and regulator of the DGR project and facility.

This Licensing Annex supports the IPD by describing the magnitude and volume of assessments and studies that are required in order to meet the licensing requirements of the NSCA and its Regulations, and how that information is planned to be delivered in the Integrated Impact Statement and Licence Application.

The requirements for licensing of a Class I nuclear facility, such as the DGR, are identified primarily in the *Nuclear Safety and Control Act*, the *General Nuclear Safety and Control Regulations*, and the *Class I Nuclear Facilities Regulations*. REGDOC-1.2.3 *Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository* provides detailed guidance on how an applicant can meet the requirements of the NSCA and its Regulations. This is in addition to the approximately fifty additional REGDOCs that are potentially applicable to the DGR project in some capacity, either at the Initial Licence stage, or somewhere in the project lifecycle.

The requirements for Site Preparation, Construction, and Operations licences of a Class I nuclear facility were compared in order to demonstrate the CNSC's phased approach to licensing. The level of detail and robustness of assessments progressively increases at each licensing step. The information required for the Initial Licence (Site Preparation) is commensurate with the activities being licenced. Detailed designs of the nuclear facilities will be developed in support of the Licence to Construct, as per the *Class I Nuclear Facilities Regulations*.

Many activities performed to support the Impact Assessment process are continued throughout the entire lifecycle of the project, per the licence requirements and conditions. For example, the collection of site characterization data continues, which supports the safety case, and provides real data in which to compare the initial effects assessments and predictions. The assessment of risk to the environment and humans also continues through periodic Environmental Risk Assessments, which are required for each Licensing stage. Through the Environmental Protection Program, environmental monitoring activities are required to continue for the duration of the licence.

There are a large number of individual reports and assessments that are required to be prepared for the Integrated Impact Statement and Licence Application. Many of the licensing submissions support the Impact Assessment and will be summarized within the Impact Statement. However, there will be many licensing submissions that apply only to the NSCA and will not necessarily be discussed or referenced within the Impact Statement. The integration and synthesis of all licensing content and submissions will be summarized within the Safety Case document.

9. References

Canadian Nuclear Safety Commission (CNSC). REGDOC-1.2.1, Guidance on Deep Geological Repository Site Characterization.

Canadian Nuclear Safety Commission (CNSC). REGDOC-1.2.3, Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository.

Canadian Nuclear Safety Commission (CNSC). REGDOC-2.1.1, Management System.

Canadian Nuclear Safety Commission (CNSC). REGDOC-2.4.4, Safety Analysis for Class IB Nuclear Facilities.

Canadian Nuclear Safety Commission (CNSC). REGDOC-2.5.1, General Design Considerations: Human Factors.

Canadian Nuclear Safety Commission (CNSC). REGDOC-2.9.1, Environnemental Protection : Environnemental Principles, Assessments and Protection Masures.

Canadian Nuclear Safety Commission (CNSC). REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*.

Canadian Nuclear Safety Commission (CNSC). REGDOC-2.11.1, Safeguards and Nuclear Material Accountancy.

Canadian Nuclear Safety Commission (CNSC). REGDOC-2.13.1, Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste.

Canadian Nuclear Safety Commission (CNSC). REGDOC-3.1.2, Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills.

Canadian Nuclear Safety Commission (CNSC). REGDOC-3.2.1, Public Information and Disclosure.

Canadian Nuclear Safety Commission (CNSC). REGDOC-3.5.1, *Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills*.

Canadian Nuclear Safety Commission (CNSC). REGDOC-3.5.3, Regulatory Fundamentals.

CSA Group. CSA N286, Management system requirements for nuclear facilities.

CSA Group. CSA N288.6, Environmental risk assessments at Class I nuclear facilities and uranium mines and mills.

CSA Group. CSA N290.7, Cyber security for nuclear facilities.

Government of Canada. Class I Nuclear Facilities Regulations (SOR/2000-204). Available from: https://laws.justice.gc.ca/eng/regulations/SOR-2000-204/page-1.html.

Government of Canada. General Nuclear Safety and Control Regulations (SOR/2000-202). Available from: https://laws-lois.justice.gc.ca/eng/regulations/sor-2000-202/index.html.

Government of Canada. *Nuclear Safety and Control Act* (S.C. 1997, c. 9). Available from: https://laws-lois.justice.gc.ca/eng/acts/N-28.3/index.html.

Government of Canada. Nuclear Security Regulations (SOR/2000-29). Available from: https://laws.justice.gc.ca/eng/regulations/sor-2000-209/page-1.html.

Appendix B: Engagement Appendix

Engagement Appendix

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project

December 2025

Prepared by: Nuclear Waste Management Organization (NWMO)

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

1. Initial Project Description Consolidated Engagement Report: Wabigoon Lake Ojibway Nation
2. Initial Project Description Consolidated Engagement Report: Public and Interested Parties
3. What We Heard - IPD Engagement Report
    a. What We Heard - IPD Engagement Report: Ignace Information Session - July 24, 2025
    b. What We Heard - IPD Engagement Report: Ignace Information Session - July 25, 2025
    c. What We Heard - IPD Engagement Report: Webinar Information Session - August 6, 2025, Morning Session
    d. What We Heard - IPD Engagement Report: Webinar Information Session - August 6, 2025, Evening Session
    e. What We Heard - IPD Engagement Report: Dryden Drop-in Information Session - August 12, 2025
    f. What We Heard - IPD Engagement Report: IPD Feedback Workshop - August 12, 2025
    g. What We Heard - IPD Engagement Report: Dryden Information Session - August 13, 2025
    h. What We Heard - IPD Engagement Report: IPD Feedback Workshop - August 21, 2025
4. Engagement Matrix with Potentially Impacted Indigenous Communities
5. Letters to Chiefs

Initial Project Description Consolidated Engagement Report:

Wabigoon Lake Ojibway Nation

October 2025

APM-REP-05000-0215

Prepared by: Nuclear Waste Management Organization (NWMO)

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Acknowledgment of Truths

The Nuclear Waste Management Organization (NWMO) is grateful to all the First Nations and Indigenous peoples that the organization has had the great fortune to meet and interact with while developing and implementing Canada's plan for the long-term management of used nuclear fuel. The NWMO is especially grateful to the Wabigoon Lake Ojibway Nation (WLON) who have indicated that they are willing and informed hosts for the deep geological repository (DGR).

The NWMO understands the unique long-term time scale of Canada's plan to build a DGR, and the relationship it will have with land and water for generations. The NWMO acknowledges that the DGR Project will have an impact on traditional land and resource use via changes in access or perceived risks. The Project is located in the traditional territory of WLON; therefore, members of WLON will experience these impacts most meaningfully.

The NWMO commits to build meaningful and respectful relationships, and to seek the free, prior, and informed consent of impacted peoples of WLON before proceeding with development of the DGR. The NWMO will respect WLON sovereignty and will aim to align our work with WLON values, emphasizing protection and stewardship of land, water, and all Creation and will respect their traditional governance systems.

The NWMO is on a reconciliation learning journey. The NWMO has and will continue to build on advice and guidance received from the Council of Elders and Youth and the Indigenous communities with whom it has a relationship. The NWMO acknowledges there is still much learning to do as it moves through all phases of the Project.

The NWMO respects the truth that many Indigenous women and girls are at a higher risk of harm every day and therefore supports the National Inquiry into Missing and Murdered Indigenous Women and Girls and will find ways to action the Calls for Justice, specifically number 13, "Calls for Extractive and Development Industries".

The NWMO acknowledges, respects and honours that First Nation and Métis peoples of Canada have unique status and rights as recognized and affirmed in Section 35 of the *Constitution Act* (1982). The NWMO is committed to respecting the Aboriginal rights and treaties of First Nation and Métis peoples. The NWMO also recognizes that there may be unresolved claims between First Nation and Métis communities and the Crown to be considered in relation to the proposed Project site.

The NWMO will work with the Crown regarding the Crown's duty to consult and accommodate, as guided by decisions of the Supreme Court of Canada in fulfilling the NWMO's obligations under the *Nuclear Fuel Waste Act* (NFWA).

The NWMO recognizes the truth that the Federal Acts for which it is subject to, the NFWA, the *Nuclear Safety and Control Act* (NSCA) and the *Impact Assessment Act* (IAA) are being imposed on Indigenous people as a result of Canada's plan. The NWMO's approach to implementing the DGR is committed to respect and align with WLON values, philosophies, and knowledge systems. The NWMO acknowledges the need to be mindful of potential burdens which result from our Project on community and will strive to achieve balance with community.

Additionally, the NWMO recognizes the importance of data sovereignty as an important aspect of self-determination and cultural preservation for Indigenous communities. Currently, the data in the Initial Project Description (IPD) is not a full representation of the characteristics of the Indigenous identity of populations residing within district, municipal and unincorporated communities, nor is it a full representation of the characterization of on-reserve communities. All of the NWMO's work with respect to Indigenous Peoples will be guided by Reconciliation.

Initial Project Description Consolidated Engagement Report: Wabigoon Lake Ojibway Nation

APM-REP-05000-0215

October 2025

Reviewed by: Signed by: F1DFF170CD4F467...

Name: Rojin Amani Date: October 31, 2025

Title: Associate, Impact Assessment

Organization: Nuclear Waste Management Organization

Reviewed by: Signed by: 603C930244424EA...

Name: Brittany Jones Date: October 31, 2025

Title: Manager, Indigenous Assessment

Organization: Nuclear Waste Management Organization

Approved by: Signed by: michael Pahor 3A957A36721F491...

Name: Michael Pahor Date: October 31, 2025

Title: Director, Regulatory Strategy

Organization: Nuclear Waste Management Organization

Document history

Title	Initial Project Description Consolidated Engagement Report: Wabigoon Lake	
Report number	APM-REP-05000-0215	
Revision	R000	Date
Reviewed by	Rojin Amani	October 28, 2025
Reviewed by	Jeff Binns	October 28, 2025
Accepted by	Michael Pahor	October 28, 2025

Revision Summary		
Revision Number	**Date**	**Description of Changes/Improvements**
R000	October 31, 2025	Initial Issue

Contents

CONTENTS 6

ACRONYMS AND ABBREVIATIONS 7

1. INTRODUCTION 8

2. PURPOSE 8

3. ENGAGEMENT OVERVIEW 8

4. ENGAGEMENT TOOLS 9

4.1 POWERPOINT PRESENTATION 9

4.2 ZOOM MEETINGS 9

4.3 MENTIMETER POLLS 9

4.4 COMMUNICATIONS MATERIALS 9

4.4.1 HANDOUTS 9

4.4.2 POSTER BOARDS 10

5. SUMMARY OF ISSUES AND AREAS OF INTEREST 10

6. CONFIDENTIALITY NOTICE 10

7. NEXT STEPS 11

APPENDIX A: COMMUNICATIONS MATERIALS 12

ACRONYMS AND ABBREVIATIONS

DGR	Deep Geological Repository
IAA	Impact Assessment Act
IAAC	Impact Assessment Agency of Canada or “the Agency”
CNSC	Canadian Nuclear Safety Commission
IPD	Initial Project Description
NWMO	Nuclear Waste Management Organization
WLON	Wabigoon Lake Ojibway Nation

Initial Project Description (IPD) Consolidated Engagement Report: Wabigoon Lake Ojibway Nation (WLON)

1. Introduction

The Nuclear Waste Management Organization ("**NWMO**") recognizes that extensive, transparent engagement is vital to the success of the Deep Geological Repository ("**DGR**") project for Canada's Used Nuclear Fuel (the "Project"). NWMO is committed to building and sustaining respectful relationships with Indigenous Nations and communities, municipal governments, local residents, and other interested parties. Engagement activities aim to understand community perspectives and priorities, while informing on the safety of the project and the fairness of the process.

The goals of NWMO's engagement on the Initial Project Description ("**IPD**") were to provide clear and accessible information about the Project, increase understanding of the regulatory process, and gather feedback to be incorporated into the IPD and ongoing project planning. The IPD engagement created early opportunities for dialogue about the project's design, potential impacts and benefits, while also supporting the requirements of the federal Impact Assessment Agency of Canada ("**IAAC**") and the Canadian Nuclear Safety Commission ("**CNSC**") licensing processes.

Input collected through past and future workshops, information sessions, webinars, and surveys plays an integral role in both project design and regulatory submissions. Dialogue and collaboration with Indigenous communities will continue throughout the Impact Assessment process and across the full lifecycle of the Project, to enable community voices to continue to inform decision-making.

2. Purpose

NWMO planned and led two engagement events with Wabigoon Lake Ojibway Nation ("**WLON**"): one for WLON community members and another specifically for WLON Elders. WLON supported NWMO with the engagement sessions by scheduling the events, sharing a poster with event details, and coordinating logistics, including the venue, catering, and tech support. WLON also assisted NWMO in the creation of presentation materials.

During these sessions, NWMO provided informational materials, gave a presentation, and responded to questions from community members.

Note: Detailed feedback and discussions are confidential and are not for public distribution, respecting WLON's protocols and privacy.

The objectives of the NWMO-led engagement included:

- To provide WLON community members, including Elders, with clear information about the Project and regulatory process.
- To review key priorities and potential concerns raised in previous engagement activities.
- To collect community input on potential impacts and issues through various interactive tools during the sessions.

3. Engagement Overview

- Roles

    - Host and Presenter: Nuclear Waste Management Organization
    - Logistical Support: Wabigoon Lake Ojibway Nation
    - Facilitator: Mokwateh LP, an Indigenous-owned consulting firm
- Format:
    - Hybrid: In-person and virtual participation, supported by interactive feedback tools
- Dates and Times:
    - August 7, 2025, 6:00 – 8:00 PM CDT (community session)
    - October 15, 2025, 1:00 – 2:30 PM CDT (Elders)
- Attendance:
    - August 7, 2025: 111 participants (76 online and 35 in person)
    - October 15, 2025: 23 participants (11 online and 12 in-person)

4. Engagement Tools

During the events, NWMO used a variety of tools to share information and actively gather input from participants, including presentations, handouts, and interactive tools, as described below.

4.1 PowerPoint Presentation

The presentation shared information about the Project and IPD and will be kept confidential. It included an introduction to the Project with an updated site map, an explanation of the regulatory process and timelines, and a summary of community engagement feedback to date. NWMO also described baseline studies and effects assessments, explained how to provide feedback on the draft IPD Summary for Engagement, and shared upcoming engagement opportunities.

4.2 Zoom Meetings

Community members could join the sessions virtually using WLON's Zoom platform. The Zoom Q&A feature was used to collect and share questions from online attendees.

4.3 Mentimeter Polls

The NWMO leveraged a digital tool called Mentimeter to survey both online and in-person attendees in real-time. Mentimeter's built-in polling function was used to make the sessions more interactive. Attendees could see a live visual summary of the results for each question asked. NWMO also provided a paper version of the Mentimeter questions and aggregated the results of both virtual and written responses.

4.4 Communications Materials

At the engagement event, NWMO staff greeted participants and provided them with optional take-away materials. There was also a series of poster boards displayed on easels around the venue, describing key components of the project.

4.4.1 Handouts

- A 34-page public document entitled "Draft Initial Project Description: Deep Geological Repository for Canada's Used Nuclear Fuel Project, 2025 Summary for Engagement"
- Feedback guide with space for immediate feedback and instructions on how to submit feedback by letter mail or email following the event
- Informational documents about Federal regulatory agencies

- **NWMO's Reconciliation Policy (October 2019)**
- **NWMO's Water Statement (October 2023)**
- NWMO's "Who We Are" brochure

4.4.2 Poster Boards

Seven poster boards were displayed around the room with key information about the IPD from the IPD Summary for Engagement (referenced above). In addition, there were posterboards showing the geography of the proposed siting area in relation to local towns, waterways and roads. The posterboards also showed proposed locations of the above-ground facility and infrastructure, such as roads and storage areas.

5. Summary of Issues and Areas of Interest

Both sessions were well-attended, with participants asking NWMO a broad range of questions that focused on:

- The Project site's size, boundaries, and fencing;
- Impacts on land use and access for hunting, trapping, and logging;
- Method and process for transporting used nuclear fuel and the timeline for further engagement on transportation;
- Proposed location of the accommodation camp, with concerns about its proximity to a sacred site (i.e., a site where ceremony has taken place in relation to the project);
- Safety of the accommodation camp, especially for women and children;
- Funding and coordination of studies between NWMO and WLON;
- Opportunities for the process to reflect both Anishinaabe and Western knowledge systems as well as cultural protocols;
- Potential uses of excavated rock;
- Used fuel radioactivity, handling safety, and transport;
- The number and size of shafts for the DGR;
- Regulatory timelines and flexibility;
- The process for sharing baseline study data with WLON; and
- Impacts of the Province of Ontario's Bill 5 ("Protect Ontario by Unleashing our Economy Act, 2025") and the Government of Canada's Bill C-5 ("One Canadian Economy Act, 2025").

Several questions and topics were directly addressed by WLON administration:

- WLON's role in regulatory oversight and decision-making; and
- WLON's Regulatory Assessment and Approval Process ("**RAAP**")
    - Note: WLON is exercising its jurisdiction through its RAAP. The RAAP is WLON's regulatory process grounded in Anishinaabe law, values, and responsibilities, and reflects WLON's authority to review and decide on development within its territory.

6. Confidentiality Notice

The full "What We Heard" session report is intended for internal use and distribution within WLON and NWMO only. Detailed discussion points and individual feedback collected during the session are

confidential and are not to be shared with the public or external interested parties without prior consent from WLON.

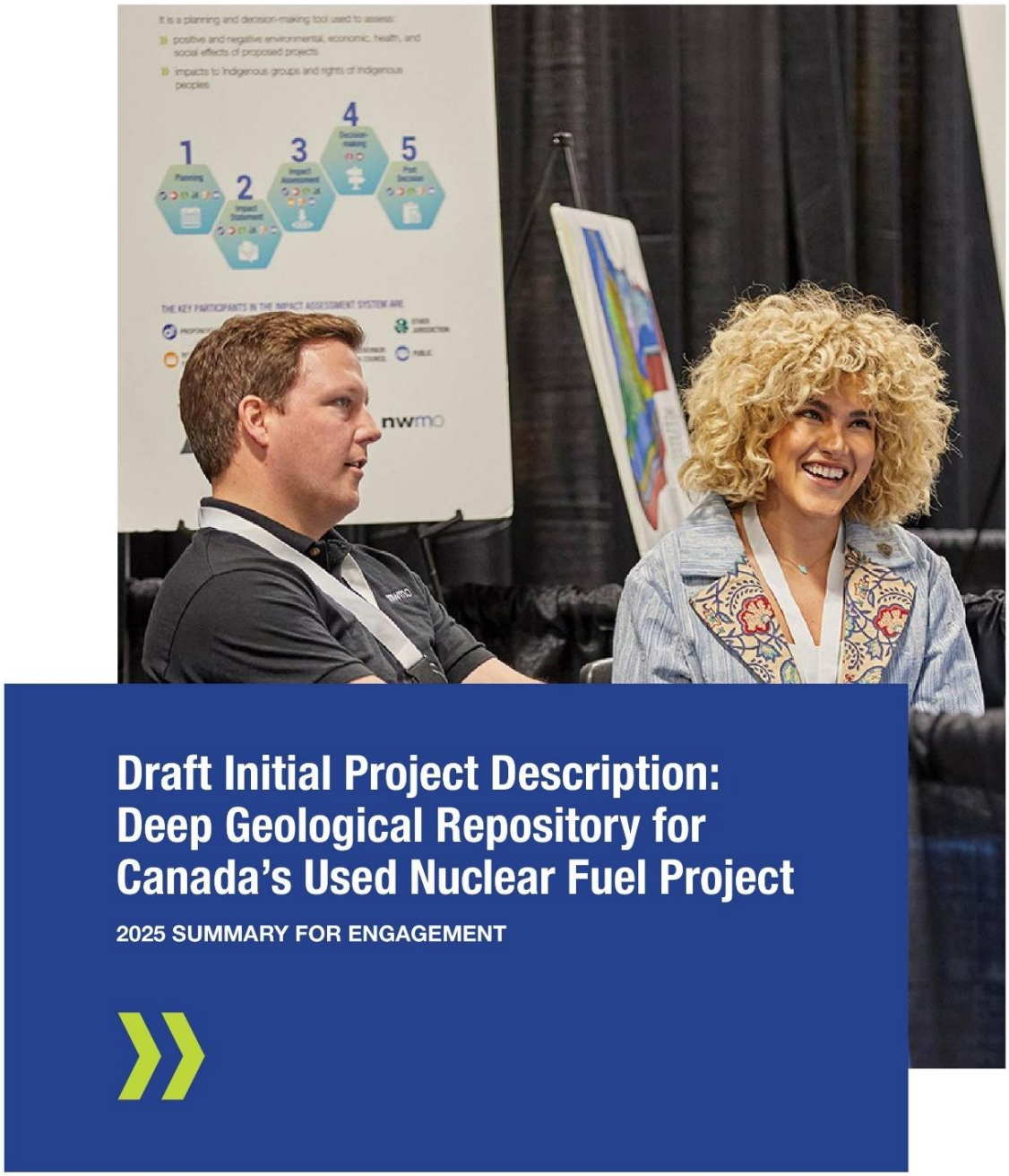
7. Next Steps

NWMO will formally initiate the regulatory process for the Project by submitting the IPD to IAAC in Fall 2025. This marks an important milestone in the Project's development. As the regulatory process progresses, NWMO will continue to work closely with WLON and Indigenous communities, providing regular updates on the Project's design, purpose, and potential impacts.

These ongoing discussions will include sharing information from effects assessments and baseline studies, answering questions, and gathering feedback to support Project decision-making. The future engagement approach and activities will be developed in collaboration with WLON. Through these activities, NWMO is committed to maintaining open dialogue and providing a clear understanding of the Project as it advances through the required steps of the regulatory process.

Appendix A: Communications Materials

- IPD Communications Summary (English)
- IPD Communications Summary (French)
- IPD feedback template (English)
- IPD feedback template (French)
- Posterboard
- Informational documents on Canadian Nuclear Safety Commission



nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

PROTECTING WHAT MATTERS. PLANNING WITH YOU.

The Nuclear Waste Management Organization (NWMO) is a not-for-profit organization tasked with the safe, long-term management of Canada's used nuclear fuel, in a manner that protects people and the environment for generations to come. The plan is to contain and isolate the used fuel in a deep geological repository using a multiple-barrier system.

Since our beginning, we have been working closely with Indigenous Peoples, Canadians, industry, regulators and all levels of government to protect people and the environment, both now and in the future. In November 2024, Wabigoon Lake Ojibway Nation and the Township of Ignace agreed to move into the regulatory decision-making phase as potential host communities for a deep geological repository for Canada's used nuclear fuel, or "the Project."

The Project now moves into the required regulatory decision-making process, which marks a new chapter in Canada's plan for used nuclear fuel, and another opportunity for Indigenous Peoples and the public to share their voice. The purpose of the regulatory process is for the safety of the repository to be independently confirmed by the regulators, including the Canadian Nuclear Safety Commission and the Impact Assessment Agency of Canada.

The process includes an impact assessment integrated with licensing. An impact assessment is a process that looks at how a deep geological repository could affect the environment, health, socioeconomics and Indigenous rights before it gets approved. A licence is required to make sure any nuclear activity in Canada is done safely, protects people and the environment, and follows strict rules.

The first step of the regulatory process is for the NWMO to draft and submit an Initial Project Description to the Impact Assessment Agency of Canada. This submission formally initiates the regulatory process.

An Initial Project Description explains the purpose and need for a project, the preliminary assessment of impacts, and how a company is planning to avoid and mitigate them. The Initial Project Description is the first of many steps in the rigorous licensing process for nuclear facilities, including engaging with Indigenous Peoples and local and regional residents.

The NWMO is currently in the process of preparing that regulatory submission document and will actively seek input as part of the process.

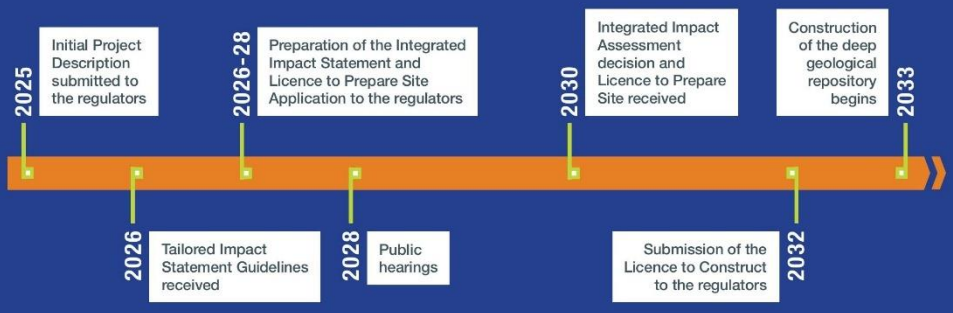


Table of contents

Introduction 2
About the Project 4
The Integrated Impact Assessment and Licensing process 7
Benefits of the deep geological repository Project 8
Continued engagement: Sustained dialogue, participation and collaboration 10
How baseline data is used in the regulatory decision-making process 17
Preliminary screening assessment considerations and findings 26
Strategic assessment of climate change 27
What's next 28
Questions or feedback? 29

Introduction

In 2002, federal legislation directed the Nuclear Waste Management Organization (NWMO) to study how to manage used nuclear fuel and to recommend a preferred approach. In 2005, after a three-year period of study and dialogue with Indigenous Peoples and Canadians from coast to coast, we submitted our proposed approach to the federal Minister of Natural Resources. In June 2007, the federal government selected the plan we are now implementing, known as Adaptive Phased Management, as Canada's plan for the safe, long-term management of used nuclear fuel.

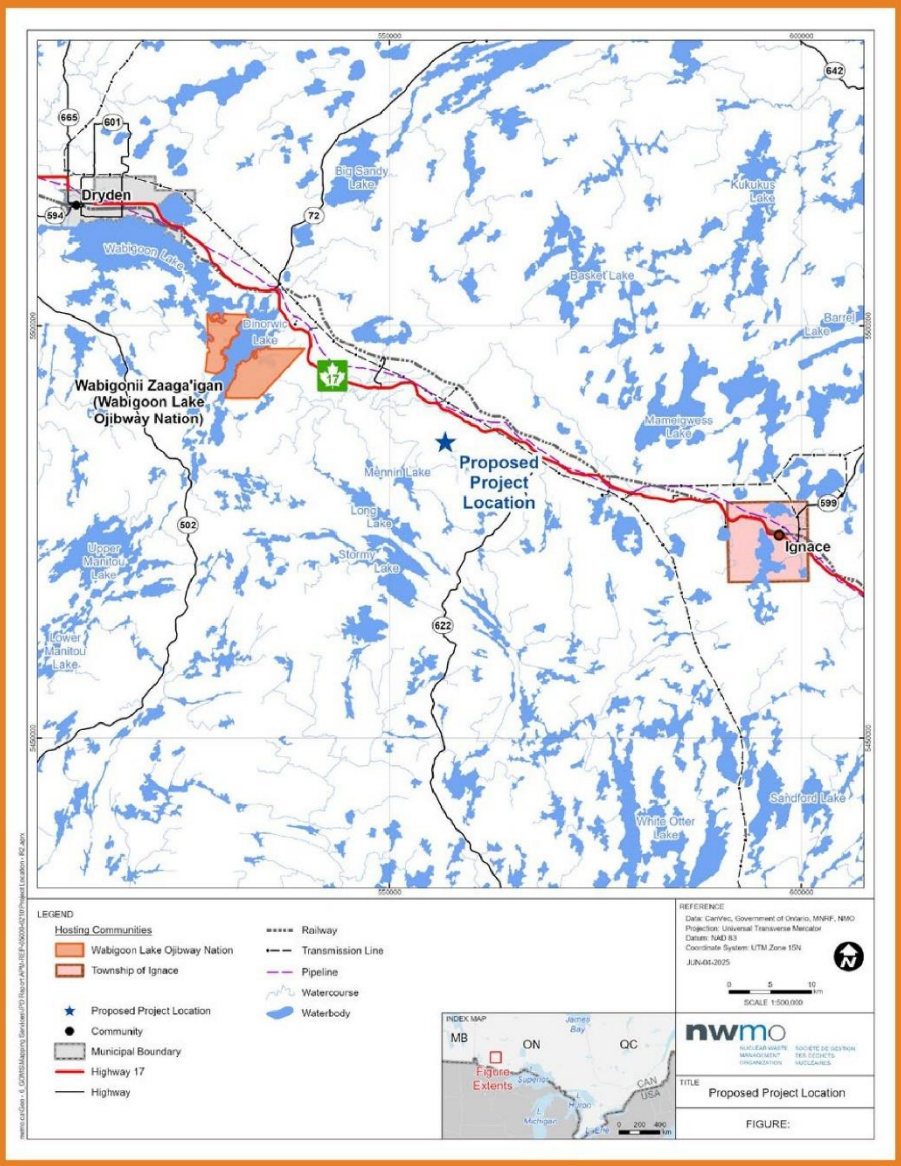
Following an extensive 14-year site selection process, Wabigoon Lake Ojibway Nation and the Township of Ignace agreed to move into the regulatory decision-making phase as potential host communities for a deep geological repository for Canada's used nuclear fuel.

We are now advancing Canada's plan to safely manage used nuclear fuel in a deep geological repository, subject to regulatory approval. The Project proposes the development of a carefully engineered underground facility, designed to safely contain and isolate used nuclear fuel essentially forever.

This document shares highlights of the NWMO's work in this pre-planning phase of impact assessment and licensing, including technical safety and design progress, engagement activities, environmental considerations and next steps as the Deep Geological Repository for Canada's Used Nuclear Fuel Project advances into regulatory decision-making.

In 2005, after a three-year period of study and dialogue with Indigenous Peoples and Canadians from coast to coast, we submitted our proposed approach to the federal Minister of Natural Resources.

PROPOSED PROJECT LOCATION



About the Project

The Deep Geological Repository for Canada's Used Nuclear Fuel Project will:

- Provide for the safe, long-term management of up to 5.9 million used nuclear fuel bundles;
- Be located in a stable rock formation to naturally contain and isolate used nuclear fuel over hundreds of thousands of years; and
- Be implemented in collaboration with surrounding First Nations and municipalities.

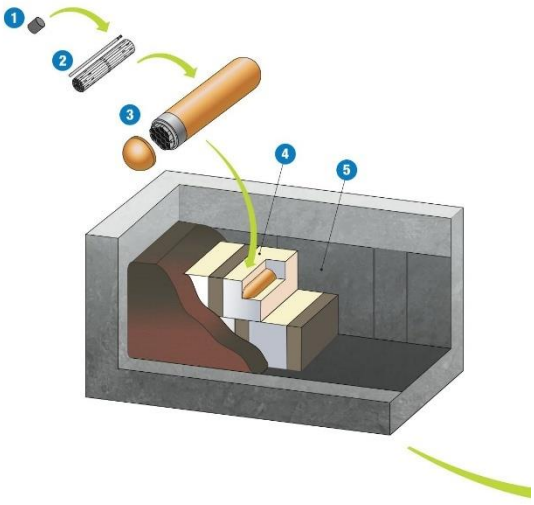
The Project will use a multiple-barrier system. The system includes a series of engineered and natural barriers, working together to safely contain and isolate used nuclear fuel within the repository.

Each barrier will provide a unique and stand-alone level of protection, while serving as a backstop to the last barrier. If any of these barriers were to fail or not perform as expected, the next barrier comes into play, to be sure materials remain contained and isolated.

Rigorous safety standards will govern the Project. The NWMO is committed to meeting all applicable federal and provincial regulatory requirements to protect the health, safety and security of people and the environment for generations to come.

The multiple-barrier system

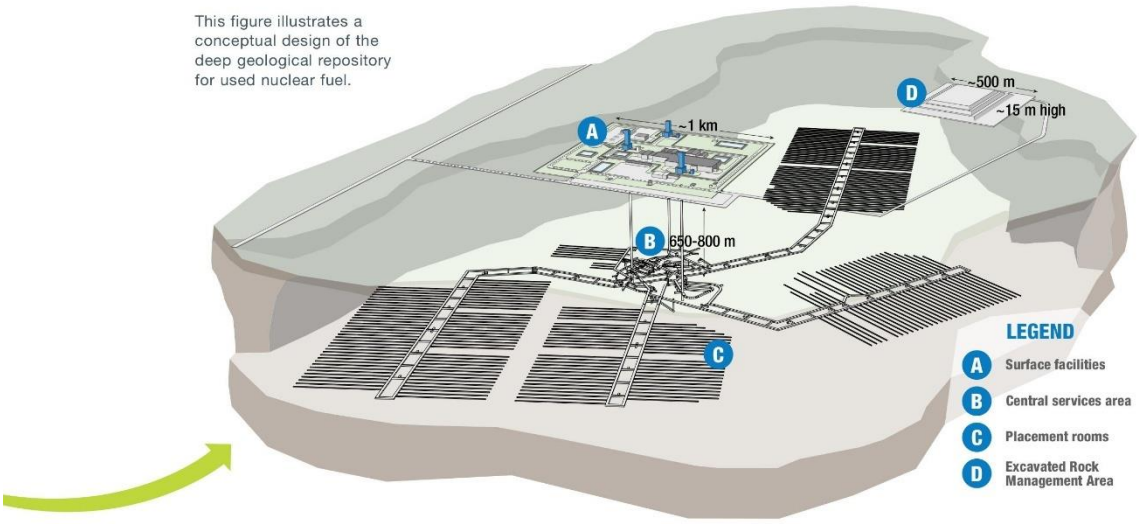
1. **Fuel pellet** — a very stable, solid ceramic made of baked uranium.
2. **Fuel bundle** — made from a highly corrosion-resistant material called Zircaloy.
3. **Copper-coated steel container** — engineered to resist corrosion and strong enough to keep the used nuclear fuel completely contained until radioactivity decreases to safe levels.
4. **Bentonite clay box** — highly compacted clay material, encasing each container and backfilling the repository.
5. **The rock itself** — protects the repository from disruptive natural events, water flow and unintentional human intrusion.



MORE ABOUT THE DEEP GEOLOGICAL REPOSITORY FOR CANADA'S USED NUCLEAR FUEL

- The host rock is stable and predictable over long periods of time.
- The host rock has low permeability, meaning that the tiny traces of water in the deep rock are isolated and do not mix with surface waters.
- The deep geological repository system would maintain an environment that is favourable to the stability and performance of the repository.
- Examples in nature provide evidence that engineered-barrier system components are stable for very long periods under similar deep geological conditions.
- The depth of the repository makes any mistaken human intrusion into the closed repository very unlikely in the future.
- Countries around the world are implementing repositories — this Project builds on scientific consensus and practical experience.
- Safety case studies indicate that any radiation impacts are likely to be well below the natural background dose rates.
- The deep geological repository can be built and operated safely using proven technologies.
- The radionuclides in the used fuel decay, making them less dangerous with time.
- The repository site can be monitored to confirm repository system performance.

This figure illustrates a conceptual design of the deep geological repository for used nuclear fuel.



PURPOSE OF THE PROJECT

The Project will protect people and the environment through sustainable, safe, long-term management of used nuclear fuel. The NWMO is proposing the site preparation, construction, operations, decommissioning and closure of the deep geological repository for Canada's used nuclear fuel to safely isolate approximately 5.9 million used nuclear fuel bundles. The Project will be licensed by the Canadian Nuclear Safety Commission for approximately 160 years.

UNDERSTANDING NUCLEAR POWER IN CANADA

In Canada, nuclear power is responsible for 15 per cent of electricity generation with 19 operable Canada Deuterium Uranium (CANDU) reactors at four nuclear generating stations. For many years, Canada has been a leader in nuclear research and technology, exporting reactor systems developed in Canada, as well as a high proportion of the world supply of radioisotopes used in medical diagnosis and cancer therapy.

Nuclear power offers a reliable power source, contributing to sustainable economic growth and improved human welfare. The Government of Canada has been clear nuclear power will play an essential role in decarbonization and the ability of Canada to achieve carbon neutrality by 2050. The growth of Canadian investment in nuclear will help strengthen our energy security now and in the future.

Currently, Canada's used nuclear fuel is managed in facilities licensed for interim storage. This approach is safe; however, given the long time frames associated with the hazardous nature of used nuclear fuel, it is not a permanent solution as it requires ongoing maintenance and management. That is why the NWMO agrees with international best practice to construct a deep geological repository to safely contain and isolate used nuclear fuel for the very long term.

ESTIMATED PLAN TIMELINE

The implementation of Canada's plan will span approximately 160 years. It will take approximately 10 years to prepare the site and construct the deep geological repository, with an expected operations start date in the mid-2040s. The deep geological repository will operate for approximately 50 years. After that, the repository will be monitored for an extended period of time before decommissioning, closure and post-closure monitoring.

Over the lifespan of the Project, the NWMO will maintain a commitment to host communities and the surrounding area to contribute to long-term well-being. This requires awareness and analysis of how the Project may impact social and economic conditions, including employment and job opportunities.

ASSUMED PROJECT PHASES AND PLANNING TIMELINES

Project phase	Approximate timeline (years)	Phase duration (years)
Site Preparation and Construction	2030-42	13
Operations	2043-92	50
Extended Monitoring, Decommissioning and Closure	2093-2192	100
Institutional Control[1]	2193+	

[1] The control of any risks at a site after decommissioning and closure, including activity like surveillance, maintenance or signs/markers.

The Integrated Impact Assessment and Licensing process

The Project will undergo a thorough impact assessment process, co-ordinated by the Impact Assessment Agency of Canada and integrated with the initial licence application to the Canadian Nuclear Safety Commission.

This process will ensure that details like impacts on harvesting, hunting and Indigenous ways of life are considered alongside any possible impacts on overall environmental, health, social and economic factors.

The Project is currently in the pre-planning phase, and the impact assessment has not started yet. Early input from the host communities, Indigenous communities in the region and the public is shaping our Initial Project Description document for submission to the regulators and our path forward to decision-making.

The preliminary assessment and proposed mitigation strategies for potential impacts described in the draft Initial Project Description will require input from the host communities, Indigenous communities, interested groups and individuals, and regulators. The results of the assessment will be used to tailor the impact statement guidelines for the Project, which will be issued by the Impact Assessment Agency of Canada.

The Initial Project Description is simply an initial screening step. The Impact Statement work that comes after the Initial Project Description must describe the designated project, key project components and ancillary activities, scheduling details, the timing of each phase of the project and other key features.

When drafting the Impact Statement, the NWMO will also work to respectfully align with Indigenous Knowledge and land use studies in the impact assessments and the design of mitigation strategies, so that the Project supports the interests of Wabigoon Lake Ojibway Nation, the Township of Ignace, and other Indigenous communities and the public in the region.

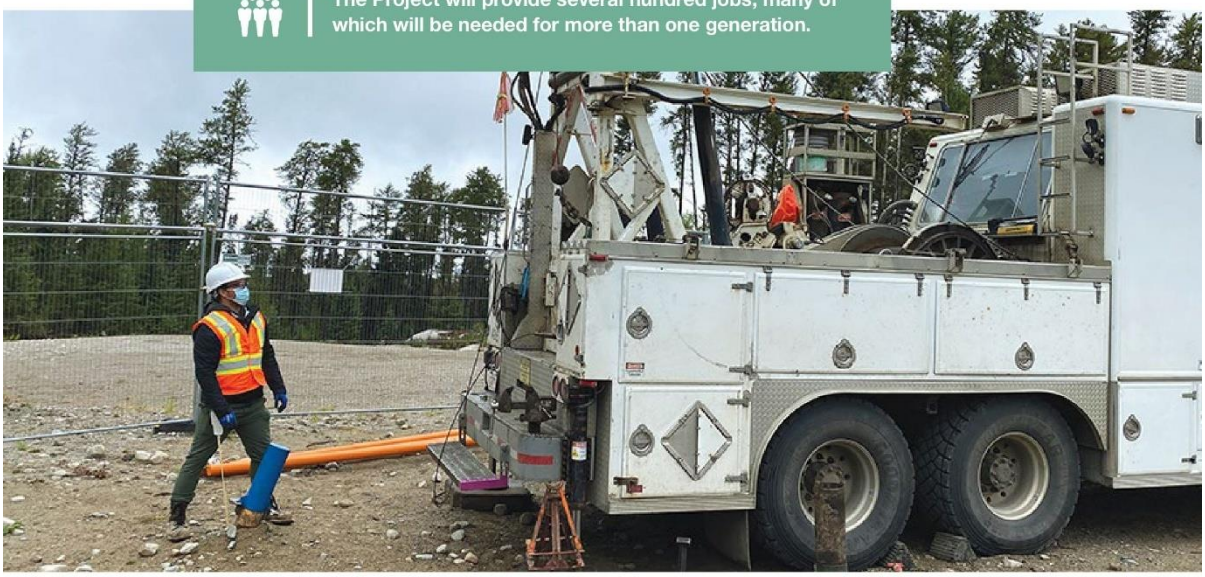
> The next decade of our work will be focused on navigating the robust regulatory decision-making process to deliver on our promise to sustainably protect people and the environment. We are grateful for the close collaboration we have with Indigenous Peoples, Canadians, industry and regulators, which will help ensure our success.
>
> **— Dr. Mackenzie Denyes, Director of Impact Assessment and Licensing at the NWMO**

Benefits of the deep geological repository Project

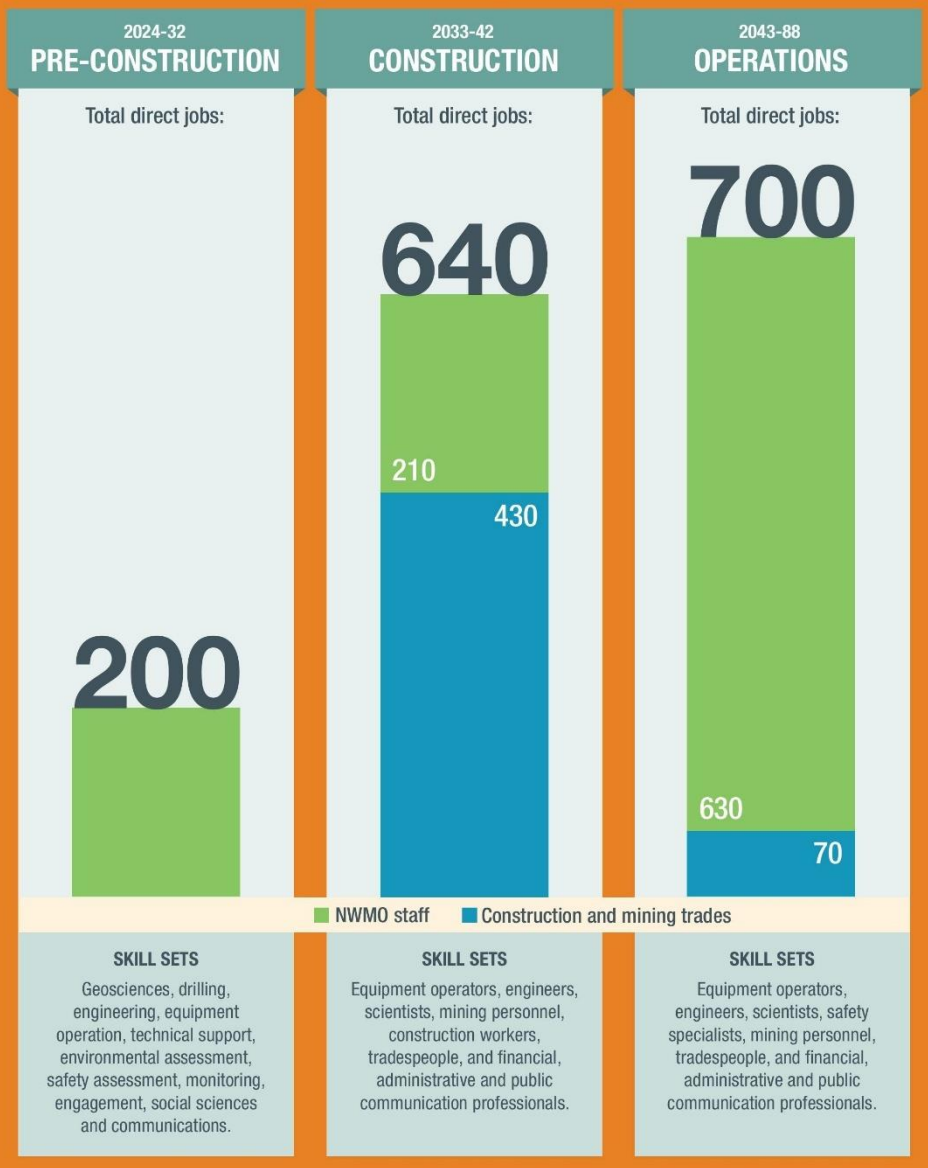
In addition to helping Canada achieve net-zero and energy security targets, the Project will create and sustain high-quality jobs in northwestern Ontario and beyond by supporting a highly technical and diverse supply chain, and meaningful economic benefits to regional communities. This national infrastructure project will drive a wide range of benefits for the host communities, the region and Canada as a whole over the approximate 160-year timeline. The Project will provide several hundred jobs, many of which will be needed for more than one generation. It will require people resources, equipment and materials to support construction and operations.

Because this multi-generational project will be implemented in phases over a period of about 160 years, we will continually review, strengthen and adjust the plan in the face of new information, direction and guidance. We are committed to implementing the Project in a safe way to meet the applicable *General Nuclear Safety and Control Regulations* (SOR/2000-202).

The Project will provide several hundred jobs, many of which will be needed for more than one generation.



AVERAGE JOBS BY PROJECT PHASE



Continued engagement: Sustained dialogue, participation and collaboration

Engagement and relationship building with Indigenous communities, the public and interested parties will remain at the heart of this Project. Former, current and future activities include:

- **Implementation of the hosting agreements:** Collaborative work with Wabigoon Lake Ojibway Nation and the Township of Ignace, including investments in training, education and skills development. These topics are laid out in hosting agreements, including how we can move forward together through the regulatory process.
- **Regulatory engagement and participation activities:** Ongoing efforts to share information transparently and gather feedback on how the Project will proceed. This engagement and participation will seek to gain input on the potential impacts of the Project. Feedback on the design, implementation and monitoring of the Project is important to regulatory engagement because it helps ensure the Project protects the environment, respects culture, safeguards water and supports long-term benefits for the local communities.
- **Communications and information sharing:** Providing clear, timely and accessible information to Indigenous communities, the public and interested parties about the NWMO's activities and progress. This includes regular updates, opportunities for two-way discussions, published materials and other resources to help keep communities informed and aware of the Project's development.

Key themes and concerns that we heard during the site selection process will continue to be addressed as part of our engagement activities during the regulatory process. These include things like:

- The importance of protecting water resources and the natural environment;
- Requests for clear commitments on safety, health and environmental protection;
- Interest in long-term economic and capacity-building opportunities;
- Emphasis on community involvement in monitoring and oversight;
- Support for respectful alignment with Indigenous Knowledge alongside western science, to the extent that communities are willing to share; and
- Protection of the ancestral wisdom of the Knowledge Holders as their sovereign intellectual property.

The NWMO continues to maintain open communication and engagement with host communities, other Indigenous and municipal communities, and the public and will do so at every stage of the Project. The NWMO's engagement as part of impact assessment and licensing will seek feedback and participation on topics such as:

- Baseline data collection programs;
- Project activities and their interactions with people and the environment;
- Proposed mitigation measures to avoid adverse impacts, or alternatively, opportunities to enhance benefits; and
- Future followup and regulatory monitoring programs.

Building on the years of engagement that have already occurred, the NWMO will undertake outreach activities between July 17 and Aug. 22, 2025, specifically tailored to the host communities, Indigenous communities, and other interested groups and individuals.

Such activities will include information sessions and webinars, website and social media updates, and a comment period.

ENGAGEMENT AND PARTICIPATION WITH INDIGENOUS PEOPLES

The NWMO remains committed to building and maintaining strong, lasting relationships with First Nations and Indigenous Peoples, including ongoing relationships with national and provincial Indigenous organizations to ensure that continuous and meaningful dialogue persists.

Applying learnings from Elders, Knowledge Holders, Indigenous Peoples and communities, the Indigenous engagement and participation objectives for the Project include:

- Amplifying and uplifting Indigenous voice and knowledge systems;
- Respectfully aligning with Indigenous perspectives and knowledge into project planning and decision-making;
- Building respectful relationships grounded in reciprocal truth, honesty and trust; and
- Creating opportunities for equitable participation, collaboration and partnership.

The NWMO will look to Indigenous Peoples to share Indigenous Knowledge with us to the extent that they wish. The NWMO will ensure that Indigenous intellectual property is protected, as agreed to with the Indigenous Peoples who choose to share that knowledge.

The Project is located on the territory of Wabigoon Lake Ojibway Nation. Its willingness to move forward with the Project's next steps in its territory was required for making a siting decision for the Project and before the NWMO could proceed to regulatory decision-making. As part of the hosting agreement, the NWMO agreed for Wabigoon Lake Ojibway Nation to complete its own Regulatory Assessment and Approval Process for the Project. The NWMO is committed to respecting Wabigoon Lake Ojibway Nation's sovereignty throughout the implementation of the Project.

The Project is located on the territory of Wabigoon Lake Ojibway Nation. Its willingness to move forward with the Project's next steps in its territory was required for making a siting decision for the Project and before the NWMO could proceed to regulatory decision-making.

The NWMO acknowledges the importance of relationships with other Indigenous communities in the regional area of the proposed Project. The NWMO will work to maintain those relationships that currently exist and to establish new ones. The NWMO commits to meaningful communication, engagement and participation with other Indigenous communities, and the implementation of the NWMO's Reconciliation and Indigenous Knowledge policies, and Ethical and Social Framework.

The NWMO recognizes, honours and supports the belief that Indigenous Peoples have a special relationship with the natural environment and have unique stewardship responsibilities that are part of this relationship.

Nuclear Waste Management Organization:
Conversation Corner
LEARN MORE
Draft Initial Project Description (2025 summary for engagement)
13

THE NWMO'S RECONCILIATION JOURNEY

The NWMO is on a Reconciliation journey. In 2019, as part of this journey, we created and finalized through ceremony a *Reconciliation Policy*. It sets out how the organization will contribute to Reconciliation. Under the policy, the NWMO commits to respectful and meaningful engagement with Indigenous Peoples and communities, providing cultural awareness and Reconciliation training to staff and contractors.

Additionally, in 2016 and updated in 2020, the NWMO published an *Indigenous Knowledge Policy* to ensure we are guided by a clear set of principles as we work with communities and Indigenous Knowledge Holders. Under that policy, the NWMO commits to considering Indigenous Knowledge in our work and respecting the value of what Indigenous Knowledge systems can contribute to project development and decision-making processes.

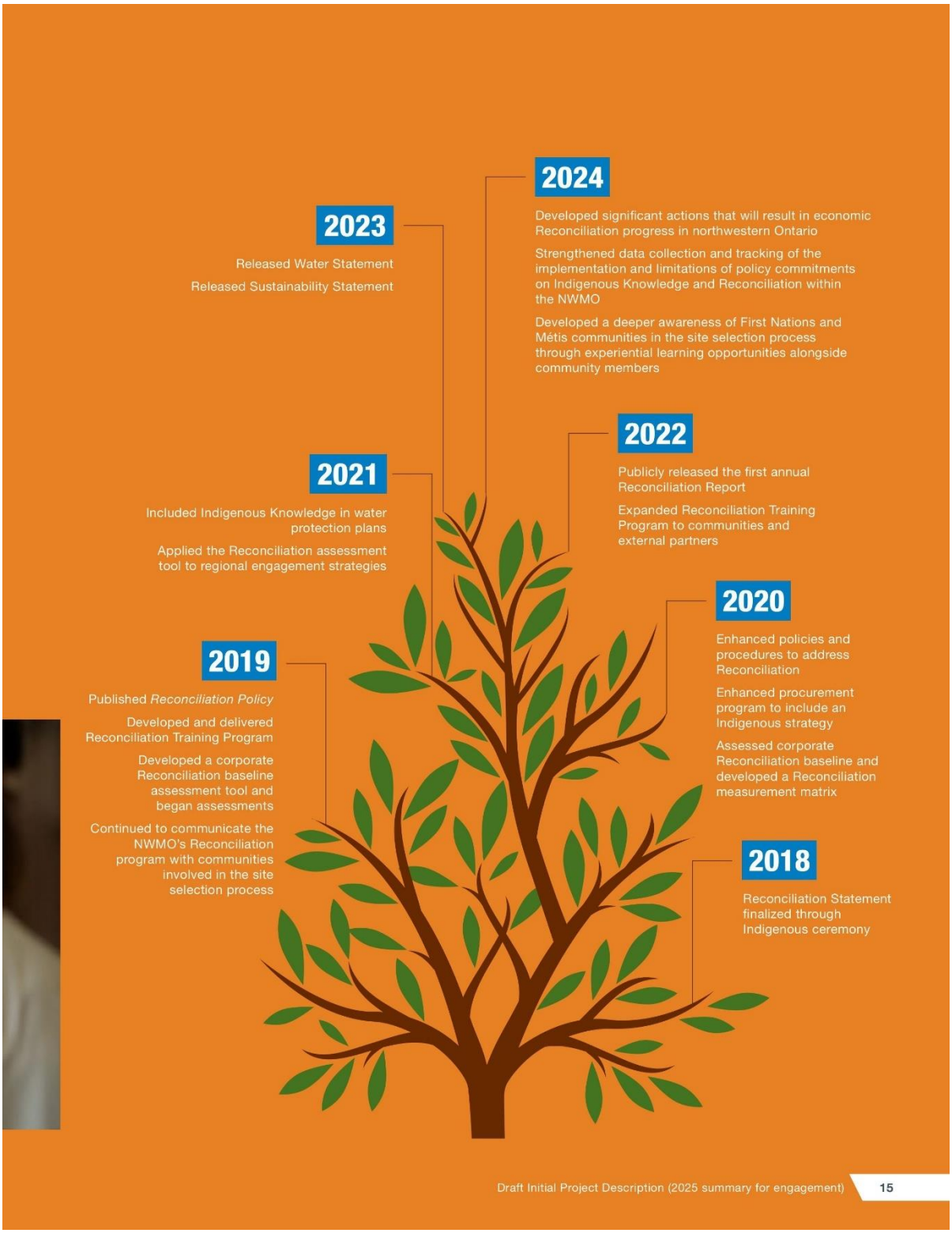
In 2023, the NWMO published a Water Statement that affirms our commitment to water protection by considering how the agency of water (from surface to underground) may be in relationship with Canada's planned deep geological repository and its surrounding area. The Water Statement is a companion document to the NWMO's Environmental Responsibility Statement.

The NWMO will continue to apply Indigenous Knowledge to both technical safety and community well-being aspects of the Project when given permission to do so by Indigenous Knowledge Holders.

The NWMO will continue to meaningfully engage with Wabigoon Lake Ojibway Nation and other Indigenous communities potentially impacted by the Project, to identify and understand the potential impacts of the Project on Indigenous Peoples and their rights, including their lands, territories and resources, and to align with Indigenous Knowledge.

For more on our Reconciliation journey, please visit nwmo.ca/reconciliation.

The NWMO will continue to meaningfully engage with Wabigoon Lake Ojibway Nation and other Indigenous communities potentially impacted by the Project.


2024
Developed significant actions that will result in economic Reconciliation progress in northwestern Ontario
Strengthened data collection and tracking of the implementation and limitations of policy commitments on Indigenous Knowledge and Reconciliation within the NWMO
Developed a deeper awareness of First Nations and Métis communities in the site selection process through experiential learning opportunities alongside community members
2023
Released Water Statement
Released Sustainability Statement
2022
Publicly released the first annual Reconciliation Report
Expanded Reconciliation Training Program to communities and external partners
2021
Included Indigenous Knowledge in water protection plans
Applied the Reconciliation assessment tool to regional engagement strategies
2020
Enhanced policies and procedures to address Reconciliation
Enhanced procurement program to include an Indigenous strategy
Assessed corporate Reconciliation baseline and developed a Reconciliation measurement matrix
2019
Published *Reconciliation Policy*
Developed and delivered Reconciliation Training Program
Developed a corporate Reconciliation baseline assessment tool and began assessments
Continued to communicate the NWMO's Reconciliation program with communities involved in the site selection process
2018
Reconciliation Statement finalized through Indigenous ceremony
Draft Initial Project Description (2025 summary for engagement)
15

PUBLIC ENGAGEMENT AND PARTICIPATION

In addition to engagement with Indigenous communities, the NWMO has engaged extensively for over two decades with interested groups and individuals and a wide range of interested parties, including the host municipality — the Township of Ignace — and other municipalities, businesses, service providers and environmental organizations.

The purpose of public engagement is to enable early discussions specific to the site while informing the Project design through various engagements on the Initial Project Description. To achieve this objective, the NWMO will:

- Identify public and affected interests through early community engagement;
- Understand public preferences for engagement methods;
- Conduct engagement activities focused on specific deliverables to solicit feedback; and
- Incorporate received input to shape Project elements and ensure transparent recordkeeping and reporting.

The NWMO will hold open sessions to ensure members of the public who have not yet begun to engage with the NWMO can join the conversation.

Now that site selection is complete, there are several ways that people can provide input, including participating in information sessions or webinars, dropping by the Ignace Learn More Centre, or sending written feedback. More information regarding feedback opportunities can be found at nwmo.ca/PlanningWithYou.

How baseline data is used in the regulatory decision-making process

Baseline data collection studies for natural and human environments are ongoing and will continue through the regulatory decision-making process. Environmental monitoring will continue to collect data to describe existing conditions of many components of the environment.

With a good understanding of baseline conditions, predictions can be made on how the project may impact people and the environment. Measures can then be explored to avoid, manage, mitigate, and in some cases, offset adverse impacts.

The Initial Project Description will summarize many years of baseline data and use that data to inform potential mitigations (discussed in next section).

Environmental monitoring will continue to collect data to describe existing conditions of many components of the environment.

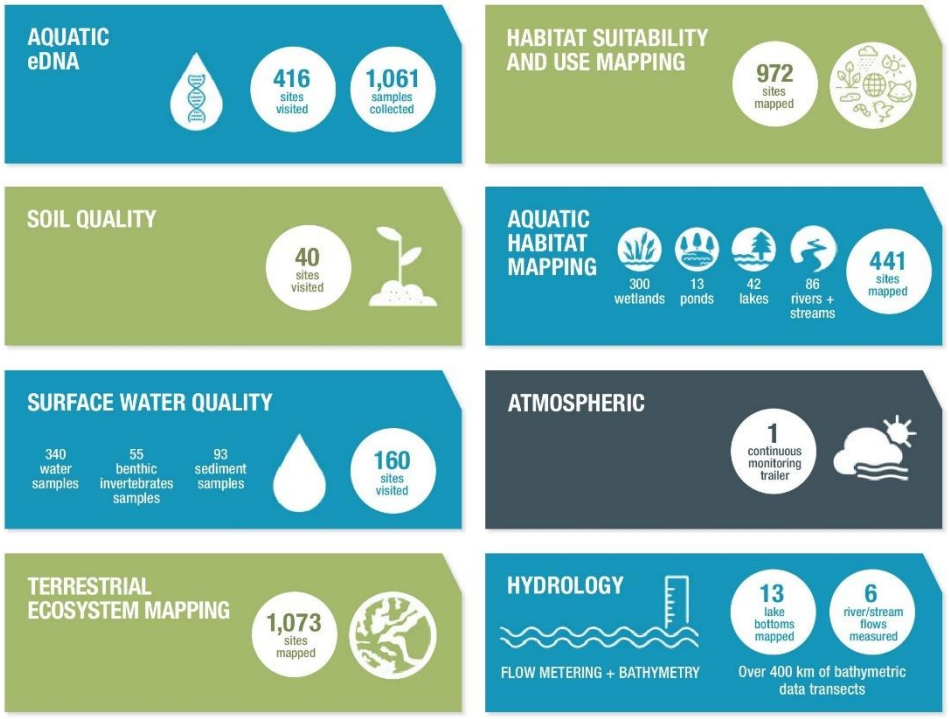
Draft Initial Project Description (2025 summary for engagement) 17

PROJECT HIGHLIGHTS TO DATE: ENVIRONMENTAL BASELINE

Regulatory decision-making requires that baseline environment data is collected and used in assessment and design planning before approval can be given for the site to be prepared for the deep geological repository. That process of studying the environmental baseline data is called "site characterization" by the Canadian Nuclear Safety Commission.

The NWMO has built an understanding of the Project site, by collecting, evaluating and modelling data about the regional geology since 2010. There have also been environmental studies conducted in the Project area since 2014.

The process of studying the environmental baseline data is called "site characterization" by the Canadian Nuclear Safety Commission.



This figure presents some of the baseline information gathered about the proposed Project site.

Draft Initial Project Description (2025 summary for engagement)
19

Highlights of components of the natural environment known to date from about 15 years of data collection

1. **Geochemistry:** When tested, rock core samples indicate that the rock does not have acid-generating or metal-leaching potential. The NWMO studied the complete chemical composition of whole rocks in the area, and their properties do not indicate the presence of dangerous minerals.

2. **Groundwater and surface water**
   - **Hydrogeology and hydrogeochemistry:** Hydrogeology and hydrochemistry are the study of groundwater. Hydrogeological and hydrogeochemical characteristics of the proposed site are favourable for the Project. At the depth where the repository would be built, water moves very slowly through the rock. This is based on tests from six deep boreholes which show that the rock lets very little water through — and even less the deeper you go.

     The composition of the groundwater samples, and the porewater (microscopic amounts of water trapped in rock) from core samples, show trends with depth that are consistent with expectations for a Canadian Shield environment.
   - **Hydrology:** Hydrology is the study of water movement. The site lies within the Wabigoon River watershed, which drains from Raleigh Lake northwest to Wabigoon Lake. Wabigoon Lake then drains towards Winnipeg River and Nelson River, eventually reaching Hudson Bay. The area surrounding the proposed Project contains several small, connected waterbodies that collectively drain into Mennin Lake. Mennin Lake flows north into Mennin River, and then northwest into Wabigoon River. The largest rivers in proximity to the proposed Project site are Mennin River located approximately two kilometres southwest of the proposed Project site and Revell River located approximately two kilometres to the north, which runs parallel with Highway 17. The confluence of Revell River and Wabigoon River is approximately six kilometres to the northwest of the site.
   - **Surface water quality:** The NWMO collects baseline surface water quality data quarterly. Water quality is normal with suitable dissolved oxygen, slightly acidic pH, and low to moderate clarity. Most contaminant-of-concern concentration levels are below guidelines, though some samples exceed guidelines for E. coli, phosphorus, aluminum, copper, manganese and mercury.

3. **Climate data:** Climate projections predict a 3 to 4 C increase in temperature by the 2050s and an approximate increase of 6 C by the 2080s. Precipitation is expected to increase by 50 to 75 mm/year by the 2050s and 100 to 125 mm/year by the 2080s.

4. **Background radiation:** In Canada, on average, 76 per cent of radiation exposure comes from naturally occurring radiation in soil and air. Average background radiation doses in Canada are estimated to be approximately 1.8 millisievert (mSv) per year, which is lower than the worldwide average of 2.4 mSv. Baseline radiation levels vary depending on location, elevation and other local geographic influences.

5. **Wildlife and wildlife habitat:** The NWMO is currently collecting baseline data for the characterization of land-based wildlife and habitat. Information will be presented for various wildlife groups within and surrounding the proposed Project site, including ungulates (moose), carnivores, small mammals, semi-aquatic mammals (e.g., beavers), bats, reptiles, amphibians, invertebrates and vegetation.
6. **Species at risk:** The NWMO is identifying species of conservation concern, including federally and provincially listed species at risk and provincially rare species. Potential species at risk include birds (Olive-sided Flycatcher, Common Nighthawk, Eastern Wood-pewee, Eastern Whip-poor-will), fish (American Eel), carnivores (American Badger, Wolverine, Grey Fox), bats (Little Brown Myotis, Northern Myotis), and vegetation (Black Ash). No critical habitat necessary for the survival or recovery of federally listed wildlife species at risk is known to occur at the proposed Project site.
7. **Birds, migratory birds and their habitat:** A total of 76 bird species were detected within and surrounding the proposed Project site, including five species at risk, 25 other priority species, 65 species protected by the *Migratory Birds Convention Act*, and one species that is afforded nest protection under the *Migratory Birds Regulations*.
8. **Fish and fish habitat:** Several important fish habitats, including spawning and nursery areas, were documented within the regional investigation area. Further work includes fish community surveys and benthic invertebrate studies to evaluate fish habitat within and surrounding the proposed Project site.

The Black-capped Chickadee is one of the bird species protected under the *Migratory Birds Convention Act* and *Migratory Birds Regulations*.

Next steps — Environmental baseline

Our current understanding of the natural environment at the proposed Project site indicates the site can meet the Project's requirements to safely contain and isolate used nuclear fuel to protect people and the environment.

The NWMO will advance additional site characterization and baseline data collection studies to further understand the baseline natural environment. These data will be used to optimize engineering designs for surface facilities and underground repository layouts.

PROJECT HIGHLIGHTS:
SOCIO-ECONOMIC AND HEALTH BASELINE

Socio-economic reporting, including effects of the NWMO's activities, on a community's way of life or on its social, cultural or economic aspirations is a mandatory requirement of the *Nuclear Fuel Waste Act*. The NWMO is required to report on it triennially under section 18 of that Act. This reporting will continue for the life of the Project.

The NWMO is also required to do an impact assessment on social, economic and health related components of the human environment. This assessment would include any impacts of the Project on the rights of Indigenous Peoples, requiring baseline data on a variety of human environment components.

Highlights of components of the human environment that are particularly important to understanding the impacts of the Project

1. **Population and demographics:** Population growth in the area has been generally flat since 1991, although this does not necessarily reflect population trends in individual communities. The communities share demographic trends between 1996 and 2021, including an aging population, slight decreases in the number of persons per census family and children living at home, and an increasing proportion of the population who identify as Indigenous.
2. **Land and resource use:** The natural environment is important to residents and visitors of the communities surrounding the Project site. Residents participate in several types of land and resource use activities, including fishing, hunting, trapping, gathering, hiking, ATVing, snowmobiling and boating. A cultural screening study for the NWMO's borehole drilling program at the proposed repository site in 2024 examined known archaeological and historic sites using the Ontario Archaeological Sites Database. The cultural screening noted that there were no known archaeological or historical sites in or near the borehole sites. Additional work should be conducted not only to confirm these results, but also to explore potential areas of cultural or historical significance to Wabigoon Lake Ojibway Nation.

Next steps — Socio-economic and health baseline

The NWMO will continue baseline data collection and reporting to meet the requirements of the *Nuclear Fuel Waste Act* and *Impact Assessment Act*. Most importantly, the NWMO will seek opportunities to work with communities to verify information collected to date, and seek opportunities to learn more via tailored, community-specific studies, including Indigenous Knowledge and land use studies where appropriate.

CONCEPTUAL SITE MODEL FOR THE BIOPHYSICAL ENVIRONMENT
SHALLOW ZONE
INTERMEDIATE ZONE
DEEP ZONE
METRES
0
100
200
300
400
Draft Initial Project Description (2025 summary for engagement)
23

PROJECT HIGHLIGHTS:
POTENTIAL EFFECTS OF THE PROJECT

The NWMO is preparing to submit an Initial Project Description to the Impact Assessment Agency of Canada to support an Impact Assessment under the *Impact Assessment Act*. The impact assessment will be integrated with the initial licence application to the Canadian Nuclear Safety Commission. In an impact assessment, the NWMO assesses the significance of impacts of the Project that remain after the implementation of mitigation measures on the following components that are within federal jurisdiction:

- Indigenous Peoples;
- Fish and fish habitat;
- Aquatic species at risk; and
- Migratory birds.

Further, the licensing under the *Nuclear Safety and Control Act*, which is integrated into the assessment, requires the NWMO to show how we will protect the environment and people when implementing the Project.

There are two opportunities in the impact assessment process for the NWMO to assess potential impacts and propose mitigation measures:

1. The Initial Project Description; and
2. The Impact Statement.

The NWMO is actively seeking participation from the host communities for the Project — Wabigoon Lake Ojibway Nation and the Township of Ignace — and from other First Nations and others in the region.

The NWMO is in the pre-planning phase of impact assessment, preparing the Initial Project Description report. The NWMO is actively seeking participation from the host communities for the Project — Wabigoon Lake Ojibway Nation and the Township of Ignace — and from other First Nations and others in the region on key themes of the Initial Project Description, which are summarized in this document.

The NWMO's engagement and opportunities to participate and provide feedback are ongoing throughout the process. A detailed overview of the Impact Assessment process is provided earlier in this report (see section *The Integrated Impact Assessment and Licensing process*).

Next steps — Potential effects of the Project

The Project has the potential to impact people and the environment (i.e., human and natural components of the environment), and the NWMO must study the pathways of those impacts as part of the regulatory process.

For an impact to occur, there must be a source (i.e., a project component or activity) that interacts with people and the environment. For the Initial Project Description, we have identified the following list of project-related activities that may have an impact on people and the natural environment, and need to be assessed as part of the impact assessment process:

- Land clearing during site preparation and construction;
- Blasting and excavation during site preparation and construction, and operations;
- Development and operations of surface facilities, the deep geological repository, the worker accommodation camp, the Excavated Rock Management Area during site preparation and construction, and operations;
- Materials handling during site preparation and construction, and operations;
- Vehicle traffic at the Project site during all Project phases; and
- Site water management and treatment (water taking, dewatering and treated water discharge) during all Project phases.

This list of Project interactions may be expanded upon through engagement with host communities, Indigenous communities, the public and regulators.

Preliminary screening assessment considerations and findings

These four conditions are the basis upon which the NWMO has made some preliminary assessments of the Project's impacts:

- No radiological materials will be on-site during site preparation and construction phases;
- Radiation safety will be subjected to rigorous Canadian Nuclear Safety Commission oversight and licensing during operations and closure;
- Effects, mitigation and monitoring during site preparation and construction will be similar to those of other infrastructure projects (such as mining and forestry) in northern Ontario; and
- As part of the screening assessment proposed in the Initial Project Description, potential changes are considered and mitigation proposed based on what has been approved on other projects with similar activities and impacts.

The NWMO will continue detailed safety assessments and a detailed quantitative human health and ecological risk assessment to confirm the safety case and that the Project will not have an adverse effect on people and the environment. These studies would be updated and submitted to the Canadian Nuclear Safety Commission at each licensing phase.

The draft Initial Project Description will share the following findings from the first level assessment of potential project impacts:

- For this Project, it is expected that best practices and standard mitigation will prevent changes or reduce the risk of impacts to fish and fish habitat, migratory birds and aquatic species at risk;
- For safety and security purposes, the Project will restrict access to land currently used by Indigenous Peoples for traditional land and resource use;
- Due to the storage of the used nuclear fuel, the Project may lead to perceptions of potential radioactive contamination that may result in alterations to traditional land use.

The impact assessment process will seek and confirm the extent of these impacts and on which communities, and assess the potential for impacts of the Project on other Indigenous communities as required by the *Impact Assessment Act*. The assessment would be tailored by community concerns, land use and pathways of impacts.

The NWMO welcomes feedback on the proposed approach and preliminary findings presented in this summary. The NWMO also welcomes the opportunity to learn more about how the Project may interact with people and the environment to allow further tailoring of the impact assessment.

Strategic assessment of climate change

The *Impact Assessment Act* requires a strategic assessment of climate change be completed for the Project to ensure climate change considerations are integrated into all stages of project planning and decision-making, ultimately contributing to more sustainable development and national climate goals.

The Project is critical to the life cycle of nuclear energy, which the federal government has identified as an important part of a low-carbon future in Canada. To maintain our commitment to protect people and the environment throughout our work, the NWMO will:

- Complete a best-available-technology assessment with the goal that the Project can become carbon neutral by 2050 during the estimated operations phase; and
- Develop and implement a credible net-zero plan that meets the requirements of the Government of Canada's strategic assessment of climate change.

Next steps for this work include additional climate change studies; optimizations to Project design; and engagement with the host communities, Indigenous communities and the public on the development of the net-zero plan.

What's next

- **Initial Project Description (IPD) submission:** Preparing an initial report that will describe the Project, current baseline conditions and potential interactions with people and the environment for regulatory and community review — the NWMO's submission of the Initial Project Description to the Impact Assessment Agency of Canada to formally initiate the Impact Assessment and Licensing process for the Project.
- **Regulatory engagement and participation:** Continuing the process of respectful relationship building with Wabigoon Lake Ojibway Nation, the Township of Ignace and surrounding communities.
- **Technical program advancement:** Advancing a site-specific design based on iterative feedback from safety, geoscience, environment and impact assessment studies and community input.
- **Technical assessments for the Integrated Impact Statement and Licence Application:** Preparing technical assessments for the Integrated Impact Statement and Licence Application throughout the impact statement phase of the impact assessment (about three years) and working collaboratively with the host communities, First Nations, and interested groups and individuals to develop mitigation measures and ensure transparency in findings. The Integrated Impact Statement and Licence Application is expected to be submitted approximately three years after the Initial Project Description is submitted.

Moving forward, the Deep Geological Repository for Canada's Used Nuclear Fuel Project will be subject to the *Impact Assessment Act* and many subsequent permits, licences and approvals that will be pursued by the NWMO during or after the Integrated Impact Assessment process.

- **Public hearing:** The Project will be subject to an independent panel of experts who will consider the impact statement, the views of various federal and provincial regulators, and the perspectives it hears from Indigenous communities and members of the public who participate. The hearing is a formal process where the Impact Assessment Agency of Canada, the Canadian Nuclear Safety Commission and others (such as Fisheries and Oceans Canada, Environment and Climate Change Canada, and Health Canada) review technical evidence to assess the safety of a proposed project or activity. It also provides an opportunity for Indigenous groups and the public to participate by presenting their views and concerns before an impact assessment or licensing decision is made.

Questions or feedback?

Your thoughts are welcome. Please submit your comments by Aug. 22, 2025, to RegulatoryFeedback@nwmo.ca or by mail to:

NWMO — IPD summary feedback
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3

See what's next, find out about upcoming in-person events and learn more at nwmo.ca/PlanningWithYou.

Together, we are working towards a safe, sustainable future for Canada's used nuclear fuel.

For more information, please contact:

Nuclear Waste Management Organization
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3, Canada
Tel.: 416.934.9814 Toll free: 1.866.249.6966
Email: contactus@nwmo.ca
Website: nwmo.ca

@nwmocanada
/company/nwmocanada

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

© 2025 Nuclear Waste Management Organization

Ébauche de Description initiale du projet : Projet de dépôt géologique en profondeur pour le combustible nucléaire irradié canadien

RÉSUMÉ DE 2025 À DES FINS DE CONCERTATION

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

PLANIFIONS ENSEMBLE, POUR PROTÉGER CE QUI COMPTE.

La Société de gestion des déchets nucléaires (SGDN) est une organisation à but non lucratif qui est chargée d'assurer la gestion à long terme sûre du combustible nucléaire irradié canadien, d'une manière qui protégera les gens et l'environnement pour les générations à venir. Le plan prévoit de confiner et d'isoler le combustible irradié dans un dépôt géologique en profondeur doté d'un système à barrières multiples.

Depuis le début de nos travaux, nous avons travaillé étroitement avec les peuples autochtones, les Canadiens, l'industrie, les autorités de réglementation et tous les ordres de gouvernement en vue de protéger les gens et l'environnement, dès maintenant et dans le futur. En novembre 2024, la Nation ojibwée de Wabigoon Lake et le canton d'Ignace ont accepté de progresser vers la phase de décision réglementaire à titre de collectivités hôtes potentielles d'un dépôt géologique en profondeur où serait stocké le combustible nucléaire irradié canadien, ou « le Projet ».

Le Projet est récemment passé au stade obligatoire du processus de décision réglementaire, ce qui marque un nouveau chapitre dans la mise en oeuvre du plan canadien de gestion du combustible nucléaire irradié. Ce processus offrira une autre occasion aux peuples autochtones et au public de faire entendre leur voix. L'objectif du processus réglementaire est de faire confirmer de manière indépendante la sûreté du dépôt par les organismes de réglementation, notamment par la Commission canadienne de sûreté nucléaire et l'Agence d'évaluation d'impact du Canada.

Le processus comprend une évaluation d'impact intégrée à un processus d'autorisation, ou de délivrance de permis. L'évaluation d'impact est un processus au cours duquel seront examinés les impacts que le dépôt géologique en profondeur pourrait avoir sur l'environnement, la santé, la situation socioéconomique et les droits des Autochtones avant que le projet soit approuvé. Pour garantir que toute activité nucléaire au Canada sera menée en toute sûreté, en protégeant les gens et l'environnement, et en respectant des règles rigoureuses, un permis doit être obtenu.

La première étape du processus réglementaire consiste pour la SGDN à rédiger et à présenter une Description initiale du projet à l'Agence d'évaluation d'impact du Canada. La présentation de ce texte marque le début officiel du processus réglementaire.

Une Description initiale du projet explique le but et la nécessité d'un projet, l'évaluation préliminaire des impacts et les moyens que l'entreprise prévoit prendre pour les éviter et les atténuer. La Description initiale du projet est la première des nombreuses étapes du processus rigoureux d'autorisation d'une installation nucléaire, qui comprend la concertation avec les peuples autochtones et les résidents locaux et régionaux.

La SGDN prépare actuellement ce document réglementaire et sollicitera activement des commentaires dans le cadre du processus.

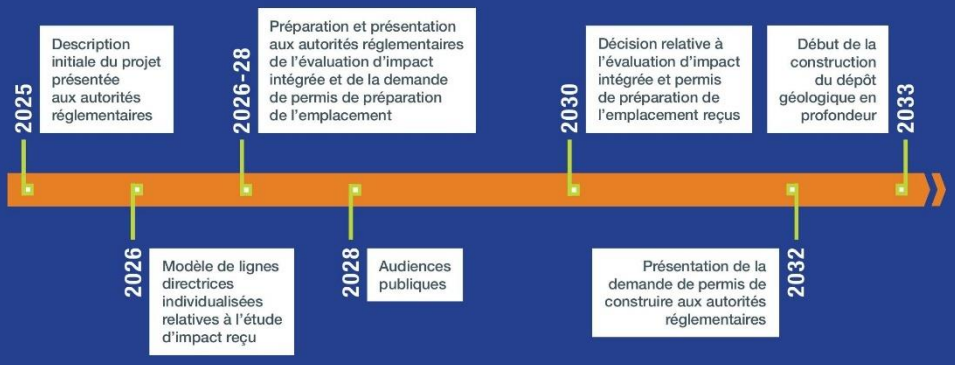


Table des matières

Introduction 2
À propos du projet 4
Le Processus intégré d'évaluation d'impact et d'autorisation 7
Avantages du Projet de dépôt géologique en profondeur 8
Poursuite de la concertation : dialogue, participation et collaboration continus 10
Comment les données de référence seront utilisées dans le cadre du processus de décision réglementaire 17
Considérations et conclusions de l'évaluation préliminaire 26
Évaluation stratégique des changements climatiques 27
Et maintenant? 28
Des questions ou des commentaires? 29

Introduction

En 2002, la Société de gestion des déchets nucléaires (SGDN) a été chargée, en vertu d'une loi fédérale, d'examiner les solutions possibles de gestion du combustible nucléaire irradié et d'en recommander une. En 2005, au terme d'un processus d'étude et de dialogue mené pendant trois ans avec des peuples autochtones et des Canadiens de tout le pays, nous avons présenté notre recommandation au ministre fédéral des Ressources naturelles. En juin 2007, le gouvernement fédéral a choisi le plan que nous mettons actuellement à l'oeuvre, appelé la Gestion adaptative progressive, comme plan canadien de gestion à long terme sûre du combustible nucléaire irradié.

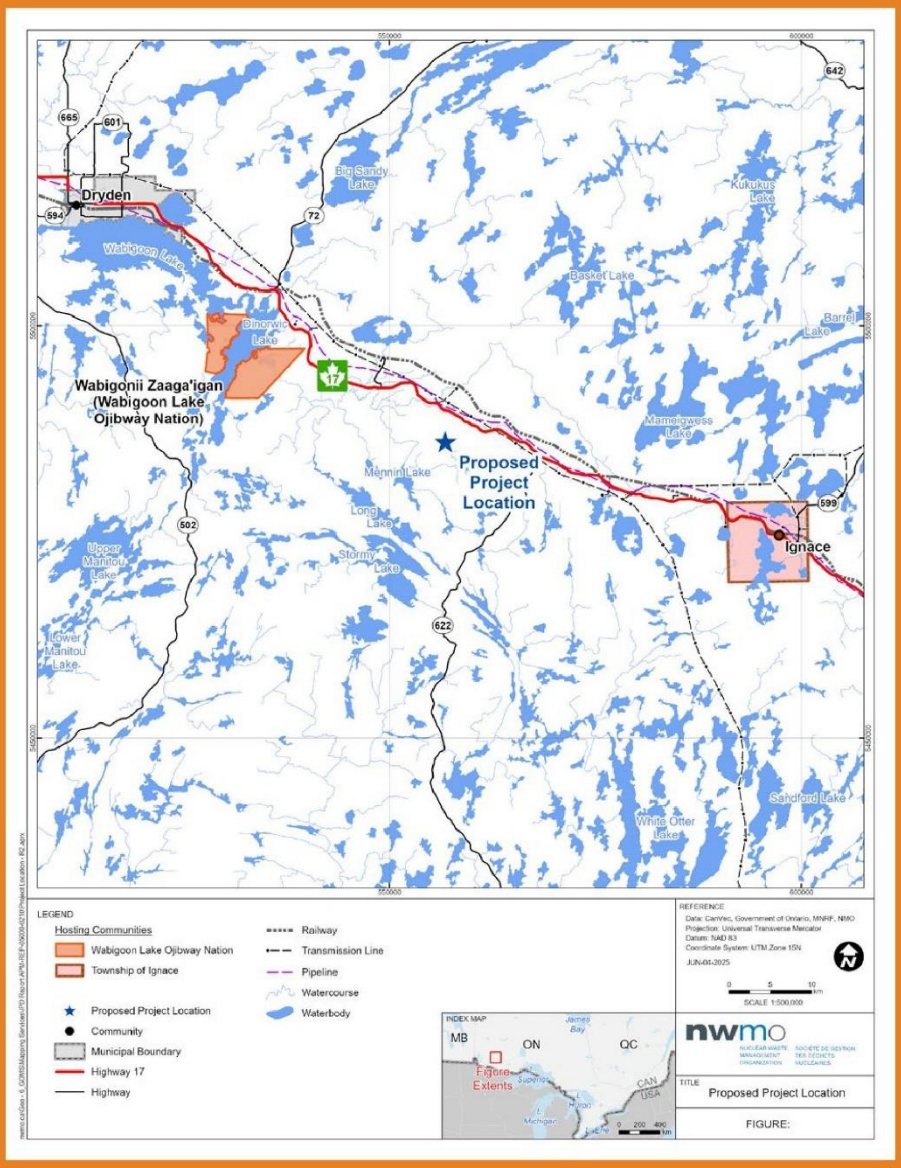
À l'issue d'un processus de sélection d'un site qui aura duré 14 ans, la Nation ojibwée de Wabigoon Lake et le canton d'Ignace ont accepté de progresser vers la phase de décision réglementaire à titre de collectivités hôtes potentielles d'un dépôt géologique en profondeur où serait stocké le combustible nucléaire irradié canadien.

Nous poursuivons maintenant la mise en oeuvre du plan canadien de gestion sûre du combustible nucléaire irradié dans un dépôt géologique en profondeur, sous réserve des approbations réglementaires requises. Le Projet propose l'aménagement d'une installation souterraine rigoureusement conçue pour confiner et isoler en toute sûreté le combustible nucléaire irradié pour une durée essentiellement indéfinie.

Le présent document fait état des faits saillants des travaux menés par la SGDN dans le cadre de la phase de préplanification de l'évaluation d'impact et de la demande d'autorisation, y compris des progrès réalisés sur le plan de la sûreté technique et de la conception, des activités de concertation, des considérations environnementales et des étapes qui suivront à mesure que le Projet de dépôt géologique en profondeur pour le combustible nucléaire irradié canadien progressera vers la prise de décisions réglementaires.

En 2005, au terme d'un processus d'étude et de dialogue mené pendant trois ans avec des peuples autochtones et des Canadiens de tout le pays, nous avons présenté notre recommandation au ministre fédéral des Ressources naturelles.

EMPLACEMENT PROPOSÉ POUR LE PROJET



À propos du projet

Le Projet de dépôt géologique en profondeur pour le combustible nucléaire irradié canadien :

- Permettra d'assurer la gestion à long terme sûre d'un maximum de 5,9 millions de grappes de combustible nucléaire irradié;
- Sera situé au sein d'une formation rocheuse stable afin de confiner et d'isoler naturellement le combustible nucléaire irradié pendant des centaines de milliers d'années;
- Sera mis en oeuvre en collaboration avec les Premières Nations et les municipalités.

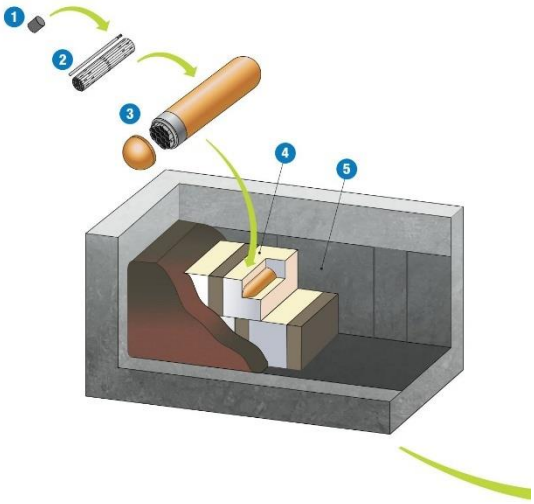
Le Projet s'appuiera sur un système à barrières multiples. Ce système comprend une série de barrières ouvragées et naturelles qui se conjugueront pour confiner et isoler de manière sûre le combustible nucléaire irradié dans le dépôt.

Chaque barrière fournira un niveau de protection unique et autonome, tout en servant de filet de sécurité à la barrière précédente. Si l'une de ces barrières venait à faire défaillance ou à être moins efficace que prévu, la barrière suivante assurerait la relève, assurant ainsi le confinement et l'isolement des matières stockées.

Des normes de sûreté rigoureuses encadreront le Projet. La SGDN est résolue à satisfaire à toutes les exigences réglementaires fédérales et provinciales applicables afin de protéger la santé, la sûreté et la sécurité des gens et de l'environnement pour les générations à venir.

Le système à barrières multiples

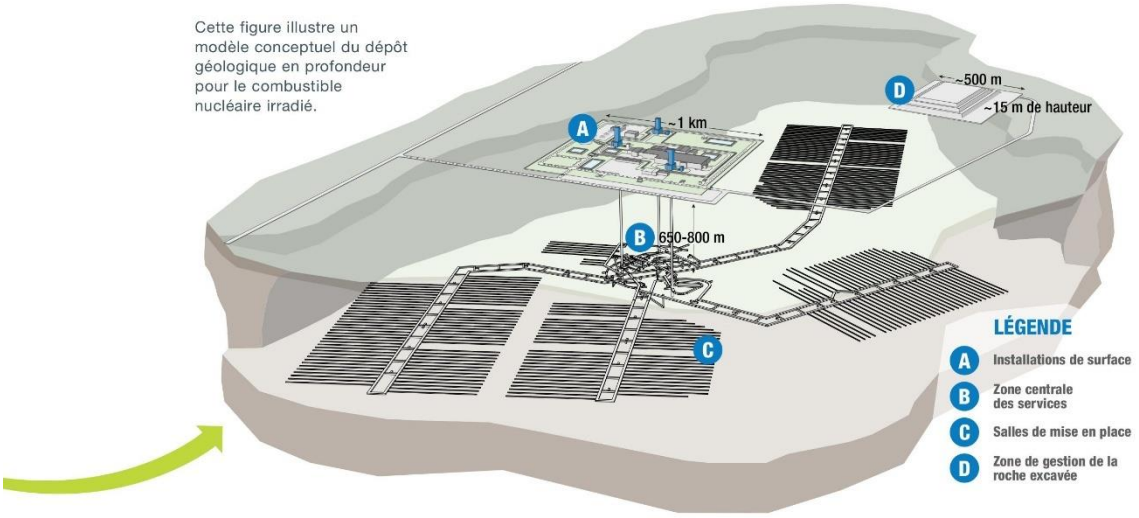
1. **Pastille de combustible** — une céramique solide très stable d'uranium cuit.
2. **Grappe de combustible** — fabriquée à partir d'un matériau hautement résistant à la corrosion appelé Zircaloy.
3. **Conteneur en acier revêtu de cuivre** — conçu pour résister à la corrosion et suffisamment résistant pour complètement confiner le combustible nucléaire irradié jusqu'à ce que sa radioactivité ait diminué à un niveau sécuritaire.
4. **Boîte d'argile de bentonite** — matériau à base d'argile hautement compactée qui enchâssera chaque conteneur et qui servira à remblayer le dépôt.
5. **La roche elle-même** — qui protégera le dépôt contre les événements naturels perturbateurs, l'écoulement de l'eau et les intrusions humaines involontaires.



PLUS D'INFORMATIONS SUR LE DÉPÔT GÉOLOGIQUE EN PROFONDEUR POUR LE COMBUSTIBLE NUCLÉAIRE IRRADIÉ CANADIEN

- La roche hôte est stable et son comportement sera prévisible pendant une très longue période.
- La roche hôte présente une faible perméabilité, ce qui signifie que les infimes traces d'eau présentes dans la roche en profondeur resteront isolées et ne se mélangeront pas aux eaux de surface.
- Le système de dépôt géologique en profondeur maintiendrait un environnement favorable à la stabilité et au rendement du dépôt.
- Des exemples d'endroits dans la nature présentant des conditions géologiques similaires en profondeur prouvent que les composants du système de barrières ouvragées resteront stables pendant une très longue période.
- La profondeur du dépôt rend très improbable toute intrusion humaine accidentelle future dans le dépôt une fois celui-ci fermé.
- Plusieurs pays dans le monde mettent actuellement en place des dépôts semblables — ce Projet s'appuie sur un consensus scientifique et sur l'expérience acquise dans le monde entier.
- Les études de cas sur la sûreté indiquent que tout éventuel impact radiologique sera probablement nettement inférieur aux débits de doses de rayonnements naturels.
- Le dépôt géologique en profondeur peut être construit et exploité en toute sûreté à l'aide de technologies éprouvées.
- Les radionucléides présents dans le combustible irradié se désintègrent, ce qui les rendra moins dangereux avec le temps.
- Le site du dépôt peut être surveillé afin de confirmer que le dépôt se comporte comme prévu.

Cette figure illustre un modèle conceptuel du dépôt géologique en profondeur pour le combustible nucléaire irradié.



BUT DU PROJET

Le Projet protégera les gens et l'environnement en assurant la gestion à long terme sûre du combustible nucléaire irradié. La SGDN propose d'assurer la préparation de l'emplacement, la construction, l'exploitation, le déclassement et la fermeture du dépôt géologique en profondeur pour le combustible nucléaire irradié canadien afin d'isoler de manière sûre approximativement 5,9 millions de grappes de combustible nucléaire irradié. Le Projet serait autorisé par la Commission canadienne de sûreté nucléaire, pour une période d'approximativement 160 ans.

COMPRENDRE L'ÉNERGIE NUCLÉAIRE AU CANADA

L'énergie nucléaire représente 15 pour cent de la production d'électricité au Canada. Le pays compte actuellement quatre centrales nucléaires et 19 réacteurs CANDU (Canada Deuterium Uranium) en service. Depuis plusieurs années, le Canada est un chef de file dans le domaine de la recherche et de la technologie nucléaires. Il exporte des systèmes de réacteurs développés au Canada et fournit une grande partie de l'approvisionnement mondial en radioisotopes, qui sont utilisés pour des diagnostics médicaux et le traitement du cancer.

L'énergie nucléaire offre une source d'énergie fiable qui contribue à une croissance économique durable et à l'amélioration du bien-être humain. Le gouvernement du Canada a clairement indiqué que l'énergie nucléaire jouera un rôle essentiel dans la décarbonisation du Canada et dans sa capacité à atteindre la carboneutralité d'ici 2050. La croissance des investissements canadiens dans le secteur nucléaire contribuera à renforcer notre sécurité énergétique actuelle et future.

À l'heure actuelle, le combustible nucléaire irradié au Canada est géré dans des installations autorisées pour l'entreposage provisoire. Cette approche est sûre, mais compte tenu de la longue période pendant laquelle le combustible nucléaire irradié restera dangereux, elle ne constitue pas une solution permanente, car elle nécessite un entretien et une gestion continus. C'est pourquoi la SGDN adhère aux meilleures pratiques internationales pour construire un dépôt géologique en profondeur afin de confiner et d'isoler en toute sûreté le combustible nucléaire irradié à très long terme.

CALENDRIER PRÉVU DE MISE EN OEUVRE DU PLAN

La mise en oeuvre du plan canadien s'étalera sur une période d'environ 160 ans. Il faudra environ 10 ans pour préparer l'emplacement et construire le dépôt géologique en profondeur, dont la mise en service devrait avoir lieu vers le milieu des années 2040. Le dépôt géologique en profondeur sera exploité pendant environ 50 ans. Le dépôt sera subséquemment surveillé pendant une longue période, après quoi il sera déclassé et fermé, et la période de surveillance post-fermeture commencera.

Pendant toute la durée du Projet, la SGDN maintiendra l'engagement que nous avons pris envers les collectivités hôtes et la région environnante de contribuer à leur bien-être à long terme. Il faudra pour cela comprendre et analyser les impacts que le Projet pourrait avoir sur les conditions sociales et économiques, y compris sur l'emploi et les possibilités d'emploi.

PHASES DU PROJET ET CALENDRIER DE PLANIFICATION PRÉVUS

Phase du projet	Calendrier approximatif (années)	Durée de la phase (années)
Préparation de l'emplacement et construction	2030-42	13
Exploitation	2043-92	50
Surveillance prolongée, déclassement et fermeture	2093-2192	100
Contrôles institutionnels[1]	2193 et +	

[1] Le contrôle de tous les risques liés à un site après son déclassement et sa fermeture, assuré notamment au moyen d'activités telles que la surveillance, la maintenance ou la mise en place de panneaux/balises.

Le Processus intégré d'évaluation d'impact et d'autorisation

Le Projet fera l'objet d'un processus d'évaluation d'impact approfondi, qui sera coordonné par l'Agence d'évaluation d'impact du Canada et intégré au processus de demande initiale de permis à la Commission canadienne de sûreté nucléaire.

Ce processus intégré permettra de s'assurer que des détails tels que les impacts sur les récoltes, la chasse et les modes de vie autochtones sont pris en compte, parallèlement à toute incidence possible sur l'ensemble des facteurs environnementaux, sanitaires, sociaux et économiques.

Le Projet en est actuellement à la phase de préplanification et l'évaluation d'impact n'a pas encore débuté. Les commentaires préliminaires des collectivités hôtes, des collectivités autochtones de la région et du public en général contribueront à l'élaboration de notre Description initiale du projet, le document que nous présenterons aux organismes de réglementation, ainsi qu'à l'établissement de la voie à suivre en ce qui concerne le processus décisionnel.

L'évaluation préliminaire et les stratégies proposées pour l'atténuation des impacts potentiels décrits dans l'ébauche de la Description initiale du projet nécessiteront la participation des collectivités hôtes, des collectivités autochtones, des groupes et des personnes intéressés, ainsi que des organismes de réglementation. Les résultats de l'évaluation serviront à adapter les lignes directrices relatives à l'étude d'impact pour le Projet, qui seront émises par l'Agence d'évaluation d'impact du Canada.

La Description initiale du projet n'est qu'une étape d'examen préliminaire. L'Étude d'impact qui suivra la Description initiale du projet devra décrire le projet désigné, ses principaux éléments et les activités connexes, le calendrier détaillé, le moment prévu de réalisation de chaque phase du projet et d'autres caractéristiques importantes.

Lors de la rédaction de l'Étude d'impact, nous nous efforcerons également à la SGDN d'aligner respectueusement nos travaux sur le savoir autochtone et les études sur l'utilisation des terres dans les évaluations des impacts et la conception des stratégies d'atténuation, afin que le Projet serve les intérêts de la Nation ojibwée de Wabigoon Lake, du canton d'Ignace ainsi que des autres collectivités autochtones et du public de la région.

La prochaine décennie de notre travail sera axée sur la participation au rigoureux processus de décision réglementaire, dans lequel nous devrons démontrer que nous pourrons tenir notre promesse de protéger durablement les gens et l'environnement. Nous sommes reconnaissants de l'étroite collaboration que nous entretenons avec les peuples autochtones, les Canadiens, l'industrie et les organismes de réglementation, une collaboration qui contribuera à notre réussite.

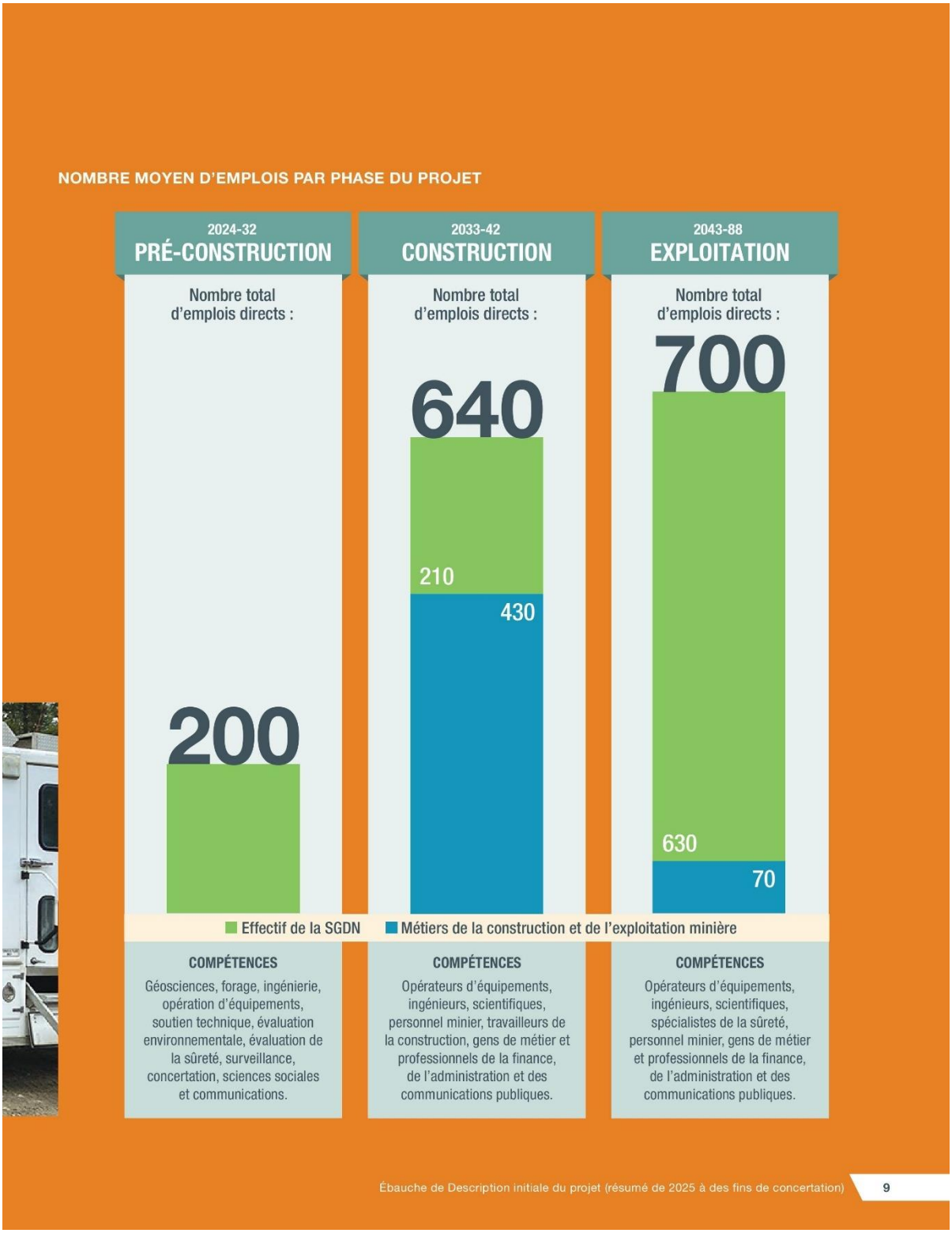
— Mackenzie Denyes, directrice d'évaluation d'impact et d'autorisation à la SGDN

Avantages du Projet de dépôt géologique en profondeur

En plus d'aider le Canada à atteindre ses objectifs de carboneutralité et de sécurité énergétique, le Projet créera et maintiendra des emplois de qualité dans le nord-ouest de l'Ontario, et au-delà, en soutenant une chaîne d'approvisionnement hautement technique et diversifiée, et générera des retombées économiques importantes dans les collectivités régionales. Les collectivités hôtes, la région et le Canada dans son ensemble tireront un large éventail d'avantages au cours de la période d'approximativement 160 années que durera la réalisation de ce projet d'infrastructure nationale. Le Projet créera plusieurs centaines d'emplois, dont beaucoup seront nécessaires pendant plus d'une génération. Il nécessitera des ressources humaines, des équipements et des matériaux pour soutenir la construction et l'exploitation de l'installation.

Comme ce projet multigénérationnel sera mis en oeuvre en plusieurs phases au cours d'une période d'approximativement 160 ans, nous examinerons, renforcerons et ajusterons continuellement le plan en tenant compte des nouvelles informations, orientations et directives à mesure qu'elles deviendront disponibles. Nous sommes résolus à mettre en oeuvre le Projet de manière sûre afin de respecter le *Règlement général sur la sûreté et la réglementation nucléaires* (DORS/2000-202).

Le Projet créera plusieurs centaines d'emplois, dont beaucoup seront nécessaires pendant plus d'une génération.


NOMBRE MOYEN D'EMPLOIS PAR PHASE DU PROJET
2024-32
PRÉ-CONSTRUCTION
Nombre total d'emplois directs :
200
2033-42
CONSTRUCTION
Nombre total d'emplois directs :
640
210
430
2043-88
EXPLOITATION
Nombre total d'emplois directs :
700
630
70
Effectif de la SGDN
Métiers de la construction et de l'exploitation minière
COMPÉTENCES
Géosciences, forage, ingénierie, opération d'équipements, soutien technique, évaluation environnementale, évaluation de la sûreté, surveillance, concertation, sciences sociales et communications.
COMPÉTENCES
Opérateurs d'équipements, ingénieurs, scientifiques, personnel minier, travailleurs de la construction, gens de métier et professionnels de la finance, de l'administration et des communications publiques.
COMPÉTENCES
Opérateurs d'équipements, ingénieurs, scientifiques, spécialistes de la sûreté, personnel minier, gens de métier et professionnels de la finance, de l'administration et des communications publiques.
Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation)
9

Poursuite de la concertation : dialogue, participation et collaboration continus

La concertation et l'établissement de relations avec les collectivités autochtones, le public et les parties intéressées demeureront au coeur de ce Projet. Les activités passées, actuelles et futures comprennent :

- **La mise en oeuvre des accords d'hébergement du dépôt :** la collaboration avec la Nation ojibwée de Wabigoon Lake et le canton d'Ignace, y compris les investissements dans la formation, l'éducation et le développement des compétences. Ces sujets sont abordés dans les accords d'hébergement du dépôt, notamment la manière dont nous pouvons avancer ensemble dans le processus réglementaire.
- **Les activités de concertation et de participation liées à la réglementation :** les efforts continus visant à informer de manière transparente et à recueillir des commentaires sur la façon dont le Projet sera mené. Cette concertation et cette participation viseront à obtenir des commentaires sur les impacts potentiels du Projet. Les commentaires recueillis dans le cadre des activités de concertation réglementaire sur la conception, la mise en oeuvre et la surveillance du Projet sont importants, car ils contribueront à assurer que le Projet protège l'environnement, respecte la culture, préserve l'eau et génère des avantages à long terme dans les collectivités locales.
- **Communications et information :** la transmission aux collectivités autochtones, au public et aux parties intéressées de renseignements clairs, opportuns et accessibles sur les activités et les progrès de la SGDN. Cela comprendra des mises à jour régulières, des occasions de discussions bidirectionnelles, la publication de documents et d'autres ressources pour aider les collectivités à se tenir informées et au courant de l'évolution du Projet.

Les thèmes et les préoccupations clés soulevés pendant le processus de sélection d'un site continueront d'être abordés dans le cadre des activités de concertation qui seront menées au cours du processus réglementaire. Ils incluront les éléments suivants :

- L'importance de protéger les ressources en eau et l'environnement naturel;
- Les demandes d'engagements clairs en matière de sûreté, de santé et de protection de l'environnement;
- L'intérêt pour les possibilités à long terme de développement économique et de renforcement des capacités;
- L'importance accordée à la participation des collectivités à la surveillance et à la supervision;
- L'appui à un alignement respectueux sur le savoir autochtone, en même temps que sur la science occidentale, dans la mesure où les collectivités sont disposées à partager ce savoir;
- La protection de la sagesse ancestrale des détenteurs du savoir autochtone en tant que leur propriété intellectuelle souveraine.

La SGDN continue de maintenir des canaux de communication et de concertation avec les collectivités hôtes, les autres collectivités autochtones et municipales, ainsi qu'avec le public, et nous continuerons de le faire à chaque étape du Projet. Dans les activités de concertation que la SGDN mènera dans le cadre de l'évaluation des impacts du Projet et du processus d'autorisation, nous solliciterons des commentaires et la participation du public sur les sujets suivants et d'autres :

- Les programmes de collection de données de référence;
- Les activités liées au Projet et leurs interactions avec les gens et l'environnement;
- Les mesures d'atténuation proposées pour éviter les impacts négatifs ou les possibilités d'accroître les avantages;
- Les futurs programmes de suivi et de surveillance réglementaire.

Dans la continuité des années de concertation passées, la SGDN mènera, du 17 juillet au 22 août 2025, des activités de sensibilisation spécialement adaptées aux collectivités hôtes, aux collectivités autochtones et aux autres groupes et personnes intéressés.

Ces activités comprendront des séances d'information et des webinaires, des mises à jour du site Web et des communications sur les médias sociaux, ainsi qu'une période de commentaires.

CONCERTATION ET PARTICIPATION DES PEUPLES AUTOCHTONES

La SGDN demeure résolue à établir et à maintenir des relations solides et durables avec les Premières Nations et les peuples autochtones, notamment des relations soutenues avec les organisations autochtones nationales et provinciales, afin d'assurer la poursuite d'un dialogue continu et significatif.

Conformément aux enseignements reçus des aînés, des détenteurs du savoir autochtone, des peuples autochtones et des collectivités autochtones, les objectifs de concertation et de participation des Autochtones reliées au Projet seront les suivants :

- Amplifier et valoriser la voix et les systèmes de connaissances des Autochtones;
- S'aligner respectueusement sur les perspectives et le savoir autochtones dans la planification et la prise de décisions relatives au projet;
- Établir des relations respectueuses fondées sur la vérité, l'honnêteté et la confiance réciproques;
- Créer des occasions de participation, de collaboration et de partenariat équitables.

La SGDN demandera aux peuples autochtones de nous transmettre leur savoir autochtone, dans la mesure où ils le souhaitent. La SGDN veillera à protéger la propriété intellectuelle des Autochtones, conformément aux ententes conclues avec les peuples autochtones qui auront choisi de transmettre leur savoir.

Le Projet est situé sur le territoire de la Nation ojibwée de Wabigoon Lake. Son consentement à ce que les prochaines étapes du Projet aillent de l'avant sur son territoire était nécessaire pour prendre une décision quant au choix d'un site pour le Projet et pour que la SGDN puisse avancer au stade du processus de décision réglementaire. Dans le cadre de l'accord d'hébergement du dépôt, la SGDN a accepté que la Nation ojibwée de Wabigoon Lake mène son propre Processus d'évaluation et d'approbation réglementaire du Projet. La SGDN est résolue à respecter la souveraineté de la Nation ojibwée de Wabigoon Lake tout au long de la mise en oeuvre du Projet.

Le Projet est situé sur le territoire de la Nation ojibwée de Wabigoon Lake. Son consentement à ce que les prochaines étapes du Projet aillent de l'avant sur son territoire était nécessaire pour prendre une décision quant au choix d'un site pour le Projet et pour que la SGDN puisse avancer au stade du processus de décision réglementaire.

La SGDN reconnaît l'importance des relations nouées avec les autres collectivités autochtones de la région d'accueil du Projet proposé. La SGDN s'efforcera de maintenir ces relations existantes et d'en établir de nouvelles. La SGDN s'engage à communiquer, à travailler en concertation et à participer de manière approfondie avec les autres collectivités autochtones, ainsi qu'à appliquer nos politiques sur la réconciliation et le savoir autochtone de même que notre Cadre éthique et social.

La SGDN reconnaît et respecte le fait que les peuples autochtones entretiennent un rapport particulier avec l'environnement naturel et ont des responsabilités uniques d'intendance qui en découlent.

Nuclear Waste Management Organization:
Conversation Corner
LEARN MORE
Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation)
13

PARCOURS DE RÉCONCILIATION DE LA SGDN

La SGDN a entrepris un cheminement vers la réconciliation. En 2019, dans le cadre de ce cheminement, nous avons créé une *Politique sur la réconciliation*, qui a été officialisée lors d'une cérémonie. Elle définit la manière dont l'organisation contribuera à la réconciliation. Par le biais de cette politique, la SGDN s'est engagée à ouvrir un dialogue respectueux et constructif avec les peuples et les collectivités autochtones et à fournir une formation de sensibilisation à la culture autochtone et à la réconciliation à notre personnel et à nos travailleurs contractuels.

De plus, la SGDN a publié en 2016 et mis à jour en 2020 une *Politique sur le savoir autochtone* afin de nous assurer que nous sommes guidés par un ensemble de principes clairs dans le cadre de notre travail avec les collectivités et les détenteurs du savoir autochtone. Par le biais de cette politique, la SGDN s'est engagée à tenir compte du savoir autochtone dans notre travail et à respecter la valeur que les systèmes de connaissances autochtones peuvent apporter à l'élaboration du projet et aux processus décisionnels.

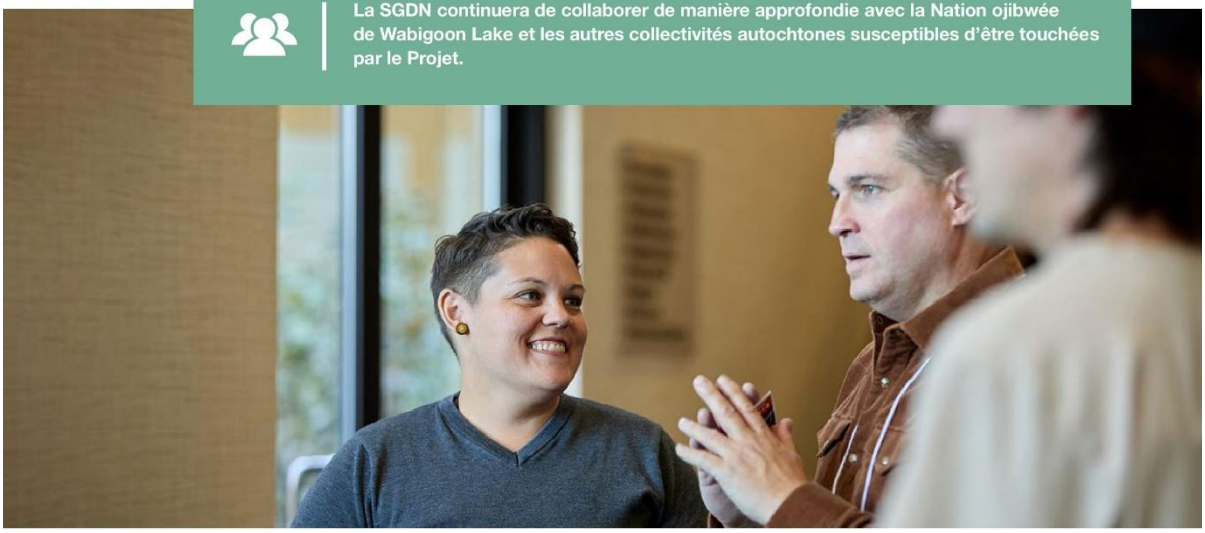
En 2023, la SGDN a publié une Déclaration sur l'eau qui réaffirme notre engagement à protéger l'eau en tenant compte de l'agentivité que peut avoir l'eau (de surface et souterraine) en relation avec le futur dépôt géologique en profondeur canadien et la région environnante. La Déclaration sur l'eau est un document complémentaire à l'Énoncé de responsabilité environnementale de la SGDN.

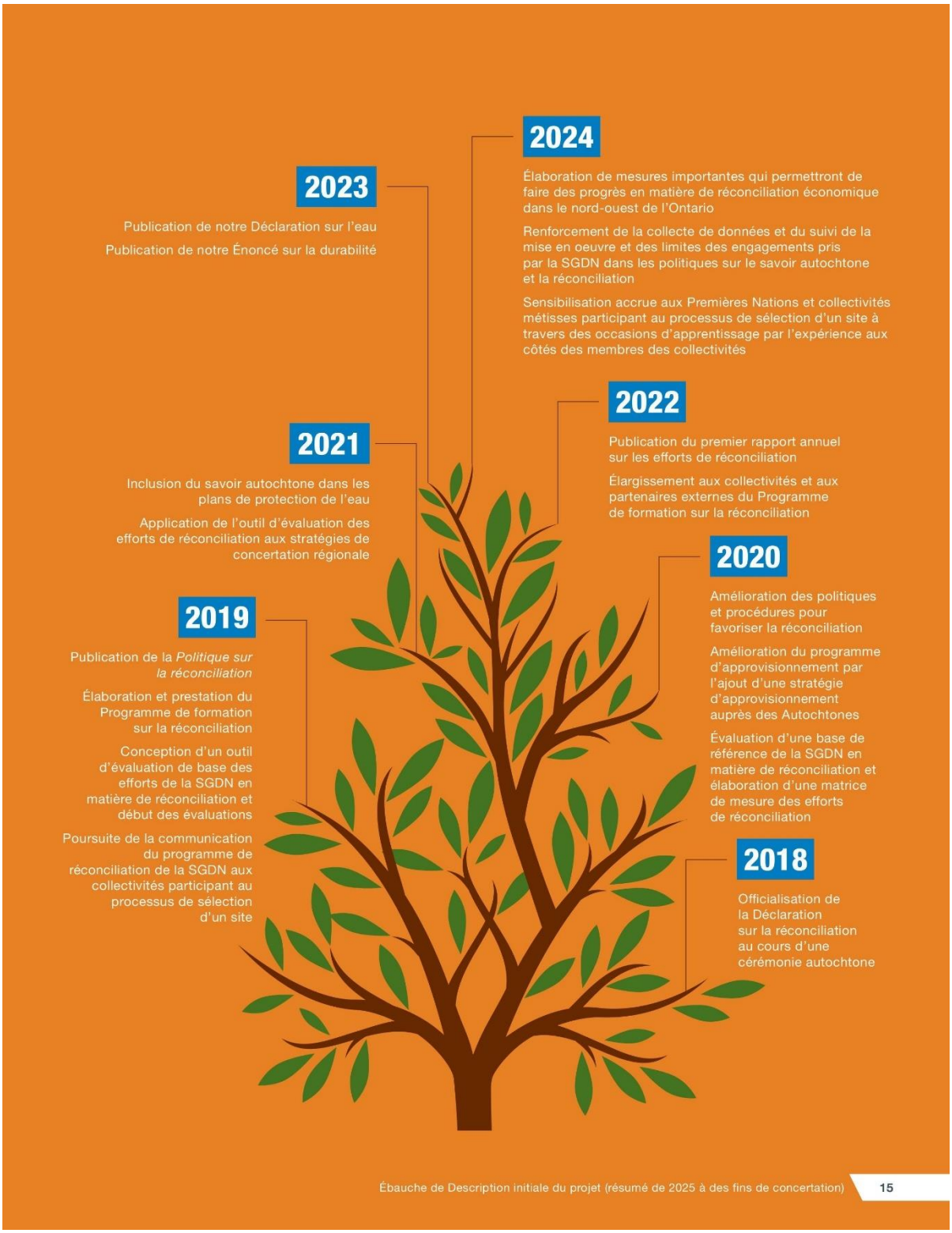
La SGDN continuera d'appliquer le savoir autochtone aux aspects du Projet liés à la sûreté technique et au bien-être des collectivités lorsque les détenteurs de ce savoir nous en donneront la permission.

La SGDN continuera de collaborer de manière approfondie avec la Nation ojibwée de Wabigoon Lake et les autres collectivités autochtones susceptibles d'être touchées par le Projet afin de cerner et de comprendre les impacts possibles du Projet sur les peuples autochtones et leurs droits, y compris leurs terres, leurs territoires et leurs ressources, de même que de nous aligner sur le savoir autochtone.

Pour en savoir plus sur notre cheminement vers la réconciliation, veuillez consulter la page nwmo.ca/fr/reconciliation.

La SGDN continuera de collaborer de manière approfondie avec la Nation ojibwée de Wabigoon Lake et les autres collectivités autochtones susceptibles d'être touchées par le Projet.




2024
Élaboration de mesures importantes qui permettront de faire des progrès en matière de réconciliation économique dans le nord-ouest de l'Ontario
Renforcement de la collecte de données et du suivi de la mise en oeuvre et des limites des engagements pris par la SGDN dans les politiques sur le savoir autochtone et la réconciliation
Sensibilisation accrue aux Premières Nations et collectivités métisses participant au processus de sélection d'un site à travers des occasions d'apprentissage par l'expérience aux côtés des membres des collectivités
2023
Publication de notre Déclaration sur l'eau
Publication de notre Énoncé sur la durabilité
2022
Publication du premier rapport annuel sur les efforts de réconciliation
Élargissement aux collectivités et aux partenaires externes du Programme de formation sur la réconciliation
2021
Inclusion du savoir autochtone dans les plans de protection de l'eau
Application de l'outil d'évaluation des efforts de réconciliation aux stratégies de concertation régionale
2020
Amélioration des politiques et procédures pour favoriser la réconciliation
Amélioration du programme d'approvisionnement par l'ajout d'une stratégie d'approvisionnement auprès des Autochtones
Évaluation d'une base de référence de la SGDN en matière de réconciliation et élaboration d'une matrice de mesure des efforts de réconciliation
2019
Publication de la *Politique sur la réconciliation*
Élaboration et prestation du Programme de formation sur la réconciliation
Conception d'un outil d'évaluation de base des efforts de la SGDN en matière de réconciliation et début des évaluations
Poursuite de la communication du programme de réconciliation de la SGDN aux collectivités participant au processus de sélection d'un site
2018
Officialisation de la Déclaration sur la réconciliation au cours d'une cérémonie autochtone
Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation)
15

CONCERTATION ET PARTICIPATION DU PUBLIC

En plus de travailler en concertation avec les collectivités autochtones, la SGDN collabore depuis plus de deux décennies avec des groupes et des personnes intéressés, ainsi qu'avec un large éventail de parties prenantes, notamment la municipalité hôte (le canton d'Ignace) et d'autres municipalités, entreprises, fournisseurs de services et organisations environnementales.

La concertation publique a pour objectif de permettre la tenue de discussions précoces liées au site hôte et d'éclairer la conception du Projet par le biais de diverses concertations sur la Description initiale du projet. Pour atteindre cet objectif, la SGDN :

- Cernera les intérêts du public et des parties concernées en discutant de manière précoce avec les collectivités;
- Apprendra à connaître les préférences du public au regard des méthodes de concertation;
- Mènera des activités de concertation sur des résultats particuliers en vue d'obtenir des commentaires;
- Intégrera les commentaires reçus pour orienter les éléments du Projet et assurer une consignation et une déclaration transparentes de l'information.

La SGDN tiendra des séances ouvertes pour donner aux membres du public qui n'ont pas encore commencé à échanger avec la SGDN l'occasion de participer à la conversation.

Maintenant que le site est choisi, le public peut donner son avis de plusieurs façons, notamment en participant à des séances d'information ou à des webinaires, en se rendant au Centre *En savoir plus* d'Ignace ou en nous envoyant des commentaires par écrit. Pour plus d'informations sur les possibilités de donner son avis, consultez le site nwmo.ca/planifionsensemble.

Comment les données de référence seront utilisées dans le cadre du processus de décision réglementaire

Des études de collecte de données de référence sur les environnements naturels et humains sont en cours et se poursuivront tout au long du processus de décision réglementaire. Des activités de surveillance environnementale continueront d'être menées pour recueillir des données qui décrivent les conditions existantes de nombreuses composantes de l'environnement.

Une bonne compréhension des conditions de référence permettra de prévoir l'impact que le projet pourrait avoir sur les gens et l'environnement. Des mesures pourront alors être envisagées pour éviter, gérer, atténuer et, dans certains cas, compenser les impacts négatifs.

La Description initiale du projet résumera plusieurs années de données de référence et utilisera ces données pour éclairer les mesures d'atténuation potentielles (abordées dans la section suivante).

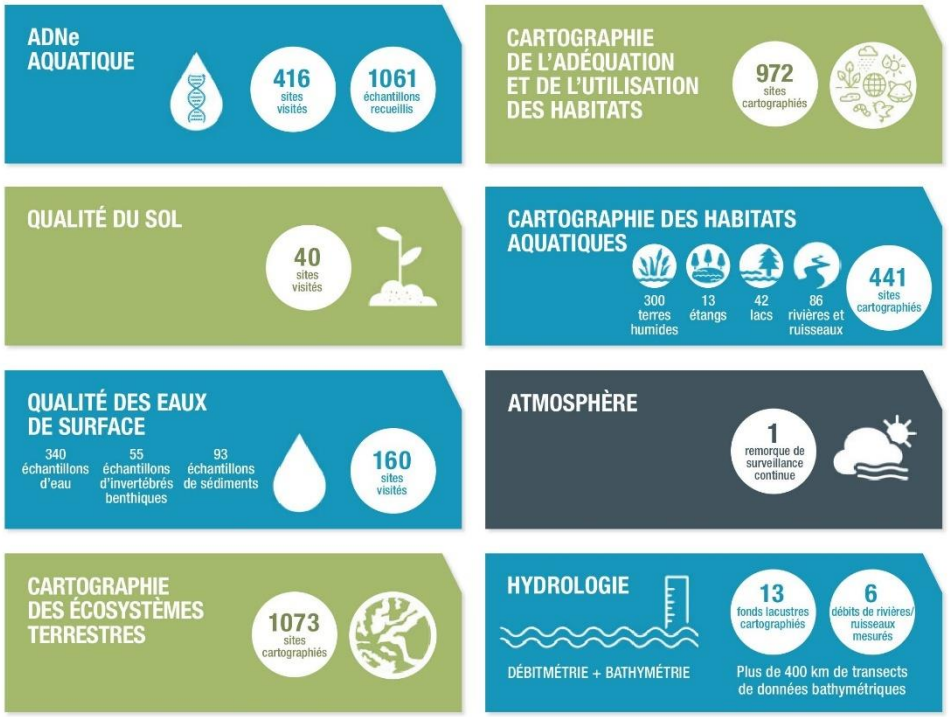
Des activités de surveillance environnementale continueront d'être menées pour recueillir des données qui décrivent les conditions existantes de nombreuses composantes de l'environnement.

POINTS SAILLANTS DU PROJET À CE JOUR : DONNÉES ENVIRONNEMENTALES DE RÉFÉRENCE

La prise de décisions réglementaires exige que des données environnementales de référence soient recueillies et utilisées pour l'évaluation et la planification de la conception du projet avant qu'une autorisation de préparation de l'emplacement en vue de l'aménagement du dépôt géologique en profondeur puisse être accordée. Ce processus d'étude des données environnementales de référence est appelé « caractérisation du site » par la Commission canadienne de sûreté nucléaire.

La SGDN a acquis une bonne compréhension du site du Projet en recueillant, en évaluant et en modélisant des données sur la géologie régionale depuis 2010. Des études environnementales ont également été menées depuis 2014 dans la région du Projet.

Le processus d'étude des données environnementales de référence est appelé « caractérisation du site » par la Commission canadienne de sûreté nucléaire.



Ce graphique présente certaines des données de référence recueillies sur le site proposé pour le Projet.

Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation)
19

Points saillants des composantes de l'environnement naturel connus à ce jour grâce aux données recueillies sur une période d'environ 15 ans

1. **Géochimie :** Les analyses des carottes rocheuses prélevées indiquent que la roche ne présente aucun potentiel de génération d'acide ou de lixiviation des métaux. La SGDN a étudié la composition chimique complète des roches de la région et leurs propriétés n'indiquent pas la présence de minéraux dangereux.

2. **Eaux souterraines et eaux de surface**

   - **Hydrogéologie et hydrogéochimie :** L'hydrogéologie et l'hydrochimie sont les sciences qui étudient les eaux souterraines. Les caractéristiques hydrogéologiques et hydrogéochimiques du site proposé sont favorables au Projet. À la profondeur où le dépôt serait construit, l'eau s'écoule très lentement à travers la roche. Cette conclusion s'appuie sur des essais réalisés dans six puits de forage profonds, qui montrent que la roche laisse passer très peu d'eau, et ce, d'autant moins à mesure que l'on descend en profondeur.

     La composition des échantillons d'eau souterraine et d'eau interstitielle (quantité microscopique d'eau emprisonnée dans la roche) provenant des carottes rocheuses révèle des tendances qui varient en fonction de la profondeur, ce qui correspond à ce dont on s'attend pour un environnement du Bouclier canadien.

   - **Hydrologie :** L'hydrologie est l'étude du mouvement de l'eau. Le site se trouve dans le bassin versant de la rivière Wabigoon, qui s'écoule vers le nord-ouest, depuis le lac Raleigh jusqu'au lac Wabigoon. Le lac Wabigoon s'écoule ensuite vers la rivière Winnipeg et la rivière Nelson, pour finalement atteindre la baie d'Hudson. La zone entourant le Projet proposé comprend plusieurs petits plans d'eau interreliés qui s'écoulent collectivement dans le lac Mennin. Le lac Mennin se jette vers le nord dans la rivière Mennin, puis vers le nord-ouest dans la rivière Wabigoon. Les plus grandes rivières à proximité du site du Projet proposé sont la rivière Mennin, située à approximativement deux kilomètres au sud-ouest du site du Projet proposé, et la rivière Revell, qui est située à environ deux kilomètres au nord et qui coule parallèlement à la route 17. Le confluent de la rivière Revell et de la rivière Wabigoon se trouve à environ six kilomètres au nord-ouest du site.

   - **Qualité des eaux de surface :** La SGDN recueille chaque trimestre des données de référence sur la qualité des eaux de surface. La qualité de l'eau est normale : sa teneur en oxygène dissous est adéquate, son pH est légèrement acide et sa limpidité est faible à modéré. Sa concentration en contaminants préoccupants est généralement inférieure aux valeurs guides, bien que certains échantillons dépassent les valeurs guides pour E. coli, le phosphore, l'aluminium, le cuivre, le manganèse et le mercure.

3. **Données climatiques :** Selon les prévisions climatiques, la température augmentera de 3 à 4 °C d'ici les années 2050 et d'environ 6 °C d'ici les années 2080. Les précipitations devraient augmenter de 50 à 75 mm/an d'ici les années 2050 et de 100 à 125 mm/an d'ici les années 2080.

4. **Rayonnements de fond :** Au Canada, en moyenne, 76 pour cent de l'exposition aux rayonnements provient des rayonnements naturellement émis dans le sol et l'air. Les doses moyennes de rayonnements de fond au Canada sont estimées à environ 1,8 millisievert (mSv) par an, ce qui est inférieur à la moyenne mondiale de 2,4 mSv. Le niveau de rayonnements de fond varie en fonction de l'emplacement, de l'altitude et d'autres facteurs géographiques locaux.

5. **Faune et habitat faunique :** La SGDN recueille actuellement des données de référence pour caractériser la faune terrestre et ses habitats. Des renseignements seront présentés pour divers groupes fauniques présents dans le périmètre du site proposé pour le Projet et dans les environs, notamment les ongulés (orignaux), les carnivores, les petits mammifères, les mammifères semi-aquatiques (p. ex., les castors), les chauves-souris, les reptiles, les amphibiens, les invertébrés et la végétation.
6. **Espèces en péril :** La SGDN recense les espèces préoccupantes sur le plan de la conservation, y compris les espèces en péril inscrites sur les listes fédérales et provinciales et les espèces rares à l'échelle provinciale. Les espèces potentiellement en péril comprennent certaines espèces d'oiseaux (Moucherolle à côtés olive, Engoulevent d'Amérique, Pioui de l'Est, Engoulevent bois-pourri), de poissons (Anguille d'Amérique), de carnivores (Blaireau d'Amérique, Carcajou, Renard gris) et de chauves-souris (Myotis brune, Myotis nordique), ainsi que l'espèce végétale du Frêne noir. Aucun habitat essentiel à la survie ou au rétablissement des espèces sauvages en péril inscrites sur les listes fédérales n'a été recensé sur le site proposé pour le Projet.
7. **Les oiseaux, les oiseaux migrateurs et leurs habitats :** Au total, 76 espèces d'oiseaux ont été recensées sur le site proposé pour le Projet et dans ses environs, dont cinq espèces en péril, 25 autres espèces prioritaires, 65 espèces protégées par la *Loi sur la convention concernant les oiseaux migrateurs* et une espèce dont le nid est protégé en vertu du *Règlement sur les oiseaux migrateurs*.
8. **Les poissons et leurs habitats :** Plusieurs habitats importants pour les poissons, notamment des zones de reproduction et d'alevinage, ont été répertoriés dans la zone d'étude régionale. D'autres travaux sont prévus, notamment des études sur les communautés de poissons et les invertébrés benthiques, afin d'évaluer l'habitat des poissons à l'intérieur et autour du site proposé pour le Projet.

La Mésange à tête noire est l'une des espèces d'oiseaux protégées en vertu de la *Loi sur la convention concernant les oiseaux migrateurs* et du *Règlement sur les oiseaux migrateurs*.

Prochaines étapes — données environnementales de référence

Selon notre compréhension actuelle de l'environnement naturel du site proposé pour le Projet, le site peut répondre aux exigences du Projet en ce qui concerne le confinement et l'isolement du combustible nucléaire irradié, et il sera par conséquent apte à protéger les gens et l'environnement.

La SGDN poursuivra nos études de caractérisation du site et de collecte de données de référence afin de mieux comprendre l'environnement naturel actuel. Ces données serviront à optimiser la conception technique des installations de surface et l'aménagement du dépôt souterrain.

POINTS SAILLANTS DU PROJET : DONNÉES DE RÉFÉRENCE SOCIOÉCONOMIQUES ET SANITAIRES

La *Loi sur les déchets de combustible nucléaire* exige que la SGDN produise des rapports socioéconomiques, notamment sur les effets que nos activités pourraient avoir sur le mode de vie ou sur les aspirations sociales, culturelles ou économiques d'une collectivité. La SGDN est tenue de produire un rapport tous les trois ans en vertu de l'article 18 de cette loi. Ces rapports seront produits pendant toute la durée du Projet.

La SGDN est également tenue de réaliser une évaluation des impacts sur les composantes sociales, économiques et sanitaires de l'environnement humain. Cette évaluation inclurait tout impact que le Projet pourrait avoir sur les droits des peuples autochtones, ce qui nécessiterait des données de référence sur diverses composantes de l'environnement humain.

Points saillants des composantes de l'environnement humain qui sont particulièrement importants pour comprendre les impacts du Projet

1. **Population et démographie :** La croissance démographique dans la région est globalement stable depuis 1991, même si cela ne reflète pas nécessairement la tendance démographique dans chaque collectivité. Les collectivités ont suivi les mêmes tendances démographiques de 1996 à 2021, notamment le vieillissement de la population, une légère diminution du nombre de personnes par famille recensée et d'enfants vivant à la maison, et une proportion croissante de la population qui s'identifie comme Autochtone.
2. **Utilisation des terres et des ressources :** L'environnement naturel est important pour les résidents et les visiteurs des collectivités environnantes du site du Projet. Les résidents participent à plusieurs types d'activités liées à l'utilisation des terres et des ressources, notamment la pêche, la chasse, le piégeage, la cueillette, la randonnée, le VTT, la motoneige et la navigation. Une étude culturelle préliminaire réalisée pour le programme de forage de la SGDN sur le site proposé pour le dépôt en 2024 a examiné les sites archéologiques et historiques connus à l'aide de la Base de données des sites archéologiques de l'Ontario. L'étude culturelle préliminaire a révélé qu'il n'y avait aucun site archéologique ou historique connu sur les sites de forage ou à proximité. Des travaux supplémentaires devraient être menés non seulement pour confirmer ces résultats, mais également pour explorer les zones potentiellement importantes sur le plan culturel ou historique pour la Nation ojibwée de Wabigoon Lake.

Prochaines étapes — données de référence socioéconomiques et sanitaires

La SGDN poursuivra la collecte de données de référence et la production de rapports afin de satisfaire aux exigences de la *Loi sur les déchets de combustible nucléaire* et de la *Loi sur l'évaluation d'impact*. Surtout, la SGDN cherchera des occasions de collaborer avec les collectivités afin de vérifier les informations recueillies à ce jour et d'en apprendre davantage grâce à des études adaptées et propres à chaque collectivité, y compris des études sur le savoir autochtone et l'utilisation des terres, le cas échéant.

MODÈLE CONCEPTUEL DU SITE POUR L'ENVIRONNEMENT BIOPHYSIQUE
ZONE À FAIBLE PROFONDEUR
ZONE INTERMÉDIAIRE
ZONE PROFONDE
MÈTRES
0
100
200
300
400
Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation)
23

POINTS SAILLANTS DU PROJET : EFFETS POTENTIELS DU PROJET

La SGDN se prépare à remettre une Description initiale du projet à l'Agence d'évaluation d'impact du Canada à l'appui d'une Évaluation d'impact qui sera réalisée en vertu de la *Loi sur l'évaluation d'impact*. L'évaluation d'impact sera intégrée à la demande initiale de permis présentée à la Commission canadienne de sûreté nucléaire. Dans le cadre d'une évaluation d'impact, la SGDN évalue l'importance des impacts du Projet qui perdureraient après la mise en oeuvre des mesures d'atténuation, relativement aux composantes suivantes qui sont de compétence fédérale :

- les peuples autochtones;
- les poissons et leurs habitats;
- les espèces aquatiques en péril;
- les oiseaux migrateurs.

De plus, le processus d'autorisation lié à *Loi sur la sûreté et la réglementation nucléaires*, qui est intégré au processus d'évaluation, exige que la SGDN démontre comment nous pourrons protéger l'environnement et les gens lors de la mise en oeuvre du Projet.

Le processus de l'évaluation d'impact offre à la SGDN deux occasions d'évaluer les impacts potentiels et de proposer des mesures d'atténuation :

1. La Description initiale du projet;
2. L'Étude d'impact.

La SGDN sollicite activement la participation des collectivités hôtes du Projet — la Nation ojibwée de Wabigoon Lake et le canton d'Ignace — ainsi que celle des autres Premières Nations et du public de la région.

La SGDN en est à la phase de préplanification de l'évaluation d'impact et prépare actuellement le rapport de Description initiale du projet. La SGDN sollicite activement la participation des collectivités hôtes du Projet — la Nation ojibwée de Wabigoon Lake et le canton d'Ignace — ainsi que celle des autres Premières Nations et du public de la région, sur les thèmes clés de la Description initiale du projet, qui sont résumés dans le présent document.

Les activités de concertation de la SGDN et les possibilités de participer et de donner son avis se poursuivront tout au long du processus. Un aperçu détaillé du processus de l'Évaluation d'impact est présenté plus haut dans le présent rapport (voir la section *Le Processus intégré d'évaluation d'impact et d'autorisation*).

Prochaines étapes — effets potentiels du projet

Le Projet pourrait avoir des impacts sur les gens et l'environnement (c'est-à-dire sur les composantes humaines et naturelles de l'environnement), et la SGDN doit étudier les voies de réalisation de ces impacts dans le cadre du processus réglementaire.

Pour qu'il y ait un impact, il doit y avoir une source (c'est-à-dire un élément ou une activité du Projet) qui interagit avec les gens et l'environnement. Pour la Description initiale du projet, nous avons dressé la liste suivante des activités liées au Projet qui pourraient avoir un impact sur les gens et l'environnement naturel et qui devront être évaluées dans le cadre du processus de l'évaluation d'impact :

- Défrichage pendant la préparation de l'emplacement et la construction;
- Dynamitage et excavation pendant la préparation de l'emplacement et la construction et l'exploitation des installations;
- Aménagement et exploitation des installations de surface, du dépôt géologique en profondeur, du camp d'hébergement des travailleurs et de la Zone de gestion de la roche excavée pendant la préparation de l'emplacement et la construction et l'exploitation des installations;
- Manutention des matériaux pendant la préparation de l'emplacement et la construction et l'exploitation des installations;
- Circulation des véhicules sur le site du Projet pendant toutes les phases du Projet;
- Gestion et traitement de l'eau sur le site (prélèvement d'eau, assèchement et rejet des eaux traitées) pendant toutes les phases du Projet.

Cette liste des interactions du Projet pourra être complétée après concertation des collectivités hôtes, des collectivités autochtones, du public et des organismes de réglementation.

Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation) 25

Considérations et conclusions de l'évaluation préliminaire

Les quatre conditions suivantes ont servi de base aux évaluations préliminaires réalisées par la SGDN sur l'impact du Projet :

- Aucune matière radioactive ne sera présente sur le site pendant les phases de préparation de l'emplacement et de construction;
- La sûreté radiologique fera l'objet d'une surveillance et d'un contrôle rigoureux par la Commission canadienne de sûreté nucléaire pendant l'exploitation et la fermeture du dépôt;
- Les effets, les mesures d'atténuation et la surveillance pendant la préparation de l'emplacement et la construction seront similaires à ceux d'autres projets d'infrastructure (comme les projets d'exploitation minière et forestiers) dans le nord de l'Ontario;
- Dans le cadre de l'évaluation préliminaire proposée dans la Description initiale du projet, les changements potentiels sont pris en compte et des mesures d'atténuation sont proposées sur la base de ce qui a été approuvé pour d'autres projets présentant des activités et des impacts similaires.

La SGDN poursuivra nos évaluations approfondies de la sûreté et notre évaluation quantitative détaillée des risques pour la santé humaine et l'environnement afin de confirmer la sûreté du Projet et de nous assurer que ce dernier n'aura pas d'effets négatifs sur les gens et l'environnement. Ces études seront mises à jour et présentées à la Commission canadienne de sûreté nucléaire à chaque étape du processus d'autorisation.

L'ébauche de la Description initiale du projet présentera les conclusions suivantes issues de la première évaluation des impacts potentiels du Projet :

- Pour ce Projet, on s'attend à ce que les pratiques exemplaires et les mesures d'atténuation standard empêchent que des changements surviennent ou réduisent le risque d'impact sur les poissons et leurs habitats, les oiseaux migrateurs et les espèces aquatiques en péril;
- Pour des raisons de sûreté et de sécurité, le Projet limitera l'accès aux terres actuellement utilisées par les peuples autochtones pour l'utilisation traditionnelle des terres et des ressources;
- En raison du stockage du combustible nucléaire irradié, le Projet pourrait donner lieu à des perceptions de contamination radioactive potentielle qui pourraient entraîner des modifications à l'utilisation traditionnelle des terres.

Le processus d'évaluation d'impact permettra de déterminer et de confirmer l'ampleur de ces impacts et les collectivités touchées, et d'évaluer la possibilité que le Projet ait des impacts sur d'autres collectivités autochtones, conformément à la *Loi sur l'évaluation d'impact*. L'évaluation serait adaptée en fonction des préoccupations de la collectivité, de son utilisation des terres et des impacts prévus.

La SGDN souhaite recevoir des commentaires sur l'approche proposée et sur les conclusions préliminaires présentées dans ce résumé. La SGDN se réjouit également de pouvoir en apprendre davantage sur la façon dont le Projet pourrait interagir avec les gens et l'environnement afin de mieux adapter l'évaluation d'impact.

Évaluation stratégique des changements climatiques

La *Loi sur l'évaluation d'impact* exige qu'une évaluation stratégique des changements climatiques soit réalisée pour le Projet afin d'assurer que les considérations relatives aux changements climatiques soient intégrées à toutes les étapes de la planification et de la prise de décision du Projet, ce qui contribuera à un développement plus durable et à la réalisation des objectifs nationaux en matière de climat.

Le Projet est essentiel au cycle de vie de l'énergie nucléaire, que le gouvernement fédéral a identifié comme un élément important d'un avenir à faibles émissions de carbone au Canada. Afin de respecter notre engagement de protéger les gens et l'environnement tout au long de nos activités, nous prendrons à la SGDN les mesures suivantes :

- Réaliser une évaluation des meilleures technologies qui permettrait de faire en sorte que le Projet soit carboneutre d'ici 2050 pendant la phase estimée d'exploitation;
- Élaborer et mettre en oeuvre un plan crédible en matière de carboneutralité qui réponde aux exigences de l'évaluation stratégique des changements climatiques du gouvernement du Canada.

Les prochaines étapes de ce travail comprendront des études supplémentaires sur les changements climatiques, l'optimisation de la conception du Projet et la concertation des collectivités hôtes, des collectivités autochtones et du public sur l'élaboration du plan de carboneutralité.

Et maintenant?

- **Présentation de la Description initiale du projet (DIP) :** Préparation d'un rapport initial qui décrira le Projet, les conditions de référence actuelles et les interactions potentielles du Projet avec les gens et l'environnement à des fins d'examen réglementaire et d'examen par les collectivités — présentation par la SGDN de la Description initiale du projet à l'Agence d'évaluation d'impact du Canada afin de lancer officiellement le processus d'évaluation d'impact et d'autorisation du Projet.
- **Activités de concertation et participation réglementaires :** Poursuite du processus d'établissement de relations respectueuses avec la Nation ojibwée de Wabigoon Lake, le canton d'Ignace et les collectivités environnantes.
- **Avancement du programme technique :** Avancement de la conception du dépôt en fonction du site choisi en tenant compte de la rétroaction itérative issue des études de sûreté, géoscientifiques, environnementales et d'évaluation d'impact, ainsi que des commentaires des collectivités.
- **Évaluations techniques pour l'Étude d'impact et la demande d'autorisation intégrées :** Préparer les évaluations techniques pour l'Étude d'impact et la demande d'autorisation intégrées tout au long de la phase d'évaluation d'impact (environ trois ans) et travailler en collaboration avec les collectivités hôtes, les Premières Nations et les groupes et personnes intéressés afin d'élaborer des mesures d'atténuation appropriées et d'assurer la transparence des conclusions. L'Étude d'impact et la demande d'autorisation intégrées devraient être présentées approximativement trois ans après la présentation de la Description initiale du projet.

Dorénavant, le Projet de dépôt géologique en profondeur pour le combustible nucléaire irradié canadien sera assujetti à la *Loi sur l'évaluation d'impact* et à plusieurs permis, licences et autorisations qui devront être obtenus par la SGDN pendant ou après le Processus intégré d'évaluation d'impact.

- **Audiences publiques :** Le Projet sera soumis à l'étude d'un groupe d'experts indépendants qui examinera l'étude d'impact, les avis des différents organismes de réglementation fédéraux et provinciaux, ainsi que les points de vue des collectivités autochtones et des membres du public qui participent au processus. L'audience est un processus officiel au cours duquel l'Agence d'évaluation d'impact du Canada, la Commission canadienne de sûreté nucléaire et d'autres organismes (tels que Pêches et Océans Canada, Environnement et Changement climatique Canada et Santé Canada) examinent les données techniques afin d'évaluer la sûreté d'un projet proposé ou d'une activité proposée. Elle offre également aux groupes autochtones et au public la possibilité de participer en présentant leurs points de vue et leurs préoccupations avant qu'une décision soit prise concernant une évaluation d'impact ou l'autorisation d'un projet.

Des questions ou des commentaires?

Vos réflexions seront les bienvenues. Veuillez les transmettre au plus tard le 22 août 2025 à l'adresse RegulatoryFeedback@nwmo.ca ou par la poste à l'adresse suivante :

SGDN — Commentaires sur le résumé de la DIP
22, avenue St. Clair Est, 4e étage
Toronto, ON M4T 2S3

Découvrez les prochaines étapes, informez-vous sur les événements en personne à venir et apprenez-en davantage à l'adresse nwmo.ca/planifionsensemble.

Ensemble, nous préparons un avenir sûr et durable pour le combustible nucléaire irradié canadien.

Pour plus d'informations, veuillez contacter :

Société de gestion des déchets nucléaires
22, avenue St. Clair Est, 4e étage
Toronto (ON) M4T 2S3, Canada
Tél. : 416.934.9814 Sans frais: 1.866.249.6966
Courriel : contactus@nwmo.ca
Site Web : nwmo.ca

@LaSGDN
/company/nwmocanada

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

© 2025 Société de gestion des déchets nucléaires

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

FEEDBACK PROMPT GUIDE FOR THE INITIAL PROJECT DESCRIPTION SUMMARY

This guide is designed to help you think about your feedback on the Nuclear Waste Management Organization's (NWMO) Initial Project Description (IPD) summary. The IPD is the first step in the Integrated Impact Assessment and Licensing process, and provides an overview of the project's purpose, objectives and potential impacts. Your input is valuable and will be used to inform the IPD before it is submitted to the Impact Assessment Agency of Canada (IAAC).

Feedback on the IPD summary is being collected until Aug. 22, 2025.

ABOUT THE INTEGRATED IMPACT ASSESSMENT AND LICENSING PROCESS

The Integrated Impact Assessment and Licensing process helps to examine the positive and negative effects (impacts) that a proposed major project could have, like the NWMO's Deep Geological Repository for Canada's Used Nuclear Fuel Project.

To learn more about the integrated assessment process, please visit the Impact Assessment Agency of Canada website at https://www.canada.ca/en/impact-assessment-agency/programs/impact-assessments-101/integrated.html.

TIPS FOR EFFECTIVE FEEDBACK

- **Be specific and refer to the IPD summary**: Where possible, please provide specific examples and details from the IPD summary to support your comments.
- **Explain your reasoning**: Clearly explain *why* you have feedback about specific aspects of the IPD summary and how they might impact the environment, community or other areas.
- **Share your knowledge**: If you have relevant knowledge (local, scientific, Indigenous Knowledge), please share it and explain how it should be considered.
- **Avoid personal or identifying information**: Please do not include information that could be considered private or confidential.
- **Communicate respectfully**: Please refrain from comments that are inappropriate or offensive.

FEEDBACK PROMPT GUIDE

PROVIDING YOUR FEEDBACK

Below are some questions to help guide your feedback on the IPD summary. While these are suggestions, the most important thing is to provide feedback related to the IPD summary that you feel is important.

1. **Understanding of the project**
   - After reviewing the IPD summary, do you have a clear understanding of the project's purpose and objectives? Why or why not?
   - What is unclear?

2. **Potential benefits**
   - Do you understand the potential benefits of the project?
   - Do you believe the IPD summary accurately reflects the potential benefits?

3. **Potential impacts and mitigation**
   - Do you believe the IPD summary identifies the potential environmental, social, economic and cultural impacts of the project, including impacts on Indigenous communities?
   - Are there any potential impacts that you believe are missing or underestimated in the IPD summary?

4. **Public and Indigenous engagement**
   - Do you feel the IPD summary summarizes the engagement that the NWMO has carried out during the site selection process?
   - If you have previously expressed concerns to the NWMO, are your concerns addressed in the IPD summary?
   - How could Indigenous Knowledge be better incorporated into the integrated assessment process?

5. **What matters to you and your community?**
   - Examples might include wildlife, noise, water quality, jobs and health.
   - Do you have specific knowledge about your community (e.g., history, environment, social, cultural and economic) that may be relevant to the integrated assessment of this project?
   - Do you have additional comments specific to the siting area?

6. **Additional comments**
   - Please provide any other comments or information that you believe are relevant to the IPD.

Nuclear Waste Management Organization
Email: RegulatoryFeedback@nwmo.ca
© 2025 Nuclear Waste Management Organization
@nwmocanada
/company/nwmocanada
nwmo.ca/PlanningWithYou

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

GUIDE POUR LA PRÉSENTATION DE COMMENTAIRES SUR LE RÉSUMÉ DE LA DESCRIPTION INITIALE DU PROJET

Ce guide a pour but de vous aider à formuler vos commentaires sur le résumé de la Description initiale du projet (DIP) de la Société de gestion des déchets nucléaires (SGDN). La DIP est la première étape du Processus intégré d'évaluation d'impact et d'autorisation. Elle donne un aperçu du but, des objectifs et des impacts potentiels du projet. Vos commentaires seront très utiles et éclaireront la formulation de la DIP avant qu'elle ne soit présentée à l'Agence d'évaluation d'impact du Canada (AEIC).

Les commentaires sur le résumé de la DIP seront recueillis jusqu'au 22 août 2025.

À PROPOS DU PROCESSUS INTÉGRÉ D'ÉVALUATION D'IMPACT ET D'AUTORISATION

Le Processus intégré d'évaluation d'impact et d'autorisation aide à examiner les effets positifs et négatifs (impacts) qu'un grand projet proposé (par exemple, le Projet de dépôt géologique en profondeur pour le combustible nucléaire irradié canadien de la SGDN) pourrait avoir.

Pour en savoir plus sur le processus d'évaluation intégrée, veuillez consulter le site Web de l'Agence d'évaluation d'impact du Canada à l'adresse https://www.canada.ca/fr/agence-evaluation-impact/programmes/evaluation-impact-101/integrees.html.

CONSEILS POUR OFFRIR DES COMMENTAIRES UTILES

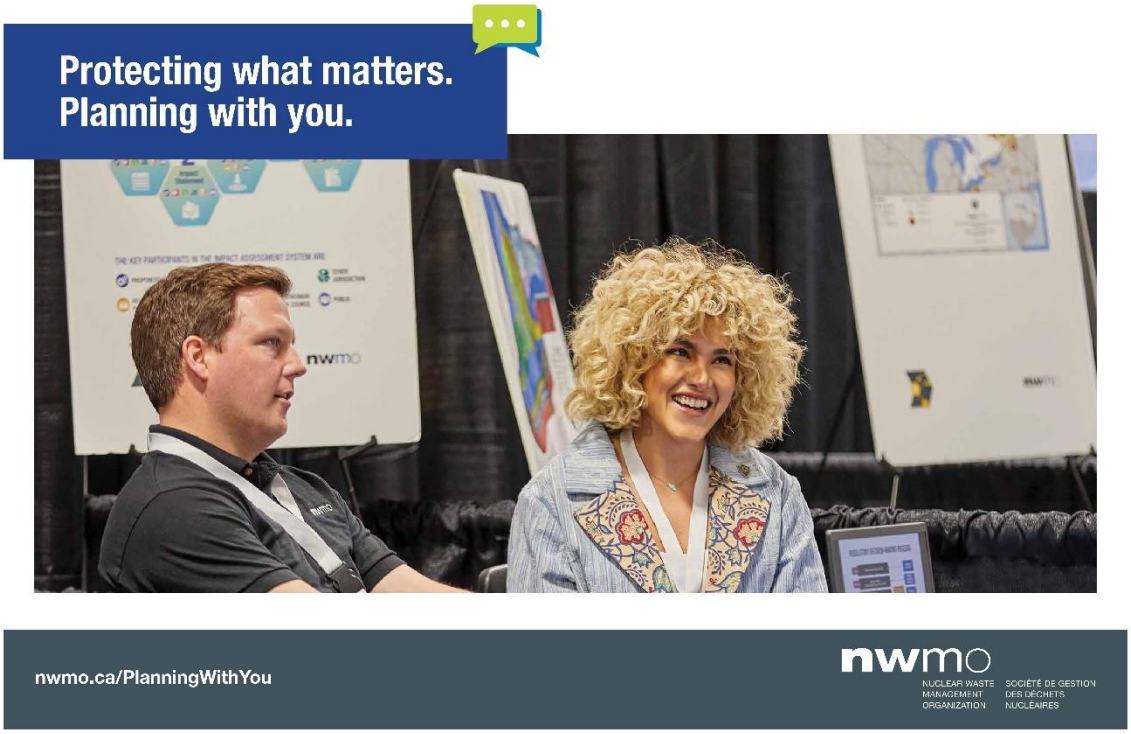
- **Soyez précis et utilisez le texte du résumé de la DIP comme référence** : Dans la mesure du possible, veuillez fournir à l'appui de vos commentaires des exemples précis et des détails tirés du résumé de la DIP.
- **Expliquez votre raisonnement** : Expliquez clairement *pourquoi* vous fournissez des commentaires sur des éléments particuliers du résumé de la DIP et quelles incidences ces éléments pourraient avoir sur l'environnement, la collectivité ou d'autres domaines.
- **Faites partager vos connaissances** : Si vous possédez des connaissances pertinentes (locales, scientifiques, savoir autochtone), veuillez nous les faire partager et expliquer comment elles devraient être prises en considération.
- **Évitez de fournir des renseignements personnels ou identifiables** : Veuillez ne pas inclure de renseignements qui pourraient être considérés comme de nature privée ou confidentielle.
- **Communiquez de manière respectueuse** : Veuillez vous abstenir de tout commentaire inapproprié ou offensant.

PRÉSENTATION DE VOS COMMENTAIRES

Vous trouverez ci-dessous quelques questions qui vous aideront à formuler vos commentaires sur le résumé de la DIP. Il s'agit de suggestions, mais le plus important est de fournir les commentaires sur le résumé de la DIP que vous jugez importants.

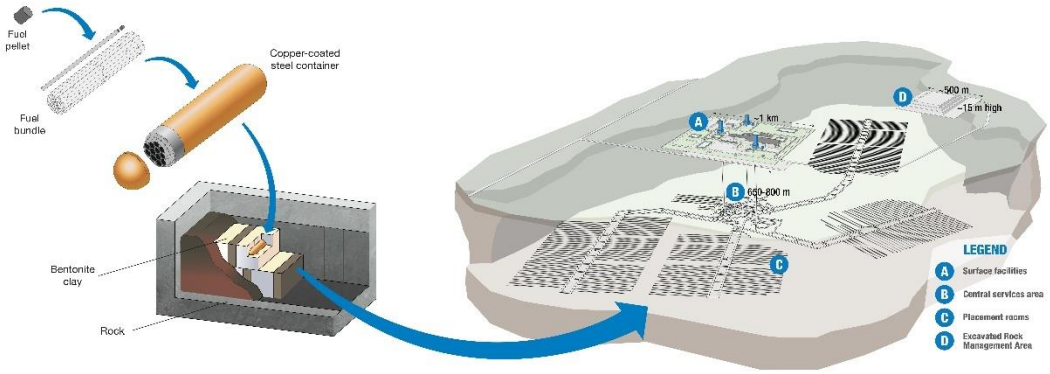
1. **Compréhension du projet**
   - Après avoir examiné le résumé de la DIP, comprenez-vous clairement le but et les objectifs du projet? Pourquoi ou pourquoi pas?
   - Quels éléments sont moins clairs?
2. **Avantages potentiels**
   - Comprenez-vous les avantages potentiels du projet?
   - Pensez-vous que le résumé de la DIP reflète fidèlement ces avantages potentiels?
3. **Impacts potentiels et mesures d'atténuation**
   - Croyez-vous que le résumé de la DIP relève correctement les impacts environnementaux, sociaux, économiques et culturels potentiels du projet, y compris les impacts qu'il pourrait avoir sur les collectivités autochtones?
   - Si ce n'est pas le cas selon vous, quels impacts potentiels ne sont pas mentionnés ou sont sous-estimés dans le résumé de la DIP?
4. **Concertation avec le public et les Autochtones**
   - Estimez-vous que le résumé de la DIP résume bien les activités de concertation menées par la SGDN au cours du processus de sélection d'un site?
   - Si vous avez déjà fait part de vos préoccupations à la SGDN, estimez-vous qu'elles ont été prises en compte dans le résumé de la DIP?
   - Comment le savoir autochtone pourrait-il être mieux incorporé dans le processus d'évaluation intégrée?
5. **Qu'est-ce qui importe pour vous et votre collectivité?**
   - Par exemple, la faune, le bruit, la qualité de l'eau, les emplois et la santé.
   - Avez-vous des connaissances particulières sur votre collectivité (p. ex., son histoire, son environnement, son contexte social, culturel et économique) qui pourraient être utiles à l'évaluation intégrée de ce projet?
   - Avez-vous des commentaires supplémentaires touchant particulièrement à la région du site proposé?
6. **Commentaires additionnels**
   - Veuillez fournir tout autre commentaire ou renseignement que vous jugez pertinent sur la DIP.

Société de gestion des déchets nucléaires
Courriel : RegulatoryFeedback@nwmo.ca
© 2025 Société de gestion des déchets nucléaires
@LaSGDN
/company/nwmocanada
nwmo.ca/planifionsensemble



Welcome

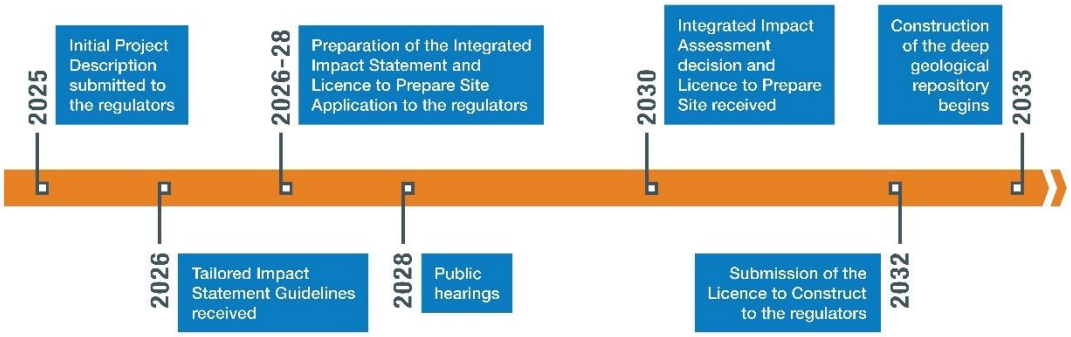
The Nuclear Waste Management Organization (NWMO) is a not-for-profit organization tasked with the safe, long-term management of Canada's used nuclear fuel, in a manner that protects people and the environment for generations to come. The plan is to contain and isolate the used fuel in a deep geological repository using a multiple-barrier system.



nwmo.ca/PlanningWithYou
nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Regulatory decision-making process

The Project will undergo a thorough impact assessment process, co-ordinated by the Impact Assessment Agency of Canada and integrated with the initial licence application to the Canadian Nuclear Safety Commission.



nwmo.ca/PlanningWithYou

nwmo NUCLEAR WASTE MANAGEMENT ORGANIZATION SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

A safe approach

Rigorous safety standards will govern the Project. The NWMO is committed to meeting all applicable federal and provincial regulatory requirements to protect the health, safety and security of people and the environment for generations to come.

nwmo.ca/PlanningWithYou

nwmo NUCLEAR WASTE MANAGEMENT ORGANIZATION SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Sustained dialogue, participation and collaboration

Engagement and relationship building with Indigenous communities, the public and interested parties will remain at the heart of this Project.

nwmo.ca/PlanningWithYou

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Have your say

nwmo.ca/PlanningWithYou

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

CANADIAN NUCLEAR SAFETY COMMISSION

The Canadian Nuclear Safety Commission (CNSC) is Canada's nuclear regulator, responsible for the regulation of all stages of the long-term management of radioactive waste. This includes everything from site preparation to construction and operation to decommissioning (closure and post-closure).

The CNSC regulates the safe use of nuclear energy and materials to protect health, safety, security and the environment; ensures Canada follows its promises to use nuclear energy peacefully; and stands to provide clear information to the public about nuclear science, technology and regulations.

WHAT LICENCES ARE REQUIRED FOR A DEEP GEOLOGICAL REPOSITORY?

The NWMO is required to complete a multi-phase licensing process as per regulations under the *Nuclear Safety and Control Act*. At each phase (which can be applied for sequentially or at the same time), the NWMO will collect and consider information gathered from Indigenous and public engagement. This includes Indigenous Knowledge and historical and current land use by members of First Nations, communities and the public.

1. **Licence to Prepare Site** — Before issuing an initial licence to prepare the site, the CNSC assesses whether the site can safely contain and isolate radioactive waste over the long term. This phase begins during the integrated assessment.
2. **Licence to Construct** — The CNSC has a number of requirements for all activities related to design, procurement, manufacturing, construction and commissioning.
3. **Licence to Operate** — A licence to operate would allow the NWMO to complete final commissioning activities and to operate the deep geological repository. Commissioning activities ensure that the facility has been properly designed and constructed and is ready for safe operation.
4. **Licence to Decommission** — Decommissioning plans include post-closure licensing, monitoring, surveillance and maintenance, including ensuring adequate financing for these activities.

1

CANADIAN NUCLEAR SAFETY COMMISSION

WHAT SAFETY AND ENVIRONMENTAL PROTECTION ARE OFFERED BY THE CANADIAN NUCLEAR SAFETY COMMISSION?

Safety and environmental protection are central to the mission of the CNSC. Its regulations ensure that these factors are considered at every phase of the facility's lifecycle, from the initial licence application to decommissioning. Key principles include ensuring that protective measures are right for the level of risk involved, account for scientific uncertainty, and follow best practices like the precautionary principle and sustainable development. Performance is measured against science-based targets.

HOW IMPORTANT IS NUCLEAR SECURITY TO THE CANADIAN NUCLEAR SAFETY COMMISSION?

The CNSC enforces Canada's *Nuclear Security Regulations* under the *Nuclear Safety and Control Act*. It works with facility operators, law enforcement, intelligence agencies and the International Atomic Energy Agency to ensure nuclear materials and facilities are secure. As part of the licensing process, the NWMO is required to meet the requirements of the *Nuclear Security Regulations* and licence-specific conditions through ongoing compliance.

Nuclear Waste Management Organization
Email: RegulatoryFeedback@nwmo.ca
© 2025 Nuclear Waste Management Organization
@nwmocanada
/company/nwmocanada
nwmo.ca/PlanningWithYou

CONFIDENTIAL – DRAFT for internal use only

Initial Project Description: Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project
January 2025

For more information, please contact:

Nuclear Waste Management Organization
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3, Canada
Tel.: 416.934.9814 Toll free: 1.866.249.6966
Email: contactus@nwmo.ca
Website: nwmo.ca

@nwmocanada
/company/nwmocanada

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

© 2025 Nuclear Waste Management Organization

Initial Project Description (IPD) Consolidated Engagement Report:

Public and Interested Parties

October 2025

APM-REP-05000-0216

Prepared by: Nuclear Waste Management Organization (NWMO)

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

NWMO-TMP-05000-0001 R000

Acknowledgment of Truths

The Nuclear Waste Management Organization (NWMO) is grateful to all the First Nations and Indigenous peoples that the organization has had the great fortune to meet and interact with while developing and implementing Canada's plan for the long-term management of used nuclear fuel. The NWMO is especially grateful to the Wabigoon Lake Ojibway Nation (WLON) who have indicated that they are willing and informed hosts for the deep geological repository (DGR).

The NWMO understands the unique long-term time scale of Canada's plan to build a DGR, and the relationship it will have with land and water for generations. The NWMO acknowledges that the DGR Project will have an impact on traditional land and resource use via changes in access or perceived risks. The Project is located in the traditional territory of WLON; therefore, members of WLON will experience these impacts most meaningfully.

The NWMO commits to build meaningful and respectful relationships, and to seek the free, prior, and informed consent of impacted peoples of WLON before proceeding with development of the DGR. The NWMO will respect WLON sovereignty and will aim to align our work with WLON values, emphasizing protection and stewardship of land, water, and all Creation and will respect their traditional governance systems.

The NWMO is on a reconciliation learning journey. The NWMO has and will continue to build on advice and guidance received from the Council of Elders and Youth and the Indigenous communities with whom it has a relationship. The NWMO acknowledges there is still much learning to do as it moves through all phases of the Project.

The NWMO respects the truth that many Indigenous women and girls are at a higher risk of harm every day and therefore supports the National Inquiry into Missing and Murdered Indigenous Women and Girls and will find ways to action the Calls for Justice, specifically number 13, "Calls for Extractive and Development Industries".

The NWMO acknowledges, respects and honours that First Nation and Métis peoples of Canada have unique status and rights as recognized and affirmed in Section 35 of the Constitution Act (1982). The NWMO is committed to respecting the Aboriginal rights and treaties of First Nation and Métis peoples. The NWMO also recognizes that there may be unresolved claims between First Nation and Métis communities and the Crown to be considered in relation to the proposed Project site.

The NWMO will work with the Crown regarding the Crown's duty to consult and accommodate, as guided by decisions of the Supreme Court of Canada in fulfilling the NWMO's obligations under the Nuclear Fuel Waste Act (NFWA).

The NWMO recognizes the truth that the Federal Acts for which it is subject to, the NFWA, the Nuclear Safety and Control Act (NSCA) and the Impact Assessment Act (IAA) are being imposed on Indigenous people as a result of Canada's plan. The NWMO's approach to implementing the DGR is committed to respect and align with WLON values, philosophies, and knowledge systems. The NWMO acknowledges the need to be mindful of potential burdens which result from our Project on community and will strive to achieve balance with community.

Additionally, the NWMO recognizes the importance of data sovereignty as an important aspect of self-determination and cultural preservation for Indigenous communities. Currently, the data in the Initial Project Description (IPD) is not a full representation of the characteristics of the Indigenous identity of populations residing within district, municipal and unincorporated communities, nor is it a full representation of the characterization of on-reserve communities. All of the NWMO's work with respect to Indigenous Peoples will be guided by Reconciliation.

Initial Project Description (IPD) Consolidated Engagement Report: Public and Interested Parties

APM-REP-05000-0216

October 2025

Reviewed by: Signed by: F1DFF170CD4F467...

Name: Rojin Amani Date: October 31, 2025

Title: Associate, Impact Assessment

Organization: Nuclear Waste Management Organization

Reviewed by: DocuSigned by: Jeff Binns F7D75156996F493...

Name: Jeff Binns Date: October 31, 2025

Title: Manager, Impact Assessment

Organization: Nuclear Waste Management Organization

Approved by: Signed by: Michael Pahor EA8ECE9A491B48D...

Name: Michael Pahor Date: October 31, 2025

Title: Director, Regulatory Strategy

Organization: Nuclear Waste Management Organization

Document history

Title	Initial Project Description (IPD) Consolidated Engagement Report: Public and Interested Parties	
Report number	APM-REP-05000-0216	
Revision	R000	Date
Reviewed by	Rojin Amani	Oct. 21, 2025
Reviewed by	Jeff Binns	Oct. 21, 2025
Accepted by	Michael Pahor	Oct. 21, 2025

Revision Summary		
Revision Number	**Date**	**Description of Changes/Improvements**
R000	Oct 31, 2025	Initial issue

Contents

CONTENTS 6

LIST OF TABLES 8

ACRONYMS AND ABBREVIATIONS 9

1. INTRODUCTION 10

2. PURPOSE 10

3. ENGAGEMENT TOOLS 10

3.1 POWERPOINT PRESENTATION 10

3.2 POST-EVENT SURVEY 11

3.3 RECORD OF ENGAGEMENT FORMS 11

3.4 MENTIMETER 11

3.5 ZOOM POLLS 11

3.6 COMMUNICATIONS MATERIALS 11

3.7 HANDOUTS 11

3.8 POSTER BOARDS 11

4. ENGAGEMENT ACTIVITIES 12

4.1 ADVERTISEMENT AND NOTIFICATIONS 13

5. IDENTIFICATION OF PUBLIC AND INTERESTED PARTIES 13

5.1 HOST COMMUNITIES 13

5.2 OTHER COMMUNITIES AND INTERESTED PARTIES 13

6. SUMMARY OF ISSUES AND AREAS OF INTEREST 14

7. NEXT STEPS: FUTURE PUBLIC ENGAGEMENT ACTIVITIES 17

APPENDICES 18

APPENDIX A: PRESENTATIONS 18

APPENDIX B: POST-EVENT SURVEY QUESTIONS 19

APPENDIX C: RECORD OF ENGAGEMENT 20

APPENDIX D: MENTIMETER AND ZOOM POLLING QUESTIONS 21

APPENDIX E: MENTIMETER AND ZOOM POLL RESULTS 23

APPENDIX F: COMMUNICATIONS MATERIALS 29

LIST OF TABLES

Table 1: Engagement Events 12

Table 2 Mentimeter and Zoom Poll Results 23

ACRONYMS AND ABBREVIATIONS

DGR	Deep Geological Repository
IAA	Impact Assessment Act
IAAC	Impact Assessment Agency of Canada or “the Agency”
CNSC	Canadian Nuclear Safety Commission
IPD	Initial Project Description
NWMO	Nuclear Waste Management Organization
WLON	Wabigoon Lake Ojibway Nation

Initial Project Description (IPD) Consolidated Engagement Report: Public and Interested Parties

1. Introduction

The Nuclear Waste Management Organization (NWMO) recognizes that extensive, transparent engagement is vital to the success of the Deep Geological Repository for Canada's Used Nuclear Fuel Project ("the Project"). NWMO is committed to building and sustaining respectful relationships with Indigenous Nations and communities, municipal governments, local residents, and other interested parties. Engagement activities aim to understand community perspectives and priorities, while fostering confidence in both the safety of the Project and the fairness of the process.

NWMO designed the engagement process for the Initial Project Description (IPD) to provide clear and accessible information about the project, increase public understanding of the regulatory process, and gather feedback to be incorporated into the IPD and ongoing project planning. The IPD engagement created early opportunities for dialogue about the project's design, potential impacts and benefits, while also supporting the requirements of the federal Impact Assessment Agency of Canada (IAAC) and the Canadian Nuclear Safety Commission (CNSC) licensing processes.

Public input collected through workshops, information sessions, webinars, and surveys play an integral role in informing both project design and regulatory submissions. Dialogue and collaboration will continue throughout the Impact Assessment process and across the full lifecycle of the Project, to enable community voices to remain at the center of decision-making.

2. Purpose

The purpose of this report is to highlight and document how NWMO engaged with the interested parties, regional residents and the public, summarize what we heard from community members about key issues and priorities, and describe how those perspectives are being integrated into project planning and regulatory submissions. Note that engagement with Wabigoon Lake Ojibway Nation (WLON) and Indigenous communities is covered separately.

3. Engagement Tools

The engagement process used a variety of tools to share information and actively gather input from participants, including presentations, handouts, and interactive tools.

3.1 PowerPoint Presentation

The presentation used for the engagement sessions shared information about the Project and IPD. The presentation included an introduction to the project with an updated site map, an explanation of the regulatory process and timelines, and a summary of community engagement feedback to date. NWMO also described baseline studies and effects assessments, explained how to provide feedback on the draft IPD, and shared upcoming engagement opportunities. See Appendix A to review the PowerPoint presentations for each of the IPD engagement events.

3.2 Post-Event Survey

NWMO used post-event surveys to capture participant feedback after engagement events. Attendees had the option to complete a physical paper copy of the survey onsite; they also received a follow-up email with a link to an online survey. An example of the typical questions asked in the post-event surveys can be found in Appendix B.

3.3 Record of Engagement Forms

At engagement events, NWMO staff also gathered feedback using an internal document called a Record of Engagement form. This form was designed to capture participant comments, questions, and key discussion points from one-on-one conversations with attendees during drop-in events or information sessions. See Appendix C for a summary of the key fields included in the Record of Engagement form.

3.4 Mentimeter

Mentimeter is an interactive presentation and polling platform that allows audiences to provide input in real time using their phones or other devices. During the in-person engagement sessions, participants could vote, rank priorities, or share concerns directly through the platform, and results were displayed live on the screen. This interactive approach made the sessions more participatory and helped surface a wide range of views. The list of Mentimeter questions and the resulting data collected during the IPD information sessions are available in Appendices D and E.

3.5 Zoom Polls

Two of the engagement sessions were conducted virtually in a webinar format using Zoom, which provided an accessible way for participants to join remotely. The platform's built-in polling functionality was used to make the sessions more interactive. Participants responded to the polls in real-time and were provided with a visual summary of the results for each question. See Appendix D for a record of the questions asked and the polling data collected.

3.6 Communications Materials

At each of the in-person engagement events, NWMO staff greeted participants and provided them with optional take-away materials. There was also a series of poster boards displayed on easels around the venue, describing key components of the project. These can be found in Appendix F.

3.7 Handouts

- A 34-page Initial Project Description (IPD) Summary for Engagement
- Feedback guide with lines for immediate feedback and instructions on how to submit feedback by letter mail or email following the event
- Informational documents on regulatory agencies
- NWMO Reconciliation Policy
- NWMO Water Statement
- Who We Are brochure

3.8 Poster Boards

Seven poster boards were displayed around the rooms with key information about the IPD from the Summary for Engagement. In addition, there were posterboards showing the geography of the proposed Project area in relation to local towns, waterways and roads. This posterboard also showed proposed locations of the above-ground facility and infrastructure such as roads and storage areas.

4. Engagement Activities

NWMO hosted eight IPD engagement events for the public and interested parties. Six were held in person, including a mix of information sessions, drop-in sessions, and workshops, while two were delivered virtually as webinars via Zoom.

Of the in-person events, four took place in Ignace and two in Dryden, with a combined attendance of 64 participants. The webinars drew an additional 25 participants from the two sessions held. Together, these sessions provided multiple avenues for community members to learn about the project, share feedback, and engage directly with NWMO staff.

Attendees included interested community members and representatives from a broad spectrum of sectors including local business, community service, non-profit, municipal government, health, education and social service, as well as interested community members and representatives from civic and volunteer organizations.

Table 1: Engagement Events

Event	Date	Time (CDT)	Venue/ Location	Attendees
Ignace Information Session #1	July 24, 2025	5:30 – 7:30 PM	NWMO Learn More Centre, Ignace	12
Ignace Information Session #2	July 25, 2025	9:30 – 11:30 AM	Ignace Recreation Centre, Ignace	8
Webinar #1	August 6, 2025	9:30 – 10:45 AM	Online (Zoom)	18
Webinar #2	August 6, 2025	5:00 – 6:15 PM	Online (Zoom)	7
Ignace IPD Workshop #1	August 12, 2025	9:30 – 11:30 AM	NWMO Learn More Centre, Ignace	6
Dryden Drop-in Session	August 12, 2025	3:00 – 5:00 PM	Dryden Native Friendship Center, Dryden	9
Dryden Information Session	August 13, 2025	7:00 – 9:00 PM	Dryden Regional Training and Cultural Centre, Dryden	15
Ignace IPD Workshop #2	August 21, 2025	9:30 – 11:30 AM	NWMO Learn More Centre, Ignace	14

4.1 Advertisement and Notifications

NWMO's communications approach emphasizes advance notification of proposed engagement activities using multiple communication channels to ensure a broad reach and to maximize accessibility. The communications campaign promoting IPD engagement events effectively raised public awareness, with over 2.2 million impressions throughout Ignace, Dryden, and the surrounding areas over 23 days.

- Communication methods included:
- Media briefing with five journalists covering news outlets with operations covering northwestern Ontario
- Household mailer to 5,500 households in Ignace, Dryden and the surrounding area
- 70 posters displayed in prominent locations in Ignace, Dryden and surrounding areas
- Digital display ad campaign in the region, reaching each person an average of 10.8 times in the campaign window
- Supporting social media posts on Facebook, Instagram and X (formerly known as Twitter)
- Paid Facebook advertisements ran for five days in advance of the Dryden information sessions

5. Identification of Public and Interested Parties

While the primary focus of IPD engagement remains on communities in closest proximity to the proposed site (i.e., Host Communities), NWMO also engaged interested parties in the surrounding area, and members of the public who may be impacted by or have an interest in the Project. Below is a detailed list of the kinds of organizations and sectors the NWMO had identified for engagement in their engagement planning.

5.1 Host Communities

Township of Ignace

Ignace is a small community in northwestern Ontario with a population of about 1,300. Its economy is supported by tourism, transportation, and resource industries. The Township is one of two host communities for the Project, having signed a Hosting Agreement with the NWMO.

Wabigoon Lake Ojibway Nation

Wabigoon Lake Ojibway Nation (WLON) is an Anishinaabe community on the shores of Dinorwic Lake west of Dryden, with about 180 members on-reserve and 1,000 members off-reserve. WLON is a host community for the Project, with a signed Hosting Agreement. A summary of IPD engagement with WLON will be shared in a separate report.

5.2 Other Communities and Interested Parties

City of Dryden

A regional hub with about 7,400 residents. It is engaged as an important neighbouring community, playing an important role in retail, services, and transportation.

Kenora District Municipal Association Members

Includes communities such as Kenora, Machin, Red Lake, Sioux Lookout, Ear Falls, Pickle Lake, and Sioux Narrows–Nestor Falls. These municipalities are part of the wider region of interest for engagement.

Local Service Boards (LSB)

Elected entities providing municipal-level services in unincorporated areas of Ontario. Local boards of interest include Melgund, Wabigoon, Upsala, and Greater Oxdrift.

Tourist Outfitters

Authorized hunting and fishing outfitters that support the local economy and tourism sector. Regional associations such as the Northern Ontario Tourist Outfitters Association represent these groups.

Unorganized Township Property Owners

Includes residents and cottage owners in unorganized areas like Long Lake, who fall under provincial jurisdiction but hold local interests in land and resource use.

Civil Society Organizations

A variety of groups, including public interest groups, environmental organizations, stewardship associations, grassroots movements, and critical voices, such as We the Nuclear Free North, Sunset Country Spirit Alliance, and No Nuclear Waste in Northwestern Ontario.

Public

The broader public, including residents, elected officials, employees, alumni, health and school boards, and community organizations in the project area.

6. Summary of Issues and Areas of Interest

Feedback was gathered, analyzed, and grouped in the eight engagement sessions, organized under the four main **What We Heard** themes included in the draft IPD; a high-level overview of the feedback is summarized below. A more detailed summary of the issues and NWMO's responses, where applicable, can be found in the individual "What We Heard" event reports.

- **Protection of Human Health and Safety**
    - Transportation Safety – Traffic: Concerns about safety risks on the highways with population growth and workers travelling to the proposed Project site, noting existing heavy truck traffic and rate of accidents and collisions. Emphasized the need for safety improvements and/or highway expansion. Interest in exploring alternative possibilities for worker transport, including the Ignace airport and inter-community transportation methods.
    - Transportation Safety – Used Fuel: Concerns about safety risks of transporting used nuclear fuel along Highway 17, and interest in how decisions would be made on whether to transport used nuclear fuel by road, rail, or a combination of both. Interest in how many trucks would deliver used fuel to the site each day, during operations.
    - Public Health – Radiation: Concerns of unseen radiation exposure, with participants asking how communities can trust medical or safety assurances.

  - Public Health – Drinking Water: Concerns of potential watershed contamination, also noting the broader risks to major river systems that support thousands of Canadians.
  - Health System Impacts: Concerns about impacts on medical and emergency services, with increased demand on already strained systems.

- **Social Considerations and Community Infrastructure**

  - Centre of Expertise: Strong interest in the Centre of Expertise (CoE) location, purpose and benefits. Desire to see the CoE not only support research but also serve as a community hub, integrating cultural, educational, recreational and tourism opportunities.
  - Anticipating and Addressing Socioeconomic Impacts: Whether NWMO has a role in anticipating and mitigating potential socioeconomic impacts. Whether NWMO will address key findings from community studies previously conducted in the region.
  - Community Infrastructure and Services: Whether new residents drawn to the community by the DGR project will be supported with adequate infrastructure and public services (e.g., sewer, water, waste disposal, banking, schools, health services). Repeated concerns about services and support for seniors, housing availability and affordability. Significant interest in youth training and preparation for future jobs.

- **Protection of the Natural Environment**

  - Water Contamination Risk: Concerns about risks to the watershed and groundwater, and contingency plans for potential leaks or contamination of nearby lakes and water sources.
  - Impacts to Aquatic and Terrestrial Environments: Concerns about potential changes to lake temperatures from project activities, risk of algae blooms, effects on fish populations, and whether there is a risk of acid rock leachate into nearby lakes. Concerns about impact and mitigation of construction and operations on wildlife, such as migration patterns, and swan populations in nearby lakes.
  - Geology: Suggestion for further study of the Lake Malagon quarry to better understand local geology and potential project impacts. Concern about seismic risk and how it is accounted for in design and safety assessments.
  - Pollution: Worries regarding potential air quality impacts and noise pollution during the construction phase.
  - Climate Change: Concerns about the impacts of climate change on the project site and surrounding area, as well as the impacts of increasing forest fire frequency.

- **Economic Conditions**

  - Economic growth and impacts: Desire to understand the potential economic impacts and opportunities for economic growth and employment, both before and after construction begins. Emphasized the imperative of economic growth, stressing that regulatory efforts must align with this goal.
  - Accommodation camp: Whether the location of the accommodation camp is final or if it can move. Strong desire to locate the camp in Ignace to support local economic development and improve access to emergency and health services for workers. Broader interest from participants in Dryden in a range of options for temporary accommodations, such as residences and hotel conversion possibilities.

- Ignace Hosting Agreement: Concern that the Agreement may not be strong enough to realize project benefits. Desire for more dialogue and information-sharing between the Township and the public, ensuring Ignace takes an active leadership role in bringing positive impacts to the community.
- Impacts on fishing and hunting: Concerns about how the project could affect culturally and economically important activities such as fishing and hunting.
- Bill C-5 (One Canadian Economy: An Act to enact the Free Trade and Labour Mobility in Canada Act and the Building Canada Act, enacted on June 26, 2025): Whether Bill C-5 could impact this project, and how that might affect the process and timeline.

In addition, feedback could be grouped in other common areas of interest falling within two main themes:

- **Project and Site Components**
  - Site Area: Interest in the total surface area that will be occupied or impacted by the project, the size of the withdrawal area, and where exclusion areas will be. Whether the site is located on Crown land and how development will proceed.
  - Site and Road Access: Anticipated impacts to road access, including Dyment Road and other adjacent routes, the current condition and deterioration of existing logging roads, and where any new entry points to the site would be located.
  - Site Restoration: Whether the site will eventually be restored to its original or an acceptable condition after Project completion.
  - Pipeline: Request for further detail regarding a pipeline mentioned on the draft site map, including its purpose and relevance to the Project.
  - Intermediate-Level Waste: Whether the intermediate-level waste intended for temporary storage might remain permanently at the site, and whether the Project might include used fuel from other countries.
- **Regulatory Process and Engagement**
  - Socioeconomic Impacts: Interest in how the regulator would address and enforce socioeconomic impacts, and predictions for future growth, including less tangible social outcomes such as community wellbeing and quality of life. Whether healthcare impacts, such as effects on local medical services, are being studied within the Impact Assessment process.
  - Assessment Methods: Concern that many studies focus on measurable data but may not fully capture community perceptions and concerns. Desire to better understand how the impact assessment process might address and incorporate these less tangible, perception-based impacts alongside factual data.
  - Public hearings: Interest in the location of upcoming public hearings, where they will be held, and how to participate.
  - Timelines: Interest in the IPD process and timeline, and that the document would be accessible to the public once it is submitted. Interest in the timeline and process for approvals for natural gas and other necessary permits tied to the Project. Whether site work can be undertaken prior to receiving CSNC licenses.
  - WLON Regulatory Assessment and Approvals Process (RAAP): Seeking clarity on the membership and role of the RAAP process. Interest in what would happen if

WLON does not support the project at the end of the RAAP process, and whether clear rationale must be provided.

- Coordination Among Regulators: Questions about whether regulators are coordinating effectively with one another to avoid miscommunication or overlap in responsibilities.
- Engagement Accessibility and Communications: Indicated that communication about engagement events could be improved, to improve awareness and participation. Suggestion to use radio and Facebook, and concerns about unreliability of mail drops. Frustration with past NWMO surveys that required access to desktop computers, which can pose a barrier.
- Indigenous Engagement: Whether other Indigenous groups have been engaged or funded in relation to the project.

7. Next Steps: Future Public Engagement Activities

NWMO will formally initiate the regulatory process for the project by submitting the IPD to IAAC in the Fall of 2025. This marks an important milestone in the Project's development. As the regulatory process progresses, NWMO will continue to engage with the public and interested parties, providing regular updates on the project's design, purpose, and potential impacts.

For 2025 and beyond, the NWMO plans to continue ongoing public engagement and discussions, including sharing information from effects assessments and baseline studies, answering questions as well as gathering feedback to help community perspectives inform decision-making.

Examples of future engagement activities could include the following:

- Open Houses (in-person and virtual): Host public open houses in local communities to provide project details and collect feedback from participants;
- Technical Workshops: Facilitate topic-specific workshops where participants can discuss and provide their feedback on the project;
- Comprehensive communications plan and roll-out, which will include informational materials, notification packages, website and social media updates; etc. to keep the public and interested parties apprised of project updates, milestones and upcoming engagement opportunities.

Through these activities, NWMO is committed to maintaining open dialogue and fostering a clear understanding of the project as it advances through the required steps of the regulatory process.

APPENDICES

Appendix A: Presentations

Ignace July 24th Information Session: **NWMO_IPD Overview_Ignace Public_V2_JB.pptx**

Ignace July 25th Information Session: **NWMO_IPD Overview_Ignace Public_V2.pptx**

Webinar Morning: **NWMO_IPD Overview_Webinar-V2S-All Slides.pptx**

Webinar Evening: **NWMO_IPD Overview_Webinar-V2S-All Slides.pptx**

Ignace August 12th IPD Workshop: **NWMO_IPD Workshop_Aug12_V1.pptx**

Dryden August 13th Information Session: **NWMO_IPD Overview_Dryden_V1.pptx**

Ignace August 21st IPD Workshop: **NWMO_IPD Workshop_Aug21.pptx**

Appendix B: Post-Event Survey Questions

Below is an example of the standard questions asked in the post-event survey:

1. Which event did you attend?

Type: Single selection

- Ignace Information Session – June 24
- Ignace Information Session – June 25
- Dryden Information Session – August 12
- Dryden Information Session – August 13
- Webinar – August 6, Morning Session
- Webinar – August 6, Evening Session
- IPD Feedback Workshop – August 12
- IPD Feedback Workshop – August 21

2. Overall, how would you rate the event?

Type: Single selection

- Excellent
- Very Good
- Good
- Fair
- Poor

3. What did you like about the event?

Type: Open-ended text

4. What could be improved for future events?

Type: Open-ended text

Appendix C: Record of Engagement

The list below summarizes the information fields included on the Record of Engagement forms.

Basic Event Details

- Engagement date
- Name of staff member recording notes
- Confidentiality
- Engagement method
- Engagement type
- Supporting materials/documents
- Event name and venue
- Head count and attendee list

Engagement Content

- **Communication summary**: Overview of discussions and key messages
- **Questions asked and answered**: Including stakeholder name and topic for each issue
- **Issues to be tracked**: Stakeholder concerns flagged for follow-up

Engagement Topics (checklist)

- **Multi-disciplinary**: Gender-Based Analysis (GBA+), Community knowledge, Indigenous knowledge
- **Environmental**: air quality, noise, climate change, biodiversity, water, radiation, species at risk, sustainability, etc.
- **Project-specific**: borehole studies, site planning, regulatory process, Centre of Expertise, CNSC licensing, Impact Assessment, approvals and permits

Appendix D: Mentimeter and Zoom Polling Questions

Below are the standard questions asked through Mentimeter and Zoom Polls. As noted in the results section below, the NWMO adapted several questions after the July 24 and 25 events in Ignace based on lessons learned. The NWMO removed open-ended and scale rating questions, replacing them with multiple selection options, and added several additional questions.

1. Tell us, how many NWMO engagement events have you previously attended? *(Note this was not asked at webinars in Zoom Polls; it was intended as an icebreaker for in-person sessions)*

- This is my first time
- I've participated in a few
- I've lost count!

2. What are your goals or hopes for today's event? (Select all that apply)

- To learn more about the project, in general
- To better understand the regulatory process and next steps
- To share my feedback, priorities, and concerns

3. What benefits do you hope this project could bring for you and/or your community? (Select all that apply)

- Long-term employment opportunities
- Training and skills development programs
- Infrastructure improvements
- Increased local business opportunities
- Youth engagement and future opportunities for younger generations
- Funding for community initiatives and services
- Improved access to science and environmental education

4. What aspects of the Deep Geological Repository Project are you most concerned about? (Select all that apply)

- Long-term safety of storing used nuclear fuel underground
- Potential impacts on water sources and the environment
- Effects on local communities, including health and well-being
- Impacts on Indigenous rights, lands, and cultures
- Transparency and trust in decision-making and oversight
- Effects on the economy, tourism, or land use in the area
- Emergency preparedness and risk management

5. What topics are you most interested in learning about in relation to the Deep Geological Repository Project? (Select all that apply)

- Water
- Social, Economic and Health
- Archaeology and Cultural Heritage

- Current Land Use – Recreation or Commercial (navigation, hunting, fishing, trapping, visual aesthetics)
- Land-Based Environment (upland vegetation, wetlands, species at risk)
- Aquatic Environment (fish and fish habitat)
- Atmospheric Environment (air quality, noise, greenhouse gases, climate change)
- Potential Effects
- Project Design and Structure
- Safety, Accidents, and Radiological Considerations

6. What else would you like to know about the regulatory process? (Select all that apply)

1. How can the community be involved within the process
2. More information about the regulatory bodies
3. More information about the key milestones and timelines

7. Does the *What We Heard* Summary do a good job of representing the priorities and concerns that matter to me, at a high level?

- Yes, it fully reflects the concerns and priorities that matter to me. I have nothing to add.
- The summary mostly reflects my priorities and concerns. I have a couple things to add.
- The summary somewhat reflects my priorities and concerns. I have several things to add.
- The summary does not reflect my priorities and concerns at all.

Appendix E: Mentimeter and Zoom Poll Results

Table 2 Mentimeter and Zoom Poll Results

Questions	Options	Ignace Information Sessions	Dryden Information Session	Dryden Drop-in Event	Webinar
1. How many NWMO engagement events have you previously attended?	I've participated in a few	3	2	n/a	n/a
	I've lost count	6	1	n/a	n/a
	This is my first time	2	1	n/a	n/a
2. What are your goals or hopes for today's event?	To have good discussions with NWMO staff and other community members	4	Omitted in revised version	Omitted in revised version	Omitted in revised version
	To better understand the regulatory process and next steps	10	4	n/a	14
	To share my feedback, priorities and concerns	3	0	n/a	2
	To learn more about the project, in general	3	3	n/a	11
3. What else would you like to know about the regulatory process?	*Note this question was only asked in an open-ended way at July 24-25 sessions; future sessions provided multiple selection options to improve participation rate.*	Can it be shortened? What contingency plans are in place for potential breaches of the facility, and how will the intermediate grade waste be stored and transported to	n/a	n/a	n/a

		limit exposure? With such a broad timeline, would there be opportunities for economic growth and new careers for Ignace residents before construction? How can the early stages benefit locals economically?			
3a. *(revised version)* **What else would you like to know about the regulatory process? (Select all that apply)**	How can the community be involved within the process	n/a	2	n/a	9
	More information about the regulatory bodies	n/a	0	n/a	9
	More information about the key milestones and timelines	n/a	3	n/a	6
4. What benefits do you hope this project could bring for you and/or your community? (Select all that apply)	Long term employment opportunities	2	5	4	11
	Training and skills development programs	2	1	4	5
	Infrastructure improvements	2	4	4	10
	Increased local business opportunities	2	3	4	6
	Youth engagement and future opportunities for younger generations	2	3	4	8

	Funding for community initiatives and services	2	3	4	6
	Improved access to science and environmental education	2	1	3	7
	Water	0	1	3	7
	Social, Economic and Health	2	1	4	9
	Archaeology and Cultural Heritage	1	2	3	3
	Current Land Use – Recreation or Commercial (ex. navigation, hunting, fishing, trapping, visual aesthetics)	0	2	2	5
5. What topics are you most interested in learning about in relation to the Deep Geological Repository Project? (Select all the apply)	Land-Based Environment (upland vegetation, wetlands, species at risk)	0	1	2	4
	Aquatic Environment (fish and fish habitat)	0	0	2	5
	Atmospheric Environment (air quality, noise, greenhouse gases, climate change)	0	0	2	4
	Potential Effects	1	0	2	4
	Project Design and Structure	2	2	2	4
	Safety, Accidents, and Radiological Considerations	0	1	3	9
6. What aspects of the Deep Geological Repository Project are you most concerned about?	Potential impacts on water sources and the environment	0	3	3	8
	Emergency preparedness and risk management	1	1	3	9
	Impacts on Indigenous rights, lands, and cultures	0	1	3	5
	Long-term safety of storing used	1	2	3	7

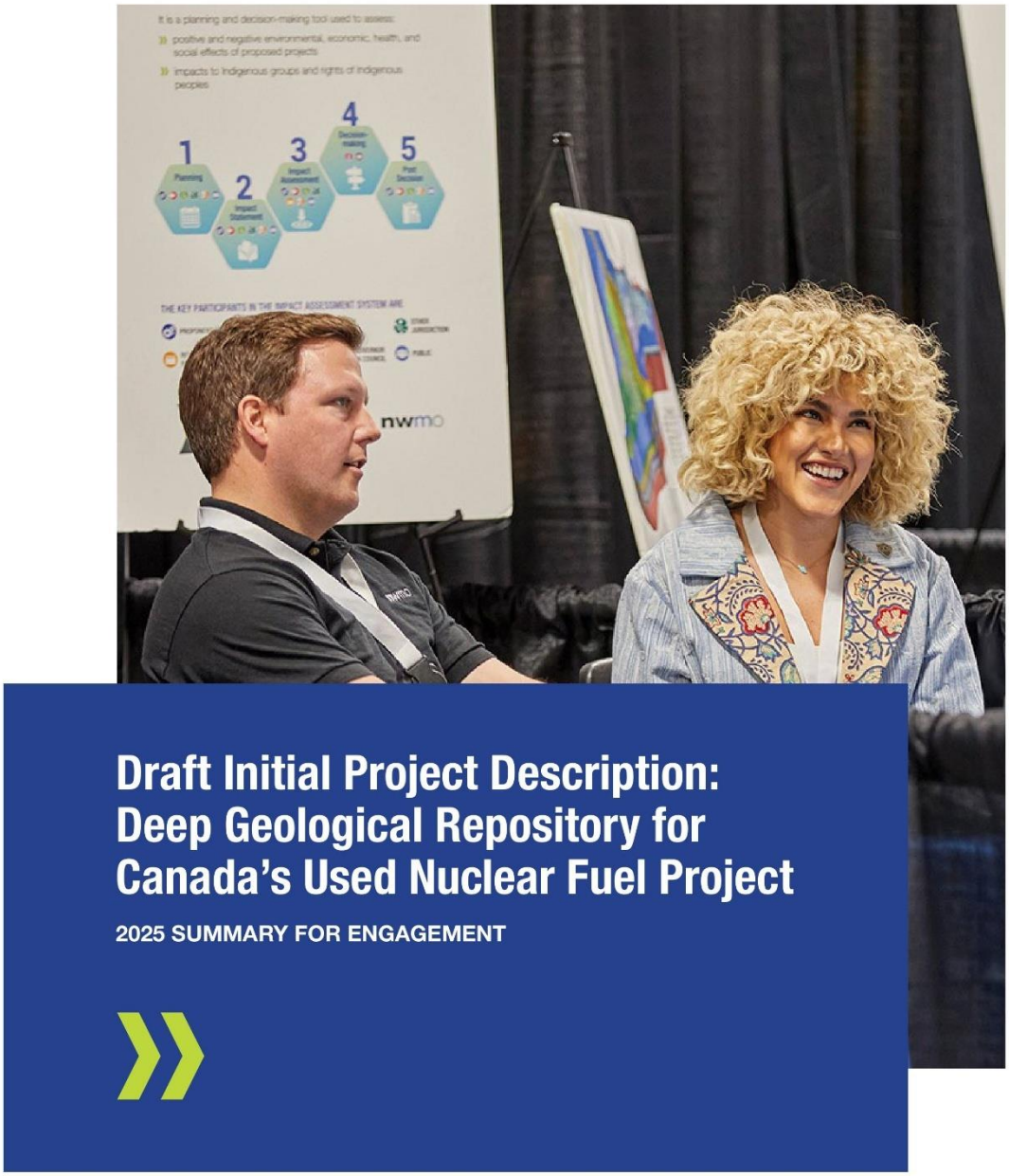
(Select all that apply)	nuclear fuel underground				
	Effects on local communities, including health and well-being	2	2	2	7
	Transparency and trust in decision-making and oversight	2	0	3	6
	Effects on the economy, tourism, or land use in the area	2	1	3	3
7. Does the What We Heard Summary do a good job of representing the priorities and concerns that matter to me, at a high level?	Yes, it fully reflects the concerns and priorities that matter to me. I have nothing to add.	n/a: see further below	1	1	7
	The summary mostly reflects my priorities and concerns. I have a couple things to add.	n/a: see further below	2	2	3
	The summary somewhat reflects my priorities and concerns. I have several things to add.	n/a: see further below	0	0	2
	The summary does not reflect my priorities and concerns at all.	n/a: see further below	0	0	1
8. What is your level of agreement with the following statement: The What We Heard Summary does a good job of representing the priorities and	Note this question was only asked at July 24-25 sessions as a rating scale, prior to pivoting approach. Future sessions pared down the rating questions to one multiple choice question, in the interests of time and ease for participant response.	Average ranking July 24: 4.0			Note this question was only asked at July 24-25 sessions as a rating scale, prior to pivoting approach. Future sessions pared down the rating questions to one multiple

concerns that matter to me, at a high level? (1-5)					choice question, in the interests of time and ease for participant response.
9. What is your level of agreement with the following statements: The feedback I previously shared is mostly reflected in the key themes? (1-5)	Note this question was only asked at July 24-25 sessions as a rating scale, prior to pivoting approach, as described above.	Average ranking July 24: 4.14			Note this question was only asked at July 24-25 sessions as a rating scale, prior to pivoting approach, as described above.
10. What is your level of agreement with the following statements: I have additional ideas, concerns, or issues to add to these themes? (1 – 5)	Note this question was only asked at July 24-25 sessions as a rating scale, prior to pivoting approach, as described above.	Average ranking July 24 and 25: 4.0	n/a	n/a	n/a
11. What other studies on the impacts of the project would you be	Note this question was only asked in an open-ended way at July 24-25 sessions; future sessions provided multiple selection options to improve participation rate.	How will the potential growth of the community impact those currently living here?			Note this question was only asked in an open-ended way at July 24-25 sessions; future sessions

interested in?					provided multiple selection options to improve participation rate.

Appendix F: Communications Materials

1. IPD Communications Summary (English)
2. IPD Communications Summary (French)
3. IPD feedback template (English)
4. IPD feedback template (French)
5. Web Story (English)
6. Web Story (French)
7. Posterboard
8. Household mailer
9. Supporting social media posts on Facebook, Instagram and X (formerly known as Twitter)
10. Ignace storefront poster
11. Informational documents on Canadian Nuclear Safety Commission


It is a planning and decision-making tool used to assess:
positive and negative environmental, economic, health, and social effects of proposed projects
impacts to Indigenous groups and rights of Indigenous peoples
1
2
3
4
5
nwmo
Draft Initial Project Description: Deep Geological Repository for Canada's Used Nuclear Fuel Project
2025 SUMMARY FOR ENGAGEMENT
nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

12.

PROTECTING WHAT MATTERS. PLANNING WITH YOU.

The Nuclear Waste Management Organization (NWMO) is a not-for-profit organization tasked with the safe, long-term management of Canada's used nuclear fuel, in a manner that protects people and the environment for generations to come. The plan is to contain and isolate the used fuel in a deep geological repository using a multiple-barrier system.

Since our beginning, we have been working closely with Indigenous Peoples, Canadians, industry, regulators and all levels of government to protect people and the environment, both now and in the future. In November 2024, Wabigoon Lake Ojibway Nation and the Township of Ignace agreed to move into the regulatory decision-making phase as potential host communities for a deep geological repository for Canada's used nuclear fuel, or "the Project."

The Project now moves into the required regulatory decision-making process, which marks a new chapter in Canada's plan for used nuclear fuel, and another opportunity for Indigenous Peoples and the public to share their voice. The purpose of the regulatory process is for the safety of the repository to be independently confirmed by the regulators, including the Canadian Nuclear Safety Commission and the Impact Assessment Agency of Canada.

The process includes an impact assessment integrated with licensing. An impact assessment is a process that looks at how a deep geological repository could affect the environment, health, socioeconomics and Indigenous rights before it gets approved. A licence is required to make sure any nuclear activity in Canada is done safely, protects people and the environment, and follows strict rules.

The first step of the regulatory process is for the NWMO to draft and submit an Initial Project Description to the Impact Assessment Agency of Canada. This submission formally initiates the regulatory process.

An Initial Project Description explains the purpose and need for a project, the preliminary assessment of impacts, and how a company is planning to avoid and mitigate them. The Initial Project Description is the first of many steps in the rigorous licensing process for nuclear facilities, including engaging with Indigenous Peoples and local and regional residents.

The NWMO is currently in the process of preparing that regulatory submission document and will actively seek input as part of the process.

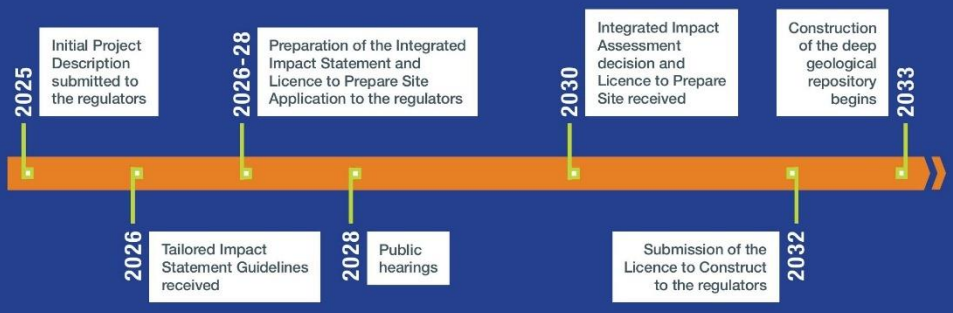


Table of contents

Introduction 2
About the Project 4
The Integrated Impact Assessment and Licensing process 7
Benefits of the deep geological repository Project 8
Continued engagement: Sustained dialogue, participation and collaboration 10
How baseline data is used in the regulatory decision-making process 17
Preliminary screening assessment considerations and findings 26
Strategic assessment of climate change 27
What's next 28
Questions or feedback? 29

Introduction

In 2002, federal legislation directed the Nuclear Waste Management Organization (NWMO) to study how to manage used nuclear fuel and to recommend a preferred approach. In 2005, after a three-year period of study and dialogue with Indigenous Peoples and Canadians from coast to coast, we submitted our proposed approach to the federal Minister of Natural Resources. In June 2007, the federal government selected the plan we are now implementing, known as Adaptive Phased Management, as Canada's plan for the safe, long-term management of used nuclear fuel.

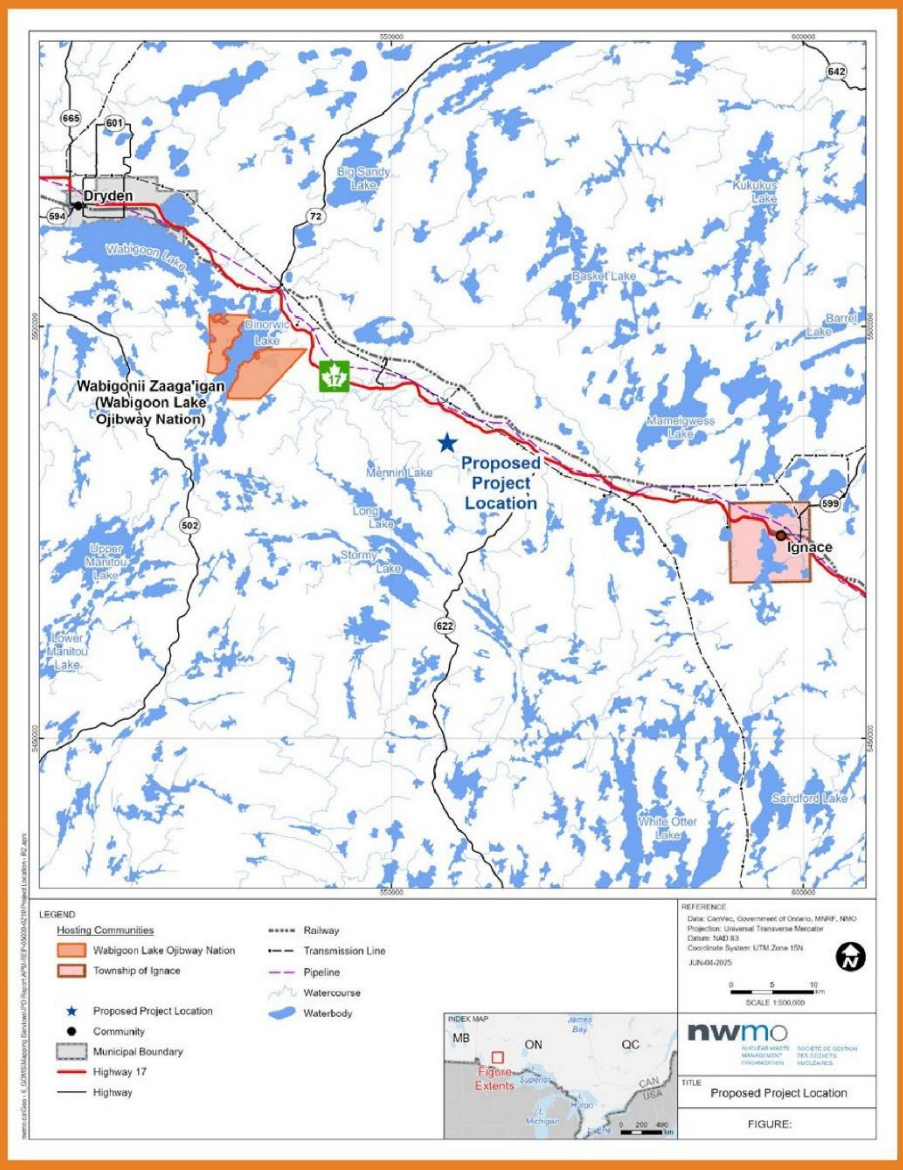
Following an extensive 14-year site selection process, Wabigoon Lake Ojibway Nation and the Township of Ignace agreed to move into the regulatory decision-making phase as potential host communities for a deep geological repository for Canada's used nuclear fuel.

We are now advancing Canada's plan to safely manage used nuclear fuel in a deep geological repository, subject to regulatory approval. The Project proposes the development of a carefully engineered underground facility, designed to safely contain and isolate used nuclear fuel essentially forever.

This document shares highlights of the NWMO's work in this pre-planning phase of impact assessment and licensing, including technical safety and design progress, engagement activities, environmental considerations and next steps as the Deep Geological Repository for Canada's Used Nuclear Fuel Project advances into regulatory decision-making.

In 2005, after a three-year period of study and dialogue with Indigenous Peoples and Canadians from coast to coast, we submitted our proposed approach to the federal Minister of Natural Resources.

PROPOSED PROJECT LOCATION



About the Project

The Deep Geological Repository for Canada's Used Nuclear Fuel Project will:

- Provide for the safe, long-term management of up to 5.9 million used nuclear fuel bundles;
- Be located in a stable rock formation to naturally contain and isolate used nuclear fuel over hundreds of thousands of years; and
- Be implemented in collaboration with surrounding First Nations and municipalities.

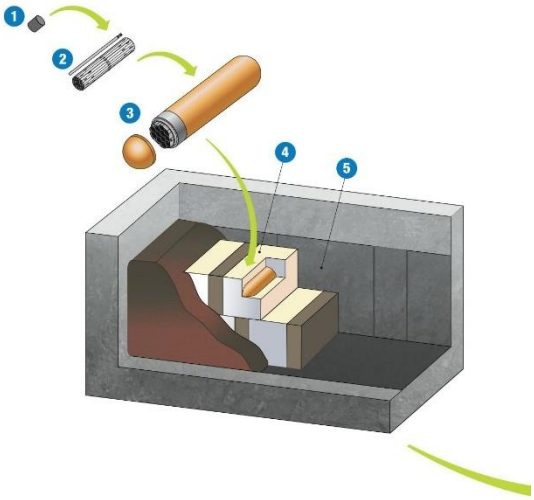
The Project will use a multiple-barrier system. The system includes a series of engineered and natural barriers, working together to safely contain and isolate used nuclear fuel within the repository.

Each barrier will provide a unique and stand-alone level of protection, while serving as a backstop to the last barrier. If any of these barriers were to fail or not perform as expected, the next barrier comes into play, to be sure materials remain contained and isolated.

Rigorous safety standards will govern the Project. The NWMO is committed to meeting all applicable federal and provincial regulatory requirements to protect the health, safety and security of people and the environment for generations to come.

The multiple-barrier system

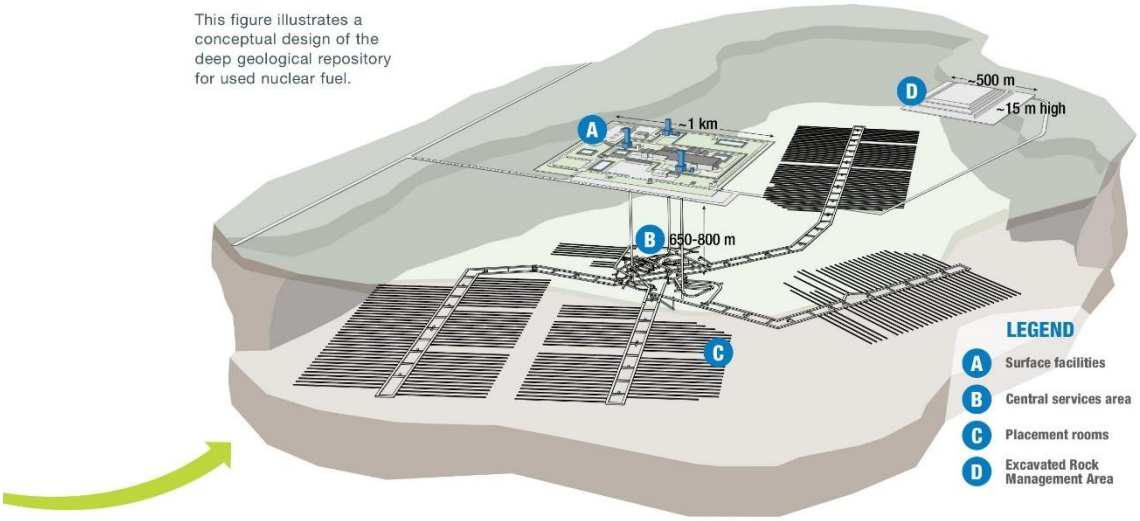
1. **Fuel pellet** — a very stable, solid ceramic made of baked uranium.
2. **Fuel bundle** — made from a highly corrosion-resistant material called Zircaloy.
3. **Copper-coated steel container** — engineered to resist corrosion and strong enough to keep the used nuclear fuel completely contained until radioactivity decreases to safe levels.
4. **Bentonite clay box** — highly compacted clay material, encasing each container and backfilling the repository.
5. **The rock itself** — protects the repository from disruptive natural events, water flow and unintentional human intrusion.



MORE ABOUT THE DEEP GEOLOGICAL REPOSITORY FOR CANADA'S USED NUCLEAR FUEL

- The host rock is stable and predictable over long periods of time.
- The host rock has low permeability, meaning that the tiny traces of water in the deep rock are isolated and do not mix with surface waters.
- The deep geological repository system would maintain an environment that is favourable to the stability and performance of the repository.
- Examples in nature provide evidence that engineered-barrier system components are stable for very long periods under similar deep geological conditions.
- The depth of the repository makes any mistaken human intrusion into the closed repository very unlikely in the future.
- Countries around the world are implementing repositories — this Project builds on scientific consensus and practical experience.
- Safety case studies indicate that any radiation impacts are likely to be well below the natural background dose rates.
- The deep geological repository can be built and operated safely using proven technologies.
- The radionuclides in the used fuel decay, making them less dangerous with time.
- The repository site can be monitored to confirm repository system performance.

This figure illustrates a conceptual design of the deep geological repository for used nuclear fuel.



Draft Initial Project Description (2025 summary for engagement) 5

PURPOSE OF THE PROJECT

The Project will protect people and the environment through sustainable, safe, long-term management of used nuclear fuel. The NWMO is proposing the site preparation, construction, operations, decommissioning and closure of the deep geological repository for Canada's used nuclear fuel to safely isolate approximately 5.9 million used nuclear fuel bundles. The Project will be licensed by the Canadian Nuclear Safety Commission for approximately 160 years.

UNDERSTANDING NUCLEAR POWER IN CANADA

In Canada, nuclear power is responsible for 15 per cent of electricity generation with 19 operable Canada Deuterium Uranium (CANDU) reactors at four nuclear generating stations. For many years, Canada has been a leader in nuclear research and technology, exporting reactor systems developed in Canada, as well as a high proportion of the world supply of radioisotopes used in medical diagnosis and cancer therapy.

Nuclear power offers a reliable power source, contributing to sustainable economic growth and improved human welfare. The Government of Canada has been clear nuclear power will play an essential role in decarbonization and the ability of Canada to achieve carbon neutrality by 2050. The growth of Canadian investment in nuclear will help strengthen our energy security now and in the future.

Currently, Canada's used nuclear fuel is managed in facilities licensed for interim storage. This approach is safe; however, given the long time frames associated with the hazardous nature of used nuclear fuel, it is not a permanent solution as it requires ongoing maintenance and management. That is why the NWMO agrees with international best practice to construct a deep geological repository to safely contain and isolate used nuclear fuel for the very long term.

ESTIMATED PLAN TIMELINE

The implementation of Canada's plan will span approximately 160 years. It will take approximately 10 years to prepare the site and construct the deep geological repository, with an expected operations start date in the mid-2040s. The deep geological repository will operate for approximately 50 years. After that, the repository will be monitored for an extended period of time before decommissioning, closure and post-closure monitoring.

Over the lifespan of the Project, the NWMO will maintain a commitment to host communities and the surrounding area to contribute to long-term well-being. This requires awareness and analysis of how the Project may impact social and economic conditions, including employment and job opportunities.

ASSUMED PROJECT PHASES AND PLANNING TIMELINES

Project phase	Approximate timeline (years)	Phase duration (years)
Site Preparation and Construction	2030-42	13
Operations	2043-92	50
Extended Monitoring, Decommissioning and Closure	2093-2192	100
Institutional Control[1]	2193+	

[1] The control of any risks at a site after decommissioning and closure, including activity like surveillance, maintenance or signs/markers.

The Integrated Impact Assessment and Licensing process

The Project will undergo a thorough impact assessment process, co-ordinated by the Impact Assessment Agency of Canada and integrated with the initial licence application to the Canadian Nuclear Safety Commission.

This process will ensure that details like impacts on harvesting, hunting and Indigenous ways of life are considered alongside any possible impacts on overall environmental, health, social and economic factors.

The Project is currently in the pre-planning phase, and the impact assessment has not started yet. Early input from the host communities, Indigenous communities in the region and the public is shaping our Initial Project Description document for submission to the regulators and our path forward to decision-making.

The preliminary assessment and proposed mitigation strategies for potential impacts described in the draft Initial Project Description will require input from the host communities, Indigenous communities, interested groups and individuals, and regulators. The results of the assessment will be used to tailor the impact statement guidelines for the Project, which will be issued by the Impact Assessment Agency of Canada.

The Initial Project Description is simply an initial screening step. The Impact Statement work that comes after the Initial Project Description must describe the designated project, key project components and ancillary activities, scheduling details, the timing of each phase of the project and other key features.

When drafting the Impact Statement, the NWMO will also work to respectfully align with Indigenous Knowledge and land use studies in the impact assessments and the design of mitigation strategies, so that the Project supports the interests of Wabigoon Lake Ojibway Nation, the Township of Ignace, and other Indigenous communities and the public in the region.

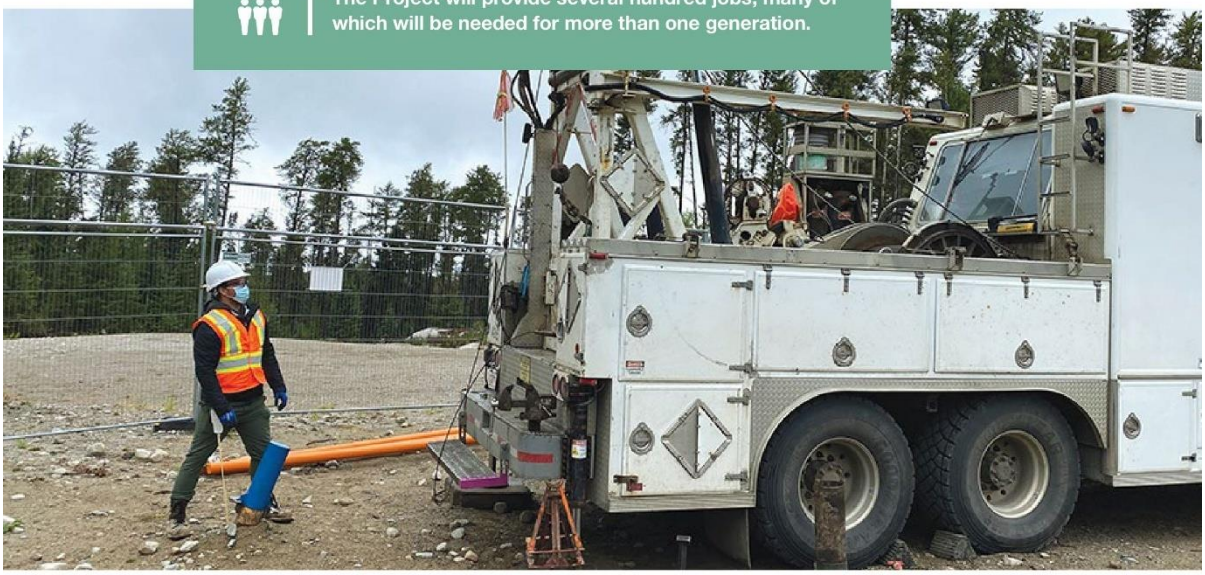
> The next decade of our work will be focused on navigating the robust regulatory decision-making process to deliver on our promise to sustainably protect people and the environment. We are grateful for the close collaboration we have with Indigenous Peoples, Canadians, industry and regulators, which will help ensure our success.
>
> **— Dr. Mackenzie Denyes, Director of Impact Assessment and Licensing at the NWMO**

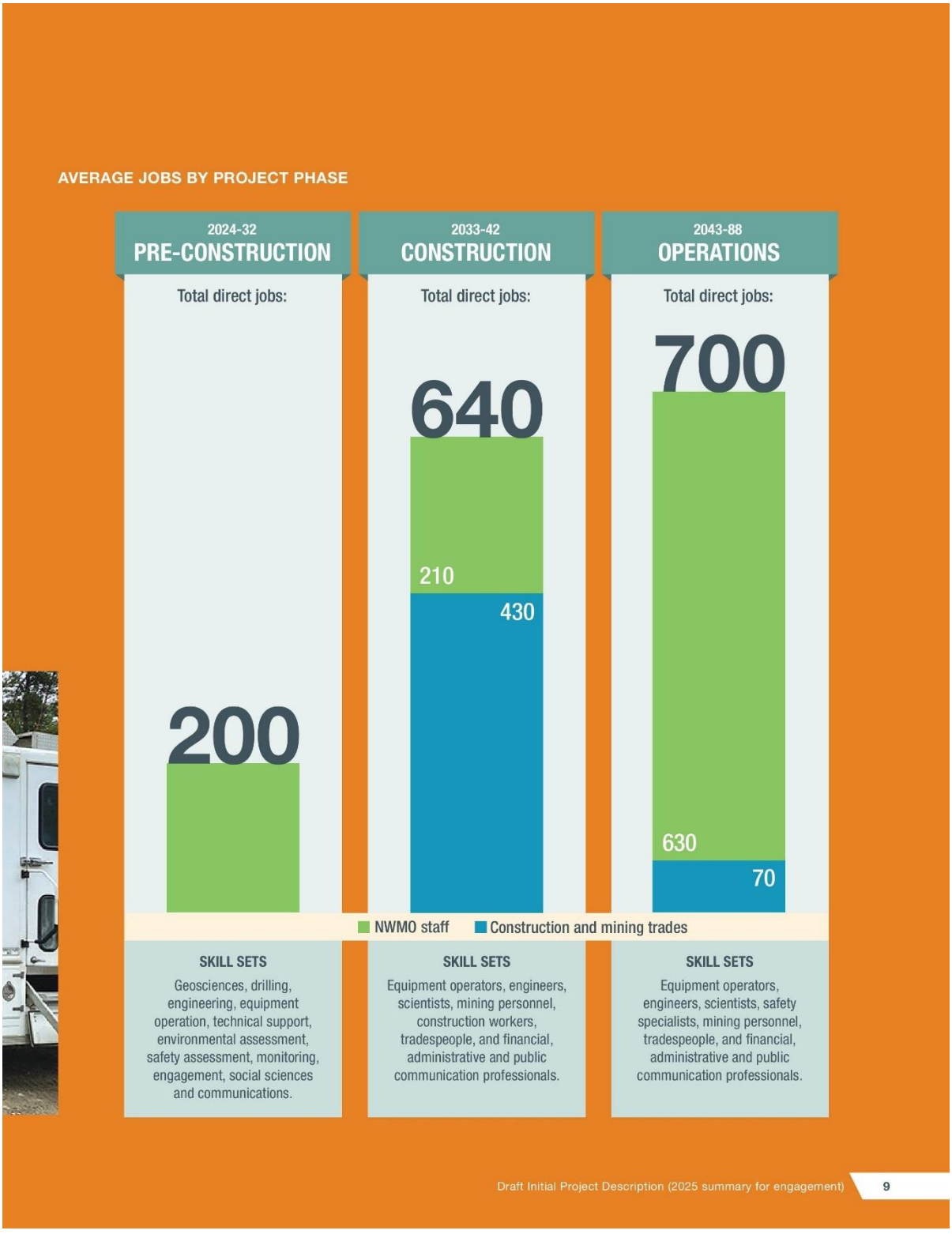
Benefits of the deep geological repository Project

In addition to helping Canada achieve net-zero and energy security targets, the Project will create and sustain high-quality jobs in northwestern Ontario and beyond by supporting a highly technical and diverse supply chain, and meaningful economic benefits to regional communities. This national infrastructure project will drive a wide range of benefits for the host communities, the region and Canada as a whole over the approximate 160-year timeline. The Project will provide several hundred jobs, many of which will be needed for more than one generation. It will require people resources, equipment and materials to support construction and operations.

Because this multi-generational project will be implemented in phases over a period of about 160 years, we will continually review, strengthen and adjust the plan in the face of new information, direction and guidance. We are committed to implementing the Project in a safe way to meet the applicable *General Nuclear Safety and Control Regulations* (SOR/2000-202).

The Project will provide several hundred jobs, many of which will be needed for more than one generation.




AVERAGE JOBS BY PROJECT PHASE
2024-32
PRE-CONSTRUCTION
Total direct jobs:
200
SKILL SETS
Geosciences, drilling, engineering, equipment operation, technical support, environmental assessment, safety assessment, monitoring, engagement, social sciences and communications.
2033-42
CONSTRUCTION
Total direct jobs:
640
210
430
SKILL SETS
Equipment operators, engineers, scientists, mining personnel, construction workers, tradespeople, and financial, administrative and public communication professionals.
2043-88
OPERATIONS
Total direct jobs:
700
630
70
SKILL SETS
Equipment operators, engineers, scientists, safety specialists, mining personnel, tradespeople, and financial, administrative and public communication professionals.
NWMO staff
Construction and mining trades
Draft Initial Project Description (2025 summary for engagement)
9

Continued engagement: Sustained dialogue, participation and collaboration

Engagement and relationship building with Indigenous communities, the public and interested parties will remain at the heart of this Project. Former, current and future activities include:

- **Implementation of the hosting agreements:** Collaborative work with Wabigoon Lake Ojibway Nation and the Township of Ignace, including investments in training, education and skills development. These topics are laid out in hosting agreements, including how we can move forward together through the regulatory process.
- **Regulatory engagement and participation activities:** Ongoing efforts to share information transparently and gather feedback on how the Project will proceed. This engagement and participation will seek to gain input on the potential impacts of the Project. Feedback on the design, implementation and monitoring of the Project is important to regulatory engagement because it helps ensure the Project protects the environment, respects culture, safeguards water and supports long-term benefits for the local communities.
- **Communications and information sharing:** Providing clear, timely and accessible information to Indigenous communities, the public and interested parties about the NWMO's activities and progress. This includes regular updates, opportunities for two-way discussions, published materials and other resources to help keep communities informed and aware of the Project's development.

Key themes and concerns that we heard during the site selection process will continue to be addressed as part of our engagement activities during the regulatory process. These include things like:

- The importance of protecting water resources and the natural environment;
- Requests for clear commitments on safety, health and environmental protection;
- Interest in long-term economic and capacity-building opportunities;
- Emphasis on community involvement in monitoring and oversight;
- Support for respectful alignment with Indigenous Knowledge alongside western science, to the extent that communities are willing to share; and
- Protection of the ancestral wisdom of the Knowledge Holders as their sovereign intellectual property.

The NWMO continues to maintain open communication and engagement with host communities, other Indigenous and municipal communities, and the public and will do so at every stage of the Project. The NWMO's engagement as part of impact assessment and licensing will seek feedback and participation on topics such as:

- Baseline data collection programs;
- Project activities and their interactions with people and the environment;
- Proposed mitigation measures to avoid adverse impacts, or alternatively, opportunities to enhance benefits; and
- Future followup and regulatory monitoring programs.

Building on the years of engagement that have already occurred, the NWMO will undertake outreach activities between July 17 and Aug. 22, 2025, specifically tailored to the host communities, Indigenous communities, and other interested groups and individuals.

Such activities will include information sessions and webinars, website and social media updates, and a comment period.

ENGAGEMENT AND PARTICIPATION WITH INDIGENOUS PEOPLES

The NWMO remains committed to building and maintaining strong, lasting relationships with First Nations and Indigenous Peoples, including ongoing relationships with national and provincial Indigenous organizations to ensure that continuous and meaningful dialogue persists.

Applying learnings from Elders, Knowledge Holders, Indigenous Peoples and communities, the Indigenous engagement and participation objectives for the Project include:

- Amplifying and uplifting Indigenous voice and knowledge systems;
- Respectfully aligning with Indigenous perspectives and knowledge into project planning and decision-making;
- Building respectful relationships grounded in reciprocal truth, honesty and trust; and
- Creating opportunities for equitable participation, collaboration and partnership.

The NWMO will look to Indigenous Peoples to share Indigenous Knowledge with us to the extent that they wish. The NWMO will ensure that Indigenous intellectual property is protected, as agreed to with the Indigenous Peoples who choose to share that knowledge.

The Project is located on the territory of Wabigoon Lake Ojibway Nation. Its willingness to move forward with the Project's next steps in its territory was required for making a siting decision for the Project and before the NWMO could proceed to regulatory decision-making. As part of the hosting agreement, the NWMO agreed for Wabigoon Lake Ojibway Nation to complete its own Regulatory Assessment and Approval Process for the Project. The NWMO is committed to respecting Wabigoon Lake Ojibway Nation's sovereignty throughout the implementation of the Project.

The Project is located on the territory of Wabigoon Lake Ojibway Nation. Its willingness to move forward with the Project's next steps in its territory was required for making a siting decision for the Project and before the NWMO could proceed to regulatory decision-making.

The NWMO acknowledges the importance of relationships with other Indigenous communities in the regional area of the proposed Project. The NWMO will work to maintain those relationships that currently exist and to establish new ones. The NWMO commits to meaningful communication, engagement and participation with other Indigenous communities, and the implementation of the NWMO's Reconciliation and Indigenous Knowledge policies, and Ethical and Social Framework.

The NWMO recognizes, honours and supports the belief that Indigenous Peoples have a special relationship with the natural environment and have unique stewardship responsibilities that are part of this relationship.

Nuclear Waste Management Organization:
Conversation Corner
LEARN MORE
Draft Initial Project Description (2025 summary for engagement)
13

THE NWMO'S RECONCILIATION JOURNEY

The NWMO is on a Reconciliation journey. In 2019, as part of this journey, we created and finalized through ceremony a *Reconciliation Policy*. It sets out how the organization will contribute to Reconciliation. Under the policy, the NWMO commits to respectful and meaningful engagement with Indigenous Peoples and communities, providing cultural awareness and Reconciliation training to staff and contractors.

Additionally, in 2016 and updated in 2020, the NWMO published an *Indigenous Knowledge Policy* to ensure we are guided by a clear set of principles as we work with communities and Indigenous Knowledge Holders. Under that policy, the NWMO commits to considering Indigenous Knowledge in our work and respecting the value of what Indigenous Knowledge systems can contribute to project development and decision-making processes.

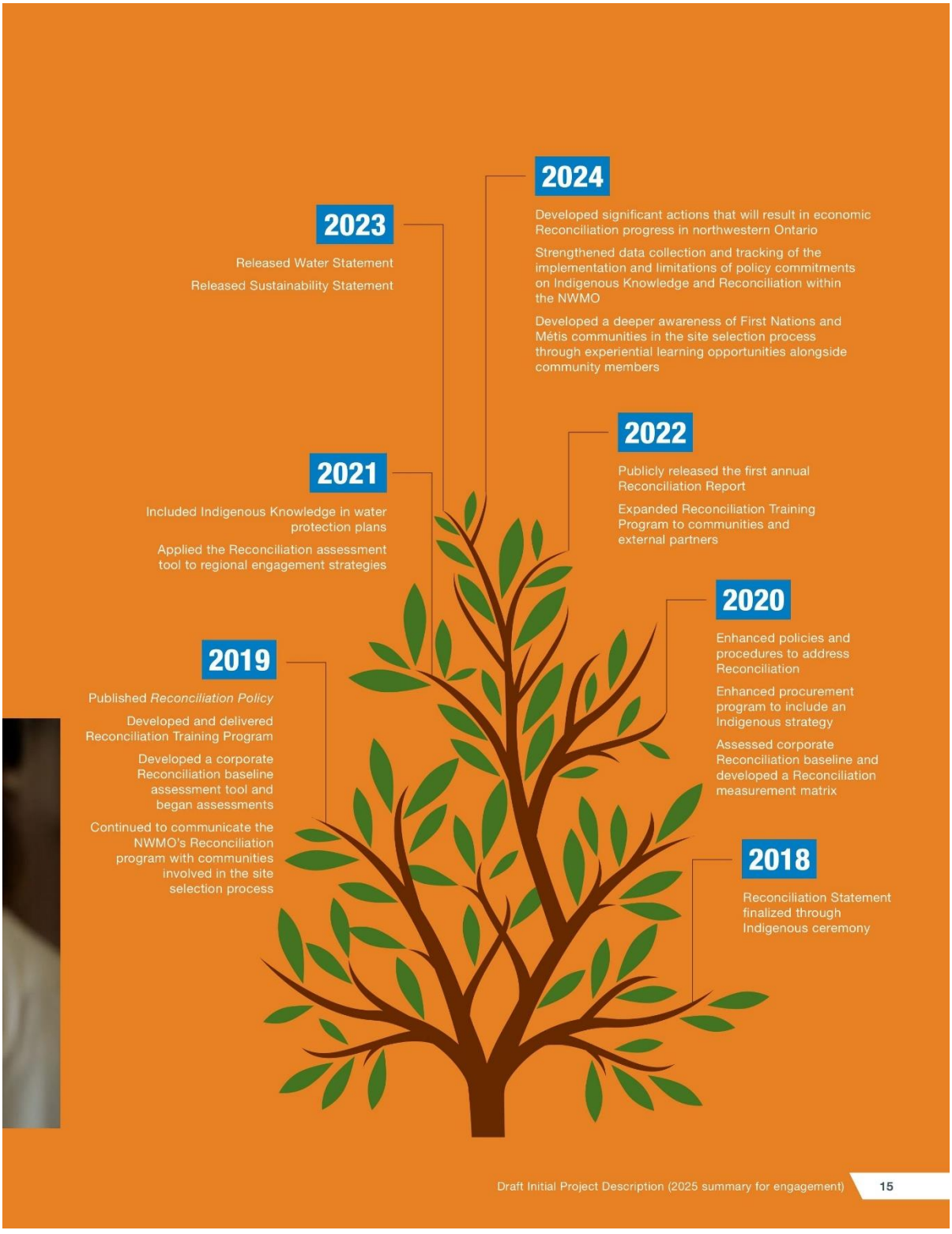
In 2023, the NWMO published a Water Statement that affirms our commitment to water protection by considering how the agency of water (from surface to underground) may be in relationship with Canada's planned deep geological repository and its surrounding area. The Water Statement is a companion document to the NWMO's Environmental Responsibility Statement.

The NWMO will continue to apply Indigenous Knowledge to both technical safety and community well-being aspects of the Project when given permission to do so by Indigenous Knowledge Holders.

The NWMO will continue to meaningfully engage with Wabigoon Lake Ojibway Nation and other Indigenous communities potentially impacted by the Project, to identify and understand the potential impacts of the Project on Indigenous Peoples and their rights, including their lands, territories and resources, and to align with Indigenous Knowledge.

For more on our Reconciliation journey, please visit nwmo.ca/reconciliation.

The NWMO will continue to meaningfully engage with Wabigoon Lake Ojibway Nation and other Indigenous communities potentially impacted by the Project.


2024
Developed significant actions that will result in economic Reconciliation progress in northwestern Ontario
Strengthened data collection and tracking of the implementation and limitations of policy commitments on Indigenous Knowledge and Reconciliation within the NWMO
Developed a deeper awareness of First Nations and Métis communities in the site selection process through experiential learning opportunities alongside community members
2023
Released Water Statement
Released Sustainability Statement
2022
Publicly released the first annual Reconciliation Report
Expanded Reconciliation Training Program to communities and external partners
2021
Included Indigenous Knowledge in water protection plans
Applied the Reconciliation assessment tool to regional engagement strategies
2020
Enhanced policies and procedures to address Reconciliation
Enhanced procurement program to include an Indigenous strategy
Assessed corporate Reconciliation baseline and developed a Reconciliation measurement matrix
2019
Published *Reconciliation Policy*
Developed and delivered Reconciliation Training Program
Developed a corporate Reconciliation baseline assessment tool and began assessments
Continued to communicate the NWMO's Reconciliation program with communities involved in the site selection process
2018
Reconciliation Statement finalized through Indigenous ceremony
Draft Initial Project Description (2025 summary for engagement)
15

PUBLIC ENGAGEMENT AND PARTICIPATION

In addition to engagement with Indigenous communities, the NWMO has engaged extensively for over two decades with interested groups and individuals and a wide range of interested parties, including the host municipality — the Township of Ignace — and other municipalities, businesses, service providers and environmental organizations.

The purpose of public engagement is to enable early discussions specific to the site while informing the Project design through various engagements on the Initial Project Description. To achieve this objective, the NWMO will:

- Identify public and affected interests through early community engagement;
- Understand public preferences for engagement methods;
- Conduct engagement activities focused on specific deliverables to solicit feedback; and
- Incorporate received input to shape Project elements and ensure transparent recordkeeping and reporting.

The NWMO will hold open sessions to ensure members of the public who have not yet begun to engage with the NWMO can join the conversation.

Now that site selection is complete, there are several ways that people can provide input, including participating in information sessions or webinars, dropping by the Ignace Learn More Centre, or sending written feedback. More information regarding feedback opportunities can be found at nwmo.ca/PlanningWithYou.

How baseline data is used in the regulatory decision-making process

Baseline data collection studies for natural and human environments are ongoing and will continue through the regulatory decision-making process. Environmental monitoring will continue to collect data to describe existing conditions of many components of the environment.

With a good understanding of baseline conditions, predictions can be made on how the project may impact people and the environment. Measures can then be explored to avoid, manage, mitigate, and in some cases, offset adverse impacts.

The Initial Project Description will summarize many years of baseline data and use that data to inform potential mitigations (discussed in next section).

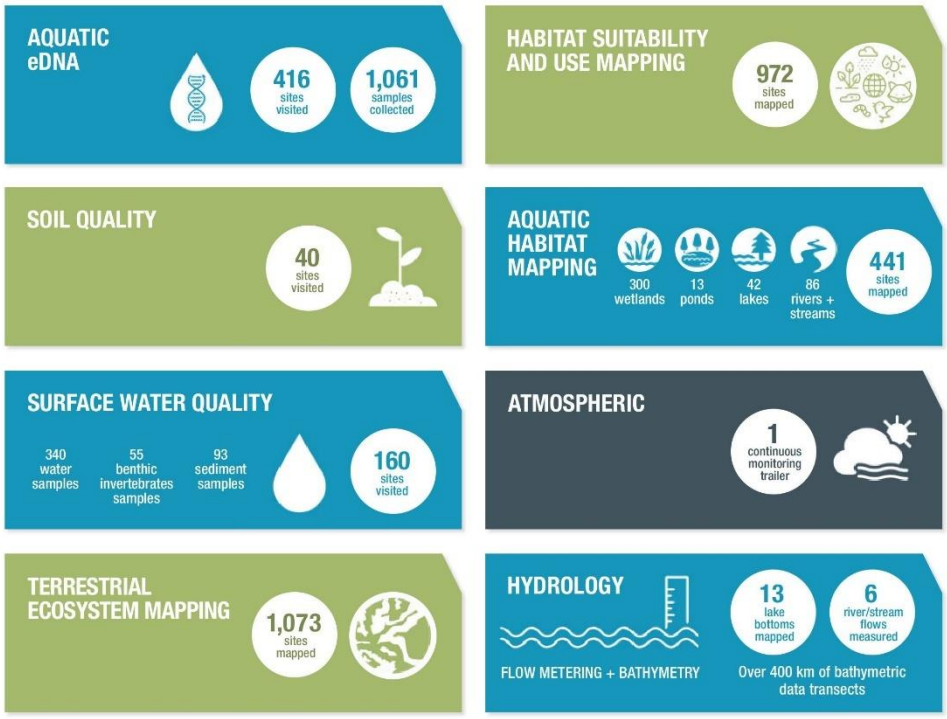
Environmental monitoring will continue to collect data to describe existing conditions of many components of the environment.

PROJECT HIGHLIGHTS TO DATE: ENVIRONMENTAL BASELINE

Regulatory decision-making requires that baseline environment data is collected and used in assessment and design planning before approval can be given for the site to be prepared for the deep geological repository. That process of studying the environmental baseline data is called "site characterization" by the Canadian Nuclear Safety Commission.

The NWMO has built an understanding of the Project site, by collecting, evaluating and modelling data about the regional geology since 2010. There have also been environmental studies conducted in the Project area since 2014.

The process of studying the environmental baseline data is called "site characterization" by the Canadian Nuclear Safety Commission.



This figure presents some of the baseline information gathered about the proposed Project site.

Draft Initial Project Description (2025 summary for engagement)
19

Highlights of components of the natural environment known to date from about 15 years of data collection

1. **Geochemistry:** When tested, rock core samples indicate that the rock does not have acid-generating or metal-leaching potential. The NWMO studied the complete chemical composition of whole rocks in the area, and their properties do not indicate the presence of dangerous minerals.
2. **Groundwater and surface water**
   - **Hydrogeology and hydrogeochemistry:** Hydrogeology and hydrochemistry are the study of groundwater. Hydrogeological and hydrogeochemical characteristics of the proposed site are favourable for the Project. At the depth where the repository would be built, water moves very slowly through the rock. This is based on tests from six deep boreholes which show that the rock lets very little water through — and even less the deeper you go.

     The composition of the groundwater samples, and the porewater (microscopic amounts of water trapped in rock) from core samples, show trends with depth that are consistent with expectations for a Canadian Shield environment.
   - **Hydrology:** Hydrology is the study of water movement. The site lies within the Wabigoon River watershed, which drains from Raleigh Lake northwest to Wabigoon Lake. Wabigoon Lake then drains towards Winnipeg River and Nelson River, eventually reaching Hudson Bay. The area surrounding the proposed Project contains several small, connected waterbodies that collectively drain into Mennin Lake. Mennin Lake flows north into Mennin River, and then northwest into Wabigoon River. The largest rivers in proximity to the proposed Project site are Mennin River located approximately two kilometres southwest of the proposed Project site and Revell River located approximately two kilometres to the north, which runs parallel with Highway 17. The confluence of Revell River and Wabigoon River is approximately six kilometres to the northwest of the site.
   - **Surface water quality:** The NWMO collects baseline surface water quality data quarterly. Water quality is normal with suitable dissolved oxygen, slightly acidic pH, and low to moderate clarity. Most contaminant-of-concern concentration levels are below guidelines, though some samples exceed guidelines for E. coli, phosphorus, aluminum, copper, manganese and mercury.
3. **Climate data:** Climate projections predict a 3 to 4 C increase in temperature by the 2050s and an approximate increase of 6 C by the 2080s. Precipitation is expected to increase by 50 to 75 mm/year by the 2050s and 100 to 125 mm/year by the 2080s.
4. **Background radiation:** In Canada, on average, 76 per cent of radiation exposure comes from naturally occurring radiation in soil and air. Average background radiation doses in Canada are estimated to be approximately 1.8 millisievert (mSv) per year, which is lower than the worldwide average of 2.4 mSv. Baseline radiation levels vary depending on location, elevation and other local geographic influences.

5. **Wildlife and wildlife habitat:** The NWMO is currently collecting baseline data for the characterization of land-based wildlife and habitat. Information will be presented for various wildlife groups within and surrounding the proposed Project site, including ungulates (moose), carnivores, small mammals, semi-aquatic mammals (e.g., beavers), bats, reptiles, amphibians, invertebrates and vegetation.
6. **Species at risk:** The NWMO is identifying species of conservation concern, including federally and provincially listed species at risk and provincially rare species. Potential species at risk include birds (Olive-sided Flycatcher, Common Nighthawk, Eastern Wood-pewee, Eastern Whip-poor-will), fish (American Eel), carnivores (American Badger, Wolverine, Grey Fox), bats (Little Brown Myotis, Northern Myotis), and vegetation (Black Ash). No critical habitat necessary for the survival or recovery of federally listed wildlife species at risk is known to occur at the proposed Project site.
7. **Birds, migratory birds and their habitat:** A total of 76 bird species were detected within and surrounding the proposed Project site, including five species at risk, 25 other priority species, 65 species protected by the *Migratory Birds Convention Act*, and one species that is afforded nest protection under the *Migratory Birds Regulations*.
8. **Fish and fish habitat:** Several important fish habitats, including spawning and nursery areas, were documented within the regional investigation area. Further work includes fish community surveys and benthic invertebrate studies to evaluate fish habitat within and surrounding the proposed Project site.

The Black-capped Chickadee is one of the bird species protected under the *Migratory Birds Convention Act* and *Migratory Birds Regulations*.

Next steps — Environmental baseline

Our current understanding of the natural environment at the proposed Project site indicates the site can meet the Project's requirements to safely contain and isolate used nuclear fuel to protect people and the environment.

The NWMO will advance additional site characterization and baseline data collection studies to further understand the baseline natural environment. These data will be used to optimize engineering designs for surface facilities and underground repository layouts.

PROJECT HIGHLIGHTS:
SOCIO-ECONOMIC AND HEALTH BASELINE

Socio-economic reporting, including effects of the NWMO's activities, on a community's way of life or on its social, cultural or economic aspirations is a mandatory requirement of the *Nuclear Fuel Waste Act*. The NWMO is required to report on it triennially under section 18 of that Act. This reporting will continue for the life of the Project.

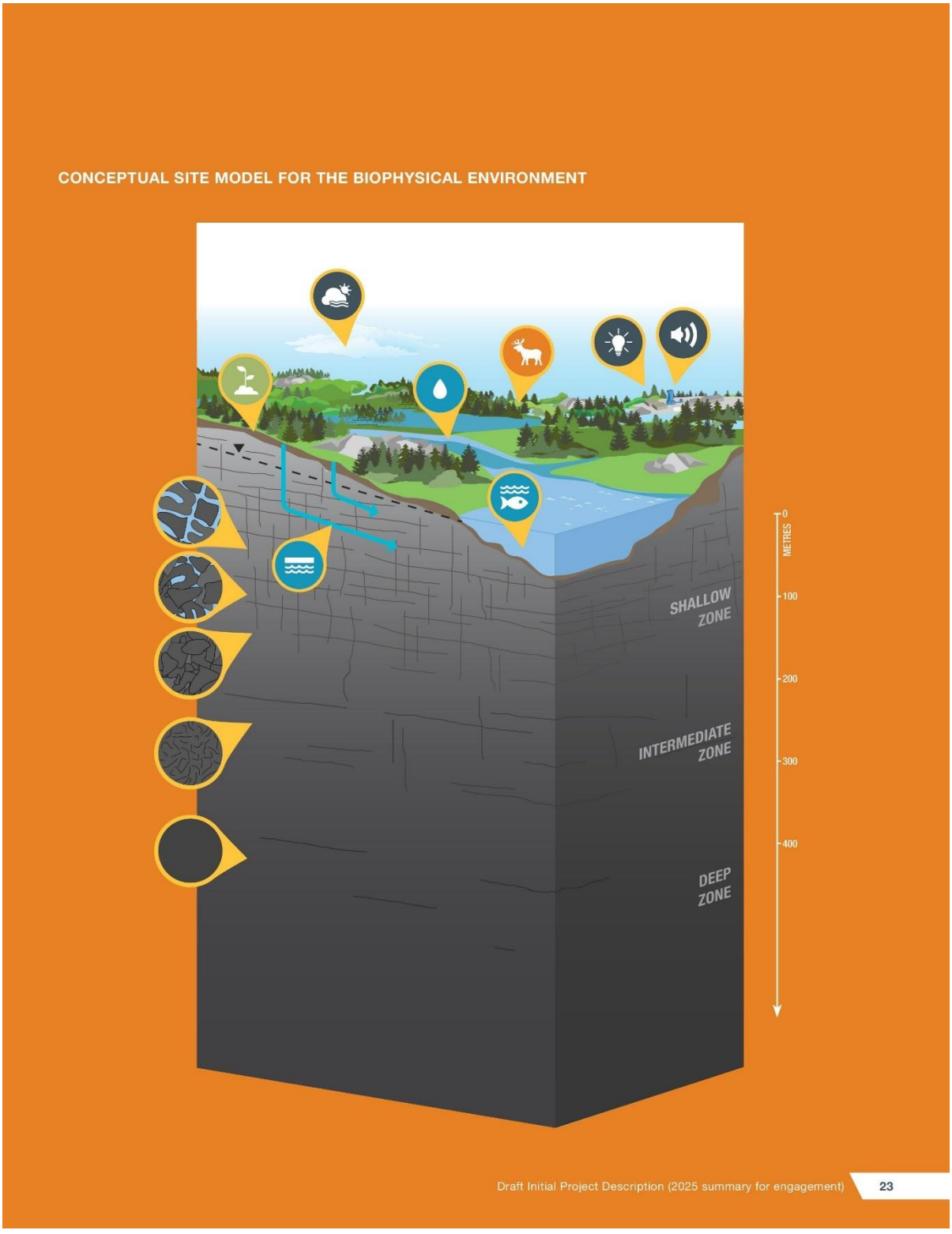
The NWMO is also required to do an impact assessment on social, economic and health related components of the human environment. This assessment would include any impacts of the Project on the rights of Indigenous Peoples, requiring baseline data on a variety of human environment components.

Highlights of components of the human environment that are particularly important to understanding the impacts of the Project

1. **Population and demographics:** Population growth in the area has been generally flat since 1991, although this does not necessarily reflect population trends in individual communities. The communities share demographic trends between 1996 and 2021, including an aging population, slight decreases in the number of persons per census family and children living at home, and an increasing proportion of the population who identify as Indigenous.
2. **Land and resource use:** The natural environment is important to residents and visitors of the communities surrounding the Project site. Residents participate in several types of land and resource use activities, including fishing, hunting, trapping, gathering, hiking, ATVing, snowmobiling and boating. A cultural screening study for the NWMO's borehole drilling program at the proposed repository site in 2024 examined known archaeological and historic sites using the Ontario Archaeological Sites Database. The cultural screening noted that there were no known archaeological or historical sites in or near the borehole sites. Additional work should be conducted not only to confirm these results, but also to explore potential areas of cultural or historical significance to Wabigoon Lake Ojibway Nation.

Next steps — Socio-economic and health baseline

The NWMO will continue baseline data collection and reporting to meet the requirements of the *Nuclear Fuel Waste Act* and *Impact Assessment Act*. Most importantly, the NWMO will seek opportunities to work with communities to verify information collected to date, and seek opportunities to learn more via tailored, community-specific studies, including Indigenous Knowledge and land use studies where appropriate.


CONCEPTUAL SITE MODEL FOR THE BIOPHYSICAL ENVIRONMENT
SHALLOW ZONE
INTERMEDIATE ZONE
DEEP ZONE
METRES
0
100
200
300
400
Draft Initial Project Description (2025 summary for engagement)
23

PROJECT HIGHLIGHTS:
POTENTIAL EFFECTS OF THE PROJECT

The NWMO is preparing to submit an Initial Project Description to the Impact Assessment Agency of Canada to support an Impact Assessment under the *Impact Assessment Act*. The impact assessment will be integrated with the initial licence application to the Canadian Nuclear Safety Commission. In an impact assessment, the NWMO assesses the significance of impacts of the Project that remain after the implementation of mitigation measures on the following components that are within federal jurisdiction:

- Indigenous Peoples;
- Fish and fish habitat;
- Aquatic species at risk; and
- Migratory birds.

Further, the licensing under the *Nuclear Safety and Control Act*, which is integrated into the assessment, requires the NWMO to show how we will protect the environment and people when implementing the Project.

There are two opportunities in the impact assessment process for the NWMO to assess potential impacts and propose mitigation measures:

1. The Initial Project Description; and
2. The Impact Statement.

The NWMO is actively seeking participation from the host communities for the Project — Wabigoon Lake Ojibway Nation and the Township of Ignace — and from other First Nations and others in the region.

The NWMO is in the pre-planning phase of impact assessment, preparing the Initial Project Description report. The NWMO is actively seeking participation from the host communities for the Project — Wabigoon Lake Ojibway Nation and the Township of Ignace — and from other First Nations and others in the region on key themes of the Initial Project Description, which are summarized in this document.

The NWMO's engagement and opportunities to participate and provide feedback are ongoing throughout the process. A detailed overview of the Impact Assessment process is provided earlier in this report (see section *The Integrated Impact Assessment and Licensing process*).

Next steps — Potential effects of the Project

The Project has the potential to impact people and the environment (i.e., human and natural components of the environment), and the NWMO must study the pathways of those impacts as part of the regulatory process.

For an impact to occur, there must be a source (i.e., a project component or activity) that interacts with people and the environment. For the Initial Project Description, we have identified the following list of project-related activities that may have an impact on people and the natural environment, and need to be assessed as part of the impact assessment process:

- Land clearing during site preparation and construction;
- Blasting and excavation during site preparation and construction, and operations;
- Development and operations of surface facilities, the deep geological repository, the worker accommodation camp, the Excavated Rock Management Area during site preparation and construction, and operations;
- Materials handling during site preparation and construction, and operations;
- Vehicle traffic at the Project site during all Project phases; and
- Site water management and treatment (water taking, dewatering and treated water discharge) during all Project phases.

This list of Project interactions may be expanded upon through engagement with host communities, Indigenous communities, the public and regulators.

Preliminary screening assessment considerations and findings

These four conditions are the basis upon which the NWMO has made some preliminary assessments of the Project's impacts:

- No radiological materials will be on-site during site preparation and construction phases;
- Radiation safety will be subjected to rigorous Canadian Nuclear Safety Commission oversight and licensing during operations and closure;
- Effects, mitigation and monitoring during site preparation and construction will be similar to those of other infrastructure projects (such as mining and forestry) in northern Ontario; and
- As part of the screening assessment proposed in the Initial Project Description, potential changes are considered and mitigation proposed based on what has been approved on other projects with similar activities and impacts.

The NWMO will continue detailed safety assessments and a detailed quantitative human health and ecological risk assessment to confirm the safety case and that the Project will not have an adverse effect on people and the environment. These studies would be updated and submitted to the Canadian Nuclear Safety Commission at each licensing phase.

The draft Initial Project Description will share the following findings from the first level assessment of potential project impacts:

- For this Project, it is expected that best practices and standard mitigation will prevent changes or reduce the risk of impacts to fish and fish habitat, migratory birds and aquatic species at risk;
- For safety and security purposes, the Project will restrict access to land currently used by Indigenous Peoples for traditional land and resource use;
- Due to the storage of the used nuclear fuel, the Project may lead to perceptions of potential radioactive contamination that may result in alterations to traditional land use.

The impact assessment process will seek and confirm the extent of these impacts and on which communities, and assess the potential for impacts of the Project on other Indigenous communities as required by the *Impact Assessment Act*. The assessment would be tailored by community concerns, land use and pathways of impacts.

The NWMO welcomes feedback on the proposed approach and preliminary findings presented in this summary. The NWMO also welcomes the opportunity to learn more about how the Project may interact with people and the environment to allow further tailoring of the impact assessment.

Strategic assessment of climate change

The *Impact Assessment Act* requires a strategic assessment of climate change be completed for the Project to ensure climate change considerations are integrated into all stages of project planning and decision-making, ultimately contributing to more sustainable development and national climate goals.

The Project is critical to the life cycle of nuclear energy, which the federal government has identified as an important part of a low-carbon future in Canada. To maintain our commitment to protect people and the environment throughout our work, the NWMO will:

- Complete a best-available-technology assessment with the goal that the Project can become carbon neutral by 2050 during the estimated operations phase; and
- Develop and implement a credible net-zero plan that meets the requirements of the Government of Canada's strategic assessment of climate change.

Next steps for this work include additional climate change studies; optimizations to Project design; and engagement with the host communities, Indigenous communities and the public on the development of the net-zero plan.

What's next

- **Initial Project Description (IPD) submission:** Preparing an initial report that will describe the Project, current baseline conditions and potential interactions with people and the environment for regulatory and community review — the NWMO's submission of the Initial Project Description to the Impact Assessment Agency of Canada to formally initiate the Impact Assessment and Licensing process for the Project.
- **Regulatory engagement and participation:** Continuing the process of respectful relationship building with Wabigoon Lake Ojibway Nation, the Township of Ignace and surrounding communities.
- **Technical program advancement:** Advancing a site-specific design based on iterative feedback from safety, geoscience, environment and impact assessment studies and community input.
- **Technical assessments for the Integrated Impact Statement and Licence Application:** Preparing technical assessments for the Integrated Impact Statement and Licence Application throughout the impact statement phase of the impact assessment (about three years) and working collaboratively with the host communities, First Nations, and interested groups and individuals to develop mitigation measures and ensure transparency in findings. The Integrated Impact Statement and Licence Application is expected to be submitted approximately three years after the Initial Project Description is submitted.

Moving forward, the Deep Geological Repository for Canada's Used Nuclear Fuel Project will be subject to the *Impact Assessment Act* and many subsequent permits, licences and approvals that will be pursued by the NWMO during or after the Integrated Impact Assessment process.

- **Public hearing:** The Project will be subject to an independent panel of experts who will consider the impact statement, the views of various federal and provincial regulators, and the perspectives it hears from Indigenous communities and members of the public who participate. The hearing is a formal process where the Impact Assessment Agency of Canada, the Canadian Nuclear Safety Commission and others (such as Fisheries and Oceans Canada, Environment and Climate Change Canada, and Health Canada) review technical evidence to assess the safety of a proposed project or activity. It also provides an opportunity for Indigenous groups and the public to participate by presenting their views and concerns before an impact assessment or licensing decision is made.

Questions or feedback?

Your thoughts are welcome. Please submit your comments by Aug. 22, 2025, to RegulatoryFeedback@nwmo.ca or by mail to:

NWMO — IPD summary feedback
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3

See what's next, find out about upcoming in-person events and learn more at nwmo.ca/PlanningWithYou.

Together, we are working towards a safe, sustainable future for Canada's used nuclear fuel.

For more information, please contact:

Nuclear Waste Management Organization
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3, Canada
Tel.: 416.934.9814 Toll free: 1.866.249.6966
Email: contactus@nwmo.ca
Website: nwmo.ca

@nwmocanada
/company/nwmocanada

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

© 2025 Nuclear Waste Management Organization

Ébauche de Description initiale du projet : Projet de dépôt géologique en profondeur pour le combustible nucléaire irradié canadien

RÉSUMÉ DE 2025 À DES FINS DE CONCERTATION

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

PLANIFIONS ENSEMBLE, POUR PROTÉGER CE QUI COMPTE.

La Société de gestion des déchets nucléaires (SGDN) est une organisation à but non lucratif qui est chargée d'assurer la gestion à long terme sûre du combustible nucléaire irradié canadien, d'une manière qui protégera les gens et l'environnement pour les générations à venir. Le plan prévoit de confiner et d'isoler le combustible irradié dans un dépôt géologique en profondeur doté d'un système à barrières multiples.

Depuis le début de nos travaux, nous avons travaillé étroitement avec les peuples autochtones, les Canadiens, l'industrie, les autorités de réglementation et tous les ordres de gouvernement en vue de protéger les gens et l'environnement, dès maintenant et dans le futur. En novembre 2024, la Nation ojibwée de Wabigoon Lake et le canton d'Ignace ont accepté de progresser vers la phase de décision réglementaire à titre de collectivités hôtes potentielles d'un dépôt géologique en profondeur où serait stocké le combustible nucléaire irradié canadien, ou « le Projet ».

Le Projet est récemment passé au stade obligatoire du processus de décision réglementaire, ce qui marque un nouveau chapitre dans la mise en oeuvre du plan canadien de gestion du combustible nucléaire irradié. Ce processus offrira une autre occasion aux peuples autochtones et au public de faire entendre leur voix. L'objectif du processus réglementaire est de faire confirmer de manière indépendante la sûreté du dépôt par les organismes de réglementation, notamment par la Commission canadienne de sûreté nucléaire et l'Agence d'évaluation d'impact du Canada.

Le processus comprend une évaluation d'impact intégrée à un processus d'autorisation, ou de délivrance de permis. L'évaluation d'impact est un processus au cours duquel seront examinés les impacts que le dépôt géologique en profondeur pourrait avoir sur l'environnement, la santé, la situation socioéconomique et les droits des Autochtones avant que le projet soit approuvé. Pour garantir que toute activité nucléaire au Canada sera menée en toute sûreté, en protégeant les gens et l'environnement, et en respectant des règles rigoureuses, un permis doit être obtenu.

La première étape du processus réglementaire consiste pour la SGDN à rédiger et à présenter une Description initiale du projet à l'Agence d'évaluation d'impact du Canada. La présentation de ce texte marque le début officiel du processus réglementaire.

Une Description initiale du projet explique le but et la nécessité d'un projet, l'évaluation préliminaire des impacts et les moyens que l'entreprise prévoit prendre pour les éviter et les atténuer. La Description initiale du projet est la première des nombreuses étapes du processus rigoureux d'autorisation d'une installation nucléaire, qui comprend la concertation avec les peuples autochtones et les résidents locaux et régionaux.

La SGDN prépare actuellement ce document réglementaire et sollicitera activement des commentaires dans le cadre du processus.

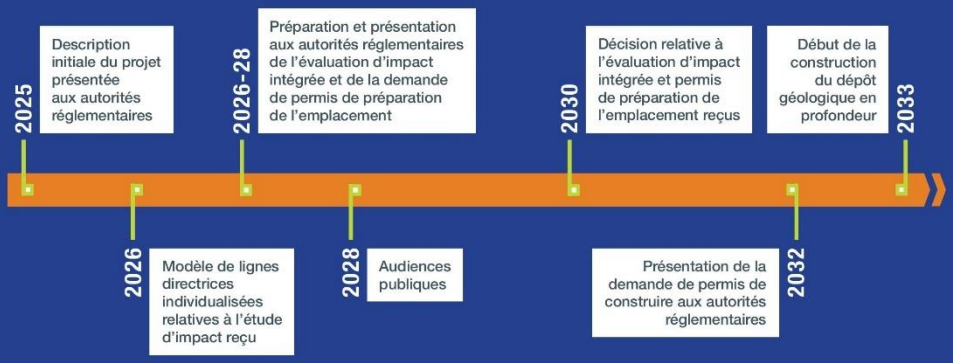


Table des matières

Introduction 2
À propos du projet 4
Le Processus intégré d'évaluation d'impact et d'autorisation 7
Avantages du Projet de dépôt géologique en profondeur 8
Poursuite de la concertation : dialogue, participation et collaboration continus 10
Comment les données de référence seront utilisées dans le cadre du processus de décision réglementaire 17
Considérations et conclusions de l'évaluation préliminaire 26
Évaluation stratégique des changements climatiques 27
Et maintenant? 28
Des questions ou des commentaires? 29

Introduction

En 2002, la Société de gestion des déchets nucléaires (SGDN) a été chargée, en vertu d'une loi fédérale, d'examiner les solutions possibles de gestion du combustible nucléaire irradié et d'en recommander une. En 2005, au terme d'un processus d'étude et de dialogue mené pendant trois ans avec des peuples autochtones et des Canadiens de tout le pays, nous avons présenté notre recommandation au ministre fédéral des Ressources naturelles. En juin 2007, le gouvernement fédéral a choisi le plan que nous mettons actuellement à l'oeuvre, appelé la Gestion adaptative progressive, comme plan canadien de gestion à long terme sûre du combustible nucléaire irradié.

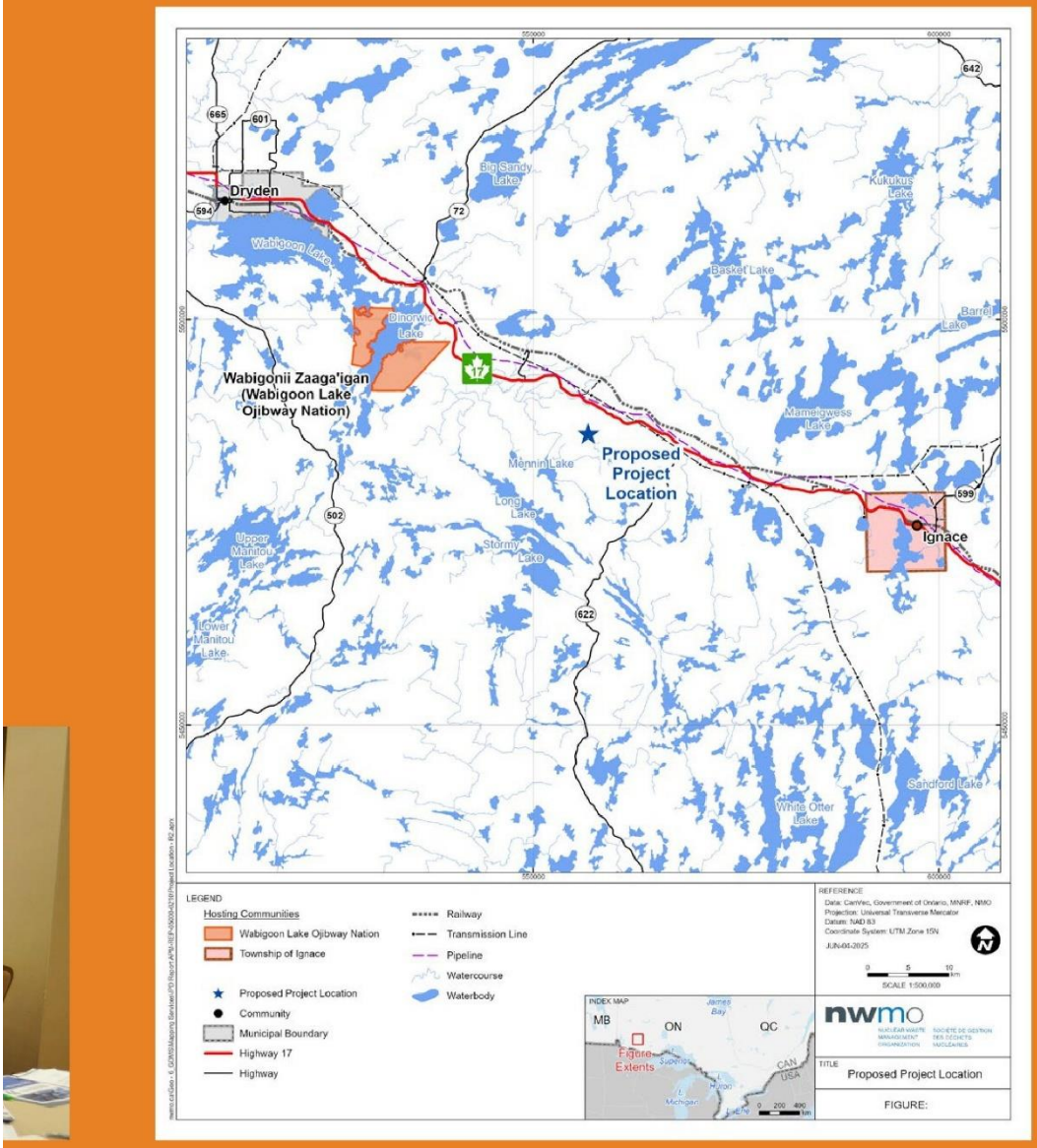
À l'issue d'un processus de sélection d'un site qui aura duré 14 ans, la Nation ojibwée de Wabigoon Lake et le canton d'Ignace ont accepté de progresser vers la phase de décision réglementaire à titre de collectivités hôtes potentielles d'un dépôt géologique en profondeur où serait stocké le combustible nucléaire irradié canadien.

Nous poursuivons maintenant la mise en oeuvre du plan canadien de gestion sûre du combustible nucléaire irradié dans un dépôt géologique en profondeur, sous réserve des approbations réglementaires requises. Le Projet propose l'aménagement d'une installation souterraine rigoureusement conçue pour confiner et isoler en toute sûreté le combustible nucléaire irradié pour une durée essentiellement indéfinie.

Le présent document fait état des faits saillants des travaux menés par la SGDN dans le cadre de la phase de préplanification de l'évaluation d'impact et de la demande d'autorisation, y compris des progrès réalisés sur le plan de la sûreté technique et de la conception, des activités de concertation, des considérations environnementales et des étapes qui suivront à mesure que le Projet de dépôt géologique en profondeur pour le combustible nucléaire irradié canadien progressera vers la prise de décisions réglementaires.

En 2005, au terme d'un processus d'étude et de dialogue mené pendant trois ans avec des peuples autochtones et des Canadiens de tout le pays, nous avons présenté notre recommandation au ministre fédéral des Ressources naturelles.

EMPLACEMENT PROPOSÉ POUR LE PROJET



À propos du projet

Le Projet de dépôt géologique en profondeur pour le combustible nucléaire irradié canadien :

- Permettra d'assurer la gestion à long terme sûre d'un maximum de 5,9 millions de grappes de combustible nucléaire irradié;
- Sera situé au sein d'une formation rocheuse stable afin de confiner et d'isoler naturellement le combustible nucléaire irradié pendant des centaines de milliers d'années;
- Sera mis en oeuvre en collaboration avec les Premières Nations et les municipalités.

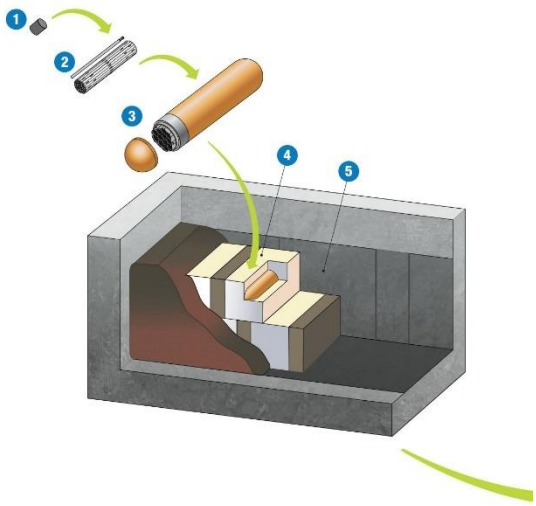
Le Projet s'appuiera sur un système à barrières multiples. Ce système comprend une série de barrières ouvragées et naturelles qui se conjugueront pour confiner et isoler de manière sûre le combustible nucléaire irradié dans le dépôt.

Chaque barrière fournira un niveau de protection unique et autonome, tout en servant de filet de sécurité à la barrière précédente. Si l'une de ces barrières venait à faire défaillance ou à être moins efficace que prévu, la barrière suivante assurerait la relève, assurant ainsi le confinement et l'isolement des matières stockées.

Des normes de sûreté rigoureuses encadreront le Projet. La SGDN est résolue à satisfaire à toutes les exigences réglementaires fédérales et provinciales applicables afin de protéger la santé, la sûreté et la sécurité des gens et de l'environnement pour les générations à venir.

Le système à barrières multiples

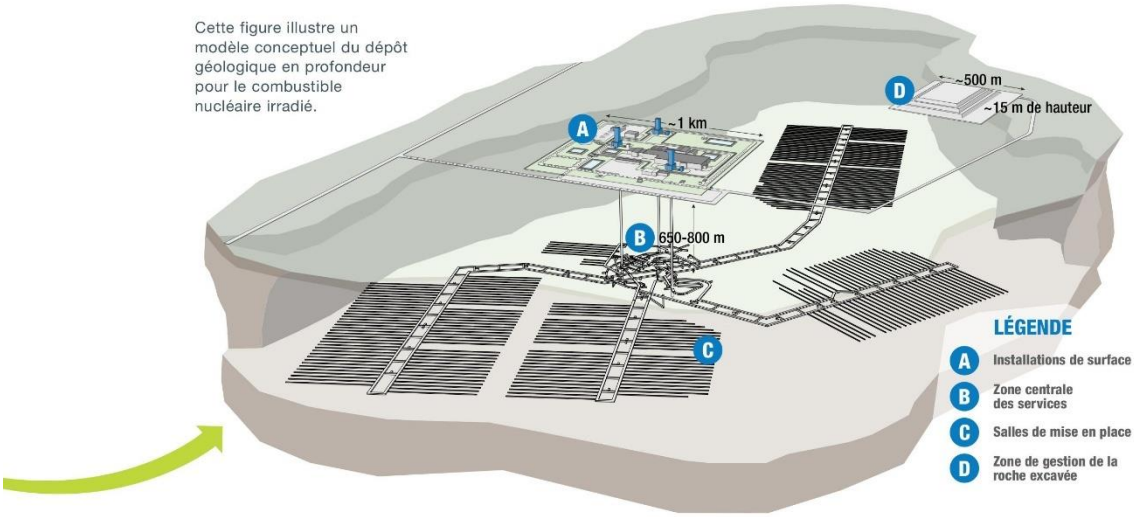
1. **Pastille de combustible** — une céramique solide très stable d'uranium cuit.
2. **Grappe de combustible** — fabriquée à partir d'un matériau hautement résistant à la corrosion appelé Zircaloy.
3. **Conteneur en acier revêtu de cuivre** — conçu pour résister à la corrosion et suffisamment résistant pour complètement confiner le combustible nucléaire irradié jusqu'à ce que sa radioactivité ait diminué à un niveau sécuritaire.
4. **Boîte d'argile de bentonite** — matériau à base d'argile hautement compactée qui enchâssera chaque conteneur et qui servira à remblayer le dépôt.
5. **La roche elle-même** — qui protégera le dépôt contre les événements naturels perturbateurs, l'écoulement de l'eau et les intrusions humaines involontaires.



PLUS D'INFORMATIONS SUR LE DÉPÔT GÉOLOGIQUE EN PROFONDEUR POUR LE COMBUSTIBLE NUCLÉAIRE IRRADIÉ CANADIEN

- La roche hôte est stable et son comportement sera prévisible pendant une très longue période.
- La roche hôte présente une faible perméabilité, ce qui signifie que les infimes traces d'eau présentes dans la roche en profondeur resteront isolées et ne se mélangeront pas aux eaux de surface.
- Le système de dépôt géologique en profondeur maintiendrait un environnement favorable à la stabilité et au rendement du dépôt.
- Des exemples d'endroits dans la nature présentant des conditions géologiques similaires en profondeur prouvent que les composants du système de barrières ouvragées resteront stables pendant une très longue période.
- La profondeur du dépôt rend très improbable toute intrusion humaine accidentelle future dans le dépôt une fois celui-ci fermé.
- Plusieurs pays dans le monde mettent actuellement en place des dépôts semblables — ce Projet s'appuie sur un consensus scientifique et sur l'expérience acquise dans le monde entier.
- Les études de cas sur la sûreté indiquent que tout éventuel impact radiologique sera probablement nettement inférieur aux débits de doses de rayonnements naturels.
- Le dépôt géologique en profondeur peut être construit et exploité en toute sûreté à l'aide de technologies éprouvées.
- Les radionucléides présents dans le combustible irradié se désintègrent, ce qui les rendra moins dangereux avec le temps.
- Le site du dépôt peut être surveillé afin de confirmer que le dépôt se comporte comme prévu.

Cette figure illustre un modèle conceptuel du dépôt géologique en profondeur pour le combustible nucléaire irradié.



BUT DU PROJET

Le Projet protégera les gens et l'environnement en assurant la gestion à long terme sûre du combustible nucléaire irradié. La SGDN propose d'assurer la préparation de l'emplacement, la construction, l'exploitation, le déclassement et la fermeture du dépôt géologique en profondeur pour le combustible nucléaire irradié canadien afin d'isoler de manière sûre approximativement 5,9 millions de grappes de combustible nucléaire irradié. Le Projet serait autorisé par la Commission canadienne de sûreté nucléaire, pour une période d'approximativement 160 ans.

COMPRENDRE L'ÉNERGIE NUCLÉAIRE AU CANADA

L'énergie nucléaire représente 15 pour cent de la production d'électricité au Canada. Le pays compte actuellement quatre centrales nucléaires et 19 réacteurs CANDU (Canada Deuterium Uranium) en service. Depuis plusieurs années, le Canada est un chef de file dans le domaine de la recherche et de la technologie nucléaires. Il exporte des systèmes de réacteurs développés au Canada et fournit une grande partie de l'approvisionnement mondial en radioisotopes, qui sont utilisés pour des diagnostics médicaux et le traitement du cancer.

L'énergie nucléaire offre une source d'énergie fiable qui contribue à une croissance économique durable et à l'amélioration du bien-être humain. Le gouvernement du Canada a clairement indiqué que l'énergie nucléaire jouera un rôle essentiel dans la décarbonisation du Canada et dans sa capacité à atteindre la carboneutralité d'ici 2050. La croissance des investissements canadiens dans le secteur nucléaire contribuera à renforcer notre sécurité énergétique actuelle et future.

À l'heure actuelle, le combustible nucléaire irradié au Canada est géré dans des installations autorisées pour l'entreposage provisoire. Cette approche est sûre, mais compte tenu de la longue période pendant laquelle le combustible nucléaire irradié restera dangereux, elle ne constitue pas une solution permanente, car elle nécessite un entretien et une gestion continus. C'est pourquoi la SGDN adhère aux meilleures pratiques internationales pour construire un dépôt géologique en profondeur afin de confiner et d'isoler en toute sûreté le combustible nucléaire irradié à très long terme.

CALENDRIER PRÉVU DE MISE EN OEUVRE DU PLAN

La mise en oeuvre du plan canadien s'étalera sur une période d'environ 160 ans. Il faudra environ 10 ans pour préparer l'emplacement et construire le dépôt géologique en profondeur, dont la mise en service devrait avoir lieu vers le milieu des années 2040. Le dépôt géologique en profondeur sera exploité pendant environ 50 ans. Le dépôt sera subséquemment surveillé pendant une longue période, après quoi il sera déclassé et fermé, et la période de surveillance post-fermeture commencera.

Pendant toute la durée du Projet, la SGDN maintiendra l'engagement que nous avons pris envers les collectivités hôtes et la région environnante de contribuer à leur bien-être à long terme. Il faudra pour cela comprendre et analyser les impacts que le Projet pourrait avoir sur les conditions sociales et économiques, y compris sur l'emploi et les possibilités d'emploi.

PHASES DU PROJET ET CALENDRIER DE PLANIFICATION PRÉVUS

Phase du projet	Calendrier approximatif (années)	Durée de la phase (années)
Préparation de l'emplacement et construction	2030-42	13
Exploitation	2043-92	50
Surveillance prolongée, déclassement et fermeture	2093-2192	100
Contrôles institutionnels[1]	2193 et +	

[1] Le contrôle de tous les risques liés à un site après son déclassement et sa fermeture, assuré notamment au moyen d'activités telles que la surveillance, la maintenance ou la mise en place de panneaux/balises.

Le Processus intégré d'évaluation d'impact et d'autorisation

Le Projet fera l'objet d'un processus d'évaluation d'impact approfondi, qui sera coordonné par l'Agence d'évaluation d'impact du Canada et intégré au processus de demande initiale de permis à la Commission canadienne de sûreté nucléaire.

Ce processus intégré permettra de s'assurer que des détails tels que les impacts sur les récoltes, la chasse et les modes de vie autochtones sont pris en compte, parallèlement à toute incidence possible sur l'ensemble des facteurs environnementaux, sanitaires, sociaux et économiques.

Le Projet en est actuellement à la phase de préplanification et l'évaluation d'impact n'a pas encore débuté. Les commentaires préliminaires des collectivités hôtes, des collectivités autochtones de la région et du public en général contribueront à l'élaboration de notre Description initiale du projet, le document que nous présenterons aux organismes de réglementation, ainsi qu'à l'établissement de la voie à suivre en ce qui concerne le processus décisionnel.

L'évaluation préliminaire et les stratégies proposées pour l'atténuation des impacts potentiels décrits dans l'ébauche de la Description initiale du projet nécessiteront la participation des collectivités hôtes, des collectivités autochtones, des groupes et des personnes intéressés, ainsi que des organismes de réglementation. Les résultats de l'évaluation serviront à adapter les lignes directrices relatives à l'étude d'impact pour le Projet, qui seront émises par l'Agence d'évaluation d'impact du Canada.

La Description initiale du projet n'est qu'une étape d'examen préliminaire. L'Étude d'impact qui suivra la Description initiale du projet devra décrire le projet désigné, ses principaux éléments et les activités connexes, le calendrier détaillé, le moment prévu de réalisation de chaque phase du projet et d'autres caractéristiques importantes.

Lors de la rédaction de l'Étude d'impact, nous nous efforcerons également à la SGDN d'aligner respectueusement nos travaux sur le savoir autochtone et les études sur l'utilisation des terres dans les évaluations des impacts et la conception des stratégies d'atténuation, afin que le Projet serve les intérêts de la Nation ojibwée de Wabigoon Lake, du canton d'Ignace ainsi que des autres collectivités autochtones et du public de la région.

> La prochaine décennie de notre travail sera axée sur la participation au rigoureux processus de décision réglementaire, dans lequel nous devrons démontrer que nous pourrons tenir notre promesse de protéger durablement les gens et l'environnement. Nous sommes reconnaissants de l'étroite collaboration que nous entretenons avec les peuples autochtones, les Canadiens, l'industrie et les organismes de réglementation, une collaboration qui contribuera à notre réussite.
>
> **— Mackenzie Denyes, directrice d'évaluation d'impact et d'autorisation à la SGDN**

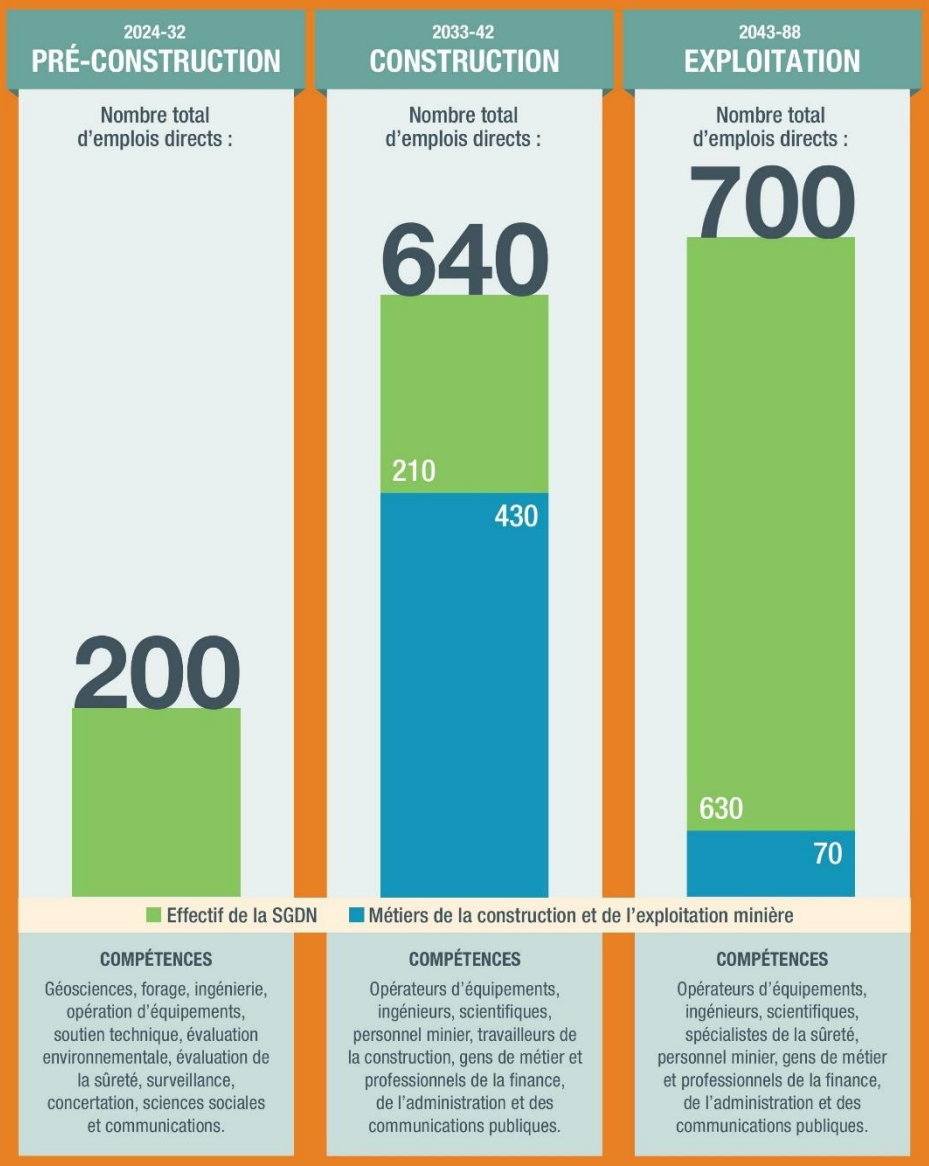
Avantages du Projet de dépôt géologique en profondeur

En plus d'aider le Canada à atteindre ses objectifs de carboneutralité et de sécurité énergétique, le Projet créera et maintiendra des emplois de qualité dans le nord-ouest de l'Ontario, et au-delà, en soutenant une chaîne d'approvisionnement hautement technique et diversifiée, et générera des retombées économiques importantes dans les collectivités régionales. Les collectivités hôtes, la région et le Canada dans son ensemble tireront un large éventail d'avantages au cours de la période d'approximativement 160 années que durera la réalisation de ce projet d'infrastructure nationale. Le Projet créera plusieurs centaines d'emplois, dont beaucoup seront nécessaires pendant plus d'une génération. Il nécessitera des ressources humaines, des équipements et des matériaux pour soutenir la construction et l'exploitation de l'installation.

Comme ce projet multigénérationnel sera mis en oeuvre en plusieurs phases au cours d'une période d'approximativement 160 ans, nous examinerons, renforcerons et ajusterons continuellement le plan en tenant compte des nouvelles informations, orientations et directives à mesure qu'elles deviendront disponibles. Nous sommes résolus à mettre en oeuvre le Projet de manière sûre afin de respecter le *Règlement général sur la sûreté et la réglementation nucléaires* (DORS/2000-202).

Le Projet créera plusieurs centaines d'emplois, dont beaucoup seront nécessaires pendant plus d'une génération.

NOMBRE MOYEN D'EMPLOIS PAR PHASE DU PROJET



Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation) 9

Poursuite de la concertation : dialogue, participation et collaboration continus

La concertation et l'établissement de relations avec les collectivités autochtones, le public et les parties intéressées demeureront au coeur de ce Projet. Les activités passées, actuelles et futures comprennent :

- **La mise en oeuvre des accords d'hébergement du dépôt :** la collaboration avec la Nation ojibwée de Wabigoon Lake et le canton d'Ignace, y compris les investissements dans la formation, l'éducation et le développement des compétences. Ces sujets sont abordés dans les accords d'hébergement du dépôt, notamment la manière dont nous pouvons avancer ensemble dans le processus réglementaire.
- **Les activités de concertation et de participation liées à la réglementation :** les efforts continus visant à informer de manière transparente et à recueillir des commentaires sur la façon dont le Projet sera mené. Cette concertation et cette participation viseront à obtenir des commentaires sur les impacts potentiels du Projet. Les commentaires recueillis dans le cadre des activités de concertation réglementaire sur la conception, la mise en oeuvre et la surveillance du Projet sont importants, car ils contribueront à assurer que le Projet protège l'environnement, respecte la culture, préserve l'eau et génère des avantages à long terme dans les collectivités locales.
- **Communications et information :** la transmission aux collectivités autochtones, au public et aux parties intéressées de renseignements clairs, opportuns et accessibles sur les activités et les progrès de la SGDN. Cela comprendra des mises à jour régulières, des occasions de discussions bidirectionnelles, la publication de documents et d'autres ressources pour aider les collectivités à se tenir informées et au courant de l'évolution du Projet.

Les thèmes et les préoccupations clés soulevés pendant le processus de sélection d'un site continueront d'être abordés dans le cadre des activités de concertation qui seront menées au cours du processus réglementaire. Ils incluront les éléments suivants :

- L'importance de protéger les ressources en eau et l'environnement naturel;
- Les demandes d'engagements clairs en matière de sûreté, de santé et de protection de l'environnement;
- L'intérêt pour les possibilités à long terme de développement économique et de renforcement des capacités;
- L'importance accordée à la participation des collectivités à la surveillance et à la supervision;
- L'appui à un alignement respectueux sur le savoir autochtone, en même temps que sur la science occidentale, dans la mesure où les collectivités sont disposées à partager ce savoir;
- La protection de la sagesse ancestrale des détenteurs du savoir autochtone en tant que leur propriété intellectuelle souveraine.

La SGDN continue de maintenir des canaux de communication et de concertation avec les collectivités hôtes, les autres collectivités autochtones et municipales, ainsi qu'avec le public, et nous continuerons de le faire à chaque étape du Projet. Dans les activités de concertation que la SGDN mènera dans le cadre de l'évaluation des impacts du Projet et du processus d'autorisation, nous solliciterons des commentaires et la participation du public sur les sujets suivants et d'autres :

- Les programmes de collection de données de référence;
- Les activités liées au Projet et leurs interactions avec les gens et l'environnement;
- Les mesures d'atténuation proposées pour éviter les impacts négatifs ou les possibilités d'accroître les avantages;
- Les futurs programmes de suivi et de surveillance réglementaire.

Dans la continuité des années de concertation passées, la SGDN mènera, du 17 juillet au 22 août 2025, des activités de sensibilisation spécialement adaptées aux collectivités hôtes, aux collectivités autochtones et aux autres groupes et personnes intéressés.

Ces activités comprendront des séances d'information et des webinaires, des mises à jour du site Web et des communications sur les médias sociaux, ainsi qu'une période de commentaires.

CONCERTATION ET PARTICIPATION DES PEUPLES AUTOCHTONES

La SGDN demeure résolue à établir et à maintenir des relations solides et durables avec les Premières Nations et les peuples autochtones, notamment des relations soutenues avec les organisations autochtones nationales et provinciales, afin d'assurer la poursuite d'un dialogue continu et significatif.

Conformément aux enseignements reçus des aînés, des détenteurs du savoir autochtone, des peuples autochtones et des collectivités autochtones, les objectifs de concertation et de participation des Autochtones reliées au Projet seront les suivants :

- Amplifier et valoriser la voix et les systèmes de connaissances des Autochtones;
- S'aligner respectueusement sur les perspectives et le savoir autochtones dans la planification et la prise de décisions relatives au projet;
- Établir des relations respectueuses fondées sur la vérité, l'honnêteté et la confiance réciproques;
- Créer des occasions de participation, de collaboration et de partenariat équitables.

La SGDN demandera aux peuples autochtones de nous transmettre leur savoir autochtone, dans la mesure où ils le souhaitent. La SGDN veillera à protéger la propriété intellectuelle des Autochtones, conformément aux ententes conclues avec les peuples autochtones qui auront choisi de transmettre leur savoir.

Le Projet est situé sur le territoire de la Nation ojibwée de Wabigoon Lake. Son consentement à ce que les prochaines étapes du Projet aillent de l'avant sur son territoire était nécessaire pour prendre une décision quant au choix d'un site pour le Projet et pour que la SGDN puisse avancer au stade du processus de décision réglementaire. Dans le cadre de l'accord d'hébergement du dépôt, la SGDN a accepté que la Nation ojibwée de Wabigoon Lake mène son propre Processus d'évaluation et d'approbation réglementaire du Projet. La SGDN est résolue à respecter la souveraineté de la Nation ojibwée de Wabigoon Lake tout au long de la mise en oeuvre du Projet.

Le Projet est situé sur le territoire de la Nation ojibwée de Wabigoon Lake. Son consentement à ce que les prochaines étapes du Projet aillent de l'avant sur son territoire était nécessaire pour prendre une décision quant au choix d'un site pour le Projet et pour que la SGDN puisse avancer au stade du processus de décision réglementaire.

La SGDN reconnaît l'importance des relations nouées avec les autres collectivités autochtones de la région d'accueil du Projet proposé. La SGDN s'efforcera de maintenir ces relations existantes et d'en établir de nouvelles. La SGDN s'engage à communiquer, à travailler en concertation et à participer de manière approfondie avec les autres collectivités autochtones, ainsi qu'à appliquer nos politiques sur la réconciliation et le savoir autochtone de même que notre Cadre éthique et social.

La SGDN reconnaît et respecte le fait que les peuples autochtones entretiennent un rapport particulier avec l'environnement naturel et ont des responsabilités uniques d'intendance qui en découlent.

Nuclear Waste Management Organization:
Conversation Corner
LEARN MORE
IGNACE
Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation)
13

PARCOURS DE RÉCONCILIATION DE LA SGDN

La SGDN a entrepris un cheminement vers la réconciliation. En 2019, dans le cadre de ce cheminement, nous avons créé une *Politique sur la réconciliation*, qui a été officialisée lors d'une cérémonie. Elle définit la manière dont l'organisation contribuera à la réconciliation. Par le biais de cette politique, la SGDN s'est engagée à ouvrir un dialogue respectueux et constructif avec les peuples et les collectivités autochtones et à fournir une formation de sensibilisation à la culture autochtone et à la réconciliation à notre personnel et à nos travailleurs contractuels.

De plus, la SGDN a publié en 2016 et mis à jour en 2020 une *Politique sur le savoir autochtone* afin de nous assurer que nous sommes guidés par un ensemble de principes clairs dans le cadre de notre travail avec les collectivités et les détenteurs du savoir autochtone. Par le biais de cette politique, la SGDN s'est engagée à tenir compte du savoir autochtone dans notre travail et à respecter la valeur que les systèmes de connaissances autochtones peuvent apporter à l'élaboration du projet et aux processus décisionnels.

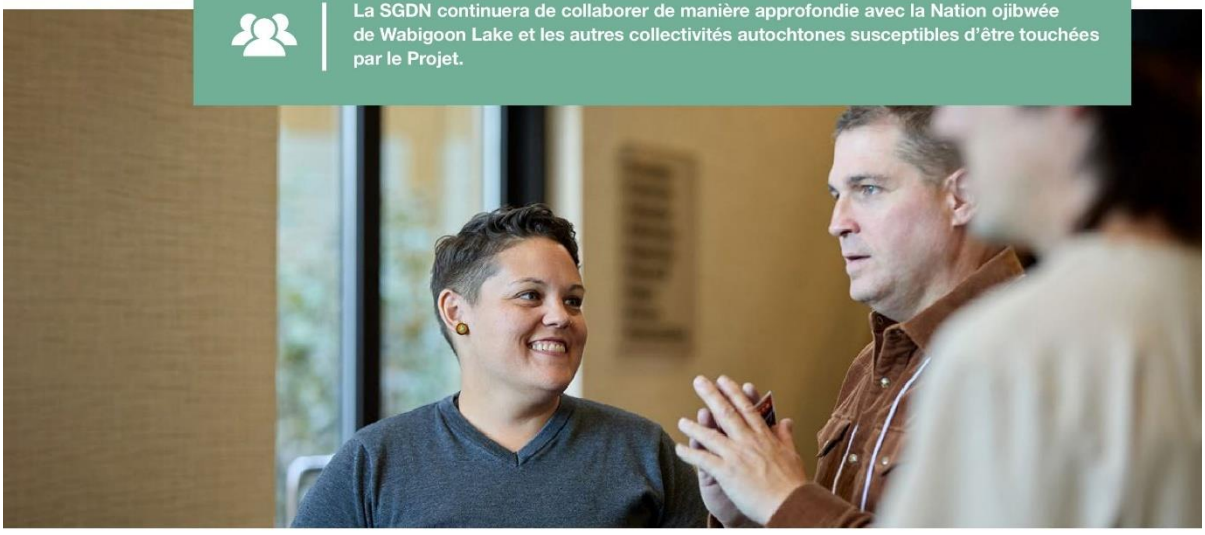
En 2023, la SGDN a publié une Déclaration sur l'eau qui réaffirme notre engagement à protéger l'eau en tenant compte de l'agentivité que peut avoir l'eau (de surface et souterraine) en relation avec le futur dépôt géologique en profondeur canadien et la région environnante. La Déclaration sur l'eau est un document complémentaire à l'Énoncé de responsabilité environnementale de la SGDN.

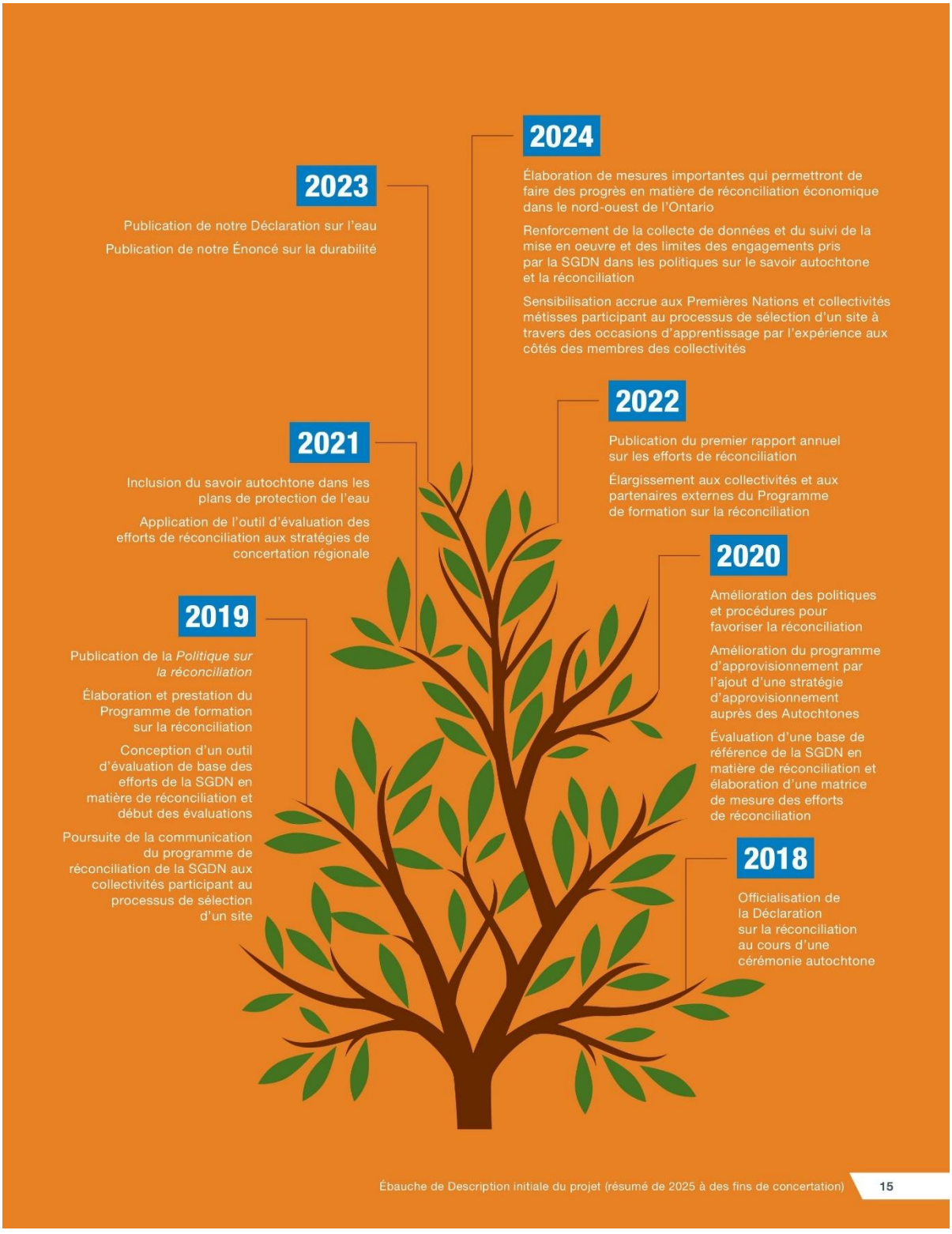
La SGDN continuera d'appliquer le savoir autochtone aux aspects du Projet liés à la sûreté technique et au bien-être des collectivités lorsque les détenteurs de ce savoir nous en donneront la permission.

La SGDN continuera de collaborer de manière approfondie avec la Nation ojibwée de Wabigoon Lake et les autres collectivités autochtones susceptibles d'être touchées par le Projet afin de cerner et de comprendre les impacts possibles du Projet sur les peuples autochtones et leurs droits, y compris leurs terres, leurs territoires et leurs ressources, de même que de nous aligner sur le savoir autochtone.

Pour en savoir plus sur notre cheminement vers la réconciliation, veuillez consulter la page nwmo.ca/fr/reconciliation.

La SGDN continuera de collaborer de manière approfondie avec la Nation ojibwée de Wabigoon Lake et les autres collectivités autochtones susceptibles d'être touchées par le Projet.




2024
Élaboration de mesures importantes qui permettront de faire des progrès en matière de réconciliation économique dans le nord-ouest de l'Ontario
Renforcement de la collecte de données et du suivi de la mise en oeuvre et des limites des engagements pris par la SGDN dans les politiques sur le savoir autochtone et la réconciliation
Sensibilisation accrue aux Premières Nations et collectivités métisses participant au processus de sélection d'un site à travers des occasions d'apprentissage par l'expérience aux côtés des membres des collectivités
2023
Publication de notre Déclaration sur l'eau
Publication de notre Énoncé sur la durabilité
2022
Publication du premier rapport annuel sur les efforts de réconciliation
Élargissement aux collectivités et aux partenaires externes du Programme de formation sur la réconciliation
2021
Inclusion du savoir autochtone dans les plans de protection de l'eau
Application de l'outil d'évaluation des efforts de réconciliation aux stratégies de concertation régionale
2020
Amélioration des politiques et procédures pour favoriser la réconciliation
Amélioration du programme d'approvisionnement par l'ajout d'une stratégie d'approvisionnement auprès des Autochtones
Évaluation d'une base de référence de la SGDN en matière de réconciliation et élaboration d'une matrice de mesure des efforts de réconciliation
2019
Publication de la *Politique sur la réconciliation*
Élaboration et prestation du Programme de formation sur la réconciliation
Conception d'un outil d'évaluation de base des efforts de la SGDN en matière de réconciliation et début des évaluations
Poursuite de la communication du programme de réconciliation de la SGDN aux collectivités participant au processus de sélection d'un site
2018
Officialisation de la Déclaration sur la réconciliation au cours d'une cérémonie autochtone
Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation)
15

CONCERTATION ET PARTICIPATION DU PUBLIC

En plus de travailler en concertation avec les collectivités autochtones, la SGDN collabore depuis plus de deux décennies avec des groupes et des personnes intéressés, ainsi qu'avec un large éventail de parties prenantes, notamment la municipalité hôte (le canton d'Ignace) et d'autres municipalités, entreprises, fournisseurs de services et organisations environnementales.

La concertation publique a pour objectif de permettre la tenue de discussions précoces liées au site hôte et d'éclairer la conception du Projet par le biais de diverses concertations sur la Description initiale du projet. Pour atteindre cet objectif, la SGDN :

- Cernera les intérêts du public et des parties concernées en discutant de manière précoce avec les collectivités;
- Apprendra à connaître les préférences du public au regard des méthodes de concertation;
- Mènera des activités de concertation sur des résultats particuliers en vue d'obtenir des commentaires;
- Intégrera les commentaires reçus pour orienter les éléments du Projet et assurer une consignation et une déclaration transparentes de l'information.

La SGDN tiendra des séances ouvertes pour donner aux membres du public qui n'ont pas encore commencé à échanger avec la SGDN l'occasion de participer à la conversation.

Maintenant que le site est choisi, le public peut donner son avis de plusieurs façons, notamment en participant à des séances d'information ou à des webinaires, en se rendant au Centre *En savoir plus* d'Ignace ou en nous envoyant des commentaires par écrit. Pour plus d'informations sur les possibilités de donner son avis, consultez le site nwmo.ca/planifionsensemble.

Comment les données de référence seront utilisées dans le cadre du processus de décision réglementaire

Des études de collecte de données de référence sur les environnements naturels et humains sont en cours et se poursuivront tout au long du processus de décision réglementaire. Des activités de surveillance environnementale continueront d'être menées pour recueillir des données qui décrivent les conditions existantes de nombreuses composantes de l'environnement.

Une bonne compréhension des conditions de référence permettra de prévoir l'impact que le projet pourrait avoir sur les gens et l'environnement. Des mesures pourront alors être envisagées pour éviter, gérer, atténuer et, dans certains cas, compenser les impacts négatifs.

La Description initiale du projet résumera plusieurs années de données de référence et utilisera ces données pour éclairer les mesures d'atténuation potentielles (abordées dans la section suivante).

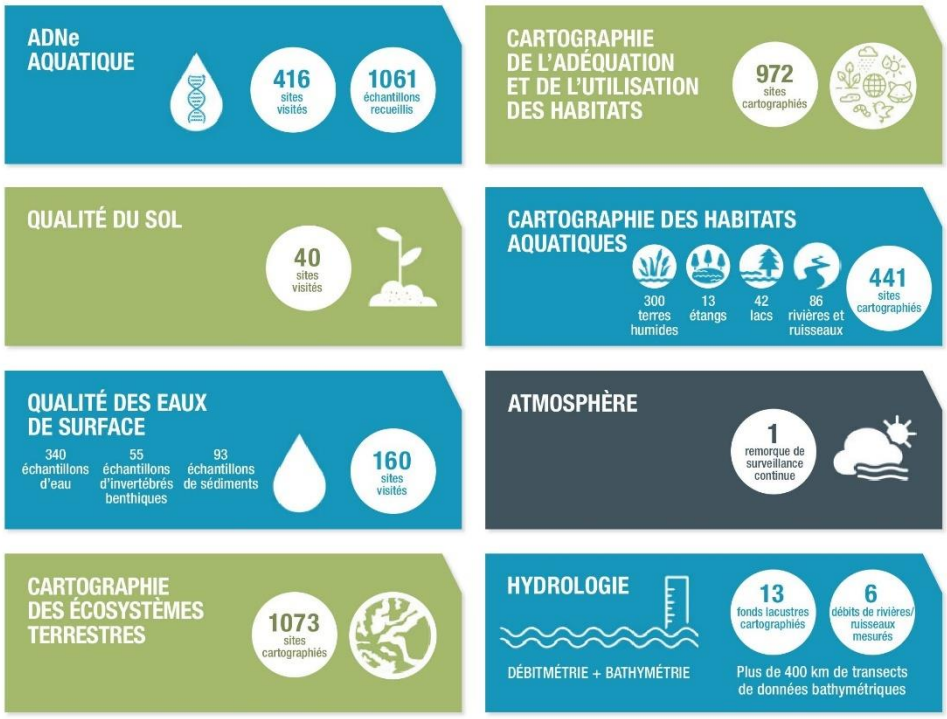
Des activités de surveillance environnementale continueront d'être menées pour recueillir des données qui décrivent les conditions existantes de nombreuses composantes de l'environnement.

POINTS SAILLANTS DU PROJET À CE JOUR : DONNÉES ENVIRONNEMENTALES DE RÉFÉRENCE

La prise de décisions réglementaires exige que des données environnementales de référence soient recueillies et utilisées pour l'évaluation et la planification de la conception du projet avant qu'une autorisation de préparation de l'emplacement en vue de l'aménagement du dépôt géologique en profondeur puisse être accordée. Ce processus d'étude des données environnementales de référence est appelé « caractérisation du site » par la Commission canadienne de sûreté nucléaire.

La SGDN a acquis une bonne compréhension du site du Projet en recueillant, en évaluant et en modélisant des données sur la géologie régionale depuis 2010. Des études environnementales ont également été menées depuis 2014 dans la région du Projet.

Le processus d'étude des données environnementales de référence est appelé « caractérisation du site » par la Commission canadienne de sûreté nucléaire.



Ce graphique présente certaines des données de référence recueillies sur le site proposé pour le Projet.

Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation)
19

Points saillants des composantes de l'environnement naturel connus à ce jour grâce aux données recueillies sur une période d'environ 15 ans

1. **Géochimie :** Les analyses des carottes rocheuses prélevées indiquent que la roche ne présente aucun potentiel de génération d'acide ou de lixiviation des métaux. La SGDN a étudié la composition chimique complète des roches de la région et leurs propriétés n'indiquent pas la présence de minéraux dangereux.

2. **Eaux souterraines et eaux de surface**

   - **Hydrogéologie et hydrogéochimie :** L'hydrogéologie et l'hydrochimie sont les sciences qui étudient les eaux souterraines. Les caractéristiques hydrogéologiques et hydrogéochimiques du site proposé sont favorables au Projet. À la profondeur où le dépôt serait construit, l'eau s'écoule très lentement à travers la roche. Cette conclusion s'appuie sur des essais réalisés dans six puits de forage profonds, qui montrent que la roche laisse passer très peu d'eau, et ce, d'autant moins à mesure que l'on descend en profondeur.

     La composition des échantillons d'eau souterraine et d'eau interstitielle (quantité microscopique d'eau emprisonnée dans la roche) provenant des carottes rocheuses révèle des tendances qui varient en fonction de la profondeur, ce qui correspond à ce dont on s'attend pour un environnement du Bouclier canadien.

   - **Hydrologie :** L'hydrologie est l'étude du mouvement de l'eau. Le site se trouve dans le bassin versant de la rivière Wabigoon, qui s'écoule vers le nord-ouest, depuis le lac Raleigh jusqu'au lac Wabigoon. Le lac Wabigoon s'écoule ensuite vers la rivière Winnipeg et la rivière Nelson, pour finalement atteindre la baie d'Hudson. La zone entourant le Projet proposé comprend plusieurs petits plans d'eau interreliés qui s'écoulent collectivement dans le lac Mennin. Le lac Mennin se jette vers le nord dans la rivière Mennin, puis vers le nord-ouest dans la rivière Wabigoon. Les plus grandes rivières à proximité du site du Projet proposé sont la rivière Mennin, située à approximativement deux kilomètres au sud-ouest du site du Projet proposé, et la rivière Revell, qui est située à environ deux kilomètres au nord et qui coule parallèlement à la route 17. Le confluent de la rivière Revell et de la rivière Wabigoon se trouve à environ six kilomètres au nord-ouest du site.

   - **Qualité des eaux de surface :** La SGDN recueille chaque trimestre des données de référence sur la qualité des eaux de surface. La qualité de l'eau est normale : sa teneur en oxygène dissous est adéquate, son pH est légèrement acide et sa limpidité est faible à modéré. Sa concentration en contaminants préoccupants est généralement inférieure aux valeurs guides, bien que certains échantillons dépassent les valeurs guides pour E. coli, le phosphore, l'aluminium, le cuivre, le manganèse et le mercure.

3. **Données climatiques :** Selon les prévisions climatiques, la température augmentera de 3 à 4 °C d'ici les années 2050 et d'environ 6 °C d'ici les années 2080. Les précipitations devraient augmenter de 50 à 75 mm/an d'ici les années 2050 et de 100 à 125 mm/an d'ici les années 2080.

4. **Rayonnements de fond :** Au Canada, en moyenne, 76 pour cent de l'exposition aux rayonnements provient des rayonnements naturellement émis dans le sol et l'air. Les doses moyennes de rayonnements de fond au Canada sont estimées à environ 1,8 millisievert (mSv) par an, ce qui est inférieur à la moyenne mondiale de 2,4 mSv. Le niveau de rayonnements de fond varie en fonction de l'emplacement, de l'altitude et d'autres facteurs géographiques locaux.

5. **Faune et habitat faunique :** La SGDN recueille actuellement des données de référence pour caractériser la faune terrestre et ses habitats. Des renseignements seront présentés pour divers groupes fauniques présents dans le périmètre du site proposé pour le Projet et dans les environs, notamment les ongulés (orignaux), les carnivores, les petits mammifères, les mammifères semi-aquatiques (p. ex., les castors), les chauves-souris, les reptiles, les amphibiens, les invertébrés et la végétation.

6. **Espèces en péril :** La SGDN recense les espèces préoccupantes sur le plan de la conservation, y compris les espèces en péril inscrites sur les listes fédérales et provinciales et les espèces rares à l'échelle provinciale. Les espèces potentiellement en péril comprennent certaines espèces d'oiseaux (Moucherolle à côtés olive, Engoulevent d'Amérique, Pioui de l'Est, Engoulevent bois-pourri), de poissons (Anguille d'Amérique), de carnivores (Blaireau d'Amérique, Carcajou, Renard gris) et de chauves-souris (Myotis brune, Myotis nordique), ainsi que l'espèce végétale du Frêne noir. Aucun habitat essentiel à la survie ou au rétablissement des espèces sauvages en péril inscrites sur les listes fédérales n'a été recensé sur le site proposé pour le Projet.

7. **Les oiseaux, les oiseaux migrateurs et leurs habitats :** Au total, 76 espèces d'oiseaux ont été recensées sur le site proposé pour le Projet et dans ses environs, dont cinq espèces en péril, 25 autres espèces prioritaires, 65 espèces protégées par la *Loi sur la convention concernant les oiseaux migrateurs* et une espèce dont le nid est protégé en vertu du *Règlement sur les oiseaux migrateurs*.

8. **Les poissons et leurs habitats :** Plusieurs habitats importants pour les poissons, notamment des zones de reproduction et d'alevinage, ont été répertoriés dans la zone d'étude régionale. D'autres travaux sont prévus, notamment des études sur les communautés de poissons et les invertébrés benthiques, afin d'évaluer l'habitat des poissons à l'intérieur et autour du site proposé pour le Projet.

La Mésange à tête noire est l'une des espèces d'oiseaux protégées en vertu de la *Loi sur la convention concernant les oiseaux migrateurs* et du *Règlement sur les oiseaux migrateurs*.

Prochaines étapes — données environnementales de référence

Selon notre compréhension actuelle de l'environnement naturel du site proposé pour le Projet, le site peut répondre aux exigences du Projet en ce qui concerne le confinement et l'isolement du combustible nucléaire irradié, et il sera par conséquent apte à protéger les gens et l'environnement.

La SGDN poursuivra nos études de caractérisation du site et de collecte de données de référence afin de mieux comprendre l'environnement naturel actuel. Ces données serviront à optimiser la conception technique des installations de surface et l'aménagement du dépôt souterrain.

POINTS SAILLANTS DU PROJET : DONNÉES DE RÉFÉRENCE SOCIOÉCONOMIQUES ET SANITAIRES

La *Loi sur les déchets de combustible nucléaire* exige que la SGDN produise des rapports socioéconomiques, notamment sur les effets que nos activités pourraient avoir sur le mode de vie ou sur les aspirations sociales, culturelles ou économiques d'une collectivité. La SGDN est tenue de produire un rapport tous les trois ans en vertu de l'article 18 de cette loi. Ces rapports seront produits pendant toute la durée du Projet.

La SGDN est également tenue de réaliser une évaluation des impacts sur les composantes sociales, économiques et sanitaires de l'environnement humain. Cette évaluation inclurait tout impact que le Projet pourrait avoir sur les droits des peuples autochtones, ce qui nécessiterait des données de référence sur diverses composantes de l'environnement humain.

Points saillants des composantes de l'environnement humain qui sont particulièrement importants pour comprendre les impacts du Projet

1. **Population et démographie :** La croissance démographique dans la région est globalement stable depuis 1991, même si cela ne reflète pas nécessairement la tendance démographique dans chaque collectivité. Les collectivités ont suivi les mêmes tendances démographiques de 1996 à 2021, notamment le vieillissement de la population, une légère diminution du nombre de personnes par famille recensée et d'enfants vivant à la maison, et une proportion croissante de la population qui s'identifie comme Autochtone.
2. **Utilisation des terres et des ressources :** L'environnement naturel est important pour les résidents et les visiteurs des collectivités environnantes du site du Projet. Les résidents participent à plusieurs types d'activités liées à l'utilisation des terres et des ressources, notamment la pêche, la chasse, le piégeage, la cueillette, la randonnée, le VTT, la motoneige et la navigation. Une étude culturelle préliminaire réalisée pour le programme de forage de la SGDN sur le site proposé pour le dépôt en 2024 a examiné les sites archéologiques et historiques connus à l'aide de la Base de données des sites archéologiques de l'Ontario. L'étude culturelle préliminaire a révélé qu'il n'y avait aucun site archéologique ou historique connu sur les sites de forage ou à proximité. Des travaux supplémentaires devraient être menés non seulement pour confirmer ces résultats, mais également pour explorer les zones potentiellement importantes sur le plan culturel ou historique pour la Nation ojibwée de Wabigoon Lake.

Prochaines étapes — données de référence socioéconomiques et sanitaires

La SGDN poursuivra la collecte de données de référence et la production de rapports afin de satisfaire aux exigences de la *Loi sur les déchets de combustible nucléaire* et de la *Loi sur l'évaluation d'impact*. Surtout, la SGDN cherchera des occasions de collaborer avec les collectivités afin de vérifier les informations recueillies à ce jour et d'en apprendre davantage grâce à des études adaptées et propres à chaque collectivité, y compris des études sur le savoir autochtone et l'utilisation des terres, le cas échéant.

MODÈLE CONCEPTUEL DU SITE POUR L'ENVIRONNEMENT BIOPHYSIQUE
ZONE À FAIBLE PROFONDEUR
ZONE INTERMÉDIAIRE
ZONE PROFONDE
METRES
0
100
200
300
400
Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation)
23

POINTS SAILLANTS DU PROJET : EFFETS POTENTIELS DU PROJET

La SGDN se prépare à remettre une Description initiale du projet à l'Agence d'évaluation d'impact du Canada à l'appui d'une Évaluation d'impact qui sera réalisée en vertu de la *Loi sur l'évaluation d'impact*. L'évaluation d'impact sera intégrée à la demande initiale de permis présentée à la Commission canadienne de sûreté nucléaire. Dans le cadre d'une évaluation d'impact, la SGDN évalue l'importance des impacts du Projet qui perdureraient après la mise en oeuvre des mesures d'atténuation, relativement aux composantes suivantes qui sont de compétence fédérale :

- les peuples autochtones;
- les poissons et leurs habitats;
- les espèces aquatiques en péril;
- les oiseaux migrateurs.

De plus, le processus d'autorisation lié à *Loi sur la sûreté et la réglementation nucléaires*, qui est intégré au processus d'évaluation, exige que la SGDN démontre comment nous pourrons protéger l'environnement et les gens lors de la mise en oeuvre du Projet.

Le processus de l'évaluation d'impact offre à la SGDN deux occasions d'évaluer les impacts potentiels et de proposer des mesures d'atténuation :

1. La Description initiale du projet;
2. L'Étude d'impact.

La SGDN sollicite activement la participation des collectivités hôtes du Projet — la Nation ojibwée de Wabigoon Lake et le canton d'Ignace — ainsi que celle des autres Premières Nations et du public de la région.

La SGDN en est à la phase de préplanification de l'évaluation d'impact et prépare actuellement le rapport de Description initiale du projet. La SGDN sollicite activement la participation des collectivités hôtes du Projet — la Nation ojibwée de Wabigoon Lake et le canton d'Ignace — ainsi que celle des autres Premières Nations et du public de la région, sur les thèmes clés de la Description initiale du projet, qui sont résumés dans le présent document.

Les activités de concertation de la SGDN et les possibilités de participer et de donner son avis se poursuivront tout au long du processus. Un aperçu détaillé du processus de l'Évaluation d'impact est présenté plus haut dans le présent rapport (voir la section *Le Processus intégré d'évaluation d'impact et d'autorisation*).

Prochaines étapes — effets potentiels du projet

Le Projet pourrait avoir des impacts sur les gens et l'environnement (c'est-à-dire sur les composantes humaines et naturelles de l'environnement), et la SGDN doit étudier les voies de réalisation de ces impacts dans le cadre du processus réglementaire.

Pour qu'il y ait un impact, il doit y avoir une source (c'est-à-dire un élément ou une activité du Projet) qui interagit avec les gens et l'environnement. Pour la Description initiale du projet, nous avons dressé la liste suivante des activités liées au Projet qui pourraient avoir un impact sur les gens et l'environnement naturel et qui devront être évaluées dans le cadre du processus de l'évaluation d'impact :

- Défrichage pendant la préparation de l'emplacement et la construction;
- Dynamitage et excavation pendant la préparation de l'emplacement et la construction et l'exploitation des installations;
- Aménagement et exploitation des installations de surface, du dépôt géologique en profondeur, du camp d'hébergement des travailleurs et de la Zone de gestion de la roche excavée pendant la préparation de l'emplacement et la construction et l'exploitation des installations;
- Manutention des matériaux pendant la préparation de l'emplacement et la construction et l'exploitation des installations;
- Circulation des véhicules sur le site du Projet pendant toutes les phases du Projet;
- Gestion et traitement de l'eau sur le site (prélèvement d'eau, assèchement et rejet des eaux traitées) pendant toutes les phases du Projet.

Cette liste des interactions du Projet pourra être complétée après concertation des collectivités hôtes, des collectivités autochtones, du public et des organismes de réglementation.

Ébauche de Description initiale du projet (résumé de 2025 à des fins de concertation) 25

Considérations et conclusions de l'évaluation préliminaire

Les quatre conditions suivantes ont servi de base aux évaluations préliminaires réalisées par la SGDN sur l'impact du Projet :

- Aucune matière radioactive ne sera présente sur le site pendant les phases de préparation de l'emplacement et de construction;
- La sûreté radiologique fera l'objet d'une surveillance et d'un contrôle rigoureux par la Commission canadienne de sûreté nucléaire pendant l'exploitation et la fermeture du dépôt;
- Les effets, les mesures d'atténuation et la surveillance pendant la préparation de l'emplacement et la construction seront similaires à ceux d'autres projets d'infrastructure (comme les projets d'exploitation minière et forestiers) dans le nord de l'Ontario;
- Dans le cadre de l'évaluation préliminaire proposée dans la Description initiale du projet, les changements potentiels sont pris en compte et des mesures d'atténuation sont proposées sur la base de ce qui a été approuvé pour d'autres projets présentant des activités et des impacts similaires.

La SGDN poursuivra nos évaluations approfondies de la sûreté et notre évaluation quantitative détaillée des risques pour la santé humaine et l'environnement afin de confirmer la sûreté du Projet et de nous assurer que ce dernier n'aura pas d'effets négatifs sur les gens et l'environnement. Ces études seront mises à jour et présentées à la Commission canadienne de sûreté nucléaire à chaque étape du processus d'autorisation.

L'ébauche de la Description initiale du projet présentera les conclusions suivantes issues de la première évaluation des impacts potentiels du Projet :

- Pour ce Projet, on s'attend à ce que les pratiques exemplaires et les mesures d'atténuation standard empêchent que des changements surviennent ou réduisent le risque d'impact sur les poissons et leurs habitats, les oiseaux migrateurs et les espèces aquatiques en péril;
- Pour des raisons de sûreté et de sécurité, le Projet limitera l'accès aux terres actuellement utilisées par les peuples autochtones pour l'utilisation traditionnelle des terres et des ressources;
- En raison du stockage du combustible nucléaire irradié, le Projet pourrait donner lieu à des perceptions de contamination radioactive potentielle qui pourraient entraîner des modifications à l'utilisation traditionnelle des terres.

Le processus d'évaluation d'impact permettra de déterminer et de confirmer l'ampleur de ces impacts et les collectivités touchées, et d'évaluer la possibilité que le Projet ait des impacts sur d'autres collectivités autochtones, conformément à la *Loi sur l'évaluation d'impact*. L'évaluation serait adaptée en fonction des préoccupations de la collectivité, de son utilisation des terres et des impacts prévus.

La SGDN souhaite recevoir des commentaires sur l'approche proposée et sur les conclusions préliminaires présentées dans ce résumé. La SGDN se réjouit également de pouvoir en apprendre davantage sur la façon dont le Projet pourrait interagir avec les gens et l'environnement afin de mieux adapter l'évaluation d'impact.

Évaluation stratégique des changements climatiques

La *Loi sur l'évaluation d'impact* exige qu'une évaluation stratégique des changements climatiques soit réalisée pour le Projet afin d'assurer que les considérations relatives aux changements climatiques soient intégrées à toutes les étapes de la planification et de la prise de décision du Projet, ce qui contribuera à un développement plus durable et à la réalisation des objectifs nationaux en matière de climat.

Le Projet est essentiel au cycle de vie de l'énergie nucléaire, que le gouvernement fédéral a identifié comme un élément important d'un avenir à faibles émissions de carbone au Canada. Afin de respecter notre engagement de protéger les gens et l'environnement tout au long de nos activités, nous prendrons à la SGDN les mesures suivantes :

- Réaliser une évaluation des meilleures technologies qui permettrait de faire en sorte que le Projet soit carboneutre d'ici 2050 pendant la phase estimée d'exploitation;
- Élaborer et mettre en oeuvre un plan crédible en matière de carboneutralité qui réponde aux exigences de l'évaluation stratégique des changements climatiques du gouvernement du Canada.

Les prochaines étapes de ce travail comprendront des études supplémentaires sur les changements climatiques, l'optimisation de la conception du Projet et la concertation des collectivités hôtes, des collectivités autochtones et du public sur l'élaboration du plan de carboneutralité.

Et maintenant?

- **Présentation de la Description initiale du projet (DIP) :** Préparation d'un rapport initial qui décrira le Projet, les conditions de référence actuelles et les interactions potentielles du Projet avec les gens et l'environnement à des fins d'examen réglementaire et d'examen par les collectivités — présentation par la SGDN de la Description initiale du projet à l'Agence d'évaluation d'impact du Canada afin de lancer officiellement le processus d'évaluation d'impact et d'autorisation du Projet.
- **Activités de concertation et participation réglementaires :** Poursuite du processus d'établissement de relations respectueuses avec la Nation ojibwée de Wabigoon Lake, le canton d'Ignace et les collectivités environnantes.
- **Avancement du programme technique :** Avancement de la conception du dépôt en fonction du site choisi en tenant compte de la rétroaction itérative issue des études de sûreté, géoscientifiques, environnementales et d'évaluation d'impact, ainsi que des commentaires des collectivités.
- **Évaluations techniques pour l'Étude d'impact et la demande d'autorisation intégrées :** Préparer les évaluations techniques pour l'Étude d'impact et la demande d'autorisation intégrées tout au long de la phase d'évaluation d'impact (environ trois ans) et travailler en collaboration avec les collectivités hôtes, les Premières Nations et les groupes et personnes intéressés afin d'élaborer des mesures d'atténuation appropriées et d'assurer la transparence des conclusions. L'Étude d'impact et la demande d'autorisation intégrées devraient être présentées approximativement trois ans après la présentation de la Description initiale du projet.

Dorénavant, le Projet de dépôt géologique en profondeur pour le combustible nucléaire irradié canadien sera assujetti à la *Loi sur l'évaluation d'impact* et à plusieurs permis, licences et autorisations qui devront être obtenus par la SGDN pendant ou après le Processus intégré d'évaluation d'impact.

- **Audiences publiques :** Le Projet sera soumis à l'étude d'un groupe d'experts indépendants qui examinera l'étude d'impact, les avis des différents organismes de réglementation fédéraux et provinciaux, ainsi que les points de vue des collectivités autochtones et des membres du public qui participent au processus. L'audience est un processus officiel au cours duquel l'Agence d'évaluation d'impact du Canada, la Commission canadienne de sûreté nucléaire et d'autres organismes (tels que Pêches et Océans Canada, Environnement et Changement climatique Canada et Santé Canada) examinent les données techniques afin d'évaluer la sûreté d'un projet proposé ou d'une activité proposée. Elle offre également aux groupes autochtones et au public la possibilité de participer en présentant leurs points de vue et leurs préoccupations avant qu'une décision soit prise concernant une évaluation d'impact ou l'autorisation d'un projet.

Des questions ou des commentaires?

Vos réflexions seront les bienvenues. Veuillez les transmettre au plus tard le 22 août 2025 à l'adresse RegulatoryFeedback@nwmo.ca ou par la poste à l'adresse suivante :

SGDN — Commentaires sur le résumé de la DIP
22, avenue St. Clair Est, 4e étage
Toronto, ON M4T 2S3

Découvrez les prochaines étapes, informez-vous sur les événements en personne à venir et apprenez-en davantage à l'adresse nwmo.ca/planifionsensemble.

Ensemble, nous préparons un avenir sûr et durable pour le combustible nucléaire irradié canadien.

Pour plus d'informations, veuillez contacter :

Société de gestion des déchets nucléaires
22, avenue St. Clair Est, 4e étage
Toronto (ON) M4T 2S3, Canada
Tél. : 416.934.9814 Sans frais: 1.866.249.6966
Courriel : contactus@nwmo.ca
Site Web : nwmo.ca

@LaSGDN
/company/nwmocanada

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

© 2025 Société de gestion des déchets nucléaires

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

FEEDBACK PROMPT GUIDE FOR THE INITIAL PROJECT DESCRIPTION SUMMARY

This guide is designed to help you think about your feedback on the Nuclear Waste Management Organization's (NWMO) Initial Project Description (IPD) summary. The IPD is the first step in the Integrated Impact Assessment and Licensing process, and provides an overview of the project's purpose, objectives and potential impacts. Your input is valuable and will be used to inform the IPD before it is submitted to the Impact Assessment Agency of Canada (IAAC).

Feedback on the IPD summary is being collected until Aug. 22, 2025.

ABOUT THE INTEGRATED IMPACT ASSESSMENT AND LICENSING PROCESS

The Integrated Impact Assessment and Licensing process helps to examine the positive and negative effects (impacts) that a proposed major project could have, like the NWMO's Deep Geological Repository for Canada's Used Nuclear Fuel Project.

To learn more about the integrated assessment process, please visit the Impact Assessment Agency of Canada website at https://www.canada.ca/en/impact-assessment-agency/programs/impact-assessments-101/integrated.html.

TIPS FOR EFFECTIVE FEEDBACK

- **Be specific and refer to the IPD summary**: Where possible, please provide specific examples and details from the IPD summary to support your comments.
- **Explain your reasoning**: Clearly explain *why* you have feedback about specific aspects of the IPD summary and how they might impact the environment, community or other areas.
- **Share your knowledge**: If you have relevant knowledge (local, scientific, Indigenous Knowledge), please share it and explain how it should be considered.
- **Avoid personal or identifying information**: Please do not include information that could be considered private or confidential.
- **Communicate respectfully**: Please refrain from comments that are inappropriate or offensive.

FEEDBACK PROMPT GUIDE

PROVIDING YOUR FEEDBACK

Below are some questions to help guide your feedback on the IPD summary. While these are suggestions, the most important thing is to provide feedback related to the IPD summary that you feel is important.

1. **Understanding of the project**
   - After reviewing the IPD summary, do you have a clear understanding of the project's purpose and objectives? Why or why not?
   - What is unclear?

2. **Potential benefits**
   - Do you understand the potential benefits of the project?
   - Do you believe the IPD summary accurately reflects the potential benefits?

3. **Potential impacts and mitigation**
   - Do you believe the IPD summary identifies the potential environmental, social, economic and cultural impacts of the project, including impacts on Indigenous communities?
   - Are there any potential impacts that you believe are missing or underestimated in the IPD summary?

4. **Public and Indigenous engagement**
   - Do you feel the IPD summary summarizes the engagement that the NWMO has carried out during the site selection process?
   - If you have previously expressed concerns to the NWMO, are your concerns addressed in the IPD summary?
   - How could Indigenous Knowledge be better incorporated into the integrated assessment process?

5. **What matters to you and your community?**
   - Examples might include wildlife, noise, water quality, jobs and health.
   - Do you have specific knowledge about your community (e.g., history, environment, social, cultural and economic) that may be relevant to the integrated assessment of this project?
   - Do you have additional comments specific to the siting area?

6. **Additional comments**
   - Please provide any other comments or information that you believe are relevant to the IPD.

Nuclear Waste Management Organization
Email: RegulatoryFeedback@nwmo.ca
© 2025 Nuclear Waste Management Organization
@nwmocanada
/company/nwmocanada
nwmo.ca/PlanningWithYou

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

GUIDE POUR LA PRÉSENTATION DE COMMENTAIRES SUR LE RÉSUMÉ DE LA DESCRIPTION INITIALE DU PROJET

Ce guide a pour but de vous aider à formuler vos commentaires sur le résumé de la Description initiale du projet (DIP) de la Société de gestion des déchets nucléaires (SGDN). La DIP est la première étape du Processus intégré d'évaluation d'impact et d'autorisation. Elle donne un aperçu du but, des objectifs et des impacts potentiels du projet. Vos commentaires seront très utiles et éclaireront la formulation de la DIP avant qu'elle ne soit présentée à l'Agence d'évaluation d'impact du Canada (AEIC).

Les commentaires sur le résumé de la DIP seront recueillis jusqu'au 22 août 2025.

À PROPOS DU PROCESSUS INTÉGRÉ D'ÉVALUATION D'IMPACT ET D'AUTORISATION

Le Processus intégré d'évaluation d'impact et d'autorisation aide à examiner les effets positifs et négatifs (impacts) qu'un grand projet proposé (par exemple, le Projet de dépôt géologique en profondeur pour le combustible nucléaire irradié canadien de la SGDN) pourrait avoir.

Pour en savoir plus sur le processus d'évaluation intégrée, veuillez consulter le site Web de l'Agence d'évaluation d'impact du Canada à l'adresse https://www.canada.ca/fr/agence-evaluation-impact/programmes/evaluation-impact-101/integrees.html.

CONSEILS POUR OFFRIR DES COMMENTAIRES UTILES

- **Soyez précis et utilisez le texte du résumé de la DIP comme référence** : Dans la mesure du possible, veuillez fournir à l'appui de vos commentaires des exemples précis et des détails tirés du résumé de la DIP.
- **Expliquez votre raisonnement** : Expliquez clairement *pourquoi* vous fournissez des commentaires sur des éléments particuliers du résumé de la DIP et quelles incidences ces éléments pourraient avoir sur l'environnement, la collectivité ou d'autres domaines.
- **Faites partager vos connaissances** : Si vous possédez des connaissances pertinentes (locales, scientifiques, savoir autochtone), veuillez nous les faire partager et expliquer comment elles devraient être prises en considération.
- **Évitez de fournir des renseignements personnels ou identifiables** : Veuillez ne pas inclure de renseignements qui pourraient être considérés comme de nature privée ou confidentielle.
- **Communiquez de manière respectueuse** : Veuillez vous abstenir de tout commentaire inapproprié ou offensant.

PRÉSENTATION DE VOS COMMENTAIRES

Vous trouverez ci-dessous quelques questions qui vous aideront à formuler vos commentaires sur le résumé de la DIP. Il s'agit de suggestions, mais le plus important est de fournir les commentaires sur le résumé de la DIP que vous jugez importants.

1. **Compréhension du projet**
   - Après avoir examiné le résumé de la DIP, comprenez-vous clairement le but et les objectifs du projet? Pourquoi ou pourquoi pas?
   - Quels éléments sont moins clairs?

2. **Avantages potentiels**
   - Comprenez-vous les avantages potentiels du projet?
   - Pensez-vous que le résumé de la DIP reflète fidèlement ces avantages potentiels?

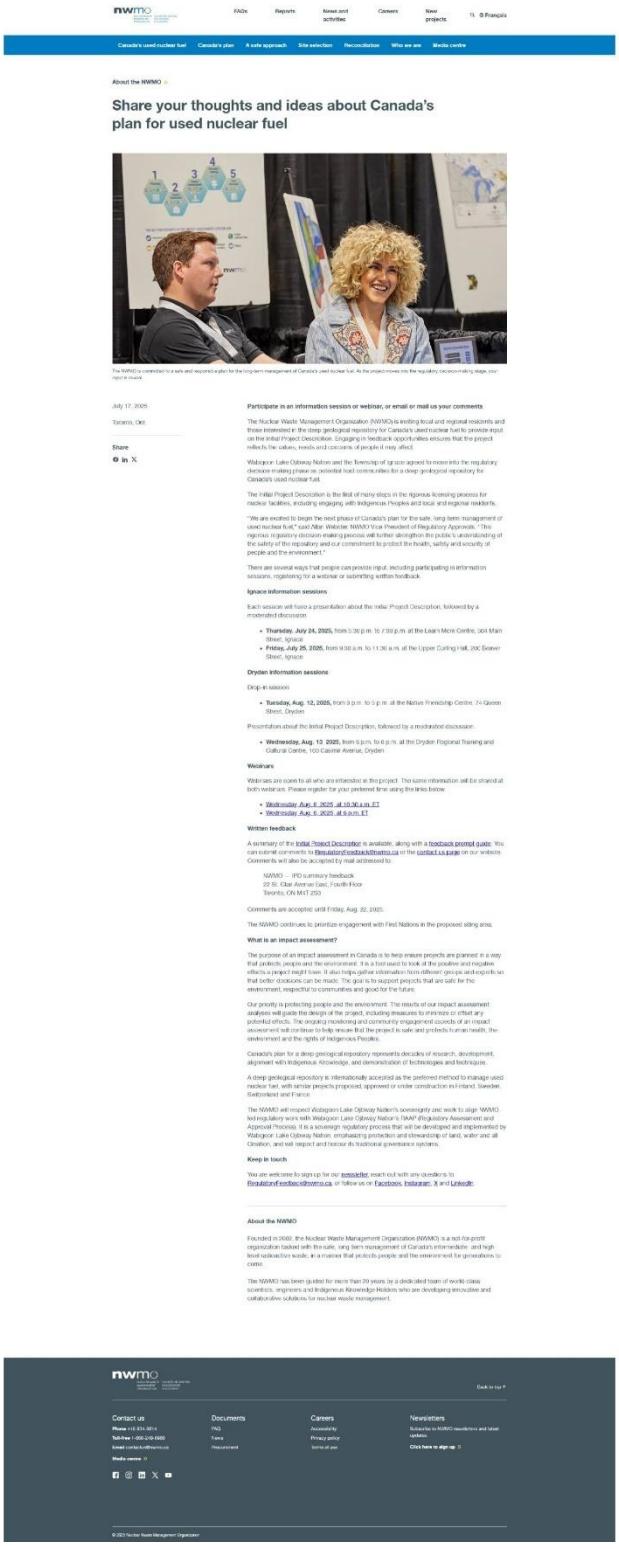
3. **Impacts potentiels et mesures d'atténuation**
   - Croyez-vous que le résumé de la DIP relève correctement les impacts environnementaux, sociaux, économiques et culturels potentiels du projet, y compris les impacts qu'il pourrait avoir sur les collectivités autochtones?
   - Si ce n'est pas le cas selon vous, quels impacts potentiels ne sont pas mentionnés ou sont sous-estimés dans le résumé de la DIP?

4. **Concertation avec le public et les Autochtones**
   - Estimez-vous que le résumé de la DIP résume bien les activités de concertation menées par la SGDN au cours du processus de sélection d'un site?
   - Si vous avez déjà fait part de vos préoccupations à la SGDN, estimez-vous qu'elles ont été prises en compte dans le résumé de la DIP?
   - Comment le savoir autochtone pourrait-il être mieux incorporé dans le processus d'évaluation intégrée?

5. **Qu'est-ce qui importe pour vous et votre collectivité?**
   - Par exemple, la faune, le bruit, la qualité de l'eau, les emplois et la santé.
   - Avez-vous des connaissances particulières sur votre collectivité (p. ex., son histoire, son environnement, son contexte social, culturel et économique) qui pourraient être utiles à l'évaluation intégrée de ce projet?
   - Avez-vous des commentaires supplémentaires touchant particulièrement à la région du site proposé?

6. **Commentaires additionnels**
   - Veuillez fournir tout autre commentaire ou renseignement que vous jugez pertinent sur la DIP.

Société de gestion des déchets nucléaires
Courriel : RegulatoryFeedback@nwmo.ca
© 2025 Société de gestion des déchets nucléaires
@LaSGDN
/company/nwmocanada
nwmo.ca/planifionsensemble



nwmo

FAQs Reports News and activities Careers New projects Français

Canada's used nuclear fuel Canada's plan A safe approach Site selection Reconciliation Who we are Media centre

About the NWMO >

Share your thoughts and ideas about Canada's plan for used nuclear fuel

The NWMO is committed to a safe and responsible plan for the long-term management of Canada's used nuclear fuel. As the project moves into the regulatory decision-making stage, your input is crucial.

July 17, 2025

Toronto, Ont.

Share

Participate in an information session or webinar, or email or mail us your comments

The Nuclear Waste Management Organization (NWMO) is inviting local and regional residents and those interested in the deep geological repository for Canada's used nuclear fuel to provide input on the Initial Project Description. Engaging in feedback opportunities ensures that the project reflects the values, needs and concerns of people it may affect.

Wabigoon Lake Ojibway Nation and the Township of Ignace agreed to move into the regulatory decision-making phase as selected host communities for a deep geological repository for Canada's used nuclear fuel.

The Initial Project Description is the first of many steps in the rigorous licensing process for nuclear facilities, including engaging with Indigenous Peoples and local and regional residents.

"We are excited to begin the next phase of Canada's plan for the safe, long-term management of used nuclear fuel," said Allan Webster, NWMO Vice President of Regulatory Approvals. "This rigorous regulatory decision-making process will further strengthen the public's understanding of the safety of the repository and our commitment to protect the health, safety and security of people and the environment."

There are several ways that people can provide input, including participating in information sessions, registering for a webinar or submitting written feedback.

Ignace information sessions

Each session will have a presentation about the Initial Project Description, followed by a moderated discussion.

- **Thursday, July 24, 2025,** from 5:30 p.m. to 7:30 p.m. at the Learn More Centre, 364 Main Street, Ignace
- **Friday, July 25, 2025,** from 9:30 a.m. to 11:30 a.m. at the Upper Curling Hall, 20C Beaver Street, Ignace

Dryden information sessions

Drop-in session

- **Tuesday, Aug. 12, 2025,** from 3 p.m. to 5 p.m. at the Native Friendship Centre, 74 Queen Street, Dryden

Presentation about the Initial Project Description, followed by a moderated discussion

- **Wednesday, Aug. 13, 2025,** from 6 p.m. to 8 p.m. at the Dryden Regional Training and Cultural Centre, 100 Casimir Avenue, Dryden

Webinars

Webinars are open to all who are interested in the project. The same information will be shared at both webinars. Please register for your preferred time using the links below.

- Wednesday, Aug. 6, 2025, at 10:30 a.m. ET
- Wednesday, Aug. 6, 2025, at 6 p.m. ET

Written feedback

A summary of the Initial Project Description is available, along with a feedback prompt guide. You can submit comments to RegulatoryFeedback@nwmo.ca or the contact us page on our website. Comments will also be accepted by mail addressed to:

NWMO – IPD summary feedback
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3

Comments are accepted until Friday, Aug. 22, 2025.

The NWMO continues to prioritize engagement with First Nations in the proposed siting area.

What is an impact assessment?

The purpose of an impact assessment in Canada is to help ensure projects are planned in a way that protects people and the environment. It is a tool used to look at the positive and negative effects a project might have. It also helps gather information from different groups and experts so that better decisions can be made. The goal is to support projects that are safe for the environment, respectful to communities and good for the future.

Our priority is protecting people and the environment. The results of our impact assessment analyses will guide the design of the project, including measures to minimize or offset any potential effects. The ongoing monitoring and community engagement aspects of an impact assessment will continue to help ensure that the project is safe and protects human health, the environment and the rights of Indigenous Peoples.

Canada's plan for a deep geological repository represents decades of research, development, alignment with Indigenous Knowledge, and demonstration of technologies and techniques.

A deep geological repository is internationally accepted as the preferred method to manage used nuclear fuel, with similar projects proposed, approved or under construction in Finland, Sweden, Switzerland and France.

The NWMO will respect Wabigoon Lake Ojibway Nation's sovereignty and work to align NWMO-led regulatory work with Wabigoon Lake Ojibway Nation's TAAP (Regulatory Assessment and Approval Process). It is a sovereign regulatory process that will be developed and implemented by Wabigoon Lake Ojibway Nation, emphasizing protection and stewardship of land, water and all Creation, and will respect and honour its traditional governance systems.

Keep in touch

You are welcome to sign up for our newsletter, reach out with any questions to RegulatoryFeedback@nwmo.ca, or follow us on Facebook, Instagram, X and LinkedIn.

About the NWMO

Founded in 2002, the Nuclear Waste Management Organization (NWMO) is a not-for-profit organization tasked with the safe, long-term management of Canada's intermediate- and high-level radioactive waste, in a manner that protects people and the environment for generations to come.

The NWMO has been guided for more than 20 years by a dedicated team of world-class scientists, engineers and Indigenous Knowledge Holders who are developing innovative and collaborative solutions for nuclear waste management.

nwmo

Back to top ^

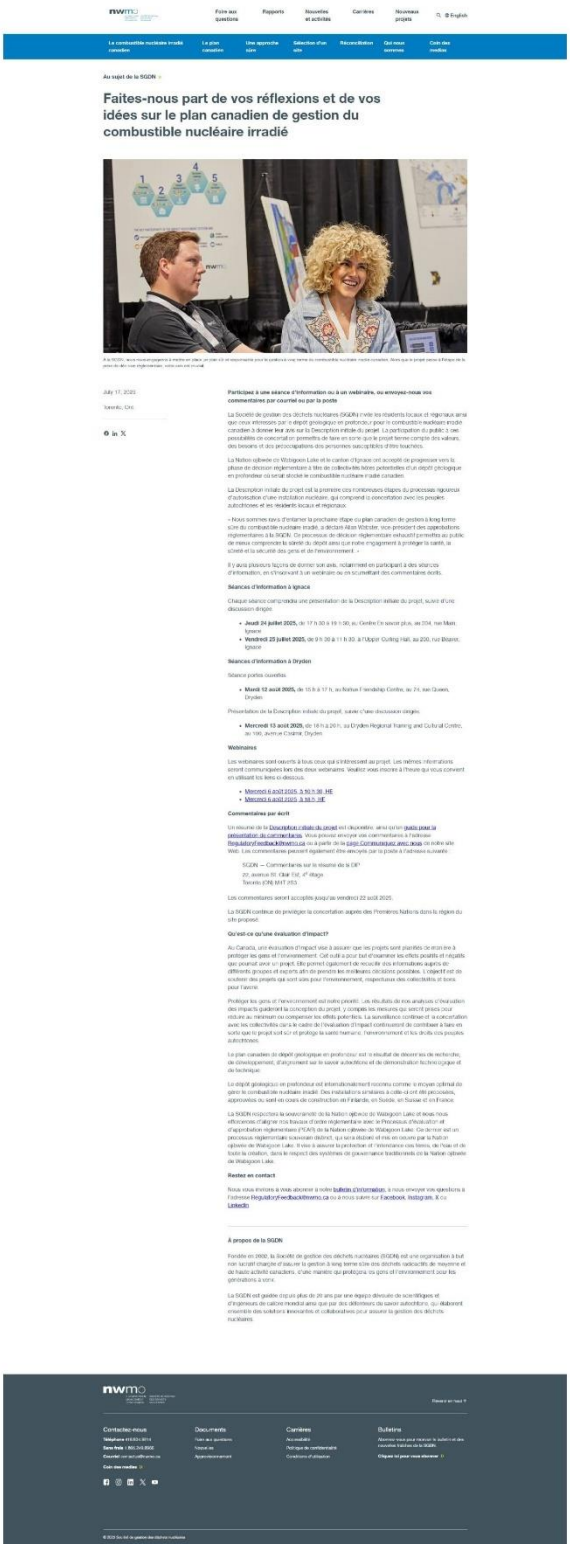
Contact us
Phone
Toll-free
Email
Media centre

Documents
FAQ
Terms
Procurement

Careers
Accessibility
Privacy policy
Terms of use

Newsletters
Subscribe to NWMO newsletters and latest updates
Click here to sign up

© 2025 Nuclear Waste Management Organization



nwmo

Foire aux questions | Rapports | Nouvelles et activités | Carrières | Nouveaux projets | English

Le combustible nucléaire irradié canadien | Le plan canadien | Une approche sûre | Sélection d'un site | Réconciliation | Qui nous sommes | Coin des médias

Au sujet de la SGDN

Faites-nous part de vos réflexions et de vos idées sur le plan canadien de gestion du combustible nucléaire irradié

À la SGDN, nous nous engageons à mettre en place un plan sûr et responsable pour la gestion à vue lointaine du combustible nucléaire irradié canadien. Alors que le projet passe à l'étape de la prise de décision réglementaire, votre voix est primordiale.

July 17, 2025

Toronto, ON

Participez à une séance d'information ou à un webinaire, ou envoyez-nous vos commentaires par courriel ou par la poste

La Société de gestion des déchets nucléaires (SGDN) invite les résidents locaux et régionaux ainsi que ceux intéressés par le dépôt géologique en profondeur pour le combustible nucléaire irradié canadien à donner leur avis sur la Description initiale du projet. La participation du public a ces possibilités de consultation permettra de faire en sorte que le projet tienne compte des valeurs, des besoins et des préoccupations des personnes susceptibles d'être touchées.

La Nation ojibwée de Wabigoon Lake et le canton d'Ignace ont accepté de progresser vers la phase de décision réglementaire à titre de collectivités hôtes potentielles d'un dépôt géologique en profondeur où serait stocké le combustible nucléaire irradié canadien.

La Description initiale du projet est la première des nombreuses étapes du processus rigoureux d'autorisation d'une installation nucléaire, qui comprend la consultation avec les peuples autochtones et les résidents locaux et régionaux.

« Nous sommes ravis d'entamer la prochaine étape du plan canadien de gestion à long terme sûre du combustible nucléaire irradié, a déclaré Allan Webster, vice-président des opérations réglementaires à la SGDN. Ce processus de décision réglementaire exhaustif permettra au public de mieux comprendre la sûreté du dépôt ainsi que notre engagement à protéger la santé, la sûreté et la sécurité des gens et de l'environnement. »

Il y aura plusieurs façons de donner son avis, notamment en participant à des séances d'information, en s'inscrivant à un webinaire ou en soumettant des commentaires écrits.

Séances d'information à Ignace

Chaque séance comprendra une présentation de la Description initiale du projet, suivie d'une discussion élargie.

- **Jeudi 24 juillet 2025,** de 17 h 30 à 19 h 00, au Centre l'in savoir plus, au 204, rue Main, Ignace
- **Vendredi 25 juillet 2025,** de 9 h 30 à 11 h 30, à l'Upper Curling Hall, au 200, rue Blaine, Ignace

Séances d'information à Dryden

Séance portes ouvertes

- **Mardi 12 août 2025,** de 15 h à 17 h, au Native Friendship Centre, au 24, rue Queen, Dryden

Présentation de la Description initiale du projet, suivie d'une discussion élargie.

- **Mercredi 13 août 2025,** de 16 h à 20 h, au Dryden Regional Training and Cultural Centre, au 160, avenue Chapel, Dryden

Webinaires

Les webinaires sont ouverts à tous ceux qui s'intéressent au projet. Les mêmes informations seront communiquées lors des deux webinaires. Veuillez vous inscrire à l'heure qui vous convient en utilisant les liens ci-dessous.

- Mercredi 6 août 2025, à 18 h (ET) [HE]
- Mercredi 6 août 2025, à 18 h [HE]

Commentaires par écrit

Un résumé de la Description initiale du projet est disponible, ainsi qu'un guide pour la présentation de commentaires. Vous pouvez envoyer vos commentaires à l'adresse RegulatoryFeedback@nwmo.ca ou à partir de la page Communiquez avec nous de notre site Web. Les commentaires peuvent également être envoyés par la poste à l'adresse suivante :

SGDN — Commentaires sur le résumé de la DIP
22, avenue St. Clair Est, 4e étage
Toronto (ON) M4T 2S3

Les commentaires seront acceptés jusqu'au vendredi 22 août 2025.

La SGDN continue de privilégier la consultation auprès des Premières Nations dans la région du site proposé.

Qu'est-ce qu'une évaluation d'impact?

Au Canada, une évaluation d'impact vise à assurer que les projets sont planifiés de manière à protéger les gens et l'environnement. Cet outil a pour but d'examiner les effets positifs et négatifs que pourrait avoir un projet. Elle permet également de recueillir des informations auprès de différents groupes et experts afin de prendre les meilleures décisions possibles. L'objectif est de soutenir des projets qui sont sûrs pour l'environnement, respectueux des collectivités et bons pour l'avenir.

Protéger les gens et l'environnement est notre priorité. Les résultats de nos analyses d'évaluation des impacts guideront la conception du projet, y compris les mesures qui seront prises pour réduire au minimum ou compenser les effets potentiels. La surveillance continue et la consultation avec les collectivités dans le cadre de l'évaluation d'impact continueront de contribuer à faire en sorte que le projet soit sûr et protège la santé humaine, l'environnement et les droits des peuples autochtones.

Le plan canadien de dépôt géologique en profondeur est le résultat de décennies de recherche, de développement, d'engagement sur le savoir autochtone et de démonstration fructueuse et de technique.

Le dépôt géologique en profondeur est internationalement reconnu comme le moyen optimal de gérer le combustible nucléaire irradié. Des installations similaires à celle-ci ont été proposées, approuvées ou sont en cours de construction en Finlande, en Suède, en Suisse et en France.

La SGDN respectera la souveraineté de la Nation ojibwée de Wabigoon Lake et nous nous efforcerons d'aligner nos travaux d'ordre réglementaire avec le Processus d'évaluation et d'approbation réglementaires (PEAR) de la Nation ojibwée de Wabigoon Lake. Ce dernier est un processus réglementaire souverain distinct, qui sera élaboré et mis en œuvre par la Nation ojibwée de Wabigoon Lake. Il vise à assurer la protection et l'intendance des terres, de l'eau et de toute la création, dans le respect des systèmes de gouvernance traditionnels de la Nation ojibwée de Wabigoon Lake.

Restez en contact

Nous vous invitons à vous abonner à notre bulletin d'information, à nous envoyer vos questions à l'adresse RegulatoryFeedback@nwmo.ca ou à nous suivre sur Facebook, Instagram, X ou LinkedIn.

À propos de la SGDN

Fondée en 2002, la Société de gestion des déchets nucléaires (SGDN) est une organisation à but non lucratif chargée d'assurer la gestion à long terme sûre des déchets radioactifs de moyenne et de haute activité canadiens, d'une manière qui protégera les gens et l'environnement pour les générations à venir.

La SGDN est guidée depuis plus de 20 ans par une équipe diversifiée de scientifiques et d'ingénieurs de calibre mondial ainsi que par des détenteurs de savoir autochtone, qui élaborent ensemble des solutions innovantes et collaboratives pour assurer la gestion des déchets nucléaires.

nwmo

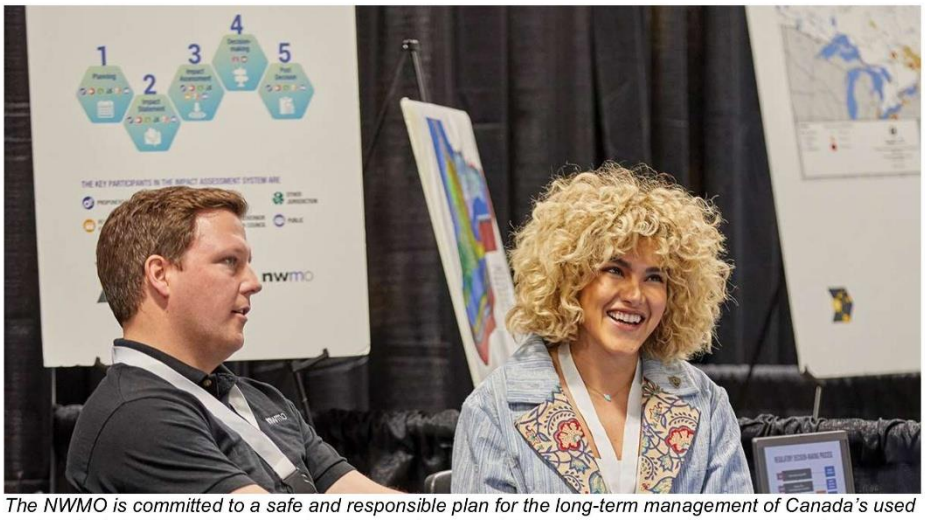
Revenir en haut

Contactez-nous | Documents | Carrières | Bulletins

Coin des médias

The NWMO seeks input on Canada's plan for used nuclear fuel

Participate in an information session or webinar, or email or mail your comments to the NWMO



The NWMO is committed to a safe and responsible plan for the long-term management of Canada's used nuclear fuel. As the project moves into the regulatory decision-making stage, your input is crucial.

IGNACE, ON, July 17, 2025 /CNW/ - The Nuclear Waste Management Organization (NWMO) is inviting local and regional residents and those interested in the deep geological repository for Canada's used nuclear fuel to provide input on the Initial Project Description. Engaging in feedback opportunities ensures that the project reflects the values, needs and concerns of people it may affect.

Wabigoon Lake Ojibway Nation and the Township of Ignace agreed to move into the regulatory decision-making phase as potential host communities for a deep geological repository for Canada's used nuclear fuel.

The Initial Project Description is the first of many steps in the rigorous licensing process for nuclear facilities, including engaging with Indigenous Peoples and local and regional residents.

"We are excited to begin the next phase of Canada's plan for the safe, long-term management of used nuclear fuel," said Allan Webster, NWMO Vice-President of Regulatory Approvals. "This rigorous regulatory decision-making process will further strengthen the public's understanding of the safety of the repository and our commitment to protect the health, safety and security of people and the environment."

There are several ways that people can provide input, including participating in information sessions, registering for a webinar or submitting written feedback.

Ignace information sessions

Each session will have a presentation about the Initial Project Description, followed by a moderated discussion.

- **Thursday, July 24, 2025,** from 5:30 p.m. to 7:30 p.m. at the Learn More Centre, 304 Main Street, Ignace
- **Friday, July 25, 2025,** from 9:30 a.m. to 11:30 a.m. at the Upper Curling Hall, 200 Beaver Street, Ignace

Dryden information sessions

Drop-in session

- **Tuesday, Aug. 12, 2025,** from 3 p.m. to 5 p.m. at the Native Friendship Centre, 74 Queen Street, Dryden

Presentation about the Initial Project Description, followed by a moderated discussion.

- **Wednesday, Aug. 13, 2025,** from 6 p.m. to 8 p.m. at the Dryden Regional Training and Cultural Centre, 100 Casimir Avenue, Dryden

Webinars

Webinars are open to all who are interested in the project. The same information will be shared at both webinars. Please register for your preferred time using the links below.

- Wednesday, Aug. 6, 2025, at 10:30 a.m. ET
- Wednesday, Aug. 6, 2025, at 6 p.m. ET

Written feedback

Beginning on Thursday, July 17, 2025, a summary of the Initial Project Description will be posted at nwmo.ca/PlanningWithYou for review. You can submit comments to RegulatoryFeedback@nwmo.ca or the contact us page on the NWMO website. Comments will also be accepted by mail addressed to:

NWMO — IPD summary feedback
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3

Comments are accepted until Friday, Aug. 22, 2025.

The NWMO continues to prioritize engagement with First Nations in the proposed siting area.

What is an impact assessment?

The purpose of an impact assessment in Canada is to help ensure projects are planned in a way that protects people and the environment. It is a tool used to look at the positive and negative effects a project might have. It also helps gather information from different groups and experts so that better decisions can be made. The goal is to support projects that are safe for the environment, respectful to communities and good for the future.

The NWMO's priority is protecting people and the environment. The results of the impact assessment analyses will guide the design of the project, including measures to minimize or offset any potential effects. The ongoing monitoring and community engagement aspects of an impact assessment will continue to help ensure that the project is safe and protects human health, the environment and the rights of Indigenous Peoples.

Canada's plan for a deep geological repository represents decades of research, development, alignment with Indigenous Knowledge, and demonstration of technologies and techniques.

A deep geological repository is internationally accepted as the preferred method to manage used nuclear fuel, with similar projects proposed, approved or under construction in Finland, Sweden, Switzerland and France.

The NWMO will respect Wabigoon Lake Ojibway Nation's sovereignty and work to align NWMO-led regulatory work with Wabigoon Lake Ojibway Nation's RAAP (Regulatory Assessment and Approval Process). It is a sovereign regulatory process that will be developed and implemented by Wabigoon Lake Ojibway Nation, emphasizing protection and stewardship of land, water and all Creation, and will respect and honour its traditional governance systems.

Keep in touch

You are welcome to sign up for the NWMO's newsletter, reach out with any questions to RegulatoryFeedback@nwmo.ca, or follow the NWMO on Facebook, Instagram, X and LinkedIn.

About the NWMO

Founded in 2002, the Nuclear Waste Management Organization (NWMO) is a not-for-profit organization tasked with the safe, long-term management of Canada's intermediate- and high-level radioactive waste, in a manner that protects people and the environment for generations to come.

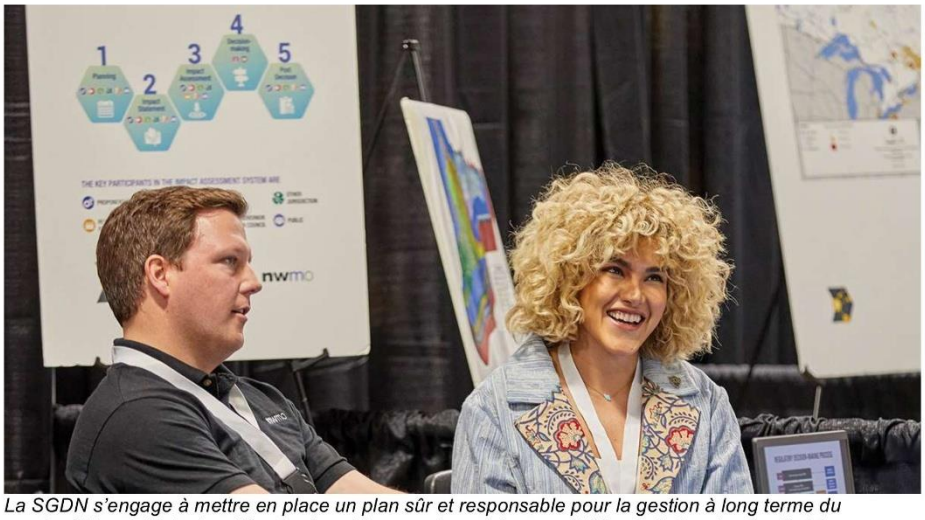
The NWMO has been guided for more than 20 years by a dedicated team of world-class scientists, engineers and Indigenous Knowledge Holders who are developing innovative and collaborative solutions for nuclear waste management.

Media contact

Carolyn Fell, NWMO Manager of Impact Assessment Communications, cfell@nwmo.ca

La SGDN sollicite des commentaires sur le plan canadien de gestion du combustible nucléaire irradié

Participez à une séance d'information ou à un webinaire, ou envoyez vos commentaires par courriel ou par la poste à la SGDN



La SGDN s'engage à mettre en place un plan sûr et responsable pour la gestion à long terme du combustible nucléaire irradié canadien. Alors que le projet passe à l'étape de la prise de décision réglementaire, votre avis est crucial.

IGNACE, ON, le 17 juill. 2025 /CNW/ - La Société de gestion des déchets nucléaires (SGDN) invite les résidents locaux et régionaux ainsi que ceux intéressés par le dépôt géologique en profondeur pour le combustible nucléaire irradié canadien à donner leur avis sur la Description initiale du projet. La participation du public à ces possibilités de concertation permettra de faire en sorte que le projet tienne compte des valeurs, des besoins et des préoccupations des personnes susceptibles d'être touchées.

La Nation ojibwée de Wabigoon Lake et le canton d'Ignace ont accepté de progresser vers la phase de décision réglementaire à titre de collectivités hôtes potentielles d'un dépôt géologique en profondeur où serait stocké le combustible nucléaire irradié canadien.

La Description initiale du projet est la première des nombreuses étapes du processus rigoureux d'autorisation d'une installation nucléaire, qui comprend la concertation avec les peuples autochtones et les résidents locaux et régionaux.

« Nous sommes ravis d'entamer la prochaine étape du plan canadien de gestion à long terme sûre du combustible nucléaire irradié, a déclaré Allan Webster, vice-président des approbations réglementaires à la SGDN. Ce processus de décision réglementaire exhaustif permettra au public de mieux comprendre la sûreté du dépôt ainsi que notre engagement à protéger la santé, la sûreté et la sécurité des gens et de l'environnement. »

Il y aura plusieurs façons de donner son avis, notamment en participant à des séances d'information, en s'inscrivant à un webinaire ou en soumettant des commentaires écrits.

Séances d'information à Ignace

Chaque séance comprendra une présentation de la Description initiale du projet, suivie d'une discussion dirigée.

- **Jeudi 24 juillet 2025,** de 17 h 30 à 19 h 30, au Centre En savoir plus, au 304, rue Main, Ignace
- **Vendredi 25 juillet 2025,** de 9 h 30 à 11 h 30, à l'Upper Curling Hall, au 200, rue Beaver, Ignace

Séances d'information à Dryden

Séance portes ouvertes

- **Mardi 12 août 2025,** de 15 h à 17 h, au Native Friendship Centre, au 74, rue Queen, Dryden

Présentation de la Description initiale du projet, suivie d'une discussion dirigée.

- **Mercredi 13 août 2025,** de 18 h à 20 h, au Dryden Regional Training and Cultural Centre, au 100, avenue Casimir, Dryden

Webinaires

Les webinaires sont ouverts à tous ceux qui s'intéressent au projet. Les mêmes informations seront communiquées lors des deux webinaires. Veuillez vous inscrire à l'heure qui vous convient en utilisant les liens ci-dessous.

- Mercredi 6 août 2025, à 10 h 30, HE
- Mercredi 6 août 2025, à 18 h, HE

Commentaires par écrit

À compter du jeudi 17 juillet 2025, un résumé de la Description initiale du projet sera publié à l'adresse nwmo.ca/planifionsensemble pour examen. Vous pouvez envoyer vos commentaires à l'adresse RegulatoryFeedback@nwmo.ca ou à partir de la page Communiquez avec nous du site Web de la SGDN. Les commentaires peuvent également être envoyés par la poste à l'adresse suivante :

SGDN — Commentaires sur le résumé de la DIP
22, avenue St. Clair Est, 4e étage
Toronto (ON) M4T 2S3

Les commentaires seront acceptés jusqu'au vendredi 22 août 2025.

La SGDN continue de privilégier la concertation auprès des Premières Nations dans la région du site proposé.

Qu'est-ce qu'une évaluation d'impact?

Au Canada, une évaluation d'impact vise à assurer que les projets sont planifiés de manière à protéger les gens et l'environnement. Cet outil a pour but d'examiner les effets positifs et négatifs que pourrait avoir un projet. Elle permet également de recueillir des informations auprès de différents groupes et experts afin de prendre les meilleures décisions possibles. L'objectif est de soutenir des projets qui sont sûrs pour l'environnement, respectueux des collectivités et bons pour l'avenir.

Protéger les gens et l'environnement est la priorité de la SGDN. Les résultats des analyses d'évaluation des impacts guideront la conception du projet, y compris les mesures qui seront prises pour réduire au

minimum ou compenser les effets potentiels. La surveillance continue et la concertation avec les collectivités dans le cadre de l'évaluation d'impact continueront de contribuer à faire en sorte que le projet soit sûr et protège la santé humaine, l'environnement et les droits des peuples autochtones.

Le plan canadien de dépôt géologique en profondeur est le résultat de décennies de recherche, de développement, d'alignement sur le savoir autochtone et de démonstration technologique et de technique.

Le dépôt géologique en profondeur est internationalement reconnu comme le moyen optimal de gérer le combustible nucléaire irradié. Des installations similaires à celle-ci ont été proposées, approuvées ou sont en cours de construction en Finlande, en Suède, en Suisse et en France.

La SGDN respectera la souveraineté de la Nation ojibwée de Wabigoon Lake et s'efforcera d'aligner ses travaux d'ordre réglementaire avec le Processus d'évaluation et d'approbation réglementaire (PEAR) de la Nation ojibwée de Wabigoon Lake. Ce dernier est un processus réglementaire souverain distinct, qui sera élaboré et mis en oeuvre par la Nation ojibwée de Wabigoon Lake. Il vise à assurer la protection et l'intendance des terres, de l'eau et de toute la création, dans le respect des systèmes de gouvernance traditionnels de la Nation ojibwée de Wabigoon Lake.

Restez en contact

La SGDN vous invite à vous abonner à son bulletin d'information, à l'envoyer vos questions à l'adresse RegulatoryFeedback@nwmo.ca ou à la suivre sur Facebook, Instagram, X ou LinkedIn.

À propos de la SGDN

Fondée en 2002, la Société de gestion des déchets nucléaires (SGDN) est une organisation à but non lucratif chargée d'assurer la gestion à long terme sûre des déchets radioactifs de moyenne et de haute activité canadiens, d'une manière qui protégera les gens et l'environnement pour les générations à venir.

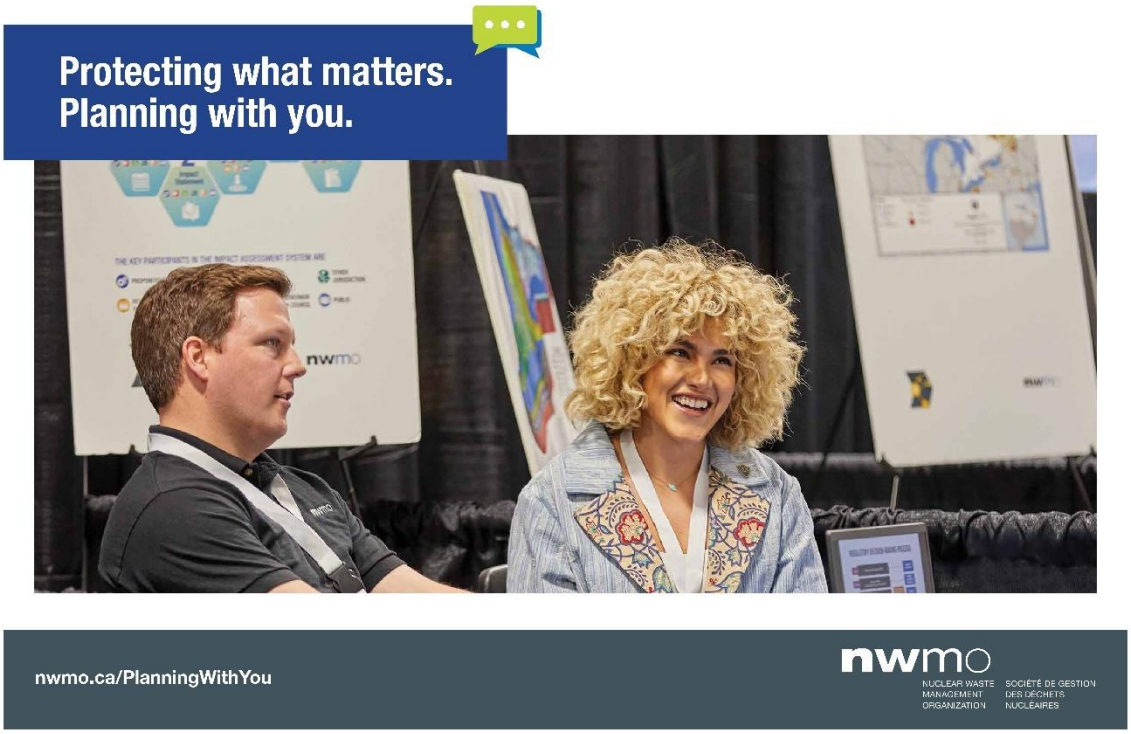
La SGDN est guidée depuis plus de 20 ans par une équipe dévouée de scientifiques et d'ingénieurs de calibre mondial ainsi que par des détenteurs du savoir autochtone, qui élaborent ensemble des solutions innovantes et collaboratives pour assurer la gestion des déchets nucléaires.

Personne-ressource pour les médias

Carolyn Fell, gestionnaire des communications sur l'évaluation d'impact à la SGDN, cfell@nwmo.ca

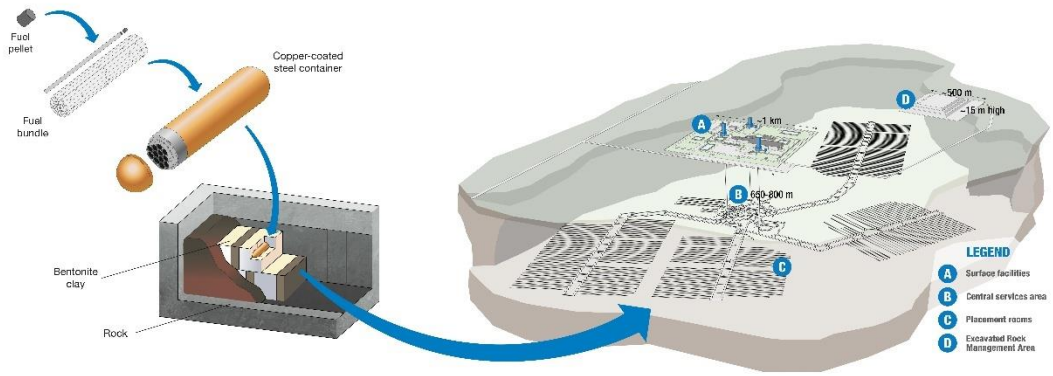
Wording to accompany social posts:

Platform	EN	FR
Facebook, Instagram, LinkedIn	The NWMO is inviting local and regional residents, and those interested in the plan to build a deep geological repository for used nuclear fuel, to provide input in the early stages of the regulatory decision-making process. Engaging in feedback opportunities ensures that the project reflects the values, needs and concerns of people it may affect.	La SGDN invite les résidents locaux et régionaux, ainsi que ceux intéressés par le projet de dépôt géologique en profondeur pour le combustible nucléaire irradié, à donner leur avis dès les premières étapes du processus de décision réglementaire. La participation du public à ces possibilités de concertation permettra de faire en sorte que le projet tienne compte des valeurs, des besoins et des préoccupations des personnes susceptibles d'être touchées.
X	The NWMO is inviting local and regional residents, and those interested in the plan to build a deep geological repository for used nuclear fuel, to provide input in the early stages of the regulatory decision-making process.	La SGDN invite les résidents locaux et régionaux, ainsi que ceux intéressés par le projet de dépôt géologique en profondeur pour le combustible nucléaire irradié, à donner leur avis dès les premières étapes du processus de décision réglementaire.



Welcome

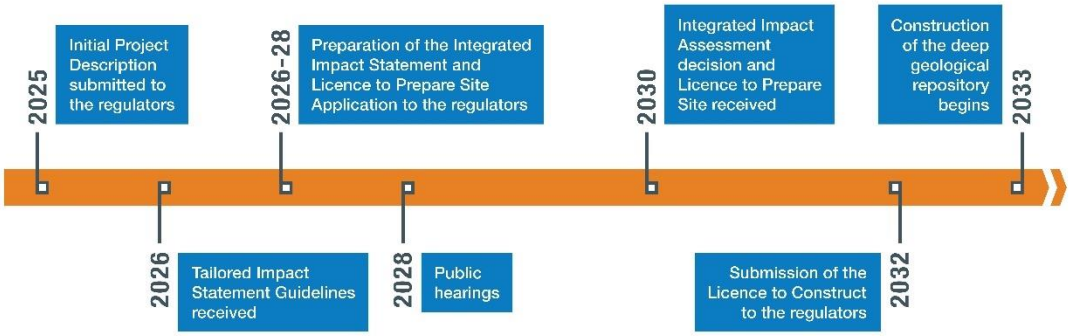
The Nuclear Waste Management Organization (NWMO) is a not-for-profit organization tasked with the safe, long-term management of Canada's used nuclear fuel, in a manner that protects people and the environment for generations to come. The plan is to contain and isolate the used fuel in a deep geological repository using a multiple-barrier system.



nwmo.ca/PlanningWithYou
nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Regulatory decision-making process

The Project will undergo a thorough impact assessment process, co-ordinated by the Impact Assessment Agency of Canada and integrated with the initial licence application to the Canadian Nuclear Safety Commission.



nwmo.ca/PlanningWithYou

nwmo NUCLEAR WASTE MANAGEMENT ORGANIZATION SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

A safe approach

Rigorous safety standards will govern the Project. The NWMO is committed to meeting all applicable federal and provincial regulatory requirements to protect the health, safety and security of people and the environment for generations to come.

nwmo.ca/PlanningWithYou

nwmo NUCLEAR WASTE MANAGEMENT ORGANIZATION SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Sustained dialogue, participation and collaboration

Engagement and relationship building with Indigenous communities, the public and interested parties will remain at the heart of this Project.

nwmo.ca/PlanningWithYou

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Have your say

nwmo.ca/PlanningWithYou

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Your voice matters

SHAPE THE FUTURE OF CANADA'S PLAN FOR USED NUCLEAR FUEL

The Nuclear Waste Management Organization is committed to a safe and responsible plan for the long-term management of Canada's used nuclear fuel. As the Project moves into the regulatory decision-making stage, your input is crucial. We want to hear your thoughts, ideas and concerns.

Ways to provide input

- Information sessions
- Webinars
- Written feedback

Listening to all voices will help ensure the Project respects local needs, protects the environment and supports strong communities.

Learn more: nwmo.ca/PlanningWithYou

@nwmocanada /company/nwmocanada nwmo.ca

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Your voice matters

SHAPE THE FUTURE OF CANADA'S PLAN FOR USED NUCLEAR FUEL

Participate in an information session or webinar, drop by the Ignace Learn More Centre, or email or mail us your comments.

The Nuclear Waste Management Organization (NWMO) is committed to a safe and responsible plan for the long-term management of Canada's used nuclear fuel. Wabigoon Lake Ojibway Nation and the Township of Ignace agreed to move into the regulatory decision-making phase as potential host communities for a deep geological repository for Canada's used nuclear fuel.

Now, as the Project moves into the regulatory decision-making stage, your input is crucial. We want to hear your thoughts, ideas and concerns. The first step is for the NWMO to draft and submit an Initial Project Description (IPD) that explains why a company wants to do a project and what it hopes to achieve. It helps people understand the reason behind the project, who it is meant to benefit and how a company is assessing the impact of the project.

There are several ways that people can provide input, including dropping by the Ignace Learn More Centre, participating in an information session or webinar, or sending written feedback.

Why engage with the Initial Project Description process?
The Initial Project Description is the first of many steps in the rigorous licensing process for nuclear facilities. At the impact assessment phase of the regulatory process, the NWMO, the Impact Assessment Agency of Canada (IAAC) and the Canadian Nuclear Safety Commission (CNSC) must engage with Indigenous Peoples and local and regional residents. This ensures that the Project reflects the values, needs and concerns of people it may affect. It helps build trust, improve decisions and create solutions that are fair, respectful and sustainable for everyone.

What is a deep geological repository?
Canada's deep geological repository for used nuclear fuel will use a multiple-barrier system designed to safely contain and isolate the used fuel over the very long term. Built to a depth of 650-800 metres, the repository will consist of a network of underground tunnels and placement rooms that will store the used nuclear fuel. A deep geological repository is internationally accepted as the preferred method to manage used nuclear fuel over the very long term, with similar projects proposed, approved or under construction in Finland, Sweden, Switzerland and France.

For more information about the Project, the regulatory process and upcoming engagement opportunities, visit our website at nwmo.ca/PlanningWithYou.

@nwmocanada /company/nwmocanada nwmo.ca

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

WAYS TO PROVIDE INPUT

Ignace information sessions
Each session will have a presentation about the Initial Project Description, followed by a moderated discussion.

- Thursday, July 24, 2025, from 5:30 p.m. to 7:30 p.m. at the Learn More Centre, 304 Main Street, Ignace
- Friday, July 25, 2025, from 9:30 a.m. to 11:30 a.m. at the Upper Curling Hall, 200 Beaver Street, Ignace

Dryden information sessions
Drop-in session

- Tuesday, Aug. 12, 2025, from 3 p.m. to 5 p.m. at the Native Friendship Centre, 74 Queen Street, Dryden

Presentation about the Initial Project Description, followed by a moderated discussion.

- Wednesday, Aug. 13, 2025, from 6 p.m. to 8 p.m. at the Dryden Regional Training and Cultural Centre, 100 Casimir Avenue, Dryden

Webinars
Webinars are open to all who are interested in the Project. The same information will be shared at both webinars. You can register at nwmo.ca/PlanningWithYou.

- Wednesday, Aug. 6, 2025, at 10:30 a.m. ET
- Wednesday, Aug. 6, 2025, at 6 p.m. ET

Written feedback
Beginning on Thursday, July 17, 2025, a summary of the Initial Project Description will be posted at nwmo.ca/PlanningWithYou for review. You can submit comments to RegulatoryFeedback@nwmo.ca or nwmo.ca/contact-us on our website. Comments will also be accepted by mail addressed to:

NWMO — IPD summary feedback
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3

Comments are accepted until Friday, Aug. 22, 2025.

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

CANADIAN NUCLEAR SAFETY COMMISSION

The Canadian Nuclear Safety Commission (CNSC) is Canada's nuclear regulator, responsible for the regulation of all stages of the long-term management of radioactive waste. This includes everything from site preparation to construction and operation to decommissioning (closure and post-closure).

The CNSC regulates the safe use of nuclear energy and materials to protect health, safety, security and the environment; ensures Canada follows its promises to use nuclear energy peacefully; and stands to provide clear information to the public about nuclear science, technology and regulations.

WHAT LICENCES ARE REQUIRED FOR A DEEP GEOLOGICAL REPOSITORY?

The NWMO is required to complete a multi-phase licensing process as per regulations under the *Nuclear Safety and Control Act*. At each phase (which can be applied for sequentially or at the same time), the NWMO will collect and consider information gathered from Indigenous and public engagement. This includes Indigenous Knowledge and historical and current land use by members of First Nations, communities and the public.

1. **Licence to Prepare Site** — Before issuing an initial licence to prepare the site, the CNSC assesses whether the site can safely contain and isolate radioactive waste over the long term. This phase begins during the integrated assessment.
2. **Licence to Construct** — The CNSC has a number of requirements for all activities related to design, procurement, manufacturing, construction and commissioning.
3. **Licence to Operate** — A licence to operate would allow the NWMO to complete final commissioning activities and to operate the deep geological repository. Commissioning activities ensure that the facility has been properly designed and constructed and is ready for safe operation.
4. **Licence to Decommission** — Decommissioning plans include post-closure licensing, monitoring, surveillance and maintenance, including ensuring adequate financing for these activities.

1

CANADIAN NUCLEAR SAFETY COMMISSION

WHAT SAFETY AND ENVIRONMENTAL PROTECTION ARE OFFERED BY THE CANADIAN NUCLEAR SAFETY COMMISSION?

Safety and environmental protection are central to the mission of the CNSC. Its regulations ensure that these factors are considered at every phase of the facility's lifecycle, from the initial licence application to decommissioning. Key principles include ensuring that protective measures are right for the level of risk involved, account for scientific uncertainty, and follow best practices like the precautionary principle and sustainable development. Performance is measured against science-based targets.

HOW IMPORTANT IS NUCLEAR SECURITY TO THE CANADIAN NUCLEAR SAFETY COMMISSION?

The CNSC enforces Canada's *Nuclear Security Regulations* under the *Nuclear Safety and Control Act*. It works with facility operators, law enforcement, intelligence agencies and the International Atomic Energy Agency to ensure nuclear materials and facilities are secure. As part of the licensing process, the NWMO is required to meet the requirements of the *Nuclear Security Regulations* and licence-specific conditions through ongoing compliance.

Nuclear Waste Management Organization
Email: RegulatoryFeedback@nwmo.ca
© 2025 Nuclear Waste Management Organization
@nwmocanada
/company/nwmocanada
nwmo.ca/PlanningWithYou

CONFIDENTIAL – DRAFT for internal use only

Initial Project Description: Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project
January 2025

For more information, please contact:

Nuclear Waste Management Organization
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3, Canada
Tel.: 416.934.9814 Toll free: 1.866.249.6966
Email: contactus@nwmo.ca
Website: nwmo.ca

@nwmocanada
/company/nwmocanada

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

© 2025 Nuclear Waste Management Organization

What We Heard - IPD Engagement Reports

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

NWMO-TMP-05000-0001 R000

What We Heard - IPD Engagement Report: Ignace Information Session - July 24, 2025

1. Introduction

This event was held at the NWMO "Learn More Centre" in Ignace and was open to the public. The NWMO gave a presentation followed by a Question (Q) & Answer (A) session while Mokwateh facilitated the event and discussion. The primary purpose of this engagement was to provide community members with a clear overview of the Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project ("the Project"), the upcoming regulatory process, and the Initial Project Description (IPD), helping NWMO refine the draft IPD by gathering valuable feedback on potential impacts and issues.

This session also reviewed a summary of priorities and concerns shared through previous engagement activities, provided information about baseline studies, and included a facilitated Q&A discussion to support transparency, learning, and two-way dialogue. Attendees could provide written feedback through Post-It notes on posterboards distributed throughout the room, and by answering questions on the interactive Mentimeter survey platform during the presentation.

2. Engagement Process

Notifications

NWMO's communications campaign effectively raised awareness of engagement activities, with over 2.2 million impressions throughout Ignace, Dryden, and the surrounding areas over 23 days (*note*: "Impressions" are a standard measurement in communications. They indicate the combined reach of the advertising, social and household campaign).

Communication objectives were two-fold:

1. Raise awareness about upcoming collaboration activities by the NWMO to inform the IPD.
2. Drive participation in the IPD community collaboration activities.

Communication methods included the following:

- Media briefing with five journalists covering news outlets with operations covering northwestern Ontario
- Household mailer to 5,500 households in Ignace, Dryden and the surrounding area
- 70 posters in Ignace, Dryden and surrounding areas
- Digital display ad campaign in the region, reaching each person an average of 10.8 times in the campaign window
- Supporting social media posts on Facebook, Instagram, LinkedIn and X (i.e. the platform formerly known as Twitter)
- Paid Facebook advertisements ran for five days in advance of the Dryden information sessions

Event Information & Attendance

Event	IPD Engagement Event – Ignace Information Session
Date	July 24, 2025
Time	5:30 – 7:30 PM CDT
Community	Ignace, Ontario
Location	NWMO Learn More Center
Number of Attendees	12

3. Summary of Issues and Areas of Interest

The session was well received, with attendees demonstrating a high level of respect and engagement, asking thoughtful and informed questions that reflected a strong interest in the Project's details and potential impacts.

Much of the discussion focused on the **siting plan for the accommodation camp**, with several community members expressing the view that moving it closer to Ignace could bring additional benefits to local businesses and the broader community.

There were also detailed conversations about the scale and nature of the **economic development** that would result from the construction and operation of the DGR, with some participants expressing uncertainty about the long-term benefits without proper planning. **Environmental concerns** were another focus, regarding the surrounding lakes and the preservation of wildlife habitats, particularly swan populations.

Issue	NWMO Response
Accommodation Camp Siting	
Participants asked for clarification on whether the site shown on the map is the final chosen location and whether it is necessary to place the accommodation camp on the Project site. They referenced past industry examples, such as the Mattabi Mines, suggesting that accommodation should be located in Ignace to promote economic development for the Township. Questions also arose about how decisions would be made if the regulators disagreed on the accommodation location.	The current site layout is draft and may change based on assessment of alternatives considered during the environmental impact assessment. Accommodation camps on-site are typical but not mandatory, and feedback on alternative locations is welcome. As for how the regulators will make decisions, this is an Integrated Impact Assessment. This means that IAAC and CNSC must work together throughout the process.
Socioeconomic Impacts	

Issue	NWMO Response
Participants were interested in understanding the potential social and economic impacts of the Project, both before and after construction begins. Some pointed out current challenges such as the lack of available seniors housing and the need for a new fire hall. Participants were curious to know how socioeconomic impacts would be mitigated.	Economic growth opportunities will exist throughout the regulatory process and Project phases, with activities varying at each stage. Assessments will be conducted at multiple scales, including local and regional levels. NWMO will work collaboratively with the Township to implement the Hosting Agreement, where commitments include investments in training, education and skills development. NWMO is studying not only the immediate site but also the broader surrounding region. Spatial and temporal boundaries have been defined to better understand socioeconomic effects and guide mitigation planning.
Economic and Business Opportunities	
Questions focused on opportunities for economic growth prior to the site being built, how the regulator would address and enforce socioeconomic impacts, and predictions for future growth, including less tangible social outcomes such as community well-being and quality of life. Participants noted the desire for ongoing information sharing between residents and the Township.	NWMO uses methods to predict population growth and key social indicators. NWMO plans to collaborate closely with the community to understand their needs and preferences, providing projections on a per-phase basis to offer clearer insights. Questions regarding the Township's process should be directed to the Township.
Initial Project Description Process	
Participants expressed interest in the IPD process and timeline, seeking assurance that the document would be accessible to the public once it is submitted. They also inquired about whether the planned submission date of Fall 2025 is still on track, reflecting a desire for transparency, timely updates, and clear communication regarding key Project milestones.	The IPD will be posted on the Impact Assessment Agency of Canada (IAAC) registry, where the public can submit comments. Comments can also be submitted by letter and/or email at RegulatoryFeedback@nwmo.ca. The Project remains on schedule for the planned submission.
Environment (Upland Veg/Wetlands/Local Wildlife)	
There were a few conversations about the potential effects of the Project on the environment, focused on how increased swan populations in nearby lakes such as Lowery Lake, Church Lake, and Long Lake	The potential effects on terrestrial environments, including vegetation, wetlands, and wildlife, will be studied as part of the environmental portion of the Impact Assessment.

Issue	NWMO Response
might be impacted. The questions reflected an interest in understanding how local species and wildlife habitats will be monitored and protected.	
Project Phases	
Participants wanted clarity on the Project phases, particularly regarding how much site work could be undertaken before the necessary licence is obtained. This reflected an interest in understanding the regulatory process and Project activity sequencing.	Activities relating to borehole drilling and baseline environmental studies will continue. No site preparation, construction, or development activities will take place prior to receiving the license from the CNSC.
Aquatic Environment (Fish and Fish Habitat)	
One participant was interested in potential impacts to the aquatic environment, specifically asking whether acid rock leachate could pose a risk of draining into Mennin Lake. This reflected broader concerns about protecting fish, fish habitat, and overall water quality in the area.	The potential effects on the aquatic environment, including potential acid rock drainage will be studied as part of the environmental impact assessment. Studies on local rock cores have found no evidence of acid generation or leachate production from the rock to date
Government Policy	
A participant inquired about the implications of Bill C-5 (*One Canadian Economy: An Act to enact the Free Trade and Labour Mobility in Canada Act and the Building Canada Act,* enacted on June 26, 2025*)* on the Project, seeking to understand how this government policy might influence the regulatory process, Project timeline, or overall outcomes.	Bill C-5 is new legislation, and the implications are still unclear. NWMO has not applied to be identified as a project under this legislation nor has the government itself identified the NWMO Project as being identified under this new legislation. NWMO will actively monitor its implementation.
Impact Assessment Methods	
Participants raised questions about the Impact Assessment methods, expressing concern that many studies focus on measurable data but may not fully capture community perceptions and concerns. They wanted to better understand how the assessment process will address and incorporate these less tangible, perception-based impacts alongside factual data.	The influence of consultation/engagement will be considered as part of the Impact Statement process. When it comes to perceived impacts from a project, some possible mitigations could include educational campaigns and ongoing dialogue with the community to address both measurable impacts and perceptions. These programs will be looked at during the assessment process.

Issue	NWMO Response
Regulatory Process	
Participants asked whether anyone could present at the IAAC and Canadian Nuclear Safety Commission (CNSC) hearings or if certain qualifications are needed. They also wanted to know if there is a public website where people can submit comments during the regulatory process. Additionally, they requested examples of the kinds of positive and negative potential impacts of the Project that may be included in the Impact Assessment.	Anyone is welcome to present at the hearings by submitting a letter requesting to speak and what they plan to discuss. The public can also comment via IAAC's registry or through NWMO's regulatory email address. An example of a positive benefit would be increased economic activity, while potential negative impacts may include things like restrictions to hunting within the Project site area (i.e., about the size of the Dryden airport).
Transportation	
There was interest in the types of roads being considered for transportation. They noted that rail transportation was not mentioned in the presentation or included in the Impact Assessment process and wanted clarification on whether it will be considered.	The transportation of used nuclear fuel is a highly regulated process which must follow specific regulatory requirements. Used fuel must be transported in certified packages designed to withstand severe accident conditions without breach. A unique license to transport issued by the regulator is required for each shipment. Real-time tracking, security escorts, a transportation security plan, driver training, and emergency preparedness are also required by regulation. For security reasons, regulatory requirements dictate that the transport routes be kept confidential. A truck carrying used fuel is roughly the same size and weight as a logging truck, well within the existing design capacity of the highway. During operations, the NWMO anticipates two to three used fuel shipments arriving at the repository site per day, six days per week, nine months per year. This represents a fraction of a per cent increase in traffic volumes on the TransCanada Highway. The one to three months of transportation downtime allows accommodation for weather conditions, and other road closures.
Safety	

Issue	NWMO Response
There was a request for information on contingency plans for potential leaks or contamination during the operation phase of the Project. They emphasized the importance of protecting nearby lakes and water sources.	Robust environmental and effluent monitoring programs are required by regulatory bodies, with reassessments every five years through the CNSC. These programs help ensure that any contamination risks remain well below dangerous levels.

4. General Comments/Notes

The NWMO received live feedback during the presentation, using a series of survey questions on the Mentimeter platform. The questions and responses are summarized below; the numbers in brackets indicate the number of respondents who selected that option.

1. **What are your goals or hopes for today's event? (Select all that apply)**
    - To better understand the regulatory process and next steps (8)
    - To have good discussions with NWMO staff and other community members (2)
    - To share my feedback, priorities and concerns (2)
    - To learn more about the Project, in general (1)

2. **What else would you like to know about the regulatory process?**
    - What contingency plans are in place for potential breaches of the facility, and how will the intermediate grade waste be stored and transported to limit exposure?
    - With such a broad timeline, would there be opportunities for economic growth and new careers for Ignace residents before construction? How can the early stages benefit locals economically?

Note: The NWMO has noted these questions and will be using them towards future engagement sessions in the Impact Statement process.

3. **What is your level of agreement with the following statements: The What We Heard Summary (in the presentation deck) does a good job of representing the priorities and concerns that matter to me, at a high level (Rank 1 to 5)**
    - Average Ranking = 4.0

4. **What is your level of agreement with the following statements: The feedback I previously shared is mostly reflected in the key themes presented in the deck (1 to 5):**
    - Average Ranking = 4.14

5. **What is your level of agreement with the following statements: I have additional ideas, concerns, or issues to add to these themes (1 to 5):**
    - Average Ranking = 4.0

6. **What other studies on the impacts of the Project would you be interested in?**
    - Is there going to be run-off from the rock pile?
    - Will there be a study of the effect on the swan population in the nearby lakes?

- What will the direction and length be of the tunnels?

Note: The NWMO answered the first two questions during the session; and has recorded the last question to inform future engagement sessions.

Comments from Feedback Board (Post-it Notes)

1. Need enhanced and more frequent communications from the Township with the community.
2. Request for details on the Centre of Expertise (location, timing, and purpose).
3. Interest in other community priorities, such as seniors housing and an expanded community fire hall.

Appendices

The communication materials and notification are included separately in the appendix to the Consolidated Report.

Ignace Information Session: IPD Engagement Presentation Deck (July 24, 2025)

Today's Presentation

What We'll Cover

1. Deep Geological Repository Project Overview
2. Regulatory Process & Initial Project Description
3. What We've Heard
4. Baseline Studies
5. Facilitated Question & Answer Discussion

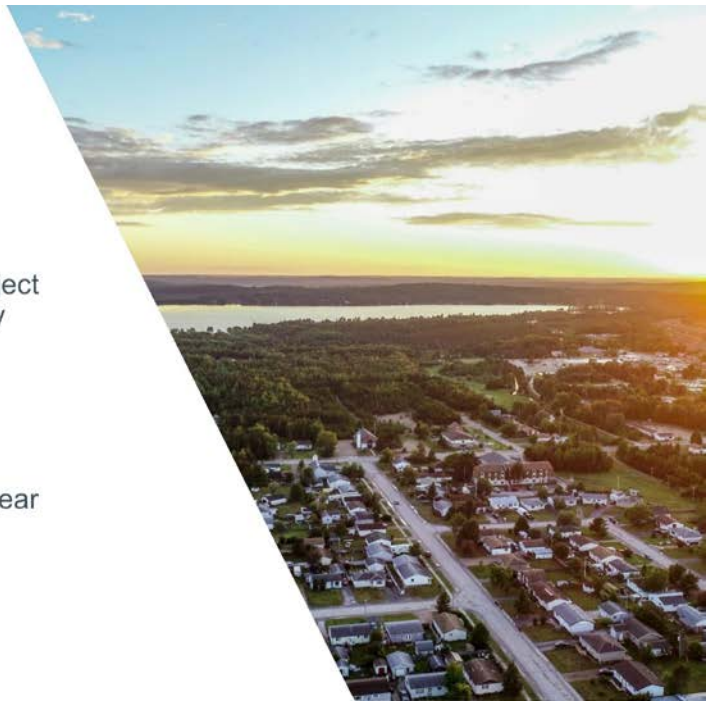
3

Today's Presentation

Goals

- To share information about the project and the next steps in the regulatory process
- Review what we've heard from engagement so far
- Gather feedback and continue to hear about key issues and impacts

4



Mentimeter Instructions

Instructions

Go to

www.menti.com

Enter the code

4616 8833

Or use QR code

nwmo

5

Join at menti.com | use code 4616 8833

Mentimeter

What are your goals or hopes for today's event?

0	0	0	0
To learn more about the project, in general	To better understand the regulatory process and next steps	To share my feedback, priorities and concerns	To have good discussions with NWMO staff and other community members

nwmo

6

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project – Initial Project Description

July 24, 2025

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Land Acknowledgement

8

About the Deep Geological Repository (DGR) Project

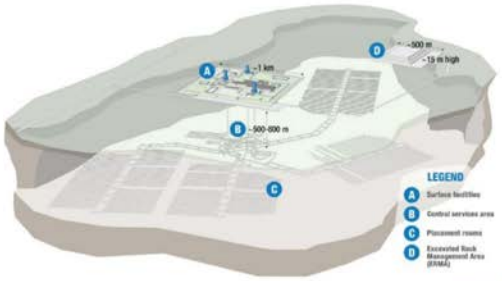
nwmo

NWMO's Proposed Deep Geological Repository (DGR) Project

- **Project Purpose:**
  - Safely contain and isolate **used nuclear fuel**
  - Manage up to **5.9 million used CANDU fuel bundles**

- **Project Name:** Deep Geological Repository for Canada's Used Nuclear Fuel

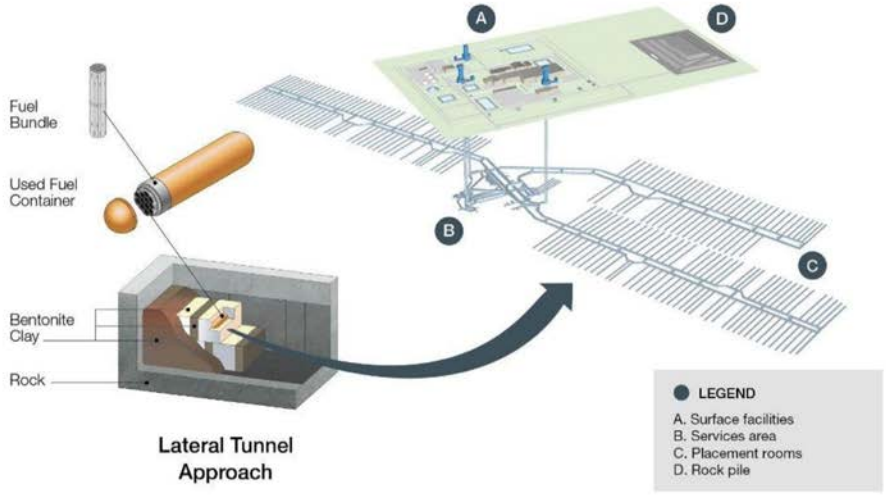
- **Host Communities**:
  - Wabigoon Lake Ojibway Nation (WLON)
  - Township of Ignace



nwmo

10

Deep Geological Repository (DGR) Concept



Lateral Tunnel Approach

11

nwmo

NWMO Site Selection Process for Canada's Used Fuel DGR Project

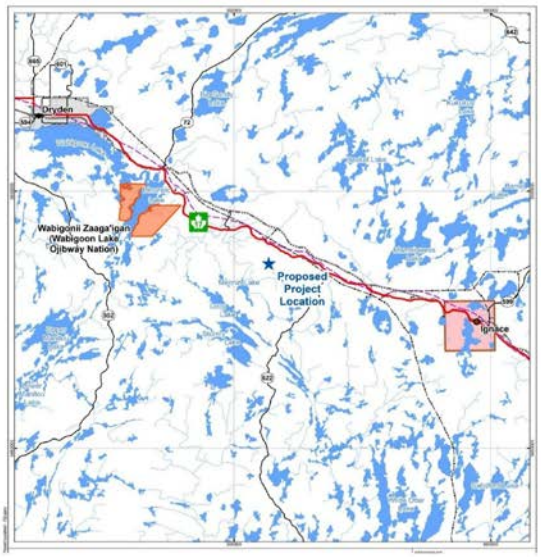
- Safety, transparency, and community engagement
- Evidence-based assessments
- Informed and willing hosts
- Fostering confidence

- Timeline & outcome:
  - **2010**: 22 communities volunteered into the process
  - **2024**: Wabigoon Lake Ojibway Nation (WLON) and the Township of Ignace selected
- The NWMO may now proceed to detailed site characterization and licensing

12

nwmo

Project Location



- Situated within Wabigoon Lake Ojibway Nation territory.

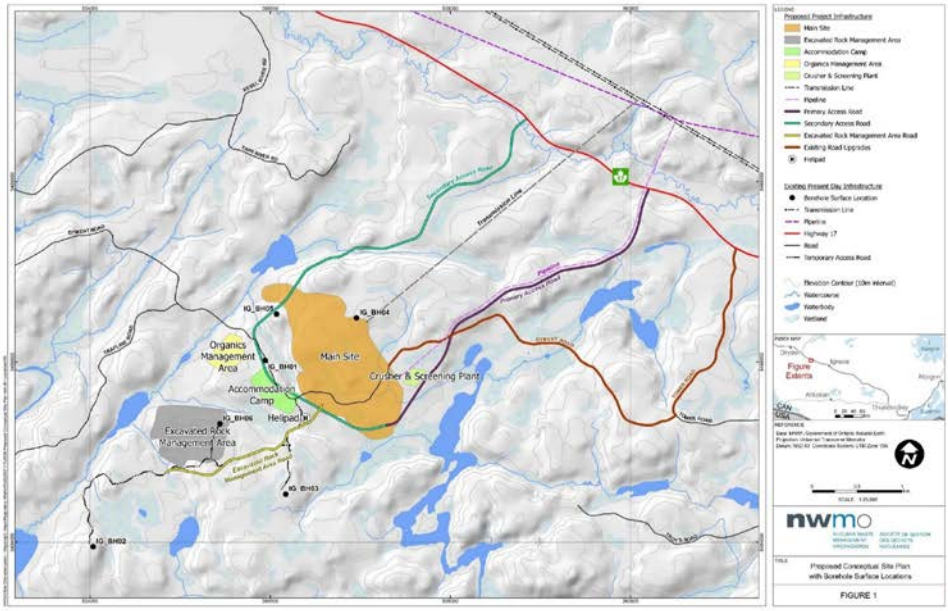
Proposed Site Location:

- ~21 km southeast of WLON Band #157 (approx. 12 km from the nearest WLON resident in Dyment)
- ~43 km northwest of Ignace, Ontario
- Located along Highway 17

nwmo

13

DRAFT Conceptual Site Plan – Surface Facilities



nwmo

14

Project Phases & Planning Timelines

- The implementation of Canada's plan via the DGR Project will span approximately 160 years.
- The Project will operate for approximately 50 years.
- The deep geological repository will be monitored for an extended period before decommissioning, closure and post-closure monitoring.

15

ASSUMED PROJECT PHASES AND PLANNING TIMELINES

Project phase	Approximate timeline (years)	Phase duration (years)
Site Preparation and Construction	2030-42	13
Operations	2043-92	50
Extended Monitoring, Decommissioning and Closure	2093-2192	100
Institutional Control[1]	2193+	

[1] The control of any risks at a site after decommissioning and closure, including activity like surveillance, maintenance or signs/markers.

Key Project Activities Across Project Phases

Site Preparation

- Clearing, grading and levelling the site
- Building shaft complexes and demonstration facility
- Developing non-nuclear infrastructure (ex. utilities, fencing, admin building, road)

16

nwmo

Benefits of the Used Fuel DGR Project

Long-term Project Benefits

(160-year timeline)

- WLON and the Township of Ignace: outlined in signed Hosting Agreements
- Other nearby communities: likely to benefit from improved infrastructure, skills training, and business opportunities
- Canada: safe long-term management of used nuclear fuel

nwmo

About the Regulatory Process & Initial Project Description (IPD)

nwmo

A Site Has Been Selected – Now What?

- The Project will now prepare to enter the Regulatory Decision-Making stage.
- This means entering an **Impact Assessment** (IA) by the federal government.
- IAs are led by the **Impact Assessment Agency of Canada** (IAAC).
- This IA will be integrated with nuclear licensing and therefore include the **Canadian Nuclear Safety Commission** (CNSC).

19

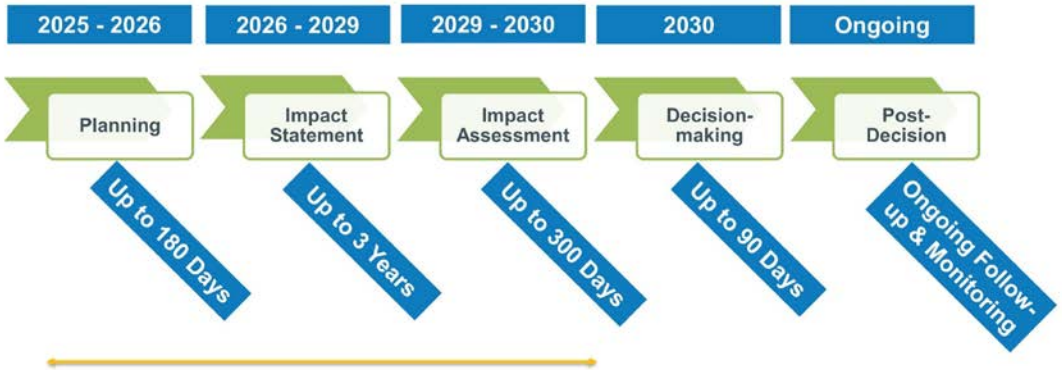
nwmo

Regulatory Oversight of the Project

20

nwmo

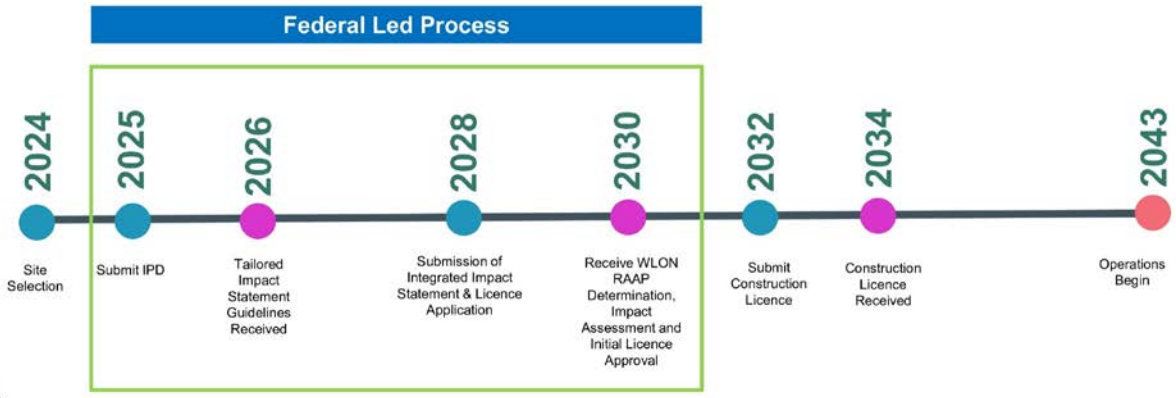
Steps in the Federal Led Impact Assessment Process



21

nwmo

NWMO Regulatory Milestones & Timelines



22

nwmo

Initial Project Description

- Submitted by the Project proponent (NWMO) to the IAAC
- Explains what the project is, where it is, and what it might affect
- Documents potential community concerns and areas where more study will be completed
- Includes plans for future regulatory engagement including communications and participation
- Guides IAAC development of the Tailored Impact Statement Guidelines specific for the Project
- **Formally starts the regulatory process when posted to IAAC's website**.

23

nwmo

Join at menti.com | use code 4616 8833

Mentimeter

What else would you like to know about the regulatory process?

All responses to your question will be shown here

Each response can be up to 200 characters long

Turn on voting to let participants vote for their favorites

24

nwmo

What We've Heard To-Date

nwmo

Public and Interested Parties Engagement

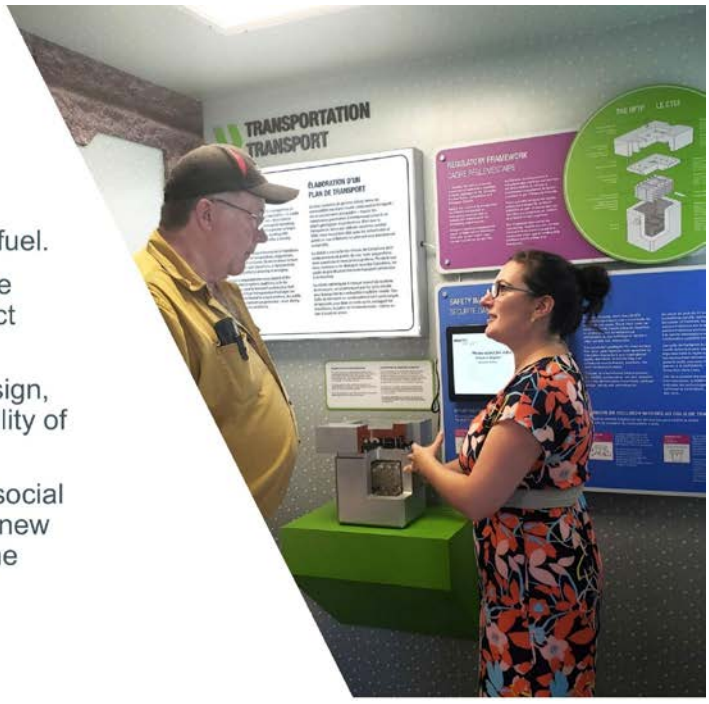
- We continue to engage extensively with the public and interested parties, including:
  - municipalities
  - businesses
  - service providers
  - environmental organizations
- In the IPD, we summarize What We've Heard for key themes and concerns during this engagement to date.
- You can help us by reviewing and providing feedback on these themes.

26

Protection of Human Health and Safety

- Concerns about radioactivity, and potential contamination from used fuel.
- Safety apprehensions regarding the long-term management, and Project execution.
- Concerns about surface facility design, monitoring systems, and the reliability of storage methods.
- Impact on the regional health and social service systems to prepare for the new families the project will bring into the area.

27



Protection of the Natural Environment

- Design of water management systems.
- Isolation of used fuel and protection of the environment.
- Environmental impacts on water, land, and wildlife from noise pollution and traffic.
- Vulnerability to natural disasters and extreme events.
- Energy and water footprints.
- Suitability of rock type to host a repository

28

Social Conditions and Community Infrastructure

- Housing shortage and increased demand for other infrastructure and services;
- Local benefits, infrastructure, and job creation;
- Youth challenges, opportunities and retention;
- Education and training for community readiness;
- Population growth/fluctuation impacts on resources, services and social conditions.

29

Economic Conditions

- Economic development, urban revitalization and risks and opportunities for local businesses; and
- New business opportunities and employment after site selection.

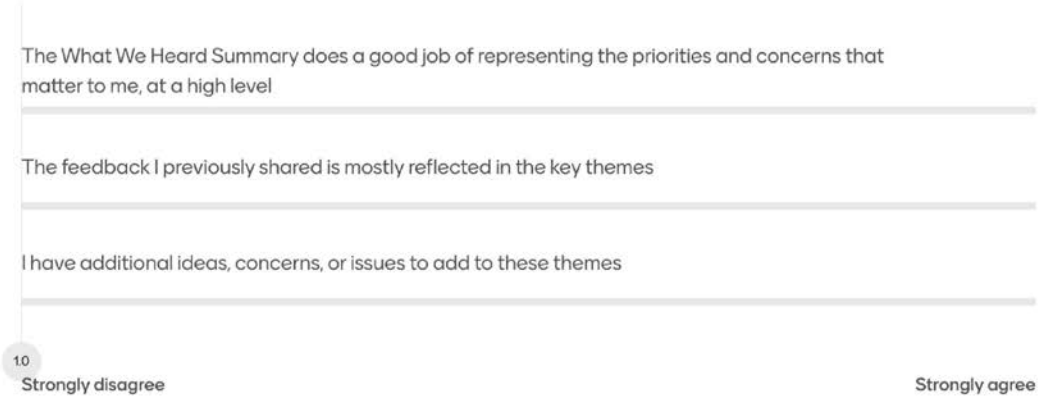
nwmo

30

Join at menti.com | use code 4616 8833

Mentimeter

What is your level of agreement with the following statements:



31

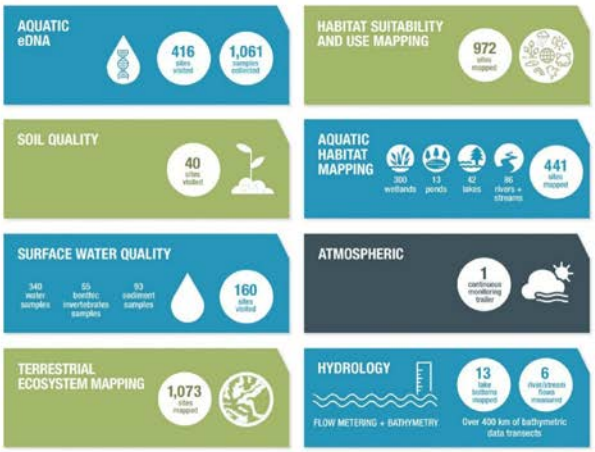
nwmo

Understanding Baseline Information

nwmo

Project Highlights: Baseline Environment

- Baseline environment data is collected and used in assessment and design planning before approval can be given.
- NWMO has studied the regional geology of the site since 2010.
- Environmental studies in the area have been ongoing since 2014.
- Working with community, data collection will continue throughout the impact assessment and regulatory process.



This figure presents some of the baseline information gathered about the proposed Project site.

33

Project Highlights: Baseline Socioeconomic and Health

Socio-economic reporting is required every three years under the *Nuclear Fuel Waste Act* and includes potential impacts on various components, including:

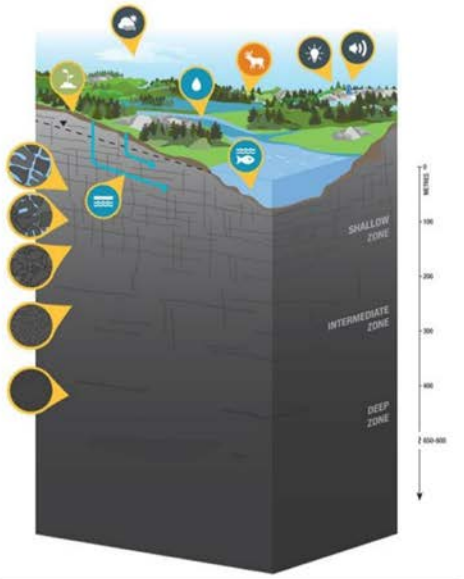
- Community way of life
- Social aspirations
- Cultural aspirations
- Economic aspirations

Under the Impact Assessment process, the NWMO is also required to assess social, economic, health, and Indigenous Rights impacts.

34

How Baseline Information is Used in the Regulatory Process

- Baseline studies collect data on environmental and social conditions before a project begins
- Baseline data creates a reference point to assess future changes and impacts on people and the environment and identify ways to avoid, reduce or manage them
- Baseline study data are used to inform design
- The IPD summarizes baseline data collected to-date and uses it to complete a preliminary screening assessment of potential project impacts and propose potential mitigation



35

Project Activities with Potential Impacts on Environmental, Socioeconomic or Health Components

- Land clearing and grubbing
- Blasting and excavation
- Site security and access management
- Development and operations of surface facilities, the DGR, worker accommodation camp, the Excavated Rock Management Area (ERMA)
- Materials handling
- Vehicle traffic
- Site water management

36

How are Effects Assessed?

- Identify an environmental, socioeconomic or health component
- How does that component interact with the Project, through what pathways?
- What mitigations can we implement to minimize the effect?
- Is there still an effect after the mitigation is applied?
- Follow-up monitoring

nwmo

Join at menti.com | use code 4616 8833

Mentimeter

Which elements of NWMO's data collection approach are most important to you?

0	0	0	0	0
Working with communities to verify existing data	Including Indigenous Knowledge in baseline studies	Community-specific land use and cultural studies	Transparency and access to reports	Opportunities to shape future data collection

38

nwmo

Wrap-up

nwmo

The Journey Continues

- We intend to submit the IPD in Fall 2025, which will formally kickstart the regulatory process.
- Review the summary IPD – copies provided today, or scan QR code in handouts.
- Share your feedback on the key themes and concerns shared through engagement to date
  - What would you add?
  - What are your values and priorities?
  - What questions are on your mind?

40

What to Expect Next?

- After IPD is posted on the IAAC registry, engagement from the regulators will begin
- Community members can provide comments online or at IAAC / CNSC events
- IAAC will provide NWMO with a Summary of Issues which NWMO responds to
- IAAC / CNSC create draft Tailored Impact Statement Guidelines (TISGs)
- IAAC / CNSC engage on TISGs in community
- IAAC posts the guidelines

41

nwmo

Q&A Opportunity

42

nwmo

Thank you.

@nwmocanada / @LaSGDN

/company/nwmocanada

www.nwmo.ca

What We Heard - IPD Engagement Report: Ignace Information Session - July 25, 2025

1. Introduction

This event was held at the Upper Curling Hall in Ignace and was open to the public. The NWMO gave a presentation followed by a Question (Q) & Answer (A) session, while Mokwateh facilitated the event and discussion. The primary purpose of this engagement was to provide community members with a clear overview of the Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project ("the Project"), the upcoming regulatory process, and the Initial Project Description (IPD), helping NWMO refine the draft IPD by gathering valuable feedback on potential impacts and issues.

This session also reviewed a summary of priorities and concerns shared through previous engagement activities, provided information about baseline studies, and included a facilitated Q&A discussion to support transparency, learning, and two-way dialogue. Attendees could provide written feedback through Post-It notes on posterboards distributed throughout room, and by answering questions on the interactive Mentimeter survey platform during the presentation.

2. Engagement Process

NWMO's communications campaign effectively raised awareness of engagement activities, with over 2.2 million impressions throughout Ignace, Dryden, and the surrounding areas over 23 days (note: "Impressions" are a standard measurement in communications. They indicate the combined reach of the advertising, social and household campaign).

Communication objectives were two-fold:

1. Raise awareness about upcoming collaboration activities by the NWMO to inform the IPD.
2. Drive participation in the IPD community collaboration activities.

Communication methods included the following:

- Media briefing with five journalists covering news outlets with operations covering northwestern Ontario
- Household mailer to 5,500 households in Ignace, Dryden and the surrounding area
- 70 posters in Ignace, Dryden and surrounding areas
- Digital display ad campaign in the region, reaching each person an average of 10.8 times in the campaign window
- Supporting social media posts on Facebook, Instagram, LinkedIn and X (i.e. the platform formerly known as Twitter)
- Paid Facebook advertisements ran for five days in advance of the Dryden information sessions

Event Information & Attendance

Event	IPD Engagement Event – Ignace Information Session
Date	July 25, 2025
Time	9:30 – 11:30 AM CDT
Community	Ignace, Ontario
Location	Upper Curling Hall, 200 Beaver Street
Number of Attendees	8

3. Summary of Issues and Areas of Interest

This session saw active participation and constructive dialogue between attendees and presenters. Key topics included concerns about how the construction and operation of the DGR could affect **local water sources**, seeking reassurance that water quality and ecosystems will be carefully protected.

There were also discussions about the importance of locating the **accommodation camp** within the Township of Ignace to boost local business and residency.

There were lengthy conversations about **socio-economic impacts and economic development**, with a strong call for a clear and detailed economic development plan to support growth in Ignace. A couple of members of the Township of Ignace administration attended and engaged in a discussion with community members, focusing on the economic development of the Township.

Issue	NWMO Response
Hosting Agreement	
Participants asked whether NWMO's role in supporting business growth is limited to the Hosting Agreement. They encouraged NWMO to "think outside of the box" to help Ignace foster long-term prosperity. There was a call to revisit and strengthen the Hosting Agreement to encourage people to live and invest in Ignace. Participants articulated a desire for the Township to be more transparent and take on a more active leadership role in ensuring positive impacts on the community. There was a concern that Ignace needs to invest in community infrastructure now.	NWMO will continue to work with the Township through the Hosting Agreement on items like economic development and access to training. Concerns with the Hosting Agreement should be directed to the Township. Township representatives were present during the public sessions and responded to Hosting Agreement related questions.
Water (Surface and Ground)	

Issue	NWMO Response
Participants expressed concerns about potential changes to lake temperatures from construction activities and their effects on fish populations. They also questioned whether the placement of the organics management area should be further from water bodies to reduce the risk of algae blooms.	The Project is not expected to affect lake temperatures like nuclear power plants might. Water usage for operations will be studied, and potential effects on water bodies will be included in the environmental assessment.
Social Environment (Health, Well-being, Economic Conditions, Social Services, Jobs)	
Participants emphasized the strong local desire for economic growth, stressing that regulatory efforts must align with this goal. Participants highlighted the importance of including grassroots groups in future studies and meetings, citing past experiences like Mattabi Mine that impacted the local economy. There was strong interest in locating the accommodation camp in Ignace, to support local economic development.	Sustainability and benefits to Canadians, including the community of Ignace, are key parts of the process. NWMO aims to be a good corporate citizen and is committed to working with Ignace to support local prosperity. NWMO-led working groups, composed of community members, will focus on economics, health, environment, and social/cultural topics, and are currently under development. The current site layout under consideration is the one NWMO intends to proceed with—subject to the outcome of the environmental impact assessment, which will confirm if it is the least impactful option or an alternative location will be utilized. The site size should not change significantly. Accommodation camps on-site are typical but not mandatory, and feedback on alternative locations is welcome.
Impact Assessment Methods	
Concerns were raised about baseline testing procedures, including whether individuals would need to grant permission or provide well water samples. One attendee mentioned that there was a study conducted some time ago that found higher than normal radioactivity in water well samples from the region. They worried about the community potentially attributing existing high radioactivity levels in wells to the Project unjustly. There was also interest in whether healthcare impacts, such as effects on local medical services,	The NWMO does not have authority to require private well owners to allow access for sampling. The concern regarding the perception of impacts that couldn't be from a project that doesn't currently exist underscores the importance of baseline studies. The scope of the Impact Statement (the next step in the regulatory process) will be determined by the Impact Assessment Agency of Canada (IAAC)

Issue	NWMO Response
are being studied within the Impact Assessment process.	through receipt of the tailored impact statement guidelines.
Regulatory Process	
Questions were asked about who would be involved and the role of the Regulatory Assessment and Approvals Process (RAAP), the Indigenous-led process being developed by Wabigoon Lake Ojibway Nation (WLON). Participants wanted to know what happens if WLON does not support the Project and whether they must provide clear rationale for any opposition.	In parallel to the federally regulated process, WLON's independent RAAP will assess any significant impact(s) on WLON's Anishinaabe values of the Project area. The WLON RAAP is being developed by WLON.

4. General Comments/Notes

The NWMO received live feedback during the presentation, using a series of survey questions on the Mentimeter platform. The questions and responses are summarized below; the numbers in brackets indicate the number of respondents who selected that option.

1. **What are your goals or hopes for today's event? (Select all that apply)**
    - To have good discussions with NWMO staff and other community members (2)
    - To better understand the regulatory process and next steps (2)
    - To share my feedback, priorities and concerns (1)
    - To learn more about the Project, in general (1)

2. **What else would you like to know about the regulatory process?**
    - Can it be shortened?

Note: The NWMO answered this question during the event.

3. **What is your level of agreement with the following statements: The What We Heard Summary does a good job of representing the priorities and concerns that matter to me, at a high level (1 to 5)**
    - Average Ranking = 4.5

4. **What is your level of agreement with the following statements: The feedback I previously shared is mostly reflected in the key themes presented in the deck (1 to 5):**
    - Average Ranking = 4.5

5. **What is your level of agreement with the following statements: I have additional ideas, concerns, or issues to add to these themes (1 to 5):**
    - Average Ranking = 4.0

Note: Most people did have additional ideas, concerns, or issues to add to the Themes presented. Combined with the previous two scale ratings, it would suggest that their feedback was mostly captured, at a high level, though they would have some additions.

6. **What other studies on the impacts of the Project would you be interested in?**
    - How will the potential growth of the community impact those currently living here?
    - Will it price out those living here currently when others come into it, and will demand drive up things like rent?

Note: The NWMO has recorded these concerns to inform future engagement sessions.

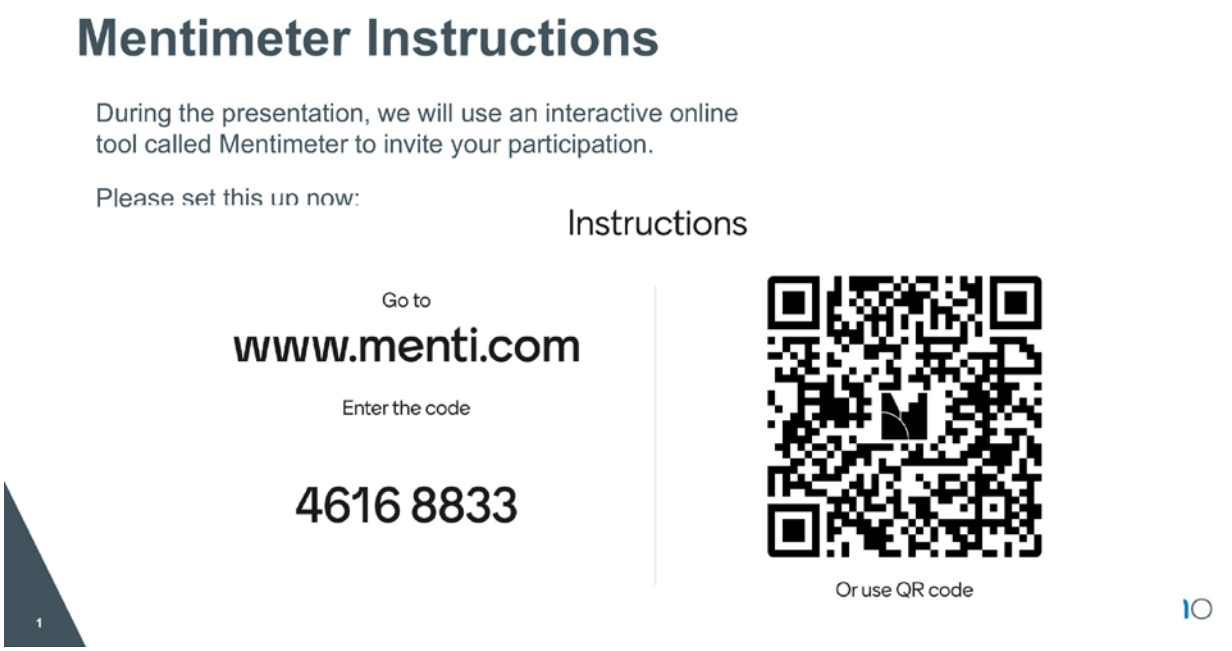
Comments from Feedback Board (Post-it Notes)

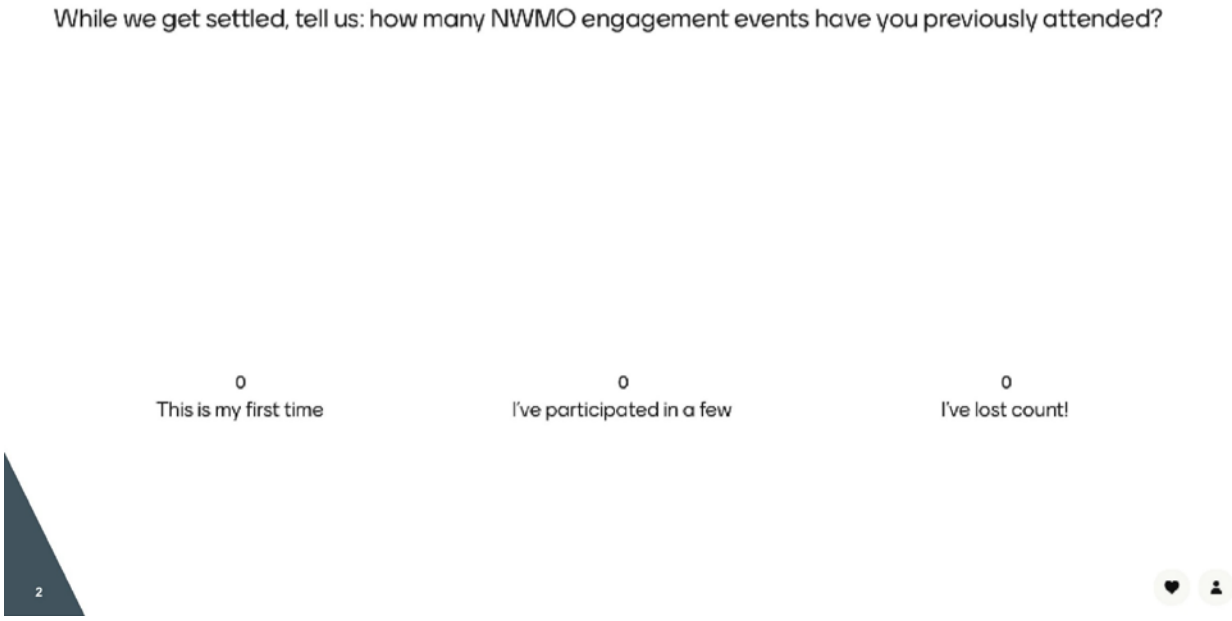
1. Interest in knowing what related developments or projects will be located directly in Ignace.
2. What the NWMO's role is to ensure prosperity for Ignace, outside of the regulatory process.
3. Concern about housing affordability and availability.
4. Desire for a strategic vision for economic development in Ignace.

Appendices

The communication materials and notification are included separately in the appendix to the Consolidated Report.

Ignace Information Session: IPD Engagement Presentation Deck (July 25, 2025)





Today's Presentation

What We'll Cover

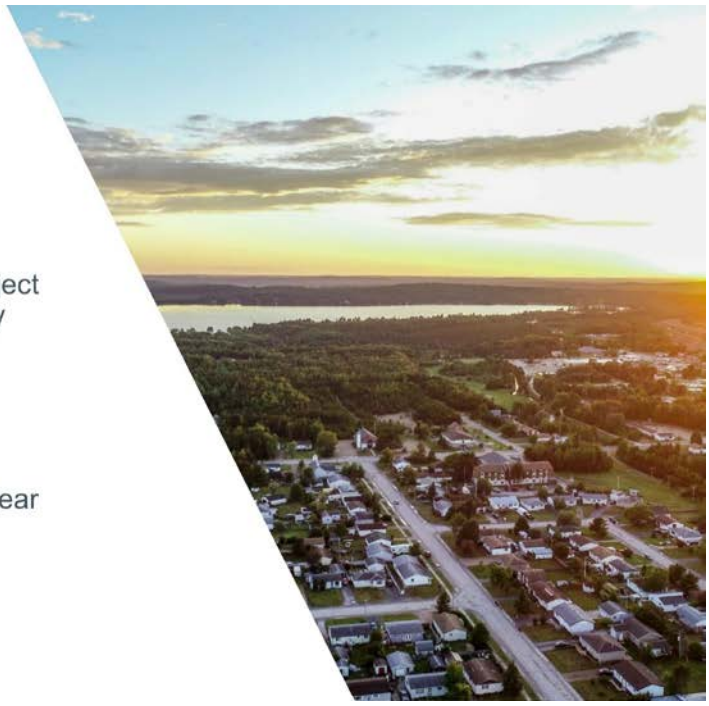
1. Deep Geological Repository Project Overview
2. Regulatory Process & Initial Project Description
3. What We've Heard
4. Baseline Studies
5. Facilitated Question & Answer Discussion

3

Today's Presentation

Goals

- To share information about the project and the next steps in the regulatory process
- Review what we've heard from engagement so far
- Gather feedback and continue to hear about key issues and impacts



4

Mentimeter Instructions

Instructions

Go to

www.menti.com

Enter the code

4616 8833

Or use QR code

5

nwmo

Join at menti.com | use code 4616 8833

Mentimeter

What are your goals or hopes for today's event?

0	0	0	0
To learn more about the project, in general	To better understand the regulatory process and next steps	To share my feedback, priorities and concerns	To have good discussions with NWMO staff and other community members

6

nwmo

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project – Initial Project Description

July 25, 2025

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Acknowledgement of Truths

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

About the Deep Geological Repository (DGR) Project

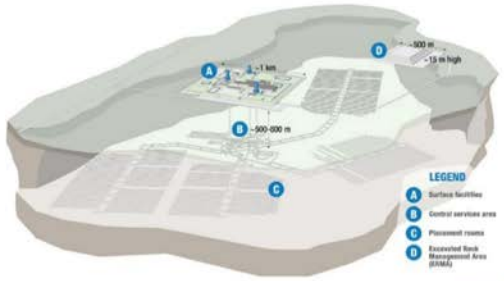
nwmo

NWMO's Proposed Deep Geological Repository (DGR) Project

- **Project Purpose:**
  - Safely contain and isolate **used nuclear fuel**
  - Manage up to **5.9 million fuel bundles**

- **Project Name:** Deep Geological Repository for Canada's Used Nuclear Fuel

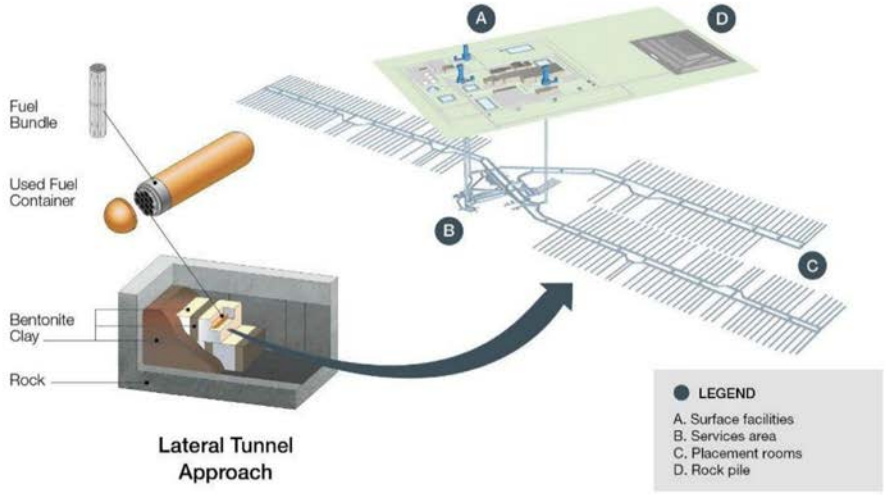
- **Host Communities**:
  - Wabigoon Lake Ojibway Nation (WLON)
  - Township of Ignace



nwmo

10

Deep Geological Repository (DGR) Concept



Lateral Tunnel Approach

11

nwmo

NWMO Site Selection Process for Canada's Used Fuel DGR Project

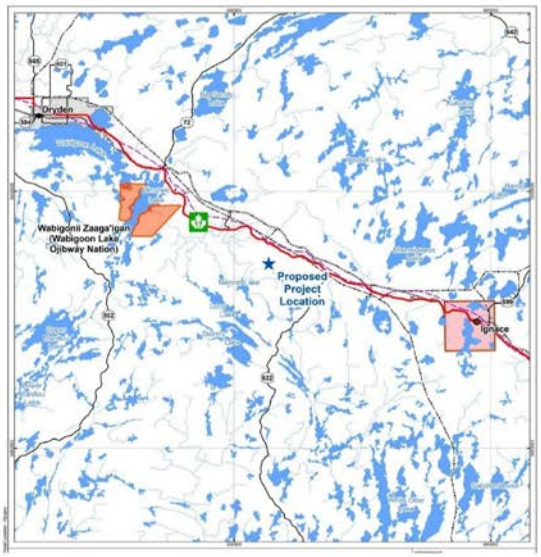
- Safety, transparency, and community engagement
- Evidence-based assessments
- Informed and willing hosts
- Fostering confidence

- Timeline & outcome:
  - **2010**: 22 communities volunteered into the process
  - **2024**: Wabigoon Lake Ojibway Nation (WLON) and the Township of Ignace selected
- The NWMO may now proceed to detailed site characterization and licensing

12

nwmo

Project Location



- Situated within Wabigoon Lake Ojibway Nation territory.

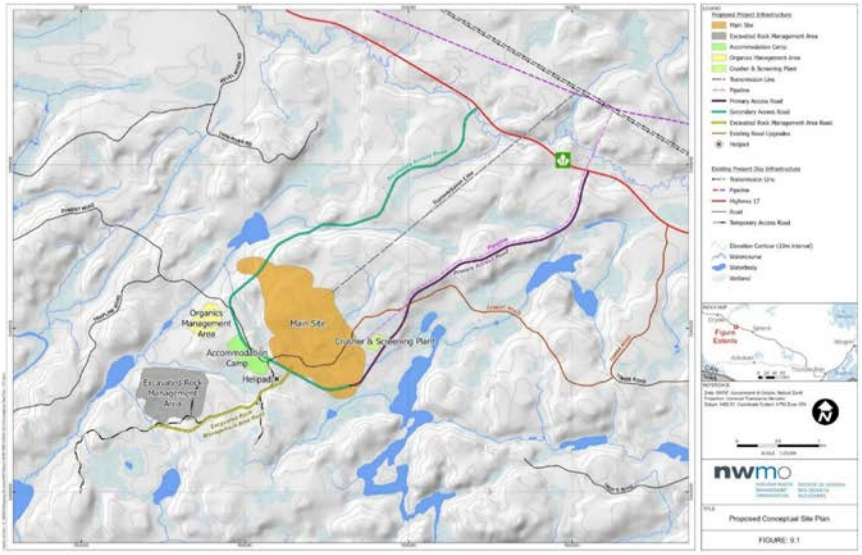
Proposed Site Location:

- ~21 km southeast of WLON Band #157 (approx. 12 km from the nearest WLON resident in Dyment)
- ~43 km northwest of Ignace, Ontario
- Located along Highway 17

13

nwmo

DRAFT Conceptual Site Plan – Surface Facilities



14

nwmo

Project Phases & Planning Timelines

- The implementation of Canada's plan via the DGR Project will span approximately 160 years.
- The Project will operate for approximately 50 years.
- The deep geological repository will be monitored for an extended period before decommissioning, closure and post-closure monitoring.

15

ASSUMED PROJECT PHASES AND PLANNING TIMELINES

Project phase	Approximate timeline (years)	Phase duration (years)
Site Preparation and Construction	2030-42	13
Operations	2043-92	50
Extended Monitoring, Decommissioning and Closure	2093-2192	100
Institutional Control[1]	2193+	

[1] The control of any risks at a site after decommissioning and closure, including activity like surveillance, maintenance or signs/markers.

Key Project Activities Across Project Phases

Site Preparation
- Clearing, grading and levelling the site
- Building shaft complexes and demonstration facility
- Developing non-nuclear infrastructure (ex. utilities, fencing, admin building, road)

Construction
- Complete main shaft and ventilation systems
- Build central services and the Used Fuel Packaging Plant (UFPP)
- Install initial placement panels
- Construct interim storage for intermediate and low-level waste

Operations
- Run the UFPP and begin waste placement
- Excavate new placement rooms and move rock to the management area
- Sort and temporarily store intermediate and low-level waste

Decommissioning and Closure
- Restore the site and rock management area
- Place remaining low-level waste
- Decommission underground structures
- Seal all tunnels and service areas
- Conduct long-term monitoring for safety

16

nwmo

Benefits of the Used Fuel DGR Project

Long-term Project Benefits

(160-year timeline)

- WLON and the Township of Ignace: outlined in signed Hosting Agreements
- Other nearby communities: likely to benefit from improved infrastructure, skills training, and business opportunities
- Canada: safe long-term management of used nuclear fuel

nwmo

About the Regulatory Process & Initial Project Description (IPD)

nwmo

A Site Has Been Selected – Now What?

- The Project will now prepare to enter the Regulatory Decision-Making stage.
- This means entering an **Impact Assessment** (IA) by the federal government.
- IAs are led by the **Impact Assessment Agency of Canada** (IAAC).
- This IA will be integrated with nuclear licensing and therefore include the **Canadian Nuclear Safety Commission** (CNSC).

19

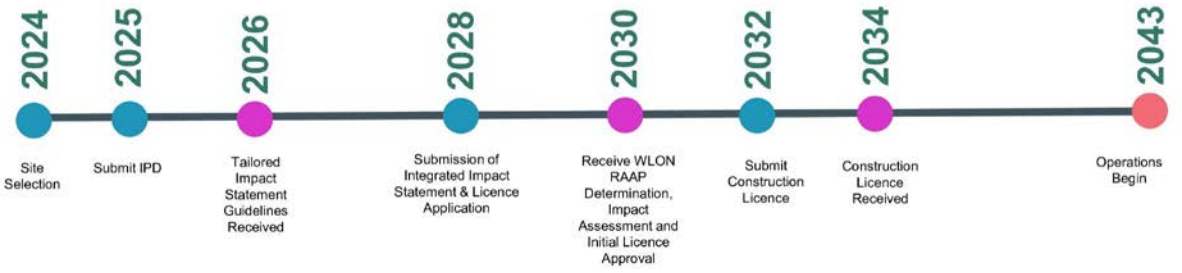
nwmo

Regulatory Oversight

20

nwmo

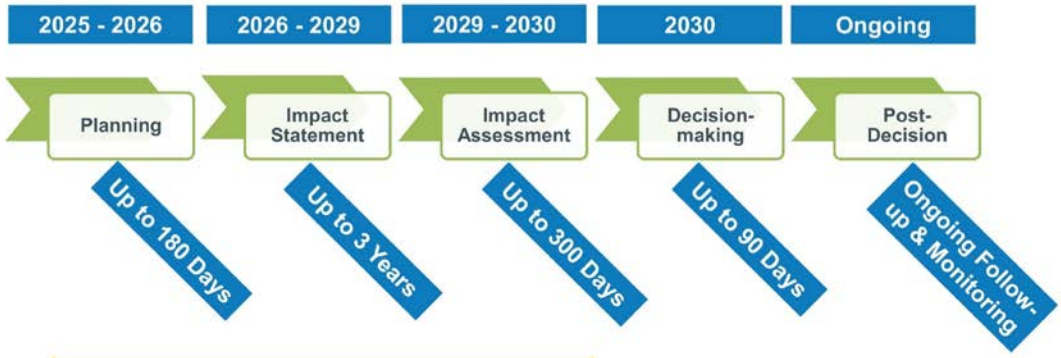
NWMO Regulatory Milestones & Timelines



21

nwmo

Steps in the Federal Led Impact Assessment Process



22

nwmo

Initial Project Description

- Submitted by the Project proponent (NWMO) to the IAAC
- Explains what the project is, where it is, and what it might affect
- Documents potential community concerns and areas where more study will be completed
- Includes plans for future regulatory engagement including communications and participation
- Guides IAAC development of the Tailored Impact Statement Guidelines specific for the Project
- **Formally starts the regulatory process**.

nwmo

Join at menti.com | use code 4616 8833

Mentimeter

What else would you like to know about the regulatory process?

All responses to your question will be shown here

Each response can be up to 200 characters long

Turn on voting to let participants vote for their favorites

nwmo

What We've Heard To-Date

nwmo

Public and Interested Parties Engagement

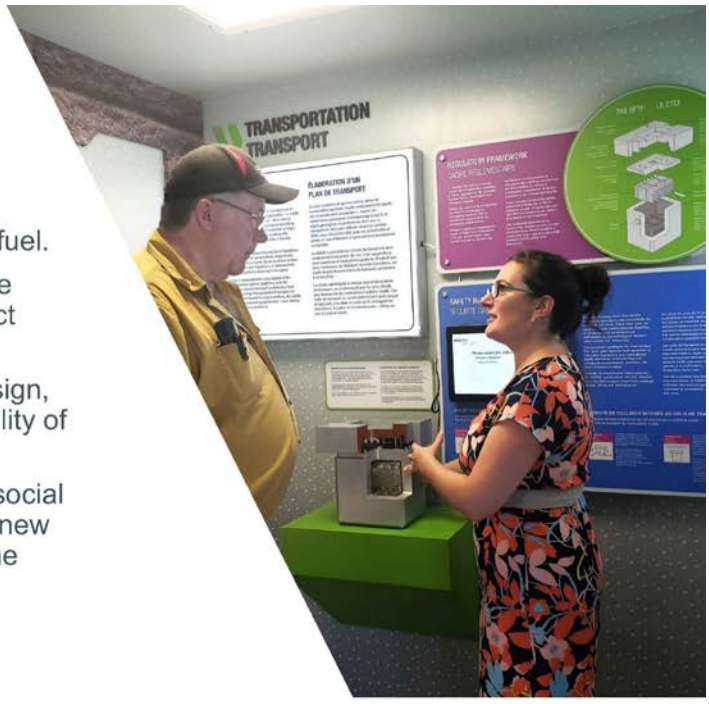
- We continue to engage extensively with the public and interested parties, including:
  - municipalities
  - businesses
  - service providers
  - environmental organizations
- In the IPD, we summarize What We've Heard for key themes and concerns during this engagement to date.
- You can help us by reviewing and providing feedback on these themes.

26

Protection of Human Health and Safety

- Concerns about radioactivity, and potential contamination from used fuel.
- Safety apprehensions regarding the long-term management, and Project execution.
- Concerns about surface facility design, monitoring systems, and the reliability of storage methods.
- Impact on the regional health and social service systems to prepare for the new families the project will bring into the area.

27



Protection of the Natural Environment

- Design of water management systems.
- Isolation of used fuel and protection of the environment.
- Environmental impacts on water, land, and wildlife from noise pollution and traffic.
- Vulnerability to natural disasters and extreme events.
- Energy and water footprints.
- Suitability of rock type to host a repository

28

Social Conditions and Community Infrastructure

- Housing shortage and increased demand for other infrastructure and services;
- Local benefits, infrastructure, and job creation;
- Youth challenges, opportunities and retention;
- Education and training for community readiness;
- Population growth/fluctuation impacts on resources, services and social conditions.

29

Economic Conditions

- Economic development, urban revitalization and risks and opportunities for local businesses; and
- New business opportunities and employment after site selection.

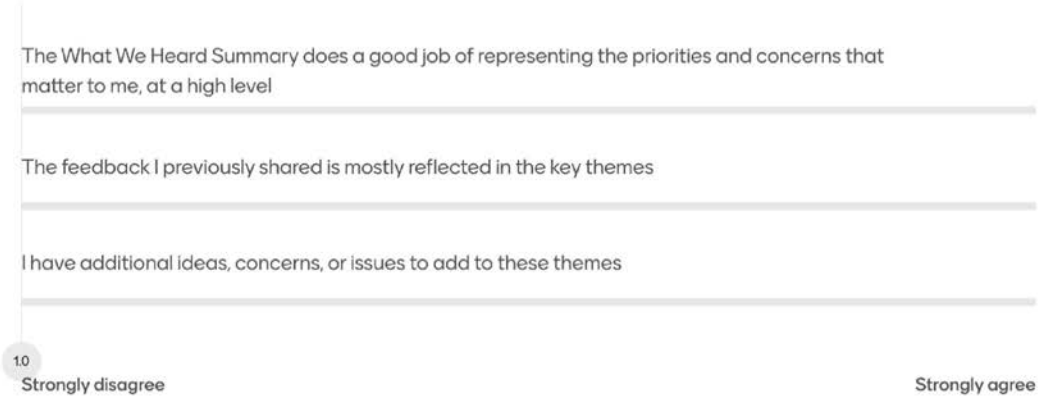
nwmo

30

Join at menti.com | use code 4616 8833

Mentimeter

What is your level of agreement with the following statements:



31

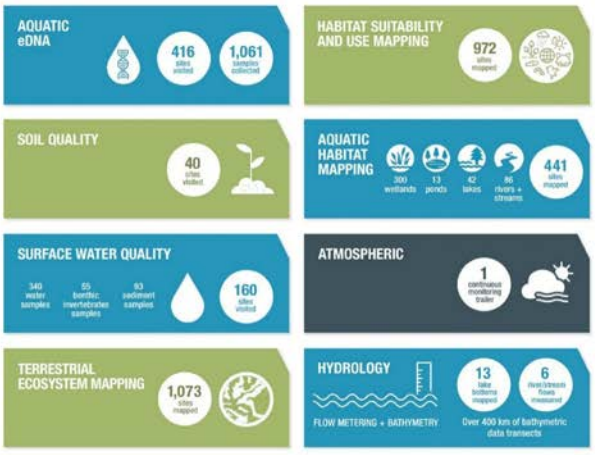
nwmo

Understanding Baseline Data

nwmo

Project Highlights: Baseline Environment

- Regulatory decision-making requires that baseline environment data is collected and used in assessment and design planning before approval can be given for the site to be prepared for the repository.
- NWMO has studied the regional geology of the site since 2010.
- Environmental studies in the area have been ongoing since 2014.
- Working with WLON, data collection will continue throughout the impact assessment and regulatory process.



This figure presents some of the baseline information gathered about the proposed Project site.

33

Project Highlights: Baseline Socioeconomic and Health

Socio-economic reporting is required every three years under the *Nuclear Fuel Waste Act* and includes potential impacts on various components of the human environment, including:

- Community way of life
- Social aspirations
- Cultural aspirations
- Economic aspirations

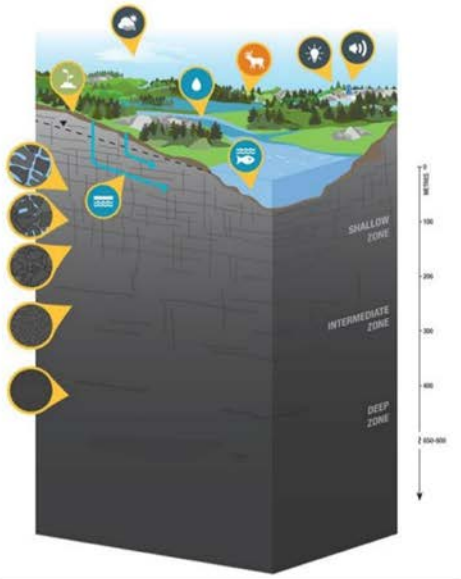
Under the Impact Assessment process, the NWMO is also required to assess social, economic, health, and Indigenous Rights impacts.

nwmo

34

How Baseline Data is Used in the Regulatory Process

- Baseline studies collect data on environmental and social conditions before a project begins
- Baseline data creates a reference point to assess future changes and impacts on people and the environment and identify ways to avoid, reduce or manage them
- Baseline study data are used to inform design
- The IPD summarizes baseline data collected to-date and uses it to complete a preliminary screening assessment of potential project impacts and propose potential mitigation



nwmo

35

Next Steps — Environment, Socioeconomic and Health Baseline

- Baseline data collection and reporting will continue, tailored to the Project layout
- NWMO will work with communities to verify data collected
- Community-specific studies will begin or continue (e.g., Indigenous Knowledge and land use studies)
- Seek input into ongoing data collection methodology and results.

nwmo

36

Project Activities with Potential Impacts on Valued Components

- Land clearing and grubbing
- Blasting and excavation
- Site security and access management
- Development and operations of surface facilities, the DGR, worker accommodation camp, the Excavated Rock Management Area (ERMA)
- Materials handling
- Vehicle traffic
- Site water management

37

nwmo

How are Effects Assessed?

- Identify a Valued Component (VC)
- How does that VC interact with the Project, through what pathways?
- What mitigations can we implement to minimize the effect?
- Is there still an effect after the mitigation is applied?
- Follow-up monitoring

nwmo

Join at menti.com | use code 4616 8833

Mentimeter

Which elements of NWMO's data collection approach are most important to you?

0	0	0	0	0
Working with communities to verify existing data	Including Indigenous Knowledge in baseline studies	Community-specific land use and cultural studies	Transparency and access to reports	Opportunities to shape future data collection

39

nwmo

Wrap-up

nwmo

The Journey Continues

- We intend to submit the IPD in Fall 2025, which will formally kickstart the regulatory process.
- Review the summary IPD – copies provided today, or scan QR code in handouts.
- Share your feedback on the key themes and concerns shared through engagement to date
  - What would you add?
  - What are your values and priorities?
  - What questions are on your mind?

41

Q&A Opportunity

42

Thank you.

@nwmocanada / @LaSGDN

/company/nwmocanada

www.nwmo.ca

What We Heard - IPD Engagement Report: Webinar Information Session - August 6, 2025, Morning Session

1. Introduction

This event was held online via Zoom Webinar and was open to the public. The NWMO gave a presentation followed by a Question (Q) & Answer (A) session while Mokwateh facilitated the event and discussion. The primary purpose of this engagement was to provide community members with a clear overview of the Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project ("the Project"), the upcoming regulatory process, and the Initial Project Description (IPD), helping NWMO refine the draft IPD by gathering valuable feedback on potential impacts and issues.

This session also reviewed a summary of priorities and concerns shared through previous engagement activities, provided information about baseline studies, and included a facilitated Q&A discussion to support transparency, learning, and two-way dialogue. Attendees could also provide feedback by answering a series of questions using the Zoom polling feature.

2. Engagement Process

Notifications

NWMO's communications campaign effectively raised awareness of engagement activities, with over 2.2 million impressions throughout Ignace, Dryden, and the surrounding areas over 23 days (note: "Impressions" are a standard measurement in communications. They indicate the combined reach of the advertising, social and household campaign).

Communication objectives were two-fold:

1. Raise awareness about upcoming collaboration activities by the NWMO to inform the IPD.
2. Drive participation in the IPD community collaboration activities.

Communication methods included the following:

- Media briefing with five journalists covering news outlets with operations covering northwestern Ontario
- Household mailer to 5,500 households in Ignace, Dryden and the surrounding area
- 70 posters in Ignace, Dryden and surrounding areas
- Digital display ad campaign in the region, reaching each person an average of 10.8 times in the campaign window
- Supporting social media posts on Facebook, Instagram, LinkedIn and X (i.e. formerly known as Twitter)
- Paid Facebook advertisements ran for five days in advance of the Dryden information sessions

Event Information & Attendance

Event	IPD Engagement – Webinar Information Session
Date	August 6, 2025
Time	10:30 AM – 11:45 AM EDT
Location	Online
Number of Attendees	18

3. Summary of Issues and Areas of Interest

Attendees were highly engaged, asking questions and participating in the Zoom Polls. Participant questions addressed the **land ownership** and **permitting process**, **potential impacts** from construction and transportation, and **technical aspects of the Project**, such as the placement of boreholes. There were also several questions about the **regulatory process**, with attendees asking about potential delays, the location of future public hearings, and the role of federal agencies.

Issue	NWMO Response
Safety/Human Environment	
Concerns were expressed about how both the construction phase and the transport of used nuclear fuel may affect nearby residential neighborhoods and local businesses.	NWMO does not anticipate direct impacts to residential neighbourhoods or businesses, since the Project site is not located in a populated area.
Terrestrial Environment	
Concern about how construction activities might disrupt wildlife in the surrounding area and what mitigation measures are being planned.	The effects on wildlife will be studied through the Project's Effects Assessment and baseline studies. These will determine which species are in the area and inform a mitigation plan to address potential impacts.
Regulatory Process	
Interest in whether NWMO anticipates any regulatory delays at this point, based on feedback from the community or regulators.	NWMO is currently on track with timelines and do not foresee delays.
Borehole Locations	
Interest in whether all proposed boreholes will be located inside the yellow-shaded area shown on the	The boreholes will be drilled in the Project siting area which includes areas outside of the yellow-shaded area.

Issue	NWMO Response
Project site map (i.e., the main site area), or if some will extend beyond it.	
Land Use	
Community members raised questions about whether the DGR site is located on Crown Land, and if so, whether the NWMO has purchased the property outright or if development will proceed under a Land Use Permit system regulated by the Ministry of Natural Resources.	Ownership of the site will transfer from the Crown to NWMO, but no final decision has been made on timing or process yet.
Project Components	
There was a request for further detail regarding a pipeline mentioned during the presentation, including its purpose and relevance to the Project.	The pipeline is intended as a utility pipeline, specifically for natural gas, which will provide heating for the facility.
Engagement and Communication	
Questions were asked about the locations of upcoming public hearings and whether they will be held in Ignace, within the new Centre of Expertise, or at another venue.	Hearings will be managed by the Impact Assessment Agency of Canada and the Canadian Nuclear Safety Commission. These regulatory bodies will select a facility, likely a public location, for the hearings.
Community Studies	
Questions were raised about how the baseline studies conducted between 2020 and 2022 and the integrated report that followed are being incorporated into the current process. They wanted to know whether the hosting communities or NWMO will take the lead in addressing recommendations from those studies.	The baseline and community studies from 2020–2022 are available online. NWMO will consider the information provided in the baseline studies for future baseline designs and Project iterations as the work evolves.

4. General Comments/Notes

Through the Zoom Polls, NWMO received feedback from participants. The questions and responses are summarized below; the numbers in brackets indicate the number of respondents who selected that option.

1. **What benefits do you hope this Project could bring for you and/or your community? (Select all that apply)**
    - Long-term employment opportunities (9)
    - Infrastructure improvements (7)
    - Youth engagement opportunities for younger generations (8)

- Improved access to science and environmental education (6)
- Funding for community initiatives and services (5)
- Increased local business opportunities (3)
- Training and skills development programs (3)

2. **What topics are you most interested in learning about in relation to the Deep Geological Repository Project? (Select all that apply)**
    - Social, Economic and Health (7)
    - Water (6)
    - Safety, Accidents, and Radiological Considerations (6)
    - Aquatic Environment (fish and fish habitat) (4)
    - Current Land Use – Recreation or Commercial (ex. navigation, hunting, fishing, trapping, visual aesthetics) (4)
    - Atmospheric Environment (air quality, noise, greenhouse gases, climate change) (3)
    - Project Design and Structure (3)
    - Potential Effects (3)
    - Land-Based Environment (upland vegetation, wetlands, species at risk) (3)
    - Archaeology and Cultural Heritage (2)

3. **What aspects of the Deep Geological Repository Project are you most concerned about? (Select all that apply)**
    - Potential impacts on water sources and the environment (7)
    - Emergency preparedness and risk management (7)
    - Effects on local communities, including health and well-being (6)
    - Long-term safety of storing used nuclear fuel underground (5)
    - Impacts on Indigenous rights, lands, and cultures (4)
    - Transparency and trust in decision-making and oversight (4)
    - Effects on the economy, tourism, or land use in the area (2)

4. **What else would you like to know about the regulatory process? (Select all that apply)**
    - More information about the key milestones and timelines (7)
    - How can the community be involved within the process (7)
    - More information about the regulatory bodies (5)

5. **Does the What We Heard Summary (in the presentation) do a good job of representing the priorities and concerns that matter to me, at a high level? (Select one)**
    - Fully reflects the concerns and priorities that matter to me (6)
    - Mostly reflects my priorities and concerns (2)
    - Somewhat reflects my priorities and concerns (1)
    - Does not reflect my priorities and concerns at all (1)

Appendices

The communication materials and notification are included separately in the appendix to the Consolidated Report.

Webinar Information Session: IPD Engagement Presentation Deck (August 6, 2025, Morning Session)

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project – Initial Project Description

August 6, 2025

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Engagement Purpose

- To provide community members with a clear overview of the Deep Geological Repository (DGR) Project, including key information about the regulatory process and the Initial Project Description (IPD), helping NWMO to gather important feedback on these topics.
- This session also shares what we've heard from communities so far, discusses baseline environmental and technical studies, and includes a facilitated question and answer session.

nwmo

Today's Presentation

What We'll Cover

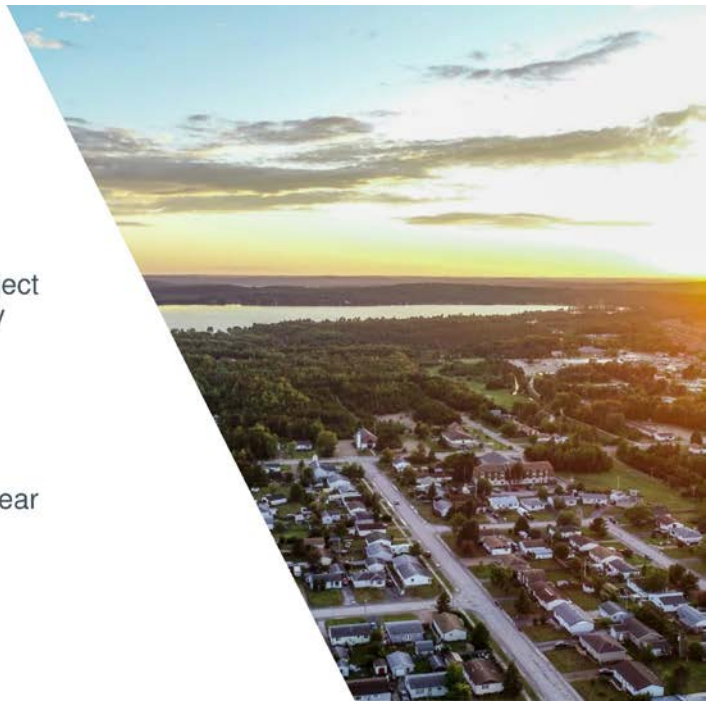
1. Deep Geological Repository Project Overview
2. Regulatory Process & Initial Project Description
3. What We've Heard
4. Baseline Studies
5. Facilitated Question & Answer Discussion (15mins)

3

Today's Presentation

Goals

- To share information about the project and the next steps in the regulatory process
- Review what we've heard from engagement so far
- Gather feedback and continue to hear about key issues and impacts



4

Zoom Tools

- Please **only** use the chat box for **tech issues**
- Add your questions to the Q&A box as they arise
- Questions will be answered either in writing during the presentation or live during the Q&A portion
- Unanswered questions will be addressed by email in the coming weeks

5

nwmo

Question 1: What are your goals or hopes for today's event? (select all that apply)

- ☐ To learn more about the project, in general
- ☐ To better understand the regulatory process and next steps
- ☐ To share my feedback, priorities, and concerns

6

nwmo

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project – Initial Project Description

August 6, 2025

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Land Acknowledgement

8

About the Deep Geological Repository (DGR) Project

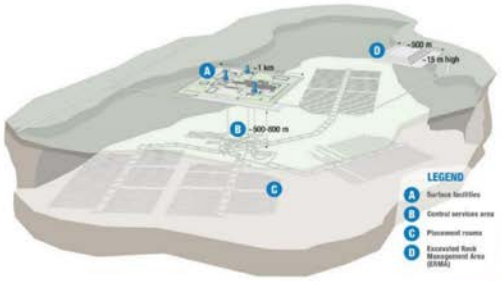
nwmo

NWMO's Proposed Deep Geological Repository (DGR) Project

- **Project Purpose:**
  - Safely contain and isolate **used nuclear fuel**
  - Manage up to **5.9 million used CANDU fuel bundles**

- **Project Name:** Deep Geological Repository for Canada's Used Nuclear Fuel

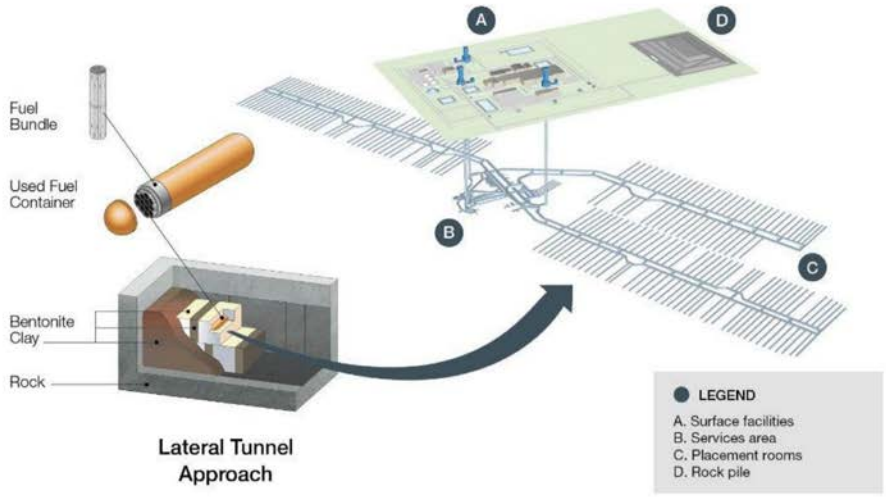
- **Host Communities**:
  - Wabigoon Lake Ojibway Nation (WLON)
  - Township of Ignace



nwmo

10

Deep Geological Repository (DGR) Concept



Lateral Tunnel Approach

11

nwmo

NWMO Site Selection Process for Canada's Used Fuel DGR Project

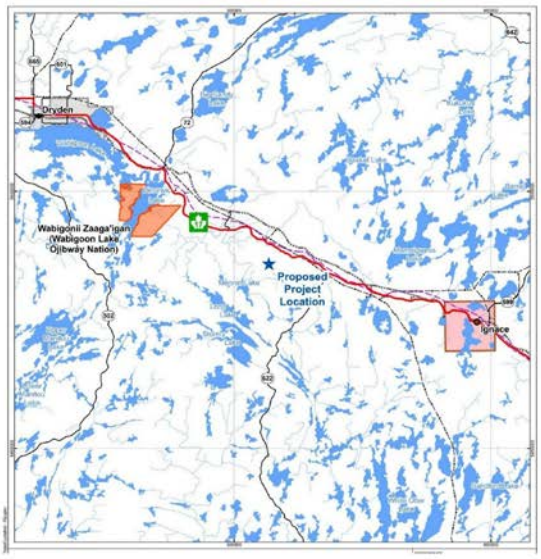
- Safety, transparency, and community engagement
- Evidence-based assessments
- Informed and willing hosts
- Fostering confidence

- Timeline & outcome:
  - **2010**: 22 communities volunteered into the process
  - **2024**: Wabigoon Lake Ojibway Nation (WLON) and the Township of Ignace selected
- The NWMO may now proceed to detailed site characterization and licensing

12

nwmo

Project Location



- Situated within Wabigoon Lake Ojibway Nation territory.

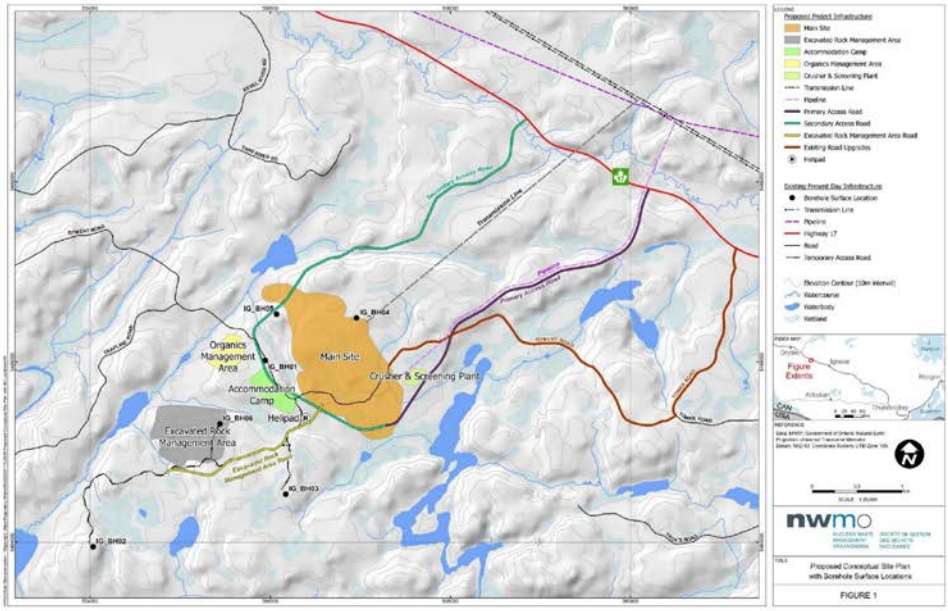
Proposed Site Location:

- ~21 km southeast of WLON Band #157 (approx. 12 km from the nearest WLON resident in Dyment)
- ~43 km northwest of Ignace, Ontario
- Located along Highway 17

nwmo

13

DRAFT Conceptual Site Plan – Surface Facilities



nwmo

14

Project Phases & Planning Timelines

- The implementation of Canada's plan via the DGR Project will span approximately 160 years.
- The Project will operate for approximately 50 years.
- The deep geological repository will be monitored for an extended period before decommissioning, closure and post-closure monitoring.

15

ASSUMED PROJECT PHASES AND PLANNING TIMELINES

Project phase	Approximate timeline (years)	Phase duration (years)
Site Preparation and Construction	2030-42	13
Operations	2043-92	50
Extended Monitoring, Decommissioning and Closure	2093-2192	100
Institutional Control[1]	2193+	

[1] The control of any risks at a site after decommissioning and closure, including activity like surveillance, maintenance or signs/markers.

Key Project Activities Across Project Phases

Site Preparation
- Clearing, grading and levelling the site
- Building shaft complexes and demonstration facility
- Developing non-nuclear infrastructure (ex. utilities, fencing, admin building, road)

Construction
- Complete main shaft and ventilation systems
- Build central services and the Used Fuel Packaging Plant (UFPP)
- Install initial placement panels
- Construct interim storage for intermediate and low-level waste

Operations
- Run the UFPP and begin waste placement
- Excavate new placement rooms and move rock to the management area
- Sort and temporarily store intermediate and low-level waste

Decommissioning and Closure
- Restore the site and rock management area
- Place remaining low-level waste
- Decommission underground structures
- Seal all tunnels and service areas
- Conduct long-term monitoring for safety

16

nwmo

Benefits of the Used Fuel DGR Project

17

nwmo

Question 2: What benefits do you hope this project could bring for you and/or your community? (Select all that apply)

- ☐ Long-term employment opportunities
- ☐ Training and skills development programs
- ☐ Infrastructure improvements
- ☐ Increased local business opportunities
- ☐ Youth engagement and future opportunities for younger generations
- ☐ Funding for community initiatives and services
- ☐ Improved access to science and environmental education

18

nwmo

Question 3: What topics are you most interested in learning about in relation to the Deep Geological Repository Project? (Select all that apply)

- ☐ Water
- ☐ Social Environment (health, well-being, economic conditions, social services, and jobs)
- ☐ Archaeology and Cultural Heritage
- ☐ Current Land Use – Recreation or Commercial (ex. navigation, hunting, fishing, trapping, visual aesthetics)
- ☐ Terrestrial Environment (upland vegetation, wetlands, species at risk)
- ☐ Aquatic Environment (fish and fish habitat)
- ☐ Atmospheric Environment (air quality, noise, greenhouse gases, climate change)
- ☐ Potential Effects
- ☐ Project Design and Structure
- ☐ Safety, Accidents, and Radiological Considerations

19

nwmo

Question 4: What aspects of the Deep Geological Repository Project are you most concerned about? (Select all that apply)

- ☐ Long-term safety of storing used nuclear fuel underground
- ☐ Potential impacts on water sources and the environment
- ☐ Effects on local communities, including health and well-being
- ☐ Impacts on Indigenous rights, lands, and cultures
- ☐ Transparency and trust in decision-making and oversight
- ☐ Effects on the economy, tourism, or land use in the area
- ☐ Emergency preparedness and risk management

20

nwmo

About the Regulatory Process & Initial Project Description (IPD)

nwmo

A Site Has Been Selected – Now What?

- The Project will now prepare to enter the Regulatory Decision-Making stage.
- This means entering an **Impact Assessment** (IA) by the federal government.
- IAs are led by the **Impact Assessment Agency of Canada** (IAAC).
- This IA will be integrated with nuclear licensing and therefore include the **Canadian Nuclear Safety Commission** (CNSC).

22

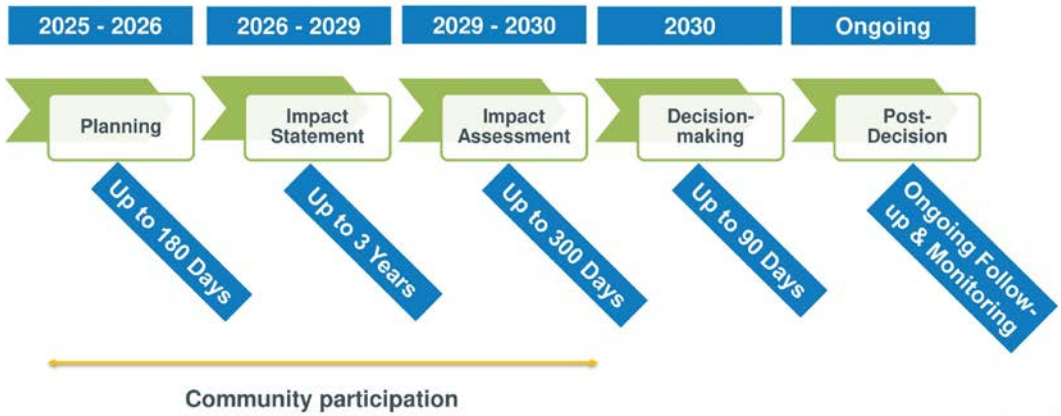
nwmo

Regulatory Oversight of the Project

23

nwmo

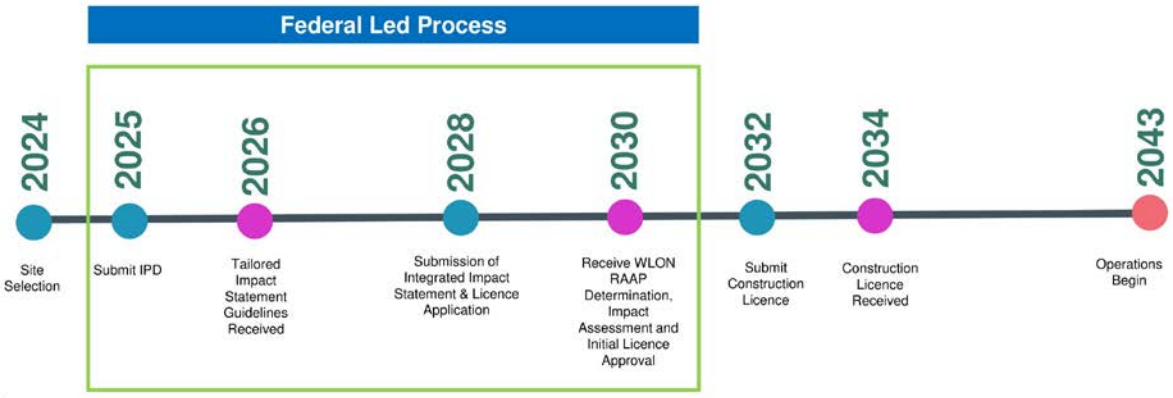
Steps in the Federal Led Impact Assessment Process



24

nwmo

NWMO Regulatory Milestones & Timelines



25

nwmo

Initial Project Description

- Submitted by the Project proponent (NWMO) to the IAAC
- Explains what the project is, where it is, and what it might affect
- Documents potential community concerns and areas where more study will be completed
- Includes plans for future regulatory engagement including communications and participation
- Guides IAAC development of the Tailored Impact Statement Guidelines specific for the Project
- **Formally starts the regulatory process when posted to IAAC's website.**

26

nwmo

Question 5: What else would you like to know about the regulatory process? (Select all that apply)

- ☐ How can the community be involved within the process
- ☐ More information about the regulatory bodies
- ☐ More information about the key milestones and timelines

27

nwmo

What We've Heard To-Date

nwmo

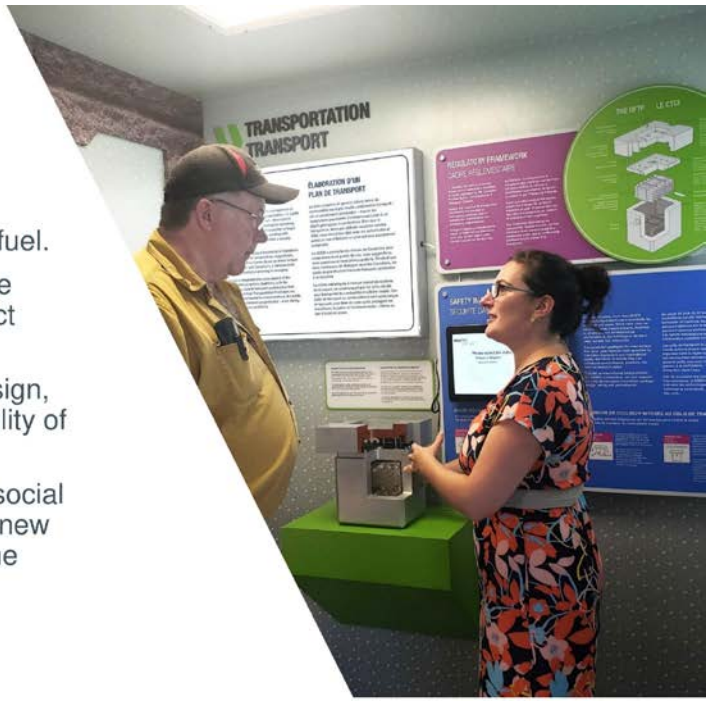
Public and Interested Parties Engagement

- We continue to engage extensively with the public and interested parties, including:
  - municipalities
  - businesses
  - service providers
  - environmental organizations
- In the IPD, we summarize What We've Heard for key themes and concerns during this engagement to date.
- You can help us by reviewing and providing feedback on these themes.

29

Protection of Human Health and Safety

- Concerns about radioactivity, and potential contamination from used fuel.
- Safety apprehensions regarding the long-term management, and Project execution.
- Concerns about surface facility design, monitoring systems, and the reliability of storage methods.
- Impact on the regional health and social service systems to prepare for the new families the project will bring into the area.



30

Protection of the Natural Environment

- Design of water management systems.
- Isolation of used fuel and protection of the environment.
- Environmental impacts on water, land, and wildlife from noise pollution and traffic.
- Vulnerability to natural disasters and extreme events.
- Energy and water footprints.
- Suitability of rock type to host a repository

31

Social Conditions and Community Infrastructure

- Housing shortage and increased demand for other infrastructure and services;
- Local benefits, infrastructure, and job creation;
- Youth challenges, opportunities and retention;
- Education and training for community readiness;
- Population growth/fluctuation impacts on resources, services and social conditions.

32

Economic Conditions

- Economic development, urban revitalization and risks and opportunities for local businesses; and
- New business opportunities and employment after site selection.

nwmo

33

Question 6: Does the What We Heard Summary do a good job of representing the priorities and concerns that matter to me, at a high level?

- ☐ Yes, it fully reflects the concerns and priorities that matter to me. I have nothing to add.
- ☐ The summary mostly reflects my priorities and concerns. I have a couple things to add.
- ☐ The summary somewhat reflects my priorities and concerns. I have several things to add.
- ☐ The summary does not reflect my priorities and concerns at all.

nwmo

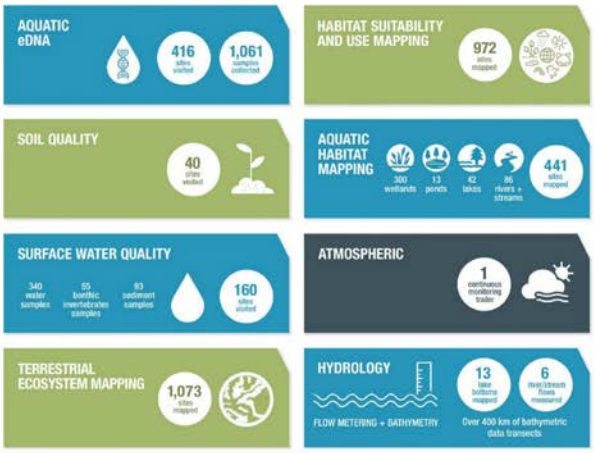
34

Understanding Baseline Information

nwmo

Project Highlights: Baseline Environment

- Baseline environment information is collected and used in assessment and design planning before approval can be given.
- NWMO has studied the regional geology of the site since 2010.
- Environmental studies in the area have been ongoing since 2014.
- Working with community, data collection will continue throughout the impact assessment and regulatory process.



This figure presents some of the baseline information gathered about the proposed Project site.

36

Project Highlights: Baseline Socioeconomic and Health

Socio-economic reporting is required every three years under the *Nuclear Fuel Waste Act* and includes potential impacts on various components, including:

- Community way of life
- Social aspirations
- Cultural aspirations
- Economic aspirations

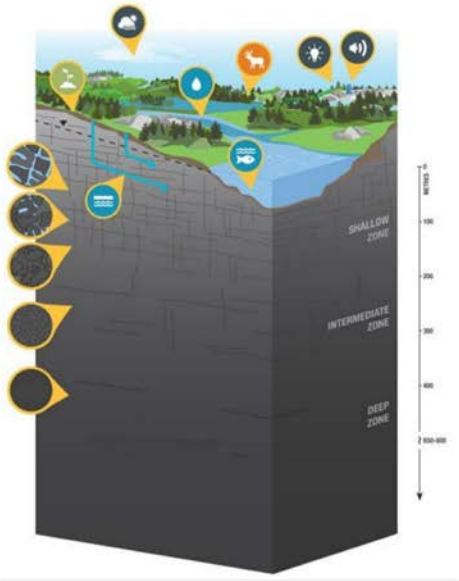
Under the Impact Assessment process, the NWMO is also required to assess social, economic, health, and Indigenous Rights impacts.

37

nwmo

How Baseline Information is Used in the Regulatory Process

- Baseline studies collect information on environmental and social conditions before a project begins
- Baseline information creates a reference point to assess future changes and impacts on people and the environment and identify ways to avoid, reduce or manage them
- Baseline study results are used to inform design
- The IPD summarizes baseline information collected to date and uses it to complete a preliminary screening assessment of potential project impacts and propose potential mitigation



38

nwmo

Project Activities with Potential Impacts on Environmental, Socioeconomic or Health Components

- Land clearing and grubbing
- Blasting and excavation
- Site security and access management
- Development and operations of surface facilities, the DGR, worker accommodation camp, the Excavated Rock Management Area (ERMA)
- Materials handling
- Vehicle traffic
- Site water management

39

nwmo

How are Effects Assessed?

- Identify an environmental, socioeconomic or health component
- How does that component interact with the Project, through what pathways?
- What mitigations can we implement to minimize the effect?
- Is there still an effect after the mitigation is applied?
- Follow-up monitoring

nwmo

Wrap-up

What to Expect Next

- After IPD is posted on the IAAC registry, engagement from the regulators will begin
- Community members can provide comments online or at IAAC / CNSC events
- IAAC will provide NWMO with a Summary of Issues which NWMO responds to
- IAAC / CNSC create draft Tailored Impact Statement Guidelines (TISGs)
- IAAC / CNSC engage on TISGs in community
- IAAC posts the guidelines

The Journey Continues

- We intend to submit the IPD in Fall 2025, which will formally kickstart the regulatory process.
- Review the summary IPD at nwmo.ca/PlanningWithYou
- Share your feedback on the key themes and concerns shared through engagement to date
  - What would you add?
  - What are your values and priorities?
  - What questions are on your mind?

43

How to Engage With Us!

You can submit comments to:

RegulatoryFeedback@nwmo.ca

nwmo.ca/contact-us on our website

Comments will also be accepted by mail addressed to:

NWMO — IPD summary feedback
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3
Comments are accepted until Friday, Aug. 22, 2025.

For more information please visit:

NWMO.ca/PlanningWithYou

nwmo

44

Q&A Opportunity

45

nwmo

Thank you.

@nwmocanada / @LaSGDN

/company/nwmocanada

www.nwmo.ca

What We Heard - IPD Engagement Report: Webinar Information Session - August 6, 2025, Evening Session

1. Introduction

This event was held online via Zoom Webinar and was open to the public. The NWMO gave a presentation followed by a Question (Q) & Answer (A) Q&A session while Mokwateh facilitated the event and discussion. The primary purpose of this engagement was to provide community members with a clear overview of the Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project ("the Project"), the upcoming regulatory process, and the Initial Project Description (IPD), helping NWMO refine the draft IPD by gathering valuable feedback on potential impacts and issues.

This session also reviewed a summary of priorities and concerns shared through previous engagement activities, provided information about baseline studies, and included a facilitated Q&A discussion to support transparency, learning, and two-way dialogue. Attendees could also provide feedback by answering a series of questions using the Zoom polling feature.

2. Engagement Process

Notifications

NWMO's communications campaign effectively raised awareness of engagement activities, with over 2.2 million impressions throughout Ignace, Dryden, and the surrounding areas over 23 days (Note: "Impressions" are a standard measurement in communications. They indicate the combined reach of the advertising, social and household campaign).

Communication objectives were two-fold:

1. Raise awareness about upcoming collaboration activities by the NWMO to inform the IPD.
2. Drive participation in the IPD community collaboration activities.

Communication methods included the following:

- Media briefing with five journalists covering news outlets with operations covering northwestern Ontario
- Household mailer to 5,500 households in Ignace, Dryden and the surrounding area
- 70 posters in Ignace, Dryden and surrounding areas
- Digital display ad campaign in the region, reaching each person an average of 10.8 times in the campaign window
- Supporting social media posts on Facebook, Instagram, LinkedIn and X X (i.e. formerly known as Twitter)
- Paid Facebook advertisements ran for five days in advance of the Dryden information sessions

Event Information & Attendance

Event	IPD Engagement – Webinar Information Session
Date	August 6, 2025
Time	6:00 PM – 7:15 PM EDT
Location	Online
Number of Attendees	7

3. Summary of Issues and Areas of Interest

In comparison to the morning webinar, the evening session had lower attendance and participation in the questions and Zoom Polls. Participant questions and concerns related to the Project components and Centre of Expertise, were as noted below.

Issue	NWMO Response
Project Components	
Request for additional details about the pipeline shown in Slide 14 (i.e., the draft conceptual site map), seeking clarity on its purpose and role within the Project.	There aren't many details available yet, as the site layout is still in the draft stage; however, the pipeline is intended as a utility pipeline, specifically for natural gas, which will provide heating for the facility.
Centre of Expertise Benefits and Engagement Process	
Desire to understand how the Centre of Expertise (CoE) contributes to the Project's broader benefits and whether its physical location may specifically help capture those benefits.	The CoE is separate from the formal regulatory process and will not be built on the Project site. It will be established in Ignace, though the exact location is still to be determined.
Interest in whether Ignace residents are being directly consulted on the preferred siting of the Centre of Expertise.	Public engagement events will be held in Ignace in coming months to gather public input on the Centre's design (i.e., not the location).

4. General Comments/Notes

Through the Zoom Polls, NWMO received feedback from participants. The questions and responses are summarized below; numbers in brackets indicate the number of respondents who selected that option.

1. **What benefits do you hope this Project could bring for you and/or your community? (Select all that apply)**
    - Infrastructure improvements (3)
    - Long-term employment opportunities (2)
    - Youth engagement opportunities for younger generations (2)
    - Training and skills development programs (2)
    - Funding for community initiatives and services (1)
    - Increased local business opportunities (1)
    - Improved access to science and environmental education (1)

2. **What topics are you most interested in learning about in relation to the Deep Geological Repository Project? (Select all that apply)**
    - Aquatic Environment (fish and fish habitat) (4)
    - Safety, Accidents, and Radiological Considerations (3)
    - Social, Economic and Health (2)
    - Water (1)
    - Land-Based Environment (upland vegetation, wetlands, species at risk) (1)
    - Archaeology and Cultural Heritage (1)
    - Current Land Use – Recreation or Commercial (ex. navigation, hunting, fishing, trapping, visual aesthetics) (1)
    - Atmospheric Environment (air quality, noise, greenhouse gases, climate change) (1)
    - Project Design and Structure (1)
    - Potential Effects (1)

3. **What aspects of the Deep Geological Repository Project are you most concerned about? (Select all that apply)**
    - Long-term safety of storing used nuclear fuel underground (2)
    - Transparency and trust in decision-making and oversight (2)
    - Emergency preparedness and risk management (2)
    - Potential impacts on water sources and the environment (1)
    - Impacts on Indigenous rights, lands, and cultures (1)
    - Effects on local communities, including health and well-being (1)
    - Effects on the economy, tourism, or land use in the area (1)

4. **What else would you like to know about the regulatory process? (Select all that apply)**
    - How can the community be involved within the process (2)
    - More information about the regulatory bodies (2)
    - More information about the key milestones and timelines (1)

5. **Does the What We Heard Summary (in the presentation) do a good job of representing the priorities and concerns that matter to me, at a high level? (Select one)**
    - Fully reflects the concerns and priorities that matter to me (1)
    - Mostly reflects my priorities and concerns (1)
    - Somewhat reflects my priorities (0)
    - Does not reflect my priorities and concerns at all (0)

Appendices

The communication materials and notification are included separately in the appendix to the Consolidated Report.

Webinar Information Session: IPD Engagement Presentation Deck (August 6, 2025, Evening Session)

Engagement Purpose

- To provide community members with a clear overview of the Deep Geological Repository (DGR) Project, including key information about the regulatory process and the Initial Project Description (IPD), helping NWMO to gather important feedback on these topics.
- This session also shares what we've heard from communities so far, discusses baseline environmental and technical studies, and includes a facilitated question and answer session.

2

nwmo

Today's Presentation

What We'll Cover

1. Deep Geological Repository Project Overview
2. Regulatory Process & Initial Project Description
3. What We've Heard
4. Baseline Studies
5. Facilitated Question & Answer Discussion (15mins)

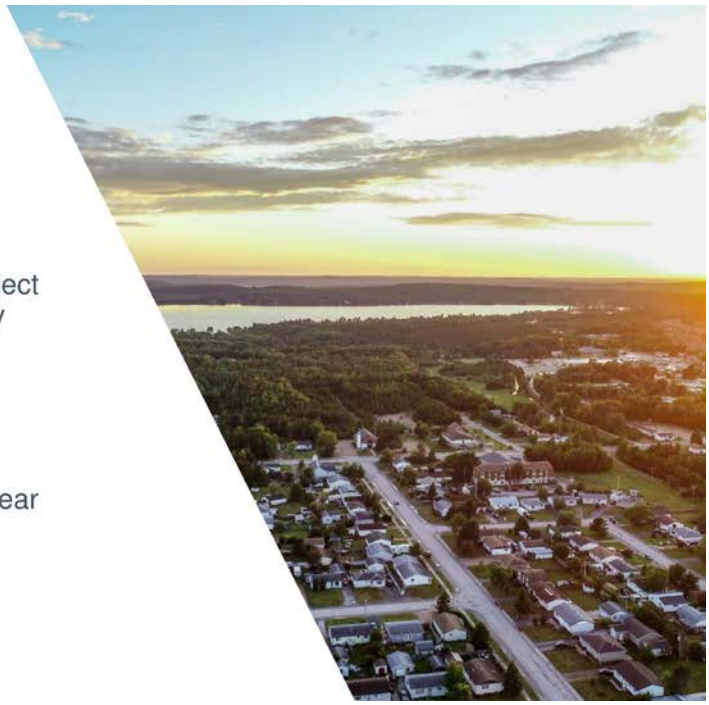
3

Today's Presentation

Goals

- To share information about the project and the next steps in the regulatory process
- Review what we've heard from engagement so far
- Gather feedback and continue to hear about key issues and impacts

4



Zoom Tools

- Please **only** use the chat box for **tech issues**
- Add your questions to the Q&A box as they arise
- Questions will be answered either in writing during the presentation or live during the Q&A portion
- Unanswered questions will be addressed by email in the coming weeks

5

nwmo

Question 1: What are your goals or hopes for today's event? (select all that apply)

- ☐ To learn more about the project, in general
- ☐ To better understand the regulatory process and next steps
- ☐ To share my feedback, priorities, and concerns

6

nwmo

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project – Initial Project Description

August 6, 2025

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Land Acknowledgement

8

About the Deep Geological Repository (DGR) Project

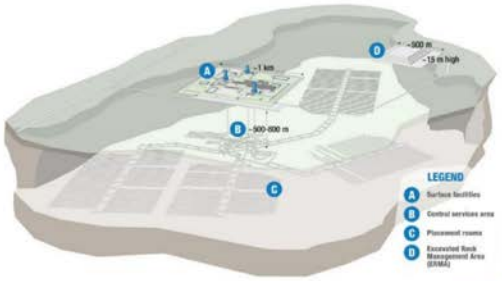
nwmo

NWMO's Proposed Deep Geological Repository (DGR) Project

- **Project Purpose:**
  - Safely contain and isolate **used nuclear fuel**
  - Manage up to **5.9 million used CANDU fuel bundles**

- **Project Name:** Deep Geological Repository for Canada's Used Nuclear Fuel

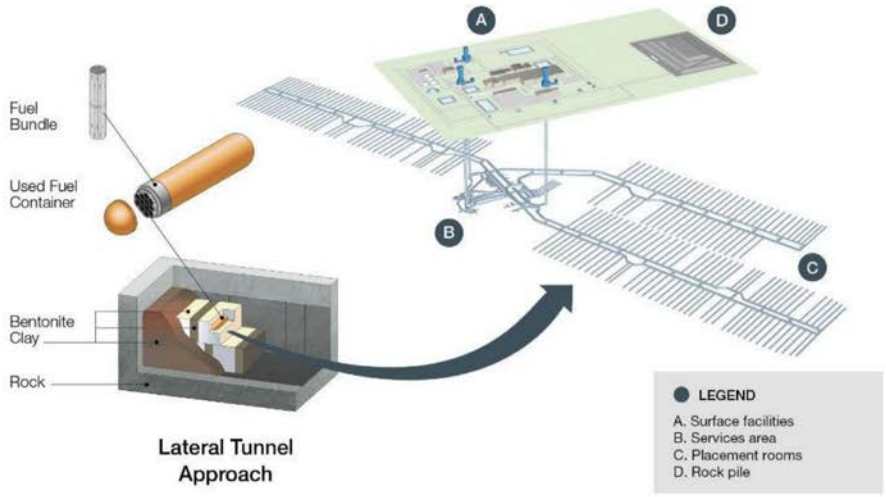
- **Host Communities**:
  - Wabigoon Lake Ojibway Nation (WLON)
  - Township of Ignace



nwmo

10

Deep Geological Repository (DGR) Concept



Lateral Tunnel Approach

11

nwmo

NWMO Site Selection Process for Canada's Used Fuel DGR Project

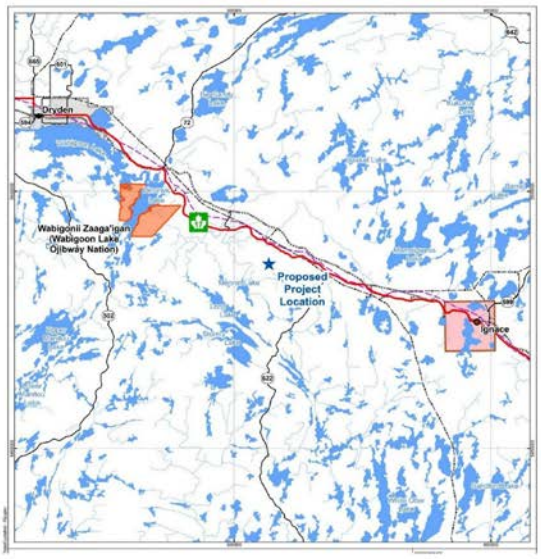
- Safety, transparency, and community engagement
- Evidence-based assessments
- Informed and willing hosts
- Fostering confidence

- Timeline & outcome:
  - **2010**: 22 communities volunteered into the process
  - **2024**: Wabigoon Lake Ojibway Nation (WLON) and the Township of Ignace selected
- The NWMO may now proceed to detailed site characterization and licensing

12

nwmo

Project Location



- Situated within Wabigoon Lake Ojibway Nation territory.

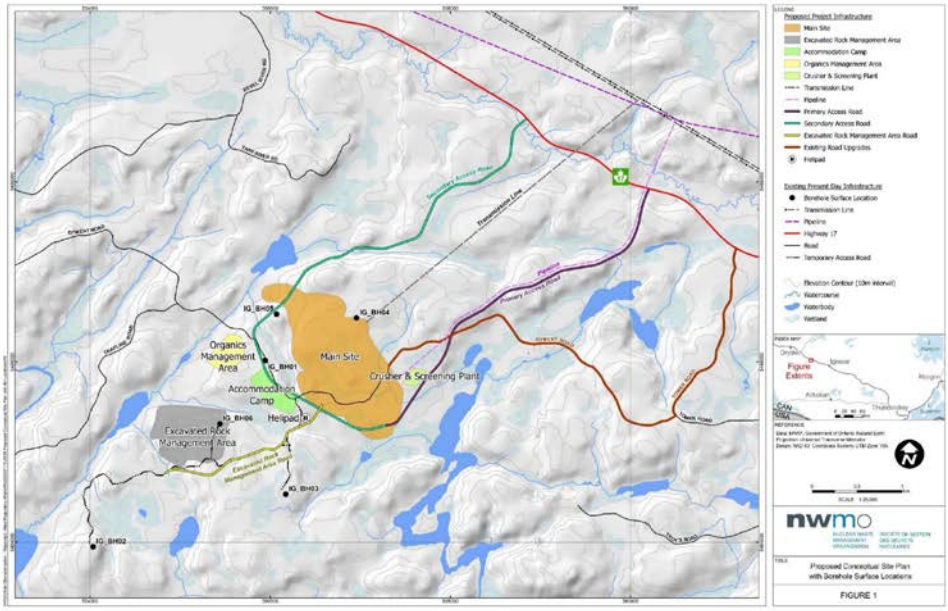
Proposed Site Location:

- ~21 km southeast of WLON Band #157 (approx. 12 km from the nearest WLON resident in Dyment)
- ~43 km northwest of Ignace, Ontario
- Located along Highway 17

nwmo

13

DRAFT Conceptual Site Plan – Surface Facilities



nwmo

14

Project Phases & Planning Timelines

- The implementation of Canada's plan via the DGR Project will span approximately 160 years.
- The Project will operate for approximately 50 years.
- The deep geological repository will be monitored for an extended period before decommissioning, closure and post-closure monitoring.

ASSUMED PROJECT PHASES AND PLANNING TIMELINES

Project phase	Approximate timeline (years)	Phase duration (years)
Site Preparation and Construction	2030-42	13
Operations	2043-92	50
Extended Monitoring, Decommissioning and Closure	2093-2192	100
Institutional Control[1]	2193+	

[1] The control of any risks at a site after decommissioning and closure, including activity like surveillance, maintenance or signs/markers.

15

Key Project Activities Across Project Phases

Site Preparation
- Clearing, grading and levelling the site
- Building shaft complexes and demonstration facility
- Developing non-nuclear infrastructure (ex. utilities, fencing, admin building, road)

Construction
- Complete main shaft and ventilation systems
- Build central services and the Used Fuel Packaging Plant (UFPP)
- Install initial placement panels
- Construct interim storage for intermediate and low-level waste

Operations
- Run the UFPP and begin waste placement
- Excavate new placement rooms and move rock to the management area
- Sort and temporarily store intermediate and low-level waste

Decommissioning and Closure
- Restore the site and rock management area
- Place remaining low-level waste
- Decommission underground structures
- Seal all tunnels and service areas
- Conduct long-term monitoring for safety

nwmo

16

Benefits of the Used Fuel DGR Project

17

nwmo

Question 2: What benefits do you hope this project could bring for you and/or your community? (Select all that apply)

- ☐ Long-term employment opportunities
- ☐ Training and skills development programs
- ☐ Infrastructure improvements
- ☐ Increased local business opportunities
- ☐ Youth engagement and future opportunities for younger generations
- ☐ Funding for community initiatives and services
- ☐ Improved access to science and environmental education

18

nwmo

Question 3: What topics are you most interested in learning about in relation to the Deep Geological Repository Project? (Select all that apply)

- ☐ Water
- ☐ Social Environment (health, well-being, economic conditions, social services, and jobs)
- ☐ Archaeology and Cultural Heritage
- ☐ Current Land Use – Recreation or Commercial (ex. navigation, hunting, fishing, trapping, visual aesthetics)
- ☐ Terrestrial Environment (upland vegetation, wetlands, species at risk)
- ☐ Aquatic Environment (fish and fish habitat)
- ☐ Atmospheric Environment (air quality, noise, greenhouse gases, climate change)
- ☐ Potential Effects
- ☐ Project Design and Structure
- ☐ Safety, Accidents, and Radiological Considerations

19

nwmo

Question 4: What aspects of the Deep Geological Repository Project are you most concerned about? (Select all that apply)

- ☐ Long-term safety of storing used nuclear fuel underground
- ☐ Potential impacts on water sources and the environment
- ☐ Effects on local communities, including health and well-being
- ☐ Impacts on Indigenous rights, lands, and cultures
- ☐ Transparency and trust in decision-making and oversight
- ☐ Effects on the economy, tourism, or land use in the area
- ☐ Emergency preparedness and risk management

20

nwmo

About the Regulatory Process & Initial Project Description (IPD)

nwmo

A Site Has Been Selected – Now What?

- The Project will now prepare to enter the Regulatory Decision-Making stage.
- This means entering an **Impact Assessment** (IA) by the federal government.
- IAs are led by the **Impact Assessment Agency of Canada** (IAAC).
- This IA will be integrated with nuclear licensing and therefore include the **Canadian Nuclear Safety Commission** (CNSC).

22

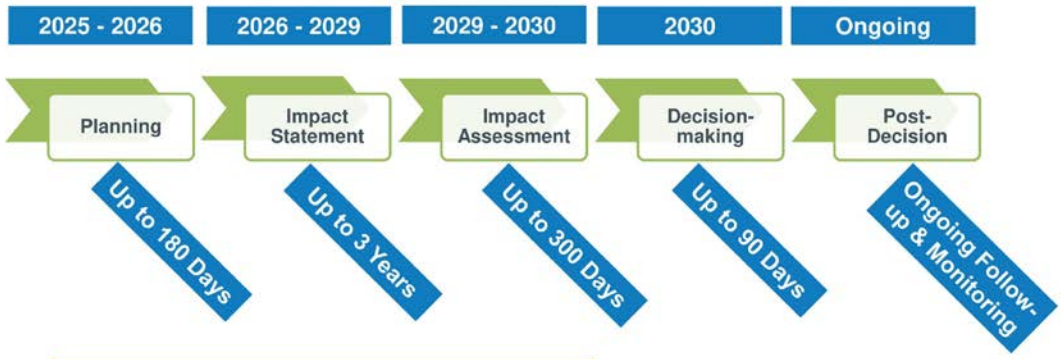
nwmo

Regulatory Oversight of the Project

23

nwmo

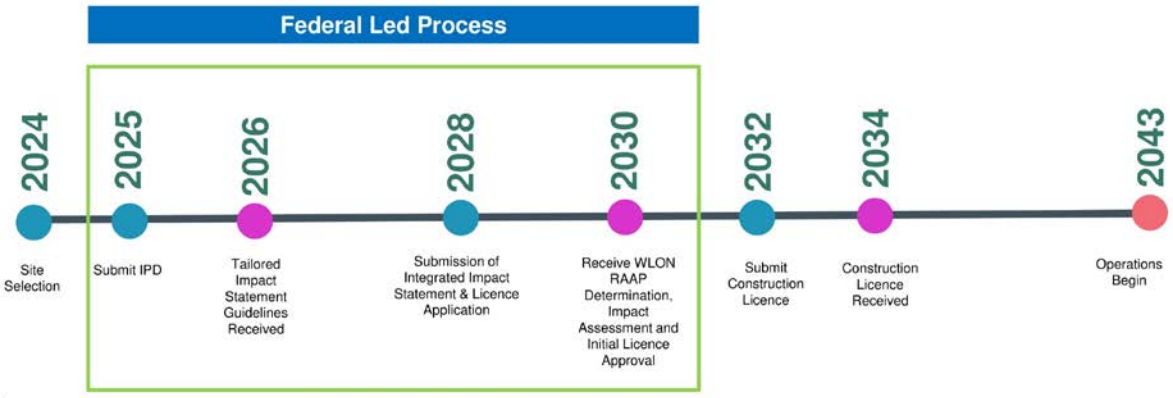
Steps in the Federal Led Impact Assessment Process



24

nwmo

NWMO Regulatory Milestones & Timelines



25

nwmo

Initial Project Description

- Submitted by the Project proponent (NWMO) to the IAAC
- Explains what the project is, where it is, and what it might affect
- Documents potential community concerns and areas where more study will be completed
- Includes plans for future regulatory engagement including communications and participation
- Guides IAAC development of the Tailored Impact Statement Guidelines specific for the Project
- **Formally starts the regulatory process when posted to IAAC's website.**

26

nwmo

Question 5: What else would you like to know about the regulatory process? (Select all that apply)

- ☐ How can the community be involved within the process
- ☐ More information about the regulatory bodies
- ☐ More information about the key milestones and timelines

27

nwmo

What We've Heard To-Date

nwmo

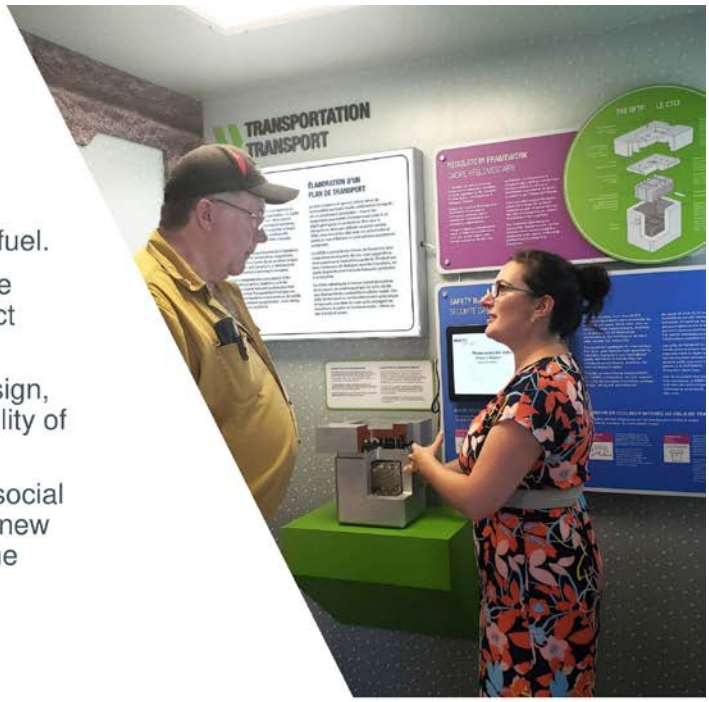
Public and Interested Parties Engagement

- We continue to engage extensively with the public and interested parties, including:
  - municipalities
  - businesses
  - service providers
  - environmental organizations
- In the IPD, we summarize What We've Heard for key themes and concerns during this engagement to date.
- You can help us by reviewing and providing feedback on these themes.

29

Protection of Human Health and Safety

- Concerns about radioactivity, and potential contamination from used fuel.
- Safety apprehensions regarding the long-term management, and Project execution.
- Concerns about surface facility design, monitoring systems, and the reliability of storage methods.
- Impact on the regional health and social service systems to prepare for the new families the project will bring into the area.



30

Protection of the Natural Environment

- Design of water management systems.
- Isolation of used fuel and protection of the environment.
- Environmental impacts on water, land, and wildlife from noise pollution and traffic.
- Vulnerability to natural disasters and extreme events.
- Energy and water footprints.
- Suitability of rock type to host a repository

31

Social Conditions and Community Infrastructure

- Housing shortage and increased demand for other infrastructure and services;
- Local benefits, infrastructure, and job creation;
- Youth challenges, opportunities and retention;
- Education and training for community readiness;
- Population growth/fluctuation impacts on resources, services and social conditions.

32

Economic Conditions

- Economic development, urban revitalization and risks and opportunities for local businesses; and
- New business opportunities and employment after site selection.

nwmo

33

Question 6: Does the What We Heard Summary do a good job of representing the priorities and concerns that matter to me, at a high level?

- ☐ Yes, it fully reflects the concerns and priorities that matter to me. I have nothing to add.
- ☐ The summary mostly reflects my priorities and concerns. I have a couple things to add.
- ☐ The summary somewhat reflects my priorities and concerns. I have several things to add.
- ☐ The summary does not reflect my priorities and concerns at all.

nwmo

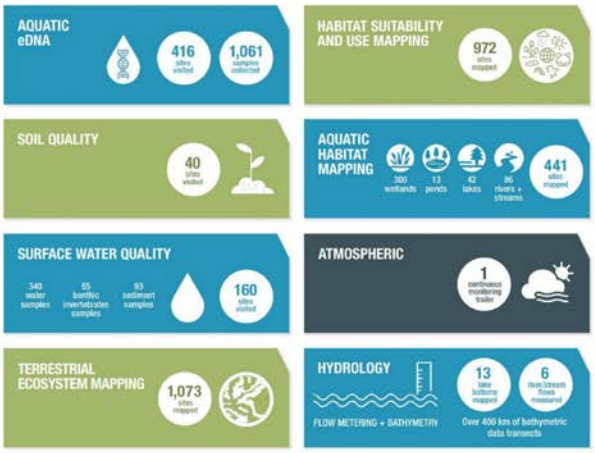
34

Understanding Baseline Information

nwmo

Project Highlights: Baseline Environment

- Baseline environment information is collected and used in assessment and design planning before approval can be given.
- NWMO has studied the regional geology of the site since 2010.
- Environmental studies in the area have been ongoing since 2014.
- Working with community, data collection will continue throughout the impact assessment and regulatory process.



This figure presents some of the baseline information gathered about the proposed Project site.

36

Project Highlights: Baseline Socioeconomic and Health

Socio-economic reporting is required every three years under the *Nuclear Fuel Waste Act* and includes potential impacts on various components, including:

- Community way of life
- Social aspirations
- Cultural aspirations
- Economic aspirations

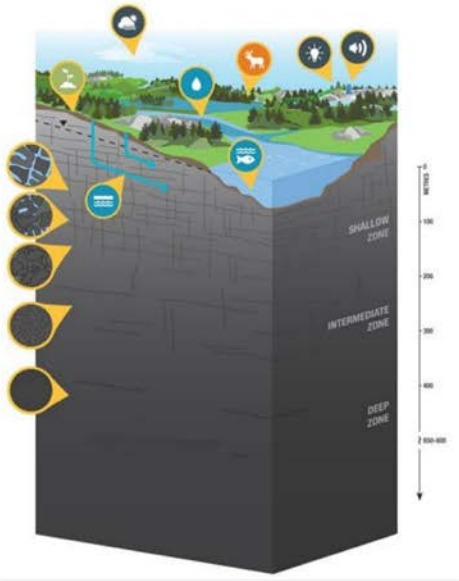
Under the Impact Assessment process, the NWMO is also required to assess social, economic, health, and Indigenous Rights impacts.

37

nwmo

How Baseline Information is Used in the Regulatory Process

- Baseline studies collect information on environmental and social conditions before a project begins
- Baseline information creates a reference point to assess future changes and impacts on people and the environment and identify ways to avoid, reduce or manage them
- Baseline study results are used to inform design
- The IPD summarizes baseline information collected to date and uses it to complete a preliminary screening assessment of potential project impacts and propose potential mitigation



38

nwmo

Project Activities with Potential Impacts on Environmental, Socioeconomic or Health Components

- Land clearing and grubbing
- Blasting and excavation
- Site security and access management
- Development and operations of surface facilities, the DGR, worker accommodation camp, the Excavated Rock Management Area (ERMA)
- Materials handling
- Vehicle traffic
- Site water management

39

nwmo

How are Effects Assessed?

- Identify an environmental, socioeconomic or health component
- How does that component interact with the Project, through what pathways?
- What mitigations can we implement to minimize the effect?
- Is there still an effect after the mitigation is applied?
- Follow-up monitoring

nwmo

Wrap-up

What to Expect Next

- After IPD is posted on the IAAC registry, engagement from the regulators will begin
- Community members can provide comments online or at IAAC / CNSC events
- IAAC will provide NWMO with a Summary of Issues which NWMO responds to
- IAAC / CNSC create draft Tailored Impact Statement Guidelines (TISGs)
- IAAC / CNSC engage on TISGs in community
- IAAC posts the guidelines

The Journey Continues

- We intend to submit the IPD in Fall 2025, which will formally kickstart the regulatory process.
- Review the summary IPD at nwmo.ca/PlanningWithYou
- Share your feedback on the key themes and concerns shared through engagement to date
  - What would you add?
  - What are your values and priorities?
  - What questions are on your mind?

43

How to Engage With Us!

You can submit comments to:

RegulatoryFeedback@nwmo.ca

nwmo.ca/contact-us on our website

Comments will also be accepted by mail addressed to:

NWMO — IPD summary feedback
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3
Comments are accepted until Friday, Aug. 22, 2025.

For more information please visit:

NWMO.ca/PlanningWithYou

nwmo

44

Q&A Opportunity

45

nwmo

Thank you.

@nwmocanada / @LaSGDN

/company/nwmocanada

www.nwmo.ca

What We Heard - IPD Engagement Report: Dryden Drop-in Information Session- August 12, 2025

1. Introduction

This event was held at the Dryden Native Friendship Center in Dryden. The primary purpose of this drop-in engagement was to provide community members with a clear overview of the Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project ("the Project"), the upcoming regulatory process, and the Initial Project Description (IPD), helping NWMO refine the draft IPD by gathering valuable feedback on potential impacts and issues.

NWMO staff were available for in-depth conversations with participants, who walked around the room visiting display boards with Project and process information. They were also invited to provide feedback via post-it notes and a written survey. The session was an opportunity to connect one-on-one with Dryden community members, answer their questions, and share Project background to improve overall awareness and understanding.

2. Engagement Process

Notifications

NWMO's communications campaign effectively raised awareness of engagement activities, with over 2.2 million impressions tthroughout Ignace, Dryden, and the surrounding areas over 23 days (note: "Impressions" are a standard measurement in communications. They indicate the combined reach of the advertising, social and household campaign).

Communication objectives were two-fold:

1. Raise awareness about upcoming collaboration activities by the NWMO to inform the IPD.
2. Drive participation in the IPD community collaboration activities.

Communication methods included the following:

- Media briefing with five journalists covering news outlets with operations covering northwestern Ontario
- Household mailer to 5,500 households in Ignace, Dryden and the surrounding area
- 70 posters in Ignace, Dryden and surrounding areas
- Digital display ad campaign in the region, reaching each person an average of 10.8 times in the campaign window
- Supporting social media posts on Facebook, Instagram and X (i.e. formerly known as Twitter)
- Paid Facebook advertisements ran for five days in advance of the Dryden information sessions

Event Information & Attendance

Event	IPD Engagement Event - Dryden Drop-in Information Session
Date	August 12, 2025
Time	3:00pm – 5:00pm CDT
Location	Dryden Native Friendship Center
Number of Attendees	9

3. Summary of Issues and Areas of Interest

The Dryden drop-in event was a constructive, informal session that led to in-depth conversations between NWMO staff and attendees. Several participants referenced historical mercury contamination in the area and broader trust concerns, while others expressed confidence in the local rock formation and interest in international examples. Among those who attended the drop-in, there was a health care professional, a member of a civic organization, and two members of the local business community.

Issue	NWMO Response
Transportation	
Participants asked how often shipments occur (citing conflicting figures of 2 vs. 45 trucks per day), raised concerns about driver exposure, women's and public safety, accident scenarios (e.g., PCB incident comparisons), and asked about package testing and program requirements.	The transportation of used nuclear fuel is a highly regulated process which must follow specific regulatory requirements. Used fuel must be transported in certified packages designed to withstand severe accident conditions without breach. A unique license to transport issued by the regulator is required for each shipment. Real-time tracking, security escorts, a transportation security plan, driver training, and emergency preparedness are also required by regulation. For security reasons, regulatory requirements dictate that the transport routes be kept confidential. A truck carrying used fuel is roughly the same size and weight as a logging truck, well within the existing design capacity of the highway. During operations, the NWMO anticipates two to three used fuel shipments arriving at the repository site per day, six days per week, nine months per year. This represents a fraction of a per cent increase in traffic volumes on the TransCanada Highway. The one to three months of transportation downtime allows accommodation for weather conditions, and other road closures.

Issue	NWMO Response
Seismic Activity	
Participants raised questions about seismic risk and how it is accounted for in design and safety assessments.	Seismic design and safety-case analyses address credible seismic scenarios to confirm facility performance. Seismic risk will also be considered in the Impact Statement as part of the evaluation of potential accident and malfunction scenarios.
Water	
Questions focused on whether the watershed (Wabigoon River/Lake) is at risk and how groundwater moves through the host rock formation.	The potential impacts on groundwater and surface water will be assessed in the Impact Statement. Safety relies on a multiple-barrier system and the surrounding rock formation. Groundwater flow and related factors are characterized through studies and monitoring; results inform design and mitigation to protect the watershed.
Worker Accommodations and Camp Location	
An attendee proposed building "residences" - hotel-style accommodations in Ignace and Dryden (with future conversion to hotel use). Participants asked about the Ignace airport and transportation between communities; approximately 430 construction workers were referenced as needing hotel accommodation.	Options such as potential hotel partnerships, future conversion, airport use, and workforce transportation will be taken into consideration over the next steps of the Project (outside of the regulatory process).
Local Employment & Training	
Participants asked how many jobs the Project brings overall and in transportation specifically, and what training requirements apply.	Training and qualifications must meet regulatory standards (including Canadian Nuclear Safety Commission (CNSC) and Transport Canada-related requirements). The Project will provide several hundred jobs: the NWMO's current forecast for job estimates are

Issue	NWMO Response
	200 direct jobs in pre-construction, 640 during construction and 700 for ongoing operations.
Scope and Project Elements	
Community members asked whether the Centre of Expertise (CoE) will be in Ignace. When design engagement starts, whether Intermediate Level Waste (ILW) affects the Impact Assessment, and whether the Project could include international waste.	The CoE is separate from the formal regulatory process and will not be built on the Project site. It will be established in Ignace, though the exact location is still to be determined. The Project scope covers Canada's used nuclear fuel. While it is technically feasible to store ILW within the proposed DGR, this is not the intent of the current Project for now. The Project will not be including international waste. Accepting international waste would require a change in mandate and approvals.
Boreholes	
Question about the depth of boreholes at the Project site.	Six, one-kilometer-long boreholes in the Revell Batholith (i.e., the host rock formation) were drilled between 2017 and 2021.
Regulatory Process	
Community members raised concerns about regulator independence, and the roles of the Impact Assessment Agency of Canada (IAAC) and the CNSC.	Roles for IAAC and the CNSC are defined in federal legislation. These are the *Impact Assessment Act* (2019) and the *Nuclear Safety and Control Act* (1997).

4. General Comments/Notes

Participants were encouraged to complete a feedback form, providing input on the event through several survey questions.

Participant feedback on the event itself was very positive, highlighting interactions with approachable and knowledgeable staff, valuable map graphics, and clarity of explanations. They valued the ability to engage directly with NWMO team members in an accessible venue and format. For future events, some highlighted the need for broader community outreach and communication so that more community members could engage.

A summary of responses to the three survey questions is provided below; the numbers in brackets indicate the number of respondents who selected that option.

- **What topics are you most interested in learning about in relation to the Deep Geological Repository Project?**
    - Social, Economic and Health (4)
    - Water (3)
    - Archaeology and Cultural Heritage (3)
    - Safety, Accidents, and Radiological Considerations (3)
    - Atmospheric Environment (air quality, noise, greenhouse gases, climate change) (2)
    - Current Land Use – Recreation or Commercial (ex. navigation, hunting, fishing, trapping, visual aesthetics) (2)
    - Project Design and Structure (2)
    - Potential Effects (2)
    - Aquatic Environment (2)
    - Land-Based Environment (upland vegetation, wetlands, species at risk) (2)
- **What aspects of the Deep Geological Repository Project are you most concerned about?** (Select all that apply)
    - Potential impacts on water sources and the environment (3)
    - Emergency preparedness and risk management (3)
    - Impacts on Indigenous rights, lands, and cultures (3)
    - Long-term safety of storing used nuclear fuel underground (3)
    - Transparency and trust in decision-making and oversight (3)
    - Effects on the economy, tourism, or land use in the area (3)
    - Effects on local communities, including health and well-being (2)

- **What benefits do you hope this Project could bring for you and/or your community?** (Select all that apply)
    - Long-term employment opportunities (4)
    - Infrastructure improvements (4)
    - Youth engagement opportunities for younger generations (4)
    - Funding for community initiatives and services (4)
    - Increased local business opportunities (4)
    - Training and skills development programs (4)
    - Improved access to science and environmental education (3)

Appendices

The communication materials and notification are included separately in the appendix to the Consolidated Report.

What We Heard - IPD Engagement Report: IPD Feedback Workshop - August 12, 2025

1. Introduction

This event was held at the NWMO "Learn More Centre" in Ignace. The primary purpose of this engagement was to provide community members with a clear overview of the Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project ("the Project"), the upcoming regulatory process, and the Initial Project Description (IPD), helping NWMO refine the draft IPD by gathering valuable feedback on potential impacts and issues.

In this session, NWMO reviewed a summary of priorities and concerns shared through previous engagement activities, provided information about baseline studies, and included an opportunity for participants to ask questions. After an initial presentation and brief discussion, participants were divided into groups for a small group exercise, where they delved deeper into the key "What We Heard" themes in the draft IPD. Groups captured their ideas on flipchart and sticky notes; following this, they used stickers to prioritize their top area of interest or concern for each theme.

2. Engagement Process

Notifications

The IPD Feedback Workshop was held on an invite-only basis. Drawing on NWMO's previous experience with working groups during the site-selection process, NWMO staff developed a participant list identifying key local leaders, community members that have closely followed the Project and subject-matter experts ("invitees") for the Ignace IPD Feedback Workshop to delve deeper into key sections and topics of interest within the IPD. Participants were invited to one of the two IPD feedback workshop meetings held over the summer (August 12 and August 21, 2025). These invitees were selected due to their history of engaging on the Project and their unique position as local and regional experts in fields relevant to the Project.

Event Information & Attendance

Event	IPD Engagement Event: IPD Feedback Workshop
Date	August 12, 2025
Time	9:30-11:30am CDT
Location	NWMO Learn More Centre, Ignace
Number of Attendees	6

3. Summary of Issues and Areas of Interest

The session was attended in person by a small group of invited Ignace community leaders, most of whom were extensively engaged in learning about the Project and site selection process. Participants came from different backgrounds including small business, emergency services, and local service clubs and community organizations.

While there were some conversations about direct Project considerations, most of the conversation focused on **community economic development**, the **Hosting Agreement**, and **social pressures** from likely population growth.

Issue	NWMO Response
Accommodation Camp Location	
Participants asked whether Ignace could lobby to host the accommodation camp within town limits. They highlighted that placing the camp in Ignace would not only create immediate economic benefits—such as local spending, job creation, and support for businesses—but also improve access to emergency and health services for workers. Some noted that hosting the camp in town would strengthen Ignace's role in the Project and help ensure that benefits are not disproportionately realized by neighbouring communities.	The location of the camp has not yet been determined. Several options remain under review. Community input may help inform the decision, and discussions with municipal and regional partners will continue before a final location is selected.
Site Preparation and Licensing	
Residents sought clarification on whether any site preparation or early construction could begin before a licence and/or permits are obtained, enabling the community to start seeing immediate benefits from the Project.	Site preparation and construction cannot begin until the coordinated regulatory process is completed and the Canadian Nuclear Safety Commission (CNSC) issues the required licence.
Centre of Expertise Location and Role	
Participants asked if the location for the Centre of Expertise (CoE) had been chosen. They stressed that the CoE should not only support research and regulatory functions but also serve as a community hub, integrating cultural, educational, and tourism opportunities - such as housing the library, providing meeting and recreational spaces, and potentially being located on Agimak Lake to attract visitors.	The CoE is separate from the formal regulatory process and will not be built on the Project site. It will be established in Ignace, though the exact location is still to be determined. Public engagement events will be held in Ignace in the coming months to gather public input on the Centre's design.

Issue	NWMO Response
Road Safety and Transportation of Used Fuel	
Participants pointed to current safety risks on highways due to heavy truck traffic and emphasized the need for highway expansion or safety improvements. They also asked how decisions would be made on whether to transport used nuclear fuel by road, rail, or a combination of both.	The transportation of used nuclear fuel is a highly regulated process which must follow specific regulatory requirements. Used fuel must be transported in certified packages designed to withstand severe accident conditions without breach. A unique license to transport issued by the regulator is required for each shipment. Real-time tracking, security escorts, a transportation security plan, driver training, and emergency preparedness are also required by regulation. For security reasons, regulatory requirements dictate that the transport routes be kept confidential. A truck carrying used fuel is roughly the same size and weight as a logging truck, well within the existing design capacity of the highway. During operations, the NWMO anticipates two to three used fuel shipments arriving at the repository site per day, six days per week, nine months per year. This represents a fraction of a per cent increase in traffic volumes on the TransCanada Highway. The one to three months of transportation downtime allows accommodation for weather conditions, and other road closures.
Low and Intermediate-Level Waste	
Participants asked whether the low and intermediate-level waste produced by the DGR would be stored on site.	The low and intermediate-level waste will be stored onsite during operations. Just prior to closure, the low-level waste will be placed underground in the DGR for permanent storage while the intermediate-level waste will be shipped offsite to another storage facility.

4. General Comments/Notes

Participants were divided into groups for a small group exercise, where they delved deeper into the key "What We Heard" themes in the draft IPD. Groups captured their ideas on flipcharts and sticky notes – these comments are captured below.

- Concerns that spin-off economic benefits will primarily go to Dryden as the larger nearby centre.

- A desire to revisit governance mechanisms, noting a loss of community ownership and trust as local committees were disbanded.
- Concerns about shortages in housing, particularly seniors' care and housing, as well as the need for infrastructure renewal (including sewer, water, waste disposal, banking, and school facilities). They noted that population growth related to the Project would increase pressure on these systems and require proactive planning.
- Concerns about whether local emergency and health services could keep pace with Project-related growth, highlighting the need for expanded paramedic coverage, a permanent doctor, an upgraded community health centre, a new fire hall, and training specific to nuclear emergency scenarios.
- Participants expressed frustration with the limited economic opportunities tied to the current Hosting Agreement, noting a perceived imbalance in benefits between Ignace and neighbouring communities. They called for stronger economic strategies, such as attracting new industries, developing a container manufacturing facility, ensuring the camp is located in town, and for rebuilding pride in the project through the Hosting Agreement.
- Concern around potential environmental impacts from population growth, including on Agimak Lake and local wildlife populations.
- The importance of improving communication so that NWMO's contributions to the Ignace community are more visible.
- Opportunities for the Centre of Expertise to serve as a tourism destination and cultural hub.

Following their group discussions, participants identified their individual priorities for each of the What We Heard themes. The numbers in brackets below indicate how many participants selected that individual sub-topic as their top priority. Wording is directly taken from the small groups' written contributions.

- **Protection of Human Health and Safety:**
    - Health care investments and impacts (2)
    - Transportation methods and highway safety (2)
- **Protection of the Natural Environment:**
    - No significant concerns (3)
    - Transportation (1)
- **Social Conditions and Community Infrastructure**
    - Infrastructure updates, including seniors' housing, sewer/water/waste, new businesses (2)
    - Centre of Expertise co-location with community services (1)
    - Municipal governance (1)
- **Economic Conditions:**
    - Economic development strategy (2),
    - Lobbying for the accommodation camp, container manufacturing plant and Centre of Expertise (2)

Appendices

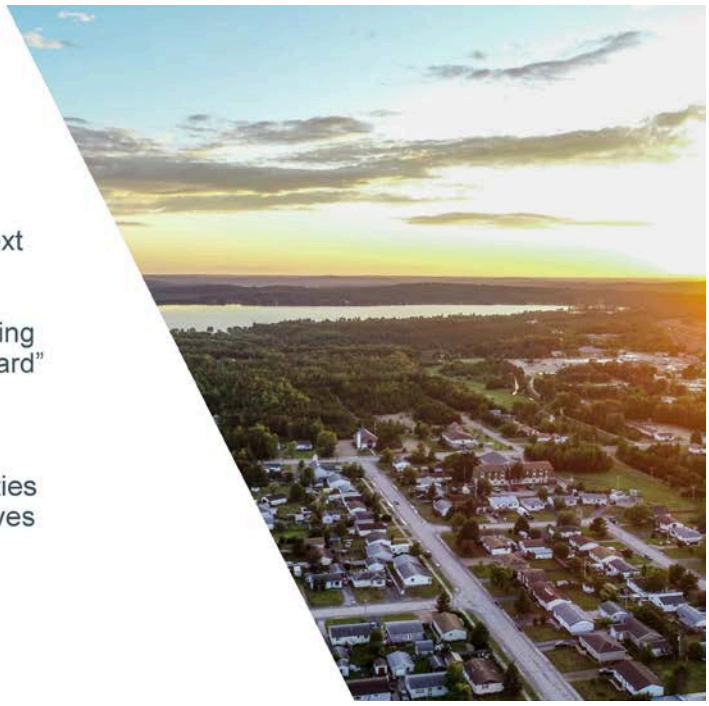
-

The communication materials and notification are included separately in the appendix to the Consolidated Report.

IPD Feedback Workshop: IPD Engagement Presentation Deck (August 12, 2025)

Purpose and Goals

- To provide a brief update on the next steps in the regulatory process
- To involve you in reviewing, validating and deepening the “what we’ve heard” summary for the Initial Project Description
- To clarify and expand on key priorities and concerns, from your perspectives as community representatives



3

Other Upcoming Engagement

- Engagement opportunities expected in Fall 2025, outside of DGR Project Regulatory process
  - Centre of Expertise
  - Transportation
  - Intermediate and High-Level Waste

4

Today's Agenda

Time	Activity	Estimated Length
9:30am	Welcome and Introductions	15 minutes
9:45am	Presentation: Update and Regulatory Process Overview	30 minutes
10:15am	Breakout Group Activity: What We Heard – Deep Dive	45 minutes
11:00am	Prioritization and Discussion	15 minutes
11:15am	Q&A	15 minutes
11:30am	Adjourn Lunch and Casual Conversations	

5

nwmo

Introductions

- Roundtable
  - Name
  - One highlight of your summer so far
  - The "hats" you are wearing today

6

Guiding Principles

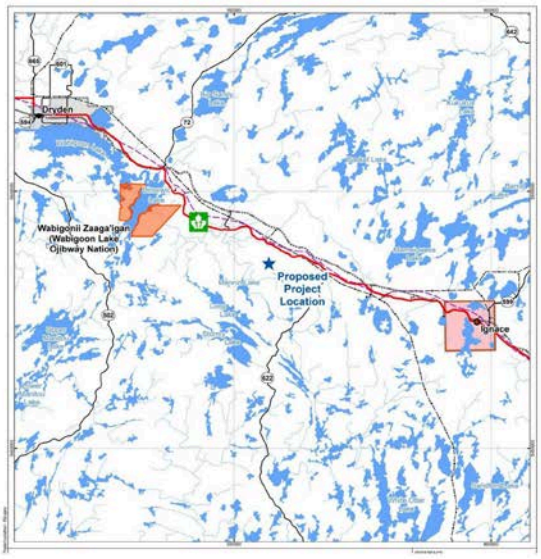
- Listen actively and be curious
- Have respectful conversations
- Hear from all voices - “3 before me”
- Tackle problems, not people

7

About the Deep Geological Repository (DGR) Project

nwmo

Project Location



- Situated within Wabigoon Lake Ojibway Nation territory.

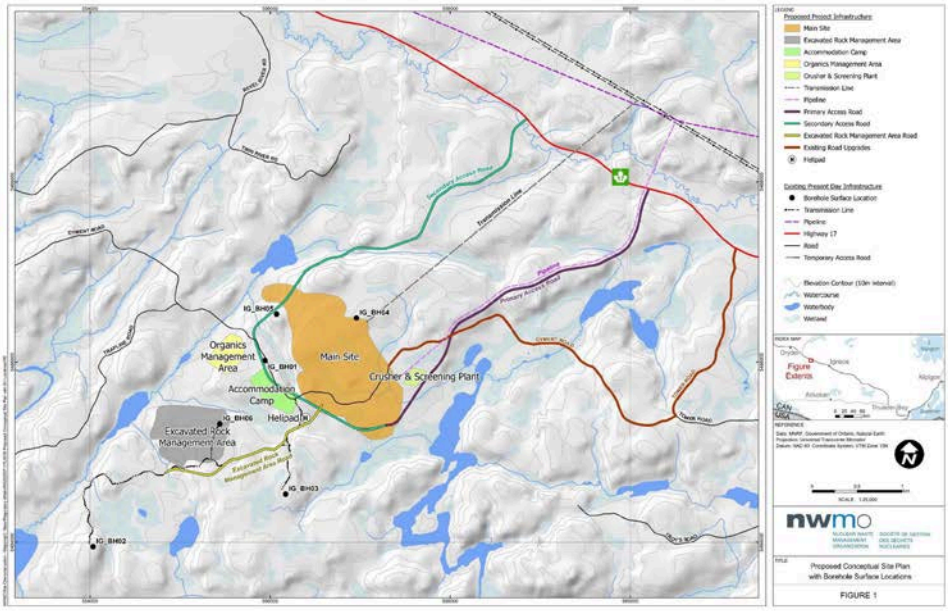
Proposed Site Location:

- ~21 km southeast of WLON Band #157 (approx. 12 km from the nearest WLON resident in Dyment)
- ~43 km northwest of Ignace, Ontario
- Located along Highway 17

nwmo

9

DRAFT Conceptual Site Plan – Surface Facilities



nwmo

10

Project Phases & Planning Timelines

- The implementation of Canada's plan via the DGR Project will span approximately 160 years.
- The Project will operate for approximately 50 years.
- The deep geological repository will be monitored for an extended period before decommissioning, closure and post-closure monitoring.

11

ASSUMED PROJECT PHASES AND PLANNING TIMELINES

Project phase	Approximate timeline (years)	Phase duration (years)
Site Preparation and Construction	2030-42	13
Operations	2043-92	50
Extended Monitoring, Decommissioning and Closure	2093-2192	100
Institutional Control[1]	2193+	

[1] The control of any risks at a site after decommissioning and closure, including activity like surveillance, maintenance or signs/markers.

Key Project Activities Across Project Phases

Site Preparation
- Clearing, grading and levelling the site
- Building shaft complexes and demonstration facility
- Developing non-nuclear infrastructure (ex. utilities, fencing, admin building, road)

Construction
- Complete main shaft and ventilation systems
- Build central services and the Used Fuel Packaging Plant (UFPP)
- Install initial placement panels
- Construct interim storage for intermediate and low-level waste

Operations
- Run the UFPP and begin waste placement
- Excavate new placement rooms and move rock to the management area
- Sort and temporarily store intermediate and low-level waste

Decommissioning and Closure
- Restore the site and rock management area
- Place remaining low-level waste
- Decommission underground structures
- Seal all tunnels and service areas
- Conduct long-term monitoring for safety

12

nwmo

Initial Project Description

- Submitted by the Project proponent (NWMO) to the IAAC
- Explains what the project is, where it is, and what it might affect
- Documents potential community concerns and areas where more study will be completed
- Includes plans for future regulatory engagement including communications and participation
- Guides IAAC development of the Tailored Impact Statement Guidelines specific for the Project
- **Formally starts the regulatory process when posted to IAAC's website**.

13

nwmo

Project Activities with Potential Impacts on Environmental, Socioeconomic or Health Components

- Land clearing and grubbing
- Blasting and excavation
- Site security and access management
- Development and operations of surface facilities, the DGR, worker accommodation camp, the Excavated Rock Management Area (ERMA)
- Materials handling
- Vehicle traffic
- Site water management

14

nwmo

How are Effects Assessed?

- Identify an environmental, socioeconomic or health component
- How does that component interact with the Project, through what pathways?
- What mitigations can we implement to minimize the effect?
- Is there still an effect after the mitigation is applied?
- Follow-up monitoring

nwmo

What We've Heard To-Date

nwmo

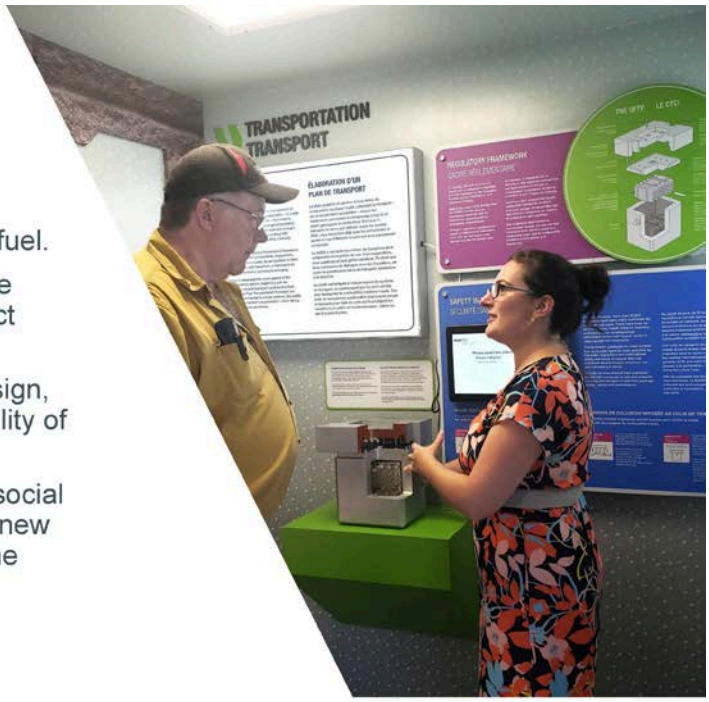
Public and Interested Parties Engagement

- We continue to engage extensively with the public and interested parties, including:
  - municipalities
  - businesses
  - service providers
  - environmental organizations
- In the IPD, we summarize What We've Heard for key themes and concerns during this engagement to date.
- You can help us by reviewing and providing feedback on these themes.

17

Protection of Human Health and Safety

- Concerns about radioactivity, and potential contamination from used fuel.
- Safety apprehensions regarding the long-term management, and Project execution.
- Concerns about surface facility design, monitoring systems, and the reliability of storage methods.
- Impact on the regional health and social service systems to prepare for the new families the project will bring into the area.



18

Protection of the Natural Environment

- Design of water management systems.
- Isolation of used fuel and protection of the environment.
- Environmental impacts on water, land, and wildlife from noise pollution and traffic.
- Vulnerability to natural disasters and extreme events.
- Energy and water footprints.
- Suitability of rock type to host a repository

19

Social Conditions and Community Infrastructure

- Housing shortage and increased demand for other infrastructure and services;
- Local benefits, infrastructure, and job creation;
- Youth challenges, opportunities and retention;
- Education and training for community readiness;
- Population growth/fluctuation impacts on resources, services and social conditions.

20

Economic Conditions

- Economic development, urban revitalization and risks and opportunities for local businesses; and
- New business opportunities and employment after site selection.

nwmo

Facilitated Activity & Discussion

nwmo

Process

- Form two groups of 3-4
- Review the What We Heard Posters & key themes from IPD Engagement so far
- Visit each board
- Discuss and capture notes on flipchart/sticky notes
- Build upon the previous group's comments
- Report-back and discussion

nwmo

Wrap-up

nwmo

What to Expect Next

- After IPD is posted on the IAAC registry, engagement from the regulators will begin
- Community members can provide comments online or at IAAC / CNSC events
- IAAC will provide NWMO with a Summary of Issues which NWMO responds to
- IAAC / CNSC create draft Tailored Impact Statement Guidelines (TISGs)
- IAAC / CNSC engage on TISGs in community
- IAAC posts the guidelines

25

nwmo

The Journey Continues

- We intend to submit the IPD in Fall 2025, which will formally kickstart the regulatory process.
- Review the summary IPD at nwmo.ca/PlanningWithYou
- Share your feedback on the key themes and concerns shared through engagement to date
  - What would you add?
  - What are your values and priorities?
  - What questions are on your mind?

26

How to Engage With Us!

You can submit comments to:

RegulatoryFeedback@nwmo.ca

nwmo.ca/contact-us on our website

For more information please visit:

NWMO.ca/PlanningWithYou

Comments will also be accepted by mail addressed to:

NWMO — IPD summary feedback
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3
Comments are accepted until Friday, Aug. 22, 2025.

27

nwmo

Q&A

28

nwmo

Thank you.

@nwmocanada / @LaSGDN

/company/nwmocanada

www.nwmo.ca

What We Heard - IPD Engagement Report: Dryden Information Session- August 13, 2025

1. Introduction

This event was held at the Dryden Regional Training and Cultural Centre and was open to the public. The NWMO gave a presentation followed by a Q&A session while Mokwateh facilitated the event and discussion.

The primary purpose of this Information Session was to provide community members with a clear overview of the Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project ("the Project"), the upcoming regulatory process, and the Initial Project Description (IPD), helping NWMO refine the draft IPD by gathering valuable feedback on potential impacts and issues.

This session also reviewed a summary of priorities and concerns shared through previous engagement activities, provided information about baseline studies, and included an opportunity for participants to ask questions. Attendees could provide feedback by answering questions on the interactive Mentimeter survey platform during the presentation.

2. Notifications

NWMO's communications campaign effectively raised awareness of engagement activities, with over 2.2 million impressions throughout Ignace, Dryden, and the surrounding areas over 23 days (note: "Impressions" are a standard measurement in communications. They indicate the combined reach of the advertising, social and household campaign).

Communication objectives were two-fold:

1. Raise awareness about upcoming collaboration activities by the NWMO to inform the IPD.
2. Drive participation in the IPD community collaboration activities.

Communication tactics included the following:

- Media briefing with five journalists covering news outlets with operations covering northwestern Ontario
- Household mailer to 5,500 households in Ignace, Dryden and the surrounding area
- 70 posters in Ignace, Dryden and surrounding areas
- Digital display ad campaign in the region, reaching each person an average of 10.8 times in the campaign window
- Supporting social media posts on Facebook, Instagram, LinkedIn and X (i.e. the platform formerly known as Twitter)
- Paid Facebook advertisements ran for five days in advance of the Dryden information sessions

Event Information & Attendance

Event	IPD Engagement Event - Dryden Information Session
Date	August 13, 2025
Time	7:00pm – 9:00pm CDT
Location	Dryden Regional Training and Cultural Centre
Number of Attendees	15

3. Summary of Issues and Areas of Interest

The session was attended by 15 participants and featured a range of questions and concerns. Several participants stayed after the session to discuss their interests and concerns further with NWMO team members.

Issue	NWMO Response
Role of WLON in the RAAP Process	
Participants questioned what role Wabigoon Lake Ojibway Nation (WLON) holds in the Regulatory Assessment and Approvals Process (RAAP) and raised concerns about whether decisions are being made fairly, given perceptions of financial influence.	NWMO is committed to ongoing engagement with Indigenous and local communities. Indigenous Knowledge is an essential part of shaping studies and next steps in this Project. The RAAP is WLON's independent process and the NWMO cannot speak to it.
Transportation Safety	
Concerns were raised about the safety of transporting used nuclear fuel along Highway 17, given existing accidents and risks. Question about how many trucks would transport used fuel to the site each day during operation.	The transportation of used nuclear fuel is a highly regulated process which must follow specific regulatory requirements. Used fuel must be transported in certified packages designed to withstand severe accident conditions without breach. A unique license to transport issued by the regulator is required for each shipment. Real-time tracking, security escorts, a transportation security plan, driver training, and emergency preparedness are also required by regulation. For security reasons, regulatory requirements dictate that the transport routes be kept confidential. A truck carrying used fuel is roughly the same size and weight as a logging truck, well within the existing design capacity of the highway. During

Issue	NWMO Response
	operations, the NWMO anticipates two to three used fuel shipments arriving at the repository site per day, six days per week, nine months per year. This represents a fraction of a per cent increase in traffic volumes on the TransCanada Highway. The one to three months of transportation downtime allows accommodation for weather conditions, and other road closures.
Local Geology	
Participants suggested further study of the Lake Malagon quarry to better understand local geology and potential Project impacts.	This suggestion will be shared with the technical team for consideration. Geological information plays a central role in the safety case, and community input on potential study sites helps ensure the assessments are comprehensive.
Watershed Risks	
Concerns were raised about potential contamination of the watershed, particularly given that Dryden's water comes from Wabigoon Lake. Participants also emphasized risks to major river systems that support thousands of people, including many Métis citizens.	NWMO will be sharing this feedback with the technical teams at the NWMO. Protecting water is a top priority for NWMO. The potential impacts to groundwater and surface water will be assessed in the Impact Assessment process. Multiple safety barriers are built into the design of the Project, and extensive monitoring programs will be in place to safeguard water sources and the environment.
Engagement of Other Indigenous Groups	
Questions were asked about whether other Indigenous groups, such as the Métis Nation of Ontario (MNO), have been engaged or funded in relation to the Project. There were also questions about NWMO's engagement with Eagle Lake First Nation, also located near the site and who may have significant concerns about the Project.	NWMO stated that engagement is ongoing with Indigenous communities and organizations. The NWMO intends to continue dialogue throughout the decision-making process.
Cultural and Economic Activities	
Participants asked how the Project could affect culturally and economically important activities such as fishing and hunting and highlighted ongoing challenges such as housing shortages.	NWMO intends to work with communities to assess potential impacts on traditional land use, cultural activities, and other ongoing challenges.

Issue	NWMO Response
Radiation Exposure and Health	
Community members raised concerns on multiple occasions about the risks of unseen radiation exposure, with participants asking how communities can trust medical or safety assurances.	Nuclear facilities are subject to extensive monitoring systems, including air and radiation monitoring. NWMO referred to studies conducted by the Canadian Nuclear Safety Commission (CNSC) and Health Canada, which show no evidence of increased cancer among workers at nuclear facilities. NWMO will continue to provide transparent information on health and safety as the Project moves forward.
Communication and Outreach	
Participants said communication about events could be improved, noting that not many people knew about this session. They suggested using radio and Facebook as more effective methods than mail drops, which were reported as unreliable.	NWMO acknowledged the feedback and committed to considering alternative outreach methods to improve community awareness of future events.
Barriers to Participation	
Participants expressed frustration with barriers to participation in surveys, including limited access to desktop computers, which prevents some community members from providing feedback.	NWMO appreciates the feedback on barriers to participation and recognizes the importance of all community members having opportunities to contribute. The NWMO will continue to explore alternative approaches and accessible tools to make it easier for people to provide input into the Project.

4. General Comments/Notes

The NWMO received live feedback during the presentation, using a series of survey questions on the Mentimeter platform. The questions and responses are summarized below; the numbers in brackets indicate the number of respondents who selected that option.

1. **What benefits do you hope this Project could bring for you and/or your community? (Select all that apply)**
    - Long-term employment opportunities (5)
    - Infrastructure improvements (4)
    - Youth engagement opportunities for younger generations (3)
    - Funding for community initiatives and services (3)
    - Increased local business opportunities (3)
    - Training and skills development programs (1)
    - Improved access to science and environmental education (1)

2. **What topics are you most interested in learning about in relation to the Deep Geological Repository Project? (Select all that apply)**
    - Current Land Use – Recreation or Commercial (ex. navigation, hunting, fishing, trapping, visual aesthetics) (2)
    - Archaeology and Cultural Heritage (2)
    - Project Design and Structure (2)
    - Water (1)
    - Social, Economic and Health (1)
    - Land-Based Environment (upland vegetation, wetlands, species at risk) (1)
    - Safety, Accidents, and Radiological Considerations (1)

3. **What aspects of the Deep Geological Repository Project are you most concerned about? (Select all that apply)**
    - Potential impacts on water sources and the environment (3)
    - Long-term safety of storing used nuclear fuel underground (2)
    - Effects on local communities, including health and well-being (2)
    - Emergency preparedness and risk management (1)
    - Impacts on Indigenous rights, lands, and cultures (1)
    - Effects on the economy, tourism, or land use in the area (1)

4. **What else would you like to know about the regulatory process? (Select all that apply)**
    - More information about the key milestones and timelines (3)
    - How can the community be involved within the process (2)
    - More information about the regulatory bodies (0)

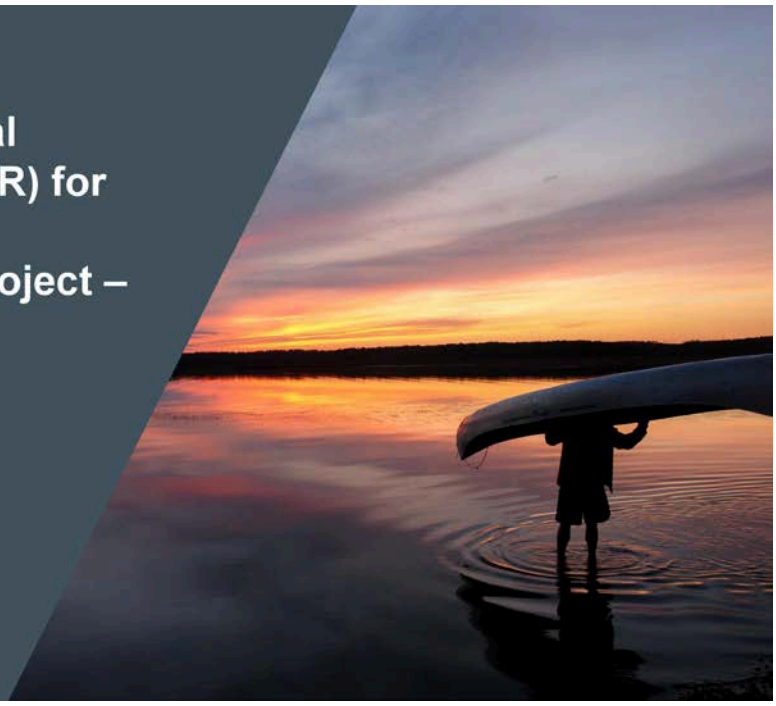
5. **Does the What We Heard Summary do a good job of representing the priorities and concerns that matter to me, at a high level? (Select one)**
    - Fully reflects the concerns and priorities that matter to me (1)
    - Mostly reflects my priorities and concerns (2)
    - Somewhat reflects my priorities and concerns (0)
    - Does not reflect my priorities and concerns at all (0)

Appendices

The communication materials and notification are included separately in the appendix to the Consolidated Report.

Dryden Information Session: IPD Engagement Presentation Deck (August 13, 2025)

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project – Initial Project Description



August 13, 2025

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Land Acknowledgement

Engagement Scope and Purpose

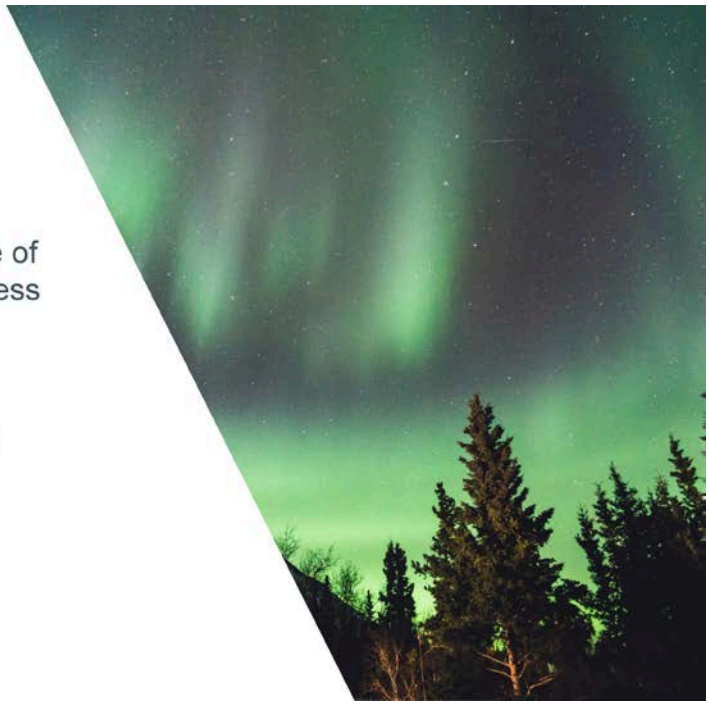
- To provide community members with a clear overview of the Deep Geological Repository (DGR) Project, including key information about the regulatory process and the Initial Project Description (IPD), helping NWMO to gather important feedback on these topics.
- This session also shares what we've heard from communities so far, discusses baseline environmental and technical studies, and includes a facilitated question and answer session.

3

nwmo

Other Upcoming Engagement

- Engagement opportunities expected in Fall 2025, outside of DGR Project Regulatory process
  - Centre of Expertise
  - Transportation
  - Intermediate and Non-fuel High-Level Waste



4

Today's Presentation

What We'll Cover

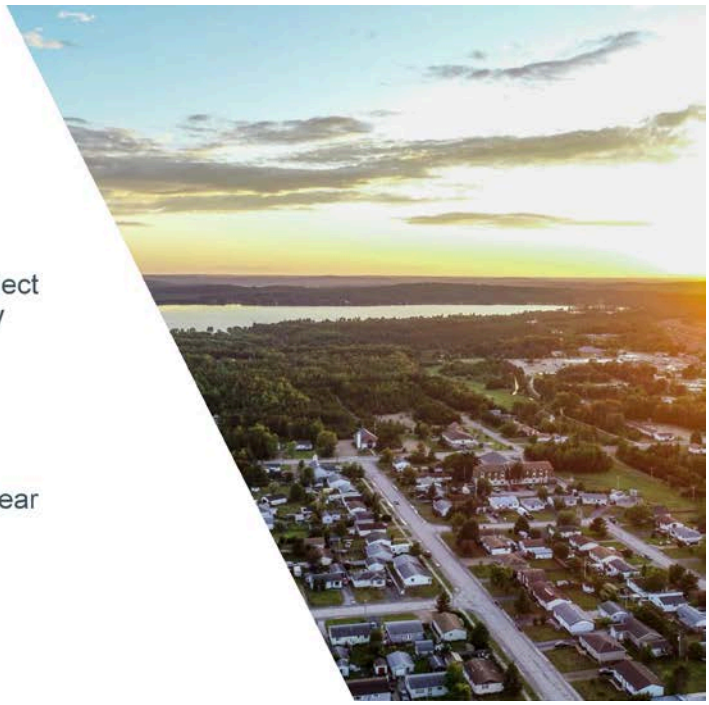
1. Deep Geological Repository Project Overview
2. Regulatory Process & Initial Project Description
3. What We've Heard
4. Baseline Studies
5. Facilitated Question & Answer Discussion (15mins)

5

Today's Presentation

Goals

- To share information about the project and the next steps in the regulatory process
- Review what we've heard from engagement so far
- Gather feedback and continue to hear about key issues and impacts



6

Question 1: What are your goals or hopes for today's event? (select all that apply)

- ☐ To learn more about the project, in general
- ☐ To better understand the regulatory process and next steps
- ☐ To share my feedback, priorities, and concerns

nwmo

About the Deep Geological Repository (DGR) Project

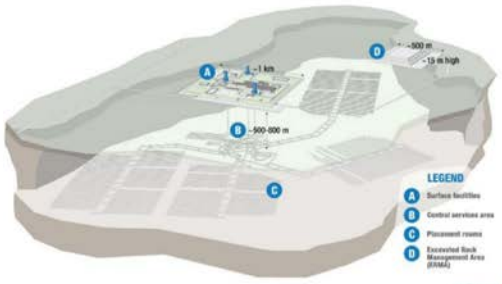
nwmo

NWMO's Proposed Deep Geological Repository (DGR) Project

- **Project Purpose:**
  - Safely contain and isolate **used nuclear fuel**
  - Manage up to **5.9 million used fuel bundles**

- **Project Name:** Deep Geological Repository for Canada's Used Nuclear Fuel

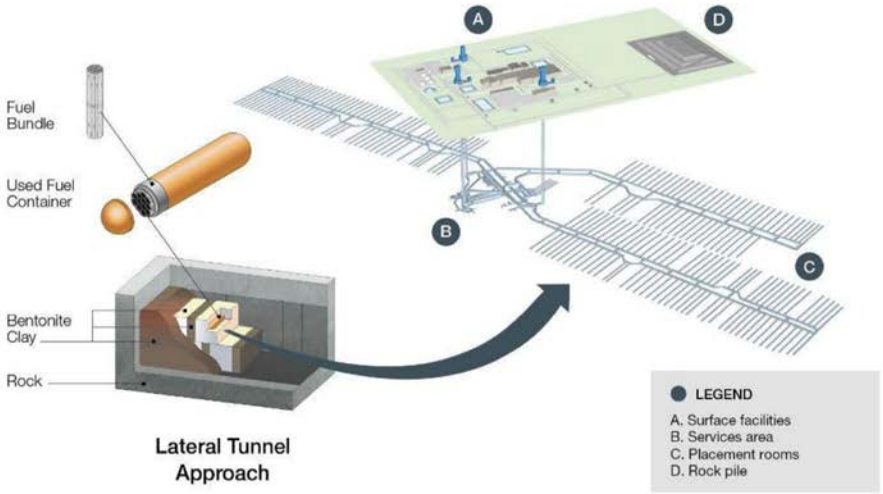
- **Host Communities**:
  - Wabigoon Lake Ojibway Nation (WLON)
  - Township of Ignace



nwmo

10

Deep Geological Repository (DGR) Concept



Lateral Tunnel Approach

nwmo

11

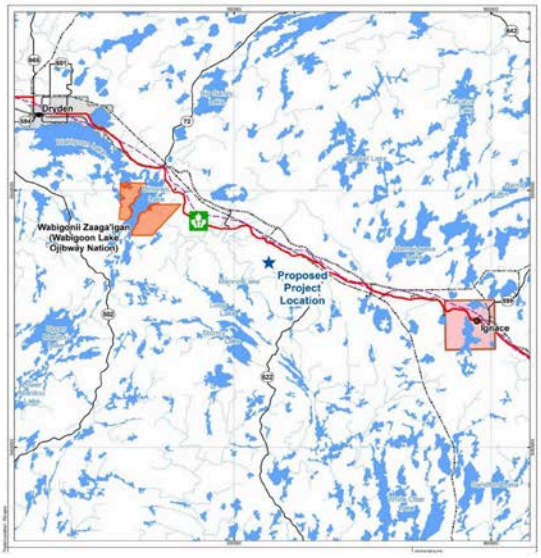
NWMO Site Selection Process for Canada's Used Fuel DGR Project

- Safety, transparency, and community engagement
- Evidence-based assessments
- Informed and willing hosts
- Fostering confidence
- Timeline & outcome:
  - **2010**: 22 communities volunteered into the process
  - **2024**: Wabigoon Lake Ojibway Nation (WLON) and the Township of Ignace selected
- The NWMO may now proceed to detailed site characterization and licensing

12

nwmo

Project Location



- Situated within Wabigoon Lake Ojibway Nation territory.

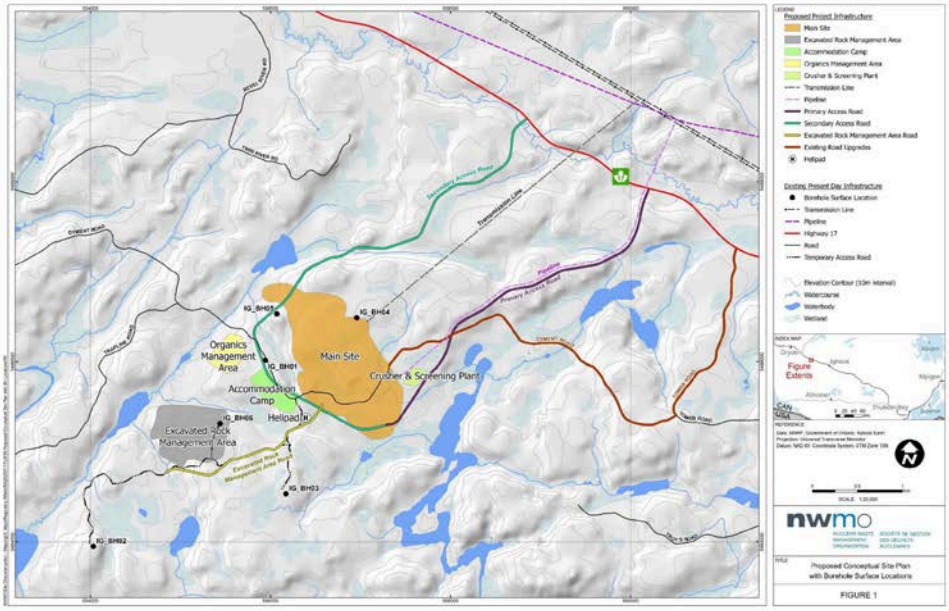
Proposed Site Location:

- ~21 km southeast of WLON Band #157 (approx. 12 km from the nearest WLON resident in Dyment)
- ~43 km northwest of Ignace, Ontario
- Located along Highway 17

13

nwmo

DRAFT Conceptual Site Plan – Surface Facilities



14

nwmo

Project Phases & Planning Timelines

- The implementation of Canada's plan via the DGR Project will span approximately 160 years.
- The Project will operate for approximately 50 years.
- The deep geological repository will be monitored for an extended period before decommissioning, closure and post-closure monitoring.

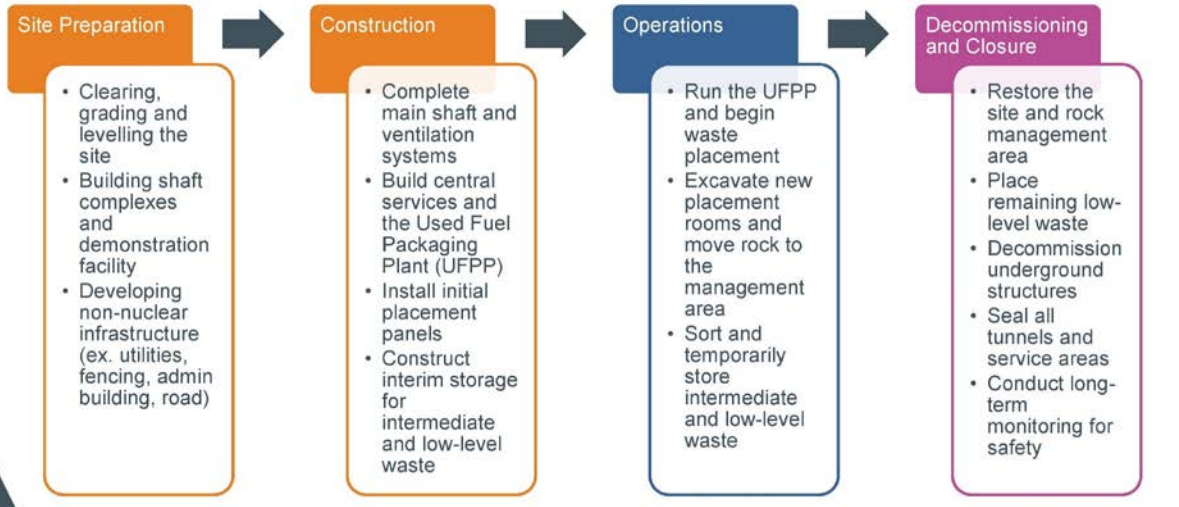
ASSUMED PROJECT PHASES AND PLANNING TIMELINES

Project phase	Approximate timeline (years)	Phase duration (years)
Site Preparation and Construction	2030-42	13
Operations	2043-92	50
Extended Monitoring, Decommissioning and Closure	2093-2192	100
Institutional Control[1]	2193+	

[1] The control of any risks at a site after decommissioning and closure, including activity like surveillance, maintenance or signs/markers.

15

Key Project Activities Across Project Phases



16

nwmo

Benefits of the Used Fuel DGR Project

Long-term Project Benefits (160-year timeline)

- WLON and the Township of Ignace: outlined in signed Hosting Agreements
- Other nearby communities: likely to benefit from improved infrastructure, skills training, and business opportunities
- Canada: safe long-term management of used nuclear fuel

17

nwmo

Question 2: What benefits do you hope this project could bring for you and/or your community? (Select all that apply)

- [ ] Long-term employment opportunities
- [ ] Training and skills development programs
- [ ] Infrastructure improvements
- [ ] Increased local business opportunities
- [ ] Youth engagement and future opportunities for younger generations
- [ ] Funding for community initiatives and services
- [ ] Improved access to science and environmental education

18

nwmo

Question 3: What topics are you most interested in learning about in relation to the Deep Geological Repository Project? (Select all that apply)

- [ ] Water
- [ ] Social Environment (health, well-being, economic conditions, social services, and jobs)
- [ ] Archaeology and Cultural Heritage
- [ ] Current Land Use – Recreation or Commercial (ex. navigation, hunting, fishing, trapping, visual aesthetics)
- [ ] Terrestrial Environment (upland vegetation, wetlands, species at risk)
- [ ] Aquatic Environment (fish and fish habitat)
- [ ] Atmospheric Environment (air quality, noise, greenhouse gases, climate change)
- [ ] Potential Effects
- [ ] Project Design and Structure
- [ ] Safety, Accidents, and Radiological Considerations

19

nwmo

Question 4: What aspects of the Deep Geological Repository Project are you most concerned about? (Select all that apply)

- ☐ Long-term safety of storing used nuclear fuel underground
- ☐ Potential impacts on water sources and the environment
- ☐ Effects on local communities, including health and well-being
- ☐ Impacts on Indigenous rights, lands, and cultures
- ☐ Transparency and trust in decision-making and oversight
- ☐ Effects on the economy, tourism, or land use in the area
- ☐ Emergency preparedness and risk management

nwmo

» About the Regulatory Process & Initial Project Description (IPD)

nwmo

A Site Has Been Selected – Now What?

- The Project will now prepare to enter the Regulatory Decision-Making stage.
- This means entering an **Impact Assessment** (IA) by the federal government.
- IAs are led by the **Impact Assessment Agency of Canada** (IAAC).
- This IA will be integrated with nuclear licensing and therefore include the **Canadian Nuclear Safety Commission** (CNSC).

22

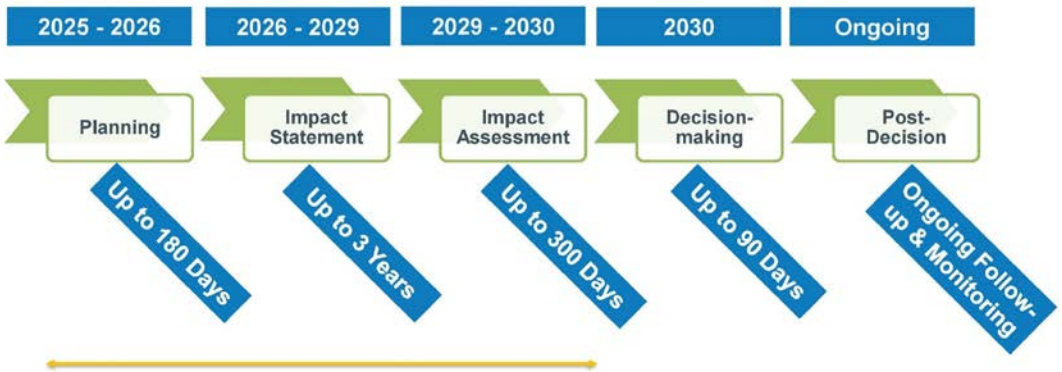
nwmo

Regulatory Oversight of the Project

23

nwmo

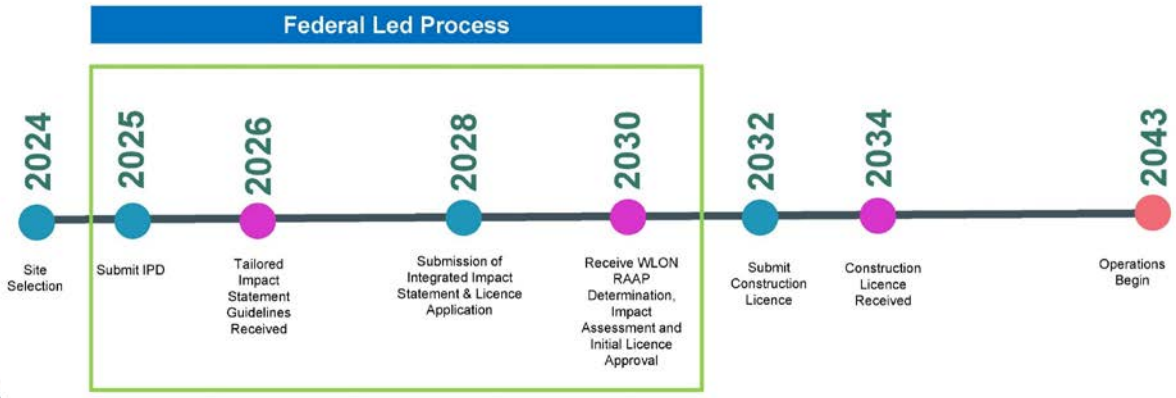
Steps in the Federal Led Impact Assessment Process



24

nwmo

NWMO Regulatory Milestones & Timelines



25

nwmo

Initial Project Description

- Submitted by the Project proponent (NWMO) to the IAAC
- Explains what the project is, where it is, and what it might affect
- Documents potential community concerns and areas where more study will be completed
- Includes plans for future regulatory engagement including communications and participation
- Guides IAAC development of the Tailored Impact Statement Guidelines specific for the Project
- **Formally starts the regulatory process when posted to IAAC's website**.

26

nwmo

Question 5: What else would you like to know about the regulatory process? (Select all that apply)

- ☐ How can the community be involved within the process
- ☐ More information about the regulatory bodies
- ☐ More information about the key milestones and timelines

27

nwmo

What We've Heard To-Date

nwmo

Public and Interested Parties Engagement

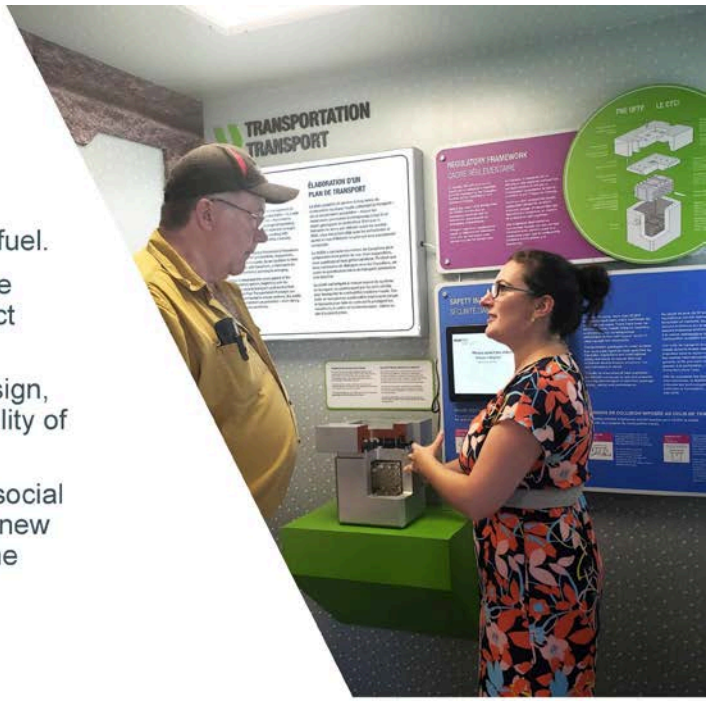
- We continue to engage extensively with the public and interested parties, including:
  - municipalities
  - businesses
  - service providers
  - environmental organizations
- In the IPD, we summarize What We've Heard for key themes and concerns during this engagement to date.
- You can help us by reviewing and providing feedback on these themes.

29

Protection of Human Health and Safety

- Concerns about radioactivity, and potential contamination from used fuel.
- Safety apprehensions regarding the long-term management, and Project execution.
- Concerns about surface facility design, monitoring systems, and the reliability of storage methods.
- Impact on the regional health and social service systems to prepare for the new families the project will bring into the area.

30



Protection of the Natural Environment

- Design of water management systems.
- Isolation of used fuel and protection of the environment.
- Environmental impacts on water, land, and wildlife from noise pollution and traffic.
- Vulnerability to natural disasters and extreme events.
- Energy and water footprints.
- Suitability of rock type to host a repository

31

Social Conditions and Community Infrastructure

- Housing shortage and increased demand for other infrastructure and services;
- Local benefits, infrastructure, and job creation;
- Youth challenges, opportunities and retention;
- Education and training for community readiness;
- Population growth/fluctuation impacts on resources, services and social conditions.

32

Economic Conditions

- Economic development, urban revitalization and risks and opportunities for local businesses; and
- New business opportunities and employment after site selection.

nwmo

33

Question 6: Does the What We Heard Summary do a good job of representing the priorities and concerns that matter to me, at a high level?

- ☐ Yes, it fully reflects the concerns and priorities that matter to me. I have nothing to add.
- ☐ The summary mostly reflects my priorities and concerns. I have a couple things to add.
- ☐ The summary somewhat reflects my priorities and concerns. I have several things to add.
- ☐ The summary does not reflect my priorities and concerns at all.

34

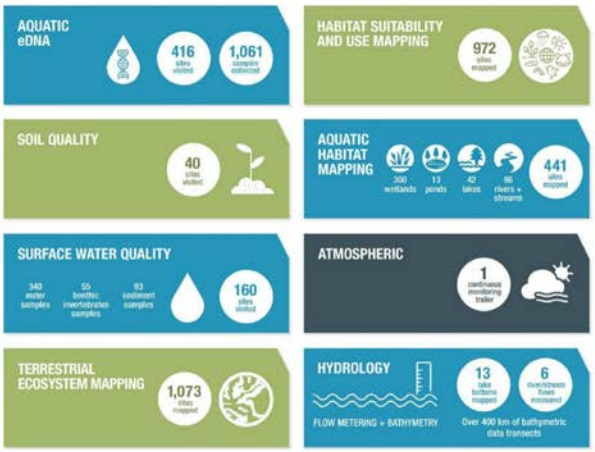
nwmo

Understanding Baseline Information

nwmo

Project Highlights: Baseline Environment

- Baseline environment information is collected and used in assessment and design planning before approval can be given.
- NWMO has studied the regional geology of the site since 2010.
- Environmental studies in the area have been ongoing since 2014.
- Working with community, data collection will continue throughout the impact assessment and regulatory process.



This figure presents some of the baseline information gathered about the proposed Project site.

36

Project Highlights: Baseline Socioeconomic and Health

Socio-economic reporting is required every three years under the *Nuclear Fuel Waste Act* and includes potential impacts on various components, including:

- Community way of life
- Social aspirations
- Cultural aspirations
- Economic aspirations

Under the Impact Assessment process, the NWMO is also required to assess social, economic, health, and Indigenous Rights impacts.

nwmo

37

How Baseline Information is Used in the Regulatory Process

- Baseline studies collect information on environmental and social conditions before a project begins
- Baseline information creates a reference point to assess future changes and impacts on people and the environment and identify ways to avoid, reduce or manage them
- Baseline study results are used to inform design
- The IPD summarizes baseline information collected to date and uses it to complete a preliminary screening assessment of potential project impacts and propose potential mitigation

38

nwmo

Project Activities with Potential Impacts on Environmental, Socioeconomic or Health Components

- Land clearing and grubbing
- Blasting and excavation
- Site security and access management
- Development and operations of surface facilities, the DGR, worker accommodation camp, the Excavated Rock Management Area (ERMA)
- Materials handling
- Vehicle traffic
- Site water management

39

nwmo

How are Effects Assessed?

- Identify an environmental, socioeconomic or health component
- How does that component interact with the Project, through what pathways?
- What mitigations can we implement to minimize the effect?
- Is there still an effect after the mitigation is applied?
- Follow-up monitoring

nwmo

Wrap-up

nwmo

What to Expect Next

- After IPD is posted on the IAAC registry, engagement from the regulators will begin
- Community members can provide comments online or at IAAC / CNSC events
- IAAC will provide NWMO with a Summary of Issues which NWMO responds to
- IAAC / CNSC create draft Tailored Impact Statement Guidelines (TISGs)
- IAAC / CNSC engage on TISGs in community
- IAAC posts the guidelines

42

nwmo

The Journey Continues

- We intend to submit the IPD in Fall 2025, which will formally kickstart the regulatory process.
- Review the summary IPD at nwmo.ca/PlanningWithYou
- Share your feedback on the key themes and concerns shared through engagement to date
  - What would you add?
  - What are your values and priorities?
  - What questions are on your mind?

43

How to Engage With Us!

You can submit comments to:

RegulatoryFeedback@nwmo.ca

nwmo.ca/contact-us on our website

Comments will also be accepted by mail addressed to:

NWMO — IPD summary feedback
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3
Comments are accepted until Friday, Aug. 22, 2025.

For more information please visit:

NWMO.ca/PlanningWithYou

44

nwmo

Q&A Opportunity

45

nwmo

Thank you.

@nwmocanada / @LaSGDN

/company/nwmocanada

www.nwmo.ca

What We Heard - IPD Engagement Report: IPD Feedback Workshop - August 21, 2025

1. Introduction

The primary purpose of this engagement was to provide community members with a clear overview of the Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project ("the Project"), the upcoming regulatory process, and the Initial Project Description (IPD), helping NWMO refine the draft IPD by gathering valuable feedback on potential impacts and issues.

In this session, NWMO reviewed a summary of priorities and concerns shared through previous engagement activities, provided information about baseline studies, and included an opportunity for participants to ask questions. After an initial presentation and brief discussion, participants were divided into groups for a small group exercise, where they delved deeper into the key "What We Heard" themes in the draft IPD. Groups captured their ideas on flipchart and sticky notes; following this, they used stickers to prioritize their top area of interest or concern for each theme.

2. Engagement Process

Notifications

The IPD Feedback Workshop was held on an invite-only basis. Drawing on NWMO's previous experience with working groups during the site-selection process, NWMO staff developed a participant list identifying key local leaders and subject-matter experts ("invitees") for the Ignace IPD Feedback Workshop to further discuss key sections and topics of interest within the IPD. Participants were invited to one of the two IPD feedback workshop meetings held over the summer (August 12 and August 21, 2025). These invitees were selected due to their history of engaging on the Project and their unique position as local and regional experts in fields relevant to the Project.

Event Information & Attendance

Event	IPD Engagement Event: IPD Feedback Workshop
Date	August 21, 2025
Time	9:30-11:30am CDT
Location	NWMO Learn More Centre, Ignace
Number of Attendees	14

3. Summary of Issues and Areas of Interest

The session was attended in person by a group of invited community members from Ignace and surrounding communities, many of whom were extensively engaged in the DGR learning and siting process. Participants represented a wide range of perspectives, including education, food security, tourism and hospitality, housing, social and community services, health care, recreation, small business, and emergency services.

While there were some discussions about direct Project considerations, most of the conversation focused on community economic development and how Project impacts would be assessed and addressed.

Issue	NWMO Response
Draft Conceptual Site Plan	
Participants asked which specific borehole will be used for the Project and whether details about its location is available.	All of the existing boreholes will be used to characterize the site. During the next phase, "detailed site characterization", we will drill more boreholes to collect even more data to provide additional information (through oversight and approvals from the Ministry of Natural Resources).
Clarification was requested on the total size of the surface area that will be occupied or impacted by the Project.	The overall surface area size was generally compared to the size of the Dryden airport to give a sense of scale. It is approximately 340 hectares.
Participants asked about the size of the withdrawal area, whether it is fixed, and if there are plans for it to expand in the future.	The exact size of the withdrawal area has not yet been confirmed, but there are no current plans for expansion.
Community members asked when an updated map showing exclusion areas will be made available.	All maps are currently conceptual and in the draft stage. These maps will be updates throughout the IA and licensing process based on community and regulator feedback. The exclusion zone has not yet been determined.
Site Access	
Questions were raised about road access, including Dyment Road and other adjacent routes, the current condition and deterioration of existing logging roads, and where any new entry points to the site would be located.	Concerns about site access were acknowledged, and participants were told that two roads would require improvements in the early stages of site preparation. Any roads not identified on the map are not currently planned for upgrades by the NWMO.

Issue	NWMO Response
Participants wanted to know whether a rail route is being planned as part of the infrastructure for the Project.	A rail spur is being considered for the Project and will be assessed in the Impact Statement.
Air Quality and Noise	
Concerns were expressed regarding potential air quality impacts and noise levels during the construction phase.	Potential air quality and noise issues will be assessed in the Impact Statement. In addition to the requirements of the federal Impact Assessment process, NWMO anticipates that provincial permits will be required for the Project. If NWMO is required to adhere to provincial permits for air quality and noise, then it will comply with such conditions and monitoring requirements.
Impacts of Bill C-5	
Questions were raised about how the Project may be affected by or align with the requirements of Bill C-5 (*One Canadian Economy: An Act to enact the Free Trade and Labour Mobility in Canada Act and the Building Canada Act,* enacted on June 26, 2025*)*.	Bill C-5 is new legislation, and the implications are still unclear. NWMO has not applied to be identified as a Project under this legislation nor has the government itself identified the DGR Project as being identified under this new legislation. NWMO will actively monitor its implementation.
Regulatory and Permitting Process	
Clarification was sought on the defined Project boundaries as well as the list of regulatory authorities overseeing the Project.	The federal regulators are the Impact Assessment Agency of Canada (IAAC) and the Canadian Nuclear Safety Commission (CNSC). Alongside the federally regulated process, the NWMO will also be subject to Wabigoon Lake Ojibway Nation's independent Regulatory Assessment and Approval Process (RAAP). In addition, the NWMO will also work with provincial permitting authorities.
There were questions about whether regulators are coordinating effectively with one another to avoid miscommunication or overlap in responsibilities.	NWMO acknowledged the need for coordination among regulators and explained this is being planned for well in advance. The NWMO also mentioned the work of their government relations team who are in constant contact with many government bodies.
Concerns were raised regarding approvals for natural gas and other necessary permits tied to the Project.	Early engagement with regulators has already begun to ensure permitting and approval processes are properly aligned.

Issue	NWMO Response
Site Restoration	
Community members wanted to know if the site will eventually be restored to its original or an acceptable condition after Project completion.	The site will eventually be restored once Project activities are complete.
Communicating Positive Impacts and Community Benefits	
Concerns were expressed about why community benefits, such as potential investments in hospitals, roads, or other infrastructure, are not clearly described in the IPD.	Such topics are covered under Hosting Agreements and will be further developed as the Project progresses. It was noted that Section 4 of the IPD summarizes community concerns and potential benefits.
Concerns were raised about whether NWMO will give equal emphasis to highlighting positive project impacts alongside the negative ones. Also, how positive social, economic, or environmental impacts are identified and included within the Impact Assessment.	NWMO will consider positive and negative impacts in accordance with the Tailored Impact Statement Guidelines.
Community Services and Infrastructure	
Questions were raised about whether new residents drawn to the community as a result of the Project will be supported with adequate infrastructure and public services.	Hosting Agreements, as implemented by the implementation committees, address infrastructure and services for new residents and community members.
Centre of Expertise	
Questions were asked about the benefits associated with the Centre of Expertise (CoE) and how it will support the community.	The CoE is separate from the formal regulatory process and will not be built on the Project site. It will be established in Ignace, though the exact location is still to be determined. Public engagement events will be held in Ignace in coming months to gather public input on the Centre's design.
Accountability for Socioeconomic Impacts	
Participants asked who will be accountable for socioeconomic impacts, including both positive and negative outcomes.	NWMO noted that triannual reporting required for the Nuclear Fuel Waste Act includes socioeconomic studies.

4. General Comments/Notes

Participants were divided into groups for a small group exercise, where they delved deeper into the key "What We Heard" themes in the draft IPD. Groups captured their ideas on flipcharts and sticky notes – these comments are captured below.

- Transportation
    - The need for highway upgrades, noting that increased traffic from the project could create dangerous conditions if roads are not properly maintained and improved.
    - How construction-related transportation would affect community safety, increase the risk of accidents and pose broader health impacts for residents.
- Socioeconomic and Health Impacts
    - Whether the local health system could handle the Project's demands, raising the possibility of needing a hospital or expanded medical services in Ignace.
    - Whether the Project would consider the needs of seniors, given Ignace's aging population, particularly in terms of healthcare and community support.
    - How the community will manage workforce influx at various stages of the Project, and whether housing and services will be adequate.
    - Local businesses already struggle to find enough workers, and participants worried the Project could worsen these shortages by increasing competition for limited labour.
    - Residents expressed concern that a large project could create a temporary boom but leave the community vulnerable to a bust cycle once construction ends.
    - While many participants acknowledged potential opportunities, there were questions about whether the Project would truly bring long-term prosperity or only short-term gains.
- Wildlife Impacts
    - Whether the Project might disturb sensitive wildlife, particularly the swans and pelicans that rely on Camp Lake.

Following their group discussions, participants identified their individual priorities for each of the What We Heard themes. The numbers in brackets below indicate how many participants selected that individual sub-topic as their top priority. Wording is directly taken from the small groups' written contributions.

Protection of Human Health and Safety:

- Road Safety – Road Conditions
- Don't want to have unsafe recreational roads, would need alternative roads for recreation (7)
- Will there be more people and support staff for health services? (3)
- The need for more medical and emergency services (1)
- Human trafficking and human safety (1)
- Prepare with teams to deal with possible accidents (1)
- Water-related concerns (1)
    - Specifically, well water should be treated, and the results shared to understand the potential impact and source (1)

Protection of the Natural Environment:

- Climate change impacts on not only the Project but the wider area (4)
- Concerns about forest fires impacting the Project (2)
- Impacts on the existing roads and access (2)
- Migration of animals (will it be the same animals?) (2)
- What is the strategy to bring people in? (1)
- The impacts to the area from visitors (1)
- Impacts on surrounding water bodies (1)

Social Conditions and Community Infrastructure:

- Preparing and training the youth for future jobs (6)
- Want to retain the current community feel (2)
- Policing, fire department, and EMS (2)
- Animosity between locals versus outsiders (1)
- Potential influx of bad actors and drug trade (1)
- Support for social concerns, example food insecurity (1)
- Housing shortage (1)

Economic Conditions:

- Community economic development plan (4)
- Accommodation camp location (3)
    - Will it be local to the site or at the site or both?
- Not a strong economic ecosystem (3)
- Experiences learned from past and similar Projects (1)
    - for example: the mines are relevant for the accommodation camp siting
- Hotels and motels? (1)
- What would happen if NWMO left? (1)
- Spaces for rent and training, is there space in the Centre of Expertise? (1)
- Dryden versus Ignace economic impacts (2)
    - Early commitments
    - Projections of growth

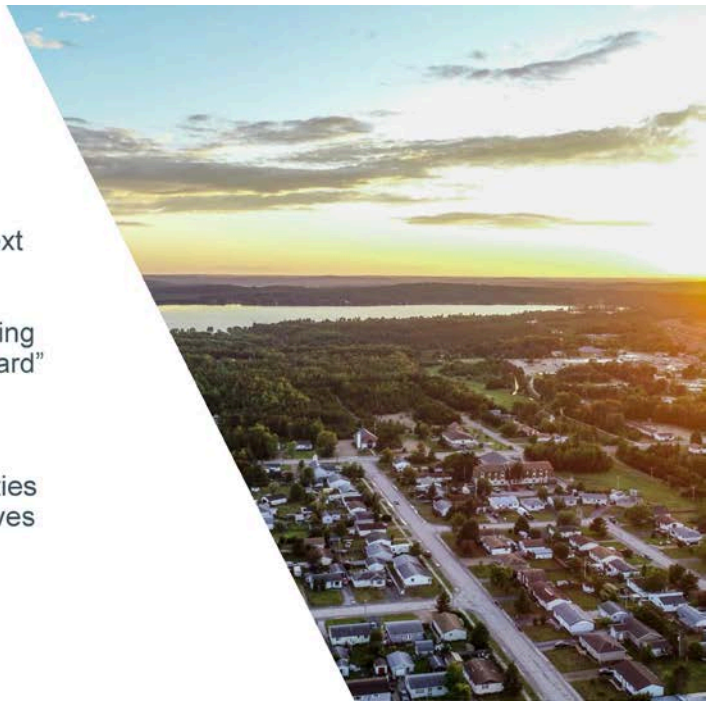
Appendices

The communication materials are included separately in the appendix to the Consolidated Report.

IPD Feedback Workshop: IPD Engagement Presentation Deck (August 21, 2025)

Purpose and Goals

- To provide a brief update on the next steps in the regulatory process
- To involve you in reviewing, validating and deepening the “what we’ve heard” summary for the Initial Project Description
- To clarify and expand on key priorities and concerns, from your perspectives as community representatives



3

Other Upcoming Engagement

- Engagement opportunities expected in Fall 2025, outside of DGR Project Regulatory process
  - Centre of Expertise
  - Transportation
  - Intermediate and High-Level Waste

4

Today's Agenda

Time	Activity	Estimated Length
9:30am	Welcome and Introductions	15 minutes
9:45am	Presentation: Update and Regulatory Process Overview	30 minutes
10:15am	Breakout Group Activity: What We Heard – Deep Dive	45 minutes
11:00am	Prioritization and Discussion	15 minutes
11:15am	Q&A	15 minutes
11:30am	Adjourn Lunch and Casual Conversations	

5

nwmo

Introductions

- Roundtable
  - Name
  - One highlight of your summer so far
  - The "hats" you are wearing today

6

Guiding Principles

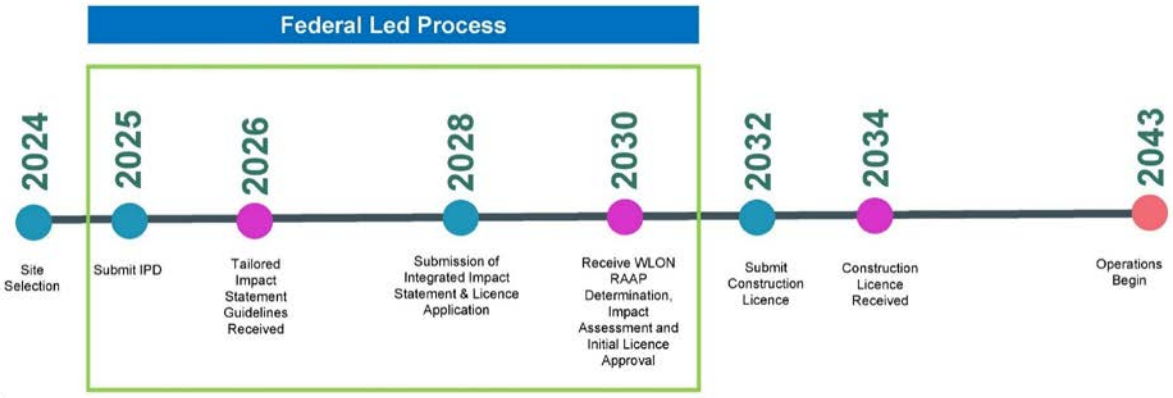
- Listen actively and be curious
- Have respectful conversations
- Hear from all voices - “3 before me”
- Tackle problems, not people

7

About the Deep Geological Repository (DGR) Project

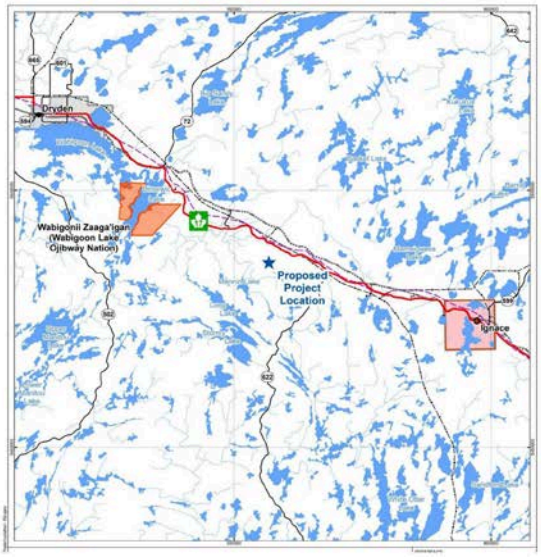
nwmo

NWMO Regulatory Milestones & Timelines



nwmo

Project Location



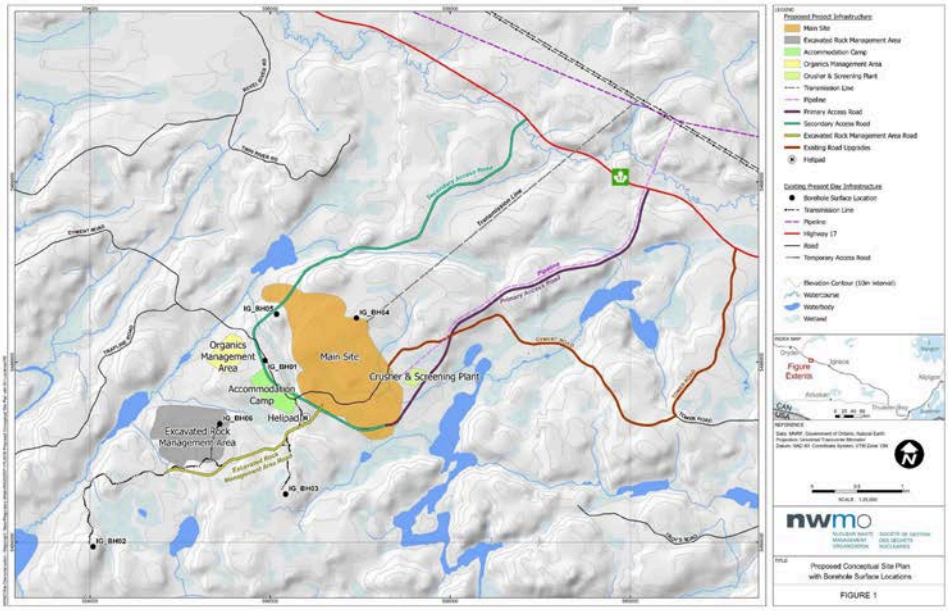
- Situated within Wabigoon Lake Ojibway Nation territory.

Proposed Site Location:

- ~21 km southeast of WLON Band #157 (approx. 12 km from the nearest WLON resident in Dyment)
- ~43 km northwest of Ignace, Ontario
- Located along Highway 17

nwmo

DRAFT Conceptual Site Plan – Surface Facilities



nwmo

11

Project Phases & Planning Timelines

- The implementation of Canada's plan via the DGR Project will span approximately 160 years.
- The Project will operate for approximately 50 years.
- The deep geological repository will be monitored for an extended period before decommissioning, closure and post-closure monitoring.

ASSUMED PROJECT PHASES AND PLANNING TIMELINES

Project phase	Approximate timeline (years)	Phase duration (years)
Site Preparation and Construction	2030-42	13
Operations	2043-92	50
Extended Monitoring, Decommissioning and Closure	2093-2192	100
Institutional Control[1]	2193+	

[1] The control of any risks at a site after decommissioning and closure, including activity like surveillance, maintenance or signs/markers.

12

Key Project Activities Across Project Phases

Site Preparation

- Clearing, grading and levelling the site
- Building shaft complexes and demonstration facility
- Developing non-nuclear infrastructure (ex. utilities, fencing, admin building, road)

Construction

- Complete main shaft and ventilation systems
- Build central services and the Used Fuel Packaging Plant (UFPP)
- Install initial placement panels
- Construct interim storage for intermediate and low-level waste

Operations

- Run the UFPP and begin waste placement
- Excavate new placement rooms and move rock to the management area
- Sort and temporarily store intermediate and low-level waste

Decommissioning and Closure

- Restore the site and rock management area
- Place remaining low-level waste
- Decommission underground structures
- Seal all tunnels and service areas
- Conduct long-term monitoring for safety

13

nwmo

Initial Project Description

- Submitted by the Project proponent (NWMO) to the IAAC
- Explains what the project is, where it is, and what it might affect
- Documents potential community concerns and areas where more study will be completed
- Includes plans for future regulatory engagement including communications and participation
- Guides IAAC development of the Tailored Impact Statement Guidelines specific for the Project
- **Formally starts the regulatory process when posted to IAAC's website.**

14

nwmo

Project Activities with Potential Impacts on Environmental, Socioeconomic or Health Components

- Land clearing and grubbing
- Blasting and excavation
- Site security and access management
- Development and operations of surface facilities, the DGR, worker accommodation camp, the Excavated Rock Management Area (ERMA)
- Materials handling
- Vehicle traffic
- Site water management

15

nwmo

How are Effects Assessed?

- Identify an environmental, socioeconomic or health component
- How does that component interact with the Project, through what pathways?
- What mitigations can we implement to minimize the effect?
- Is there still an effect after the mitigation is applied?
- Follow-up monitoring

nwmo

What We've Heard To-Date

nwmo

Public and Interested Parties Engagement

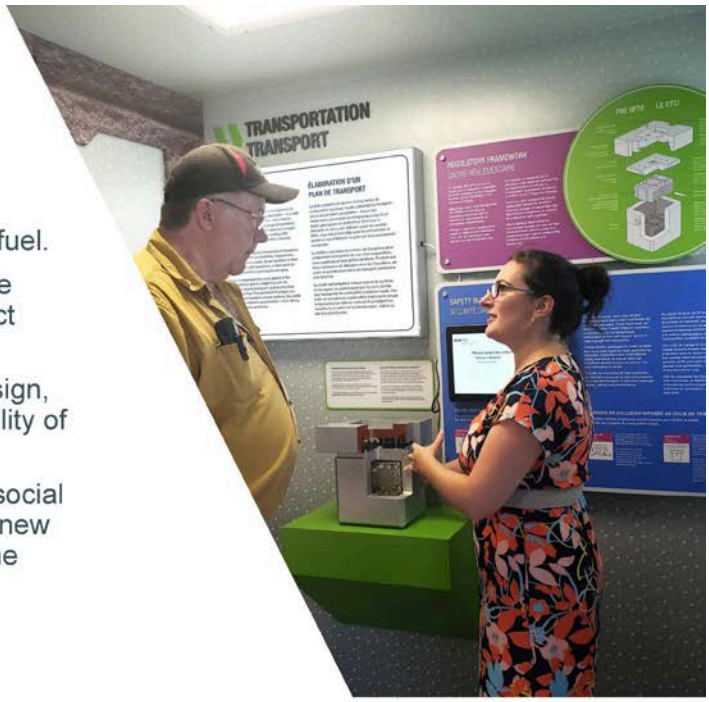
- We continue to engage extensively with the public and interested parties, including:
  - municipalities
  - businesses
  - service providers
  - environmental organizations
- In the IPD, we summarize What We've Heard for key themes and concerns during this engagement to date.
- You can help us by reviewing and providing feedback on these themes.

18

Protection of Human Health and Safety

- Concerns about radioactivity, and potential contamination from used fuel.
- Safety apprehensions regarding the long-term management, and Project execution.
- Concerns about surface facility design, monitoring systems, and the reliability of storage methods.
- Impact on the regional health and social service systems to prepare for the new families the project will bring into the area.

19



Protection of the Natural Environment

- Design of water management systems.
- Isolation of used fuel and protection of the environment.
- Environmental impacts on water, land, and wildlife from noise pollution and traffic.
- Vulnerability to natural disasters and extreme events.
- Energy and water footprints.
- Suitability of rock type to host a repository

20

Social Conditions and Community Infrastructure

- Housing shortage and increased demand for other infrastructure and services;
- Local benefits, infrastructure, and job creation;
- Youth challenges, opportunities and retention;
- Education and training for community readiness;
- Population growth/fluctuation impacts on resources, services and social conditions.

21

Economic Conditions

- Economic development, urban revitalization and risks and opportunities for local businesses; and
- New business opportunities and employment after site selection.

nwmo

22

Facilitated Activity & Discussion

nwmo

Process

- Form three groups of 2-3
- Review the What We Heard Posters & key themes from IPD Engagement so far
- Visit each board
- Discuss and capture notes on flipchart/sticky notes, for about 5min
- Build upon the previous group's comments
- Prioritization exercise
- Discussion

24

nwmo

Wrap-up

What to Expect Next

- After IPD is posted on the IAAC registry, engagement from the regulators will begin
- Community members can provide comments online or at IAAC / CNSC events
- IAAC will provide NWMO with a Summary of Issues which NWMO responds to
- IAAC / CNSC create draft Tailored Impact Statement Guidelines (TISGs)
- IAAC / CNSC engage on TISGs in community
- IAAC posts the guidelines

The Journey Continues

- We intend to submit the IPD in Fall 2025, which will formally kickstart the regulatory process.
- Review the summary IPD at nwmo.ca/PlanningWithYou
- Share your feedback on the key themes and concerns shared through engagement to date
  - What would you add?
  - What are your values and priorities?
  - What questions are on your mind?

27

How to Engage With Us!

You can submit comments to:

RegulatoryFeedback@nwmo.ca

nwmo.ca/contact-us on our website

Comments will also be accepted by mail addressed to:

NWMO — IPD summary feedback
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3
Comments are accepted until Friday, Aug. 22, 2025.

For more information please visit:

NWMO.ca/PlanningWithYou

nwmo

28

Q&A

29

nwmo

Thank you.

@nwmocanada / @LaSGDN

/company/nwmocanada

www.nwmo.ca

Engagement Matrix with Potentially Impacted Indigenous Communities

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

NWMO-TMP-05000-0001 R000

Engagement Matrix with Potentially Impacted Indigenous Communities (November 2024-current day)

Date	Department Lead -	Communication Method	Event Type	Event	Event Description	Venue
Lac Des Mille Lacs First Nation (LDMLFN)						
12-May-25	Indigenous Relations	Letter	NWMO to LDMLFN	Congratulations to Chief Whitecloud on her re-election	Congratulations	Mail
20-Jan-25	Indigenous Relations	Video Conference	NWMO to LDMLFN	Video Conference Meeting	Project update with LDMLFN expressing interest in procurement.	Teams
26-Feb-25	Indigenous Relations	Email	NWMO to LDMLFN	Potential meeting	Request to meet	Email
27-Feb-25	Indigenous Relations	Email	NWMO to LDMLFN	Potential meeting	Reply to request to meet	Email
27-Feb-25	Indigenous Relations	Email	LDMLFN to NWMO	Potential meeting	Reply to NWMO email	Email
3/1/2025	Indigenous Relations	Email	LDMLFN to NWMO	Potential meeting	Request to meet	Email
20-Mar-25	Indigenous Relations	Email	NWMO to LDMLFN	Potential meeting	Request to meet	Email
20-Mar-25	Indigenous Relations	Email	LDMLFN to NWMO	Potential meeting	Request to meet	Email
20-Mar-25	Indigenous Relations	Email	NWMO to LDMLFN	Potential meeting	Request to meet	Email
20-Mar-25	Indigenous Relations	Email	LDMLFN to NWMO	Potential meeting	Request to meet	Email
24-Mar-25	Indigenous Relations	Email	NWMO to LDMLFN	Potential meeting	Request to meet	Email
25-Mar-25	Indigenous Relations	Email	LDMLFN to NWMO	Potential meeting	Request to meet	Email
25-Mar-25	Indigenous Relations	Email	NWMO to LDMLFN	Potential meeting	Request to meet	Email
25-Mar-25	Indigenous Relations	Email	LDMLFN to NWMO	Potential meeting	Request to meet	Email
26-Mar-25	Indigenous Relations	Email	LDMLFN to NWMO	Potential meeting	Request to meet	Email
7-Jul-25	Indigenous Relations	In person meeting	Meeting	In person meeting with Chief & Council (C&C)	Project update to C&C. Discussion re: ongoing relationship	In person
9-Jul-25	Indigenous Relations	In person meeting	Meeting	Meeting	Meet with C&C	In person
29-Jul-25	Indigenous Relations	Email + Letter	NWMO to LDMLFN	Letter with update on the upcoming regulatory process for the DGR Project	Invitation to meet and share information on the Project and discuss next steps	Email

7-Aug-25	Indigenous Relations	Email	NWMO to LDMLFN	Review of Framework Agreement	LDMLFN sent Framework Agreement to NWMO which was sent to legal for review	Email
Lac Seul First Nation (LSFN)						
2-Dec-24	Indigenous Relations	Email	NWMO to LSFN	Potential meeting	Setting up mutually available time	Email
2-Dec-24	Indigenous Relations	Email	NWMO to Shared Values Solution ((SVS) LSFN Consultant)	Follow-up on reporting	Request for Traditional Knowledge (TK) reporting	Email
2-Dec-24	Indigenous Relations	Email	NWMO to LSFN	Potential meeting	Request to discuss Learn More Agreement spending	Email
2-Dec-24	Indigenous Relations	Email	LSFN to NWMO	Potential meeting reply	Accepted meeting	Email
12-Dec-24	Indigenous Relations	Teams meeting	Meeting	Teams meeting	Learn More Agreement meeting	Teams
12-Dec-24	Indigenous Relations	Email	NWMO to LSFN	Follow-up after meeting	Learn More Agreement payment	Email
12-Dec-24	Indigenous Relations	Email	NWMO to (SVS) LSFN	Follow up	TK reporting	Email
13-Dec-24	Indigenous Relations	Email	LSFN to NWMO	Reporting	TK reporting	Email
16-Dec-24	Indigenous Relations	Email	NWMO to LSFN	Reporting	TK reporting sent to NWMO's Project Management Department	Email
17-Dec-24	Indigenous Relations	Email	NWMO to LSFN	Follow up	Learn More Agreement Amendment.	Email
18-Dec-24	Indigenous Relations	Email	NWMO to LSFN	Request for invoice	TK request for invoice	Email
23-Dec-24	Indigenous Relations	Email	NWMO to LSFN	Sending reporting documents	NWMO Project Management reporting analysis for TK reporting	Email
7-Jan-25	Indigenous Relations	Email	LSFN to NWMO and Consultant	Potential meeting	TK reporting request for meeting	Email
7-Jan-25	Indigenous Relations	Email	NWMO to LSFN	Potential meeting	Acceptance of meeting	Email
7-Jan-25	Indigenous Relations	Email	NWMO to LSFN	Potential meeting	TK reporting	Email
8-Jan-25	Indigenous Relations	Email	NWMO to LSFN	Follow up	TK reporting	Email
8-Jan-25	Indigenous Relations	Email	Consultant to LSFN and NWMO	Email from consultant	Discuss Consultant engagement proposal	Email
9-Jan-25	Indigenous Relations	Email	NWMO to LSFN and Consultant	Email regarding Consultant engagement proposal	Informing consultant and LSFN we are on hold.	Email

8-Jan-25	Indigenous Relations	Email	NWMO to LSFN	NWMO Finance Department to LSFN Finance and LSFN Community Liaison	Shared documents to facilitate TK reporting	Email
3-Mar-25	Indigenous Relations	Email	NWMO to LSFN	Follow up	Checking on TK reporting	Email
3-Apr-25	Indigenous Relations	Email	NWMO to LSFN and Consultant	Email to LSFN Finance LSFN Community Liaison Consultant Project Manager	Request for TK reporting	Email
14-Apr-25	Indigenous Relations	Email	NWMO to LSFN	Email to LSFN Finance, LSFN Community Liaison	Learn More Agreement Amendment. Request for follow-up meeting	Email
7-May-25	Indigenous Relations	In-person	LSFN Event	NWMO Booth at Career Fair	One day career fair event. NWMO was a $5000 sponsor	Lac Seul Event Centre
29-Jul-25	Indigenous Relations	Email + Letter	NWMO to LSFN	Letter with update on the upcoming regulatory process for the DGR Project	Invitation to meet and share information on the Project and discuss next steps	Email
1-Aug-25	Indigenous Relations	In-person	Municipal event	Sioux Lookout Home, Craft, and Trade Show	One on one conversation with NWMO staff	Sioux Lookout Arena
1-Aug-25	Indigenous Relations	Email	NWMO to LSFN	Email from NWMO to Community Liaison	Arranging meeting with NWMO	Email
11-Aug-25	Indigenous Relations	Phone call	LSFN to NWMO	Community Liaison phoned NWMO	Community Liaison following up on meeting with NWMO	Phone call
12/13–Aug-25	Indigenous Relations	In person	Meeting	In person meeting with Community Liaison	Discussion on outstanding reporting	In person
28-Aug-25	Indigenous Relations	Email	NWMO to LSFN	Follow up on reporting	Email containing information for reporting completion.	Email
2-Sep-25	Indigenous Relations	Email	LSFN to NWMO	Learn More Agreement Amendment #4	Signed amendment submitted	Email
4-Sep-25	Indigenous Relations	Email	NWMO to LSFN	Email to LSFN Finance	Learn More Agreement Payment	Email
3-Oct-25	Indigenous Relations	Email	NWMO to LSFN	Email to LSFN Finance	Learn More Agreement Payment Transmission Letter.	Email
6-Oct-25	Indigenous Relations	Email	LSFN to NWMO	Email Events Coordinator for Sponsorship and Donation (S&D)	Request for S&D	Email
6-Oct-25	Indigenous Relations	Email	NWMO to LSFN	S&D reply	S&D	Email
8-Oct-25	Indigenous Relations	Email	NWMO to LSFN	S&D update	S&D	Email
Eagle Lake First Nation						

29-Jul-25	Indigenous Relations	Email + Letter	NWMO to ELFN	Letter with update on the upcoming regulatory process for the DGR Project	Invitation to meet and share information on the Project and discuss next steps	Email
28-Aug-25	Indigenous Relations	In-person	Meeting	Dropped off letter, re: Update on the upcoming regulatory process for the DGR Project; and met on Learn More Agreement	Learn More Agreement Amendment	In Person
Seine River First Nation (SRFN)						
26-Nov-24	Indigenous Relations	In person	Meeting	Chief and Council	NWMO Update	SRFN board room
26-Nov-24	Indigenous Relations	In person	SRFN Event	Community event	Community Update	SRFN Gym
27-Nov-24	Indigenous Relations	Email	NWMO to SRFN	Email to community liaison	Organizing open house	Email
28-Nov-24	Indigenous Relations	Email	NWMO to SRFN	Email to community liaison	Organizing open house	Email
28-Nov-24	Indigenous Relations	Email	NWMO to SRFN	Email to community liaison	Sharing info on Indigenous participating in IAAC	Email
28-Nov-24	Indigenous Relations	Email	NWMO to SRFN	Email to community liaison	Photos for open house advertising	Email
28-Nov-24	Indigenous Relations	Email	NWMO to SRFN	Email to community liaison	Photos for open house advertising; resend due to bounce back	Email
28-Nov-24	Indigenous Relations	Email	SRFN to NWMO	Email to community liaison	Organizing open house	Email
29-Nov-24	Indigenous Relations	Email	NWMO to SRFN	Email to community liaison	Photos for open house advertising; resend due to bounce back	Email
29-Nov-24	Indigenous Relations	Email	NWMO to SRFN	Email to community liaison	Photos for open house advertising; resend due to bounce back. Sent to Community Liaison's personal email	Email
2-Dec-25	Indigenous Relations	Email	NWMO to SRFN	Email to community Liaison	Question about Sponsorship and Donation application	Email
4-Dec-25	Indigenous Relations	Email	NWMO to SRFN	Email to community liaison	Question about Sponsorship and Donation application, resend	Email
4-Dec-24	Indigenous Relations	In person	SRFN Event	Community event	Open House	SRFN Gym
5-Dec-24	Indigenous Relations	Email	SRFN to NWMO	Email from Community Liaison	Response to Sponsorship and Donation question	Email

5-Dec-24	Indigenous Relations	Email	NWMO to SRFN	Email to Community Liaison	Sponsorship and Donation decision	Email
11-Dec-24	Indigenous Relations	Email	NWMO to SRFN	Email to Community Liaison	Sponsorship and Donation event	Email
17-Dec-24	Indigenous Relations	Email	SRFN to NWMO	Email from Assistant to Chief and Council	Learn More Agreement Amendment	email
17-Dec-24	Indigenous Relations	Email	SRFN to NWMO	Email to Assistant to Chief and Council	Learn More Agreement Amendment	email
17-Dec-24	Indigenous Relations	Email	SRFN to NWMO	Email to Assistant to Chief and Council	Learn More Agreement Amendment	email
19-Dec-24	Indigenous Relations	In person	Meeting	Chief and Council	Learn More Agreement Signing	SRFN Board Room
2-Jan-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Community Liaison	Discussion of Learn More Agreement	Email
9-Jan-25	Indigenous Relations	Phone call	NWMO to SRFN	Phone call to Community Liaison	Discussion Learn More Agreement	Phone call
9-Jan-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Community Liaison	Summary of phone call meeting with Community Liaison	Email
10-Jan-25	Indigenous Relations	Email	NWMO to SRFN	Email to Community Liaison and Chief	Early Investment in Education and Skills (EIES) donation	Email
22-Jan-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Councillors	Discussion of Traditional Knowledge (TK) Agreement	Email
23-Jan-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Community Liaison	EIES donation	Email
23-Jan-25	Indigenous Relations	Email	SRFN to NWMO	Email from Community Liaison	Cancel meeting	Email
29-Jan-25	Indigenous Relations	Email	SRFN to NWMO	Email from Community Liaison	Learn More Agreement	Email
10-Jan-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief, Assistant to Chief and Council, Community Liaison	Learn More Agreement Payment	Email
6-Feb-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Assistant to Chief and Council	EIES donation	Email
10-Feb-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Assistant to Chief and Council	Confirming January 18 to deliver Discovery Kits	Email
11-Feb-25	Indigenous Relations	Email	SRFN to NWMO	Email from Community Liaison	Contract Inquiry	Email
11-Feb-25	Indigenous Relations	Email	NWMO to SRFN	Email to Community Liaison	Response to inquiry	Email
18-Feb-25	Indigenous Relations	In-person meeting	Meeting	Meeting with Chief and Council	EIES donation, TK conversations, Learn More Agreement Conversation	SRFN Board Room
19-Feb-25	Indigenous Relations	Email	NWMO to SRFN	Email to Assistant to Chief and Council and Chief	EIES donation	Email
19-Feb-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Assistant to Chief and Council	Attached a signed copy of Learn More Agreement	Email

19-Feb-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Councillors	Learn More Agreement discussion	Email
21-Feb-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Assistant to Chief and Council	Learn More Agreement discussion	Email
19-Mar-25	Indigenous Relations	Email	NWMO to SRFN	Email to Assistant to Chief and Council and Chief	Learn More Agreement discussion	Email
31-Mar-25	Indigenous Relations	Phone call	Meeting	Phone call with Assistant to Chief and Council	Learn More Agreement Reporting.	phone call
27-Mar-25	Indigenous Relations	Email	NWMO to SRFN	Emailed about the Learn More Agreement	Learn More Agreement discussion	
1-Apr-25	Indigenous Relations	Email	NWMO to SRFN	Email to Assistant to Chief and Council and Chief	Learn More Agreement Reporting	Email
3-Apr-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Assistant to Chief and Council	Providing reporting documents to assist	Email
11-Apr-25	Indigenous Relations	Email	NWMO to SRFN	Email to Assistant to Chief and Council	Confirming meeting Monday	Email
14-Apr	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Assistant to Chief and Council	Cancel meeting due to unsafe driving conditions. Request to reschedule	Email
14-Apr-25	Indigenous Relations	Email	NWMO to SRFN	Email to Assistant to Chief and Council	Set new meeting Learn More Agreement Reporting	Email
29-Apr-25	Indigenous Relations	Email	NWMO to SRFN	Email to Assistant to Chief and Council	Learn More Agreement reporting.	Email
1-May-25	Indigenous Relations	In-person meeting	Meeting	In-person meeting	Meeting cancelled, due to unattendance.	SRFN Board room
1-May-25	Indigenous Relations	Email	NWMO to SRFN	Email to Assistant to Chief and Council	Follow up with new Learn More Agreement reporting meeting dates	Email
5-May-25	Indigenous Relations	Email	NWMO to SRFN	Email to Assistant to Chief and Council and Chief	Following up on previous email.	Email
12-May-25	Indigenous Relations	Call	NWMO to SRFN	Called to Assistant to Chief and Council	Called and left message on Assistant to Chief and Council's mobile phone to reschedule finance meeting	Phone call
20-May-25	Indigenous Relations	Call	NWMO to SRFN	Called Band office to speak to Assistant to Chief and Council	Called to reschedule finance meeting.	Phone call
27-May-25	Indigenous Relations	Email	NWMO to SRFN	Email to Assistant to Chief and Council and Chief	Emailed to request a finance meeting	Email

23-Jun-25	Indigenous Relations	Email	NWMO to SRFN	Email to Assistant to Chief and Council and Chief	Emailed to request a finance meeting to close out agreement.	Email
29-Jul-25	Indigenous Relations	Email + Letter	NWMO to SRFN	Letter with update on the upcoming regulatory process for the DGR Project	Invitation to meet and share information on the Project and discuss next steps	Email
12-Aug-25	Indigenous Relations	Email	NWMO to SRFN	Email to Chief and Assistant to Chief and Council	Seeking permission to share payment information with MNP	Email
22-Aug-25	Indigenous Relations	Call	NWMO to SRFN	Phone call to SRFN Band Office	Call to follow up on email meeting invite to Chief	Phone call
2-Sep-25	Indigenous Relations	Call	NWMO to SRFN	Phone call to Assistant to Chief and Council	Follow up call.	Phone call
2-Sep-25	Indigenous Relations	Call	NWMO to SRFN	Phone call to SRFN Band Office	Call to follow up on meeting invite to Chief	Phone call
2-Sep-25	Indigenous Relations	Call	MNP (accounting firm) to SRFN	Follow up call from MNP	MNP called to follow up on an information request.	Phone call
10-Sep-25	Indigenous Relations	Drop in	NWMO to SRFN	Potential in person meeting	Drop off hard copy of IPD letter, introduce to Chief	Band office
25-Sep-25	Indigenous Relations	Email	NWMO to SRFN	Email from NWMO to Chief	Follow up on IPD letter drop off	Email
30-Sep-25	Indigenous Relations	In person	Meeting	NWMO and SRFN	Conversation regarding Learn More Agreement Reporting	Nigigigoonsi minikaaning GCT#3 Fall Assembly

Letters to Chiefs

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

NWMO-TMP-05000-0001 R000

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

July 29, 2025 APM-CORR-00653-302726

Lac Seul First Nation
c/o Frenchman's Head Band Office
PO Box 100
Hudson, ON
P0V 1X0

Attention: Chief Clifford Bull

Dear Chief Bull:

We are writing to provide you with an update on the regulatory process of the Deep Geological Repository Project for used nuclear fuel (the "Project") and to extend an invitation to meet to share information on the Project and discuss next steps.

As you are likely aware, on November 28, 2024, following a 14-year siting process, the NWMO announced it had selected Wabigoon Lake Ojibway Nation (WLON) and the Township of Ignace as the host communities for the proposed site for the Project. With site selection complete, the Project has transitioned into the regulatory decision-making process, which marks a new chapter, and another opportunity for your community to provide your voice and to participate in this important process.

A key purpose of the regulatory process is for the safety of the Project to be independently assessed and approved by certain Federal regulators, including the Canadian Nuclear Safety Commission and the Impact Assessment Agency of Canada. These would be followed by a series of other federal and provincial regulatory approvals, which would be necessary to enable the Project to be built.

To formally initiate the impact assessment process, the first step is for the NWMO to submit an Initial Project Description to the Impact Assessment Agency of Canada and the Canadian Nuclear Safety Commission. An Initial Project Description explains the purpose and need for a project, provides a preliminary assessment of impacts of a project, and outlines how the proponent (in this case, the NWMO) is planning to avoid and mitigate any harms it may cause while describing the benefits a project brings.

The NWMO has invited local and regional residents and those interested in the Project to provide input on the Initial Project Description and has provided dates for information sessions and webinars; if you would like details for any of those, please let us know.

Tel. 416.934.9814
Fax 416.934.9526
Toll Free 1.866.249.6966
22 St. Clair Avenue East, Sixth Floor
Toronto, Ontario M4T 2S3, Canada
www.nwmo.ca

We would welcome the opportunity to come to your community to discuss the regulatory process relating to the Project, the Initial Project Description, and next steps, ahead of September 30, 2025. Please be assured that there will be multiple other opportunities in the future to provide input on the Project, including various documents generated as part of regulatory processes. If you would like details about those processes and the expected timing of same, please let me know.

We look forward to hearing from you. Please reach out to Joe Gaboury, Director, Indigenous Engagement by email at jgaboury@nwmo.ca or by phone at 647 328 0906.

Thank you for your consideration,

Sincerely

Signed by:
Joe Heil
FF7D947E9AA1460...

Joe Heil
Vice President
Indigenous, Municipal Relations & Transportation

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

July 29, 2025 # APM-CORR-00650-302727

Seine River First Nation
P.O. Box 124,
Mine Centre, ON P0W 1H0

Attention: Chief Whitecrow & Council

Dear Chief Whitecrow & Council:

We are writing to provide you with an update on the regulatory process of the Deep Geological Repository Project for used nuclear fuel (the "Project") and to extend an invitation to meet to share information on the Project and discuss next steps.

As you are likely aware, on November 28, 2024, following a 14-year siting process, the NWMO announced it had selected Wabigoon Lake Ojibway Nation (WLON) and the Township of Ignace as the host communities for the proposed site for the Project. With site selection complete, the Project has transitioned into the regulatory decision-making process, which marks a new chapter, and another opportunity for your community to provide your voice and to participate in this important process.

A key purpose of the regulatory process is for the safety of the Project to be independently assessed and approved by certain Federal regulators, including the Canadian Nuclear Safety Commission and the Impact Assessment Agency of Canada. These would be followed by a series of other federal and provincial regulatory approvals, which would be necessary to enable the Project to be built.

To formally initiate the impact assessment process, the first step is for the NWMO to submit an Initial Project Description to the Impact Assessment Agency of Canada and the Canadian Nuclear Safety Commission. An Initial Project Description explains the purpose and need for a project, provides a preliminary assessment of impacts of a project, and outlines how the proponent (in this case, the NWMO) is planning to avoid and mitigate any harms it may cause while describing the benefits a project brings.

The NWMO has invited local and regional residents and those interested in the Project to provide input on the Initial Project Description and has provided dates for information sessions and webinars; if you would like details for any of those, please let us know.

Tel. 416.934.9814
Fax 416.934.9526
Toll Free 1.866.249.6966
22 St. Clair Avenue East, Sixth Floor
Toronto, Ontario M4T 2S3, Canada
www.nwmo.ca

We would welcome the opportunity to come to your community to discuss the regulatory process relating to the Project, the Initial Project Description, and next steps, ahead of September 30, 2025. Please be assured that there will be multiple other opportunities in the future to provide input on the Project, including various documents generated as part of regulatory processes. If you would like details about those processes and the expected timing of same, please let me know.

We look forward to hearing from you. Please reach out to Joe Gaboury, Director, Indigenous Engagement by email at jgaboury@nwmo.ca or by phone at 647 328 0906.

Thank you for your consideration,

Sincerely

Signed by:
Joe Heil
FF7D947E9AA1460...

Joe Heil
Vice President
Indigenous, Municipal Relations & Transportation

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

July 29, 2025 # APM-CORR-00655-302725

Lac des Mille Lacs First Nation
1100 Memorial Ave, Suite 328,
Thunder Bay, ON P7B 4A3

Attention: Chief Whitecloud & Council

Dear Chief Whitecloud & Council:

We are writing to provide you with an update on the regulatory process of the Deep Geological Repository Project for used nuclear fuel (the "Project") and to extend an invitation to meet to share information on the Project and discuss next steps.

As you are likely aware, on November 28, 2024, following a 14-year siting process, the NWMO announced it had selected Wabigoon Lake Ojibway Nation (WLON) and the Township of Ignace as the host communities for the proposed site for the Project. With site selection complete, the Project has transitioned into the regulatory decision-making process, which marks a new chapter, and another opportunity for your community to provide your voice and to participate in this important process.

A key purpose of the regulatory process is for the safety of the Project to be independently assessed and approved by certain Federal regulators, including the Canadian Nuclear Safety Commission and the Impact Assessment Agency of Canada. These would be followed by a series of other federal and provincial regulatory approvals, which would be necessary to enable the Project to be built.

To formally initiate the impact assessment process, the first step is for the NWMO to submit an Initial Project Description to the Impact Assessment Agency of Canada and the Canadian Nuclear Safety Commission. An Initial Project Description explains the purpose and need for a project, provides a preliminary assessment of impacts of a project, and outlines how the proponent (in this case, the NWMO) is planning to avoid and mitigate any harms it may cause while describing the benefits a project brings.

Tel. 416.934.9814
Fax 416.934.9526
Toll Free 1.866.249.6966
22 St. Clair Avenue East, Sixth Floor
Toronto, Ontario M4T 2S3, Canada
www.nwmo.ca

The NWMO has invited local and regional residents and those interested in the Project to provide input on the Initial Project Description and has provided dates for information sessions and webinars; if you would like details for any of those, please let us know.

We would welcome the opportunity to come to your community to discuss the regulatory process relating to the Project, the Initial Project Description, and next steps, ahead of September 30, 2025. Please be assured that there will be multiple other opportunities in the future to provide input on the Project, including various documents generated as part of regulatory processes. If you would like details about those processes and the expected timing of same, please let me know.

We look forward to hearing from you. Please reach out to Joe Gaboury, Director, Indigenous Engagement by email at jgaboury@nwmo.ca or by phone at 647 328 0906.

Thank you for your consideration,

Sincerely

Signed by:
Joe Heil
FF7D947E9AA1460...

Joe Heil
Vice President
Indigenous, Municipal Relations & Transportation

Appendix C: Concordance Table

Concordance Table Appendix

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project

December 2025

Prepared by: Nuclear Waste Management Organization (NWMO)

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Section Number	Information and Management of Time Limits Regulations – Schedule 1	Practitioner's Guide to the *Impact Assessment Act* Additional Details	Reference in this Initial Project Description
Part A – General Information			
1	The project's name, type or sector and proposed location.	*When naming the project, proponents are encouraged to include a unique identifier (i.e., "Moose Jaw", "Crow's Nest", "Victory"), the main resource or sector that is the focus of the project (i.e., "gold", "hydroelectric", "all season"), and the type of project (i.e., "mine", "marine terminal", "road").*	1
2	The proponent's name and contact information and the name and contact information of their primary representative for the purpose of the description of the project.	N/A	2
3	A summary of any engagement undertaken with any jurisdiction or other party, including a summary of the key issues raised and the results of the engagement, and a brief description of any plan for future engagement.	*This should include any engagement with public or other participants.*	3 and 4
4	A list of the Indigenous groups that may be affected by the carrying out of the project, a summary of any engagement undertaken with the Indigenous Peoples of Canada, including a summary of key issues raised and the results of the engagement, and a brief description of any plan for future engagement.	N/A	3
5	Any study or plan, relevant to the project, that is being or has been conducted in respect of the region where the project is to be carried out, including a regional assessment that is being or has been carried out under Section 92 or 93 of the *Act* or by any jurisdiction, including by or on behalf of an Indigenous governing body, if the study or plan is available to the public.	*Proponents are advised to contact the Agency during the preparation of an Initial Project Description for information regarding any regional studies that may be relevant.*	5

Section Number	Information and Management of Time Limits Regulations – Schedule 1	Practitioner's Guide to the *Impact Assessment Act* Additional Details	Reference in this Initial Project Description
6	Any strategic assessment, relevant to the project, that is being or has been carried out under Section 95 of the Act.	*Proponents are advised to contact the Agency during the preparation of an Initial Project Description for information regarding any strategic assessments that may be relevant.*	6
Part B: Project Information			
7	A statement of the purpose of and need for the project, including any potential benefits.	*The purpose of the project is what is to be achieved by carrying out the project, including any objectives the proponent has in carrying out the project.* *The need for the project is the opportunity that the project is intended to solve or satisfy. That is, the "need for" establishes the fundamental justification or rationale for the project.* *The "purpose of" and "need for" the project should be established from the perspective of the project proponent and provide the context for the consideration of alternatives to and alternative means (below).*	7
8	The provisions in the schedule to the Physical Activities Regulations describing the project, in whole or in part.	*Proponents must detail how the project meets the description, threshold (e.g., provide the length of new right of way) and the criteria in any of the other provisions.* *Indicate whether the designated project is a component of a larger project that is not listed in the Project List.*	8
9	A list of all activities, infrastructure, permanent or temporary structures and physical works to be included in and associated with the construction, operation, decommissioning of the project.	*Include existing structures or related activities that will form part of or are required to accommodate or support the designated project.* *For example, activities during planning, engineering, site preparation or construction might include, but are not limited to, land clearing, excavating, grading, de-watering, directional drilling, dredging and disposal of dredged sediments, infilling, and installing structures.* *This list should make a clear distinction between any ongoing activities or existing physical works (e.g., those associated with ongoing advanced exploration) and those that form part of the designated project.* *This is to include the physical activities that are incidental to the designated project. In determining such activities, the following criteria shall be taken into account:*	9

Section Number	Information and Management of Time Limits Regulations – Schedule 1	Practitioner's Guide to the *Impact Assessment Act* Additional Details	Reference in this Initial Project Description
		• *nature of the proposed activities and whether they are subordinate or complementary to the designated project* • *whether the activity is within the care and control of the proponent* • *if the activity is to be undertaken by a third party, the nature of the relationship between the proponent and the third party and whether the proponent has the ability to "direct or influence" the carrying out of the activity* • *whether the activity is solely for the benefit of the proponent or is available for other proponents as well; and* • *the federal and/or provincial regulatory requirements for the activity* *Should an impact assessment be required for the designated project, the Agency will take these criteria into consideration in determining the activities that are incidental to the designated project.* *Should the proposed project include transportation activities, information must be provided on where transportation will join established transportation corridors (e.g., site access road connects to municipal road)*	
10	An estimate of maximum production capacity of the project and a description of the production processes to be used.	*Capacity refers to the maximum capacity based on the project's design and operating conditions, not the planned capacity of a project.* *This information may not be relevant to all project types (e.g., Highway, railway line), and the proponent should simply indicate where this is the case. The proponent may instead provide other relevant metrics of project size (e.g., area, length, usage).*	10
11	The anticipated schedule for the project's construction, operation, decommissioning, and abandonment, including any expansions of the project.	*This information should include the schedule for the key activities of the each of those phases.* *The schedule should also take into account the anticipated time required to conduct the impact assessment, should one be required.*	11

Section Number	Information and Management of Time Limits Regulations – Schedule 1	Practitioner's Guide to the *Impact Assessment Act* Additional Details	Reference in this Initial Project Description
12 (a)	A list of: (a) potential alternative means that the proponent is considering and that are technically and economically feasible, including through the use of best available technologies; and,	*The Agency recognizes that a proposed project may be in the early stages of planning when an Initial Project Description is being prepared. Proponents may not have made final decisions, and several alternatives may exist for project components (e.g., placement of infrastructure, technologies to be employed). In these situations, proponents are strongly encouraged to identify the alternatives under consideration in the Initial Project Description. Proponents should contact the Agency for further guidance in this area prior to the submission of the Initial Project Description.* *Alternative means are the various technically and economically feasible ways, including through the use of best available technologies, which would allow a designated project and its physical activities to be carried out.* *Alternatives to the project are functionally different ways to meet the need for the project and achieve its purpose that are technically and economically feasible.*	12.2
	A list of: potential alternatives to the project that the proponent is considering and that are technically and economically feasible and directly related to the project.	*The Agency recognizes that a proposed project may be in the early stages of planning when an Initial Project Description is being prepared. Proponents may not have made final decisions, and several alternatives may exist for project components (e.g., placement of infrastructure, technologies to be employed). In these situations, proponents are strongly encouraged to identify the alternatives under consideration in the Initial Project Description. Proponents should contact the Agency for further guidance in this area prior to the submission of the Initial Project Description.* *Alternative means are the various technically and economically feasible ways, including through the use of best available technologies, which would allow a designated project and its physical activities to be carried out.* *Alternatives to the project are functionally different ways to meet the need for the project and achieve its purpose that are technically and economically feasible.*	12.1

Section Number	Information and Management of Time Limits Regulations – Schedule 1	Practitioner's Guide to the *Impact Assessment Act* Additional Details	Reference in this Initial Project Description
Part C: Location Information			
13(a)	A description of the project's proposed location, including: its proposed geographic coordinates, including, for linear development projects, the proposed locations of major ancillary facilities that are integral to the project and a description of the spatial boundaries of the proposed study corridor.	*Coordinates should be provided in a form suitable for use in GIS (e.g., longitude/latitude) using international standard representation.* *Coordinates should be appropriate for the project type. For example: for the centre of a facility, for the boundaries of a proposed mine site, or for the beginning and end points and path of a linear project.* *Indicate if you will be using an existing right of way that has been previously used for a different type of linear project.*	13.1
13(b)	A description of the project's proposed location, including: site maps produced at an appropriate scale in order to determine the project's proposed general location and the spatial relationship of the project components.	N/A	13.2
13(c)	A description of the project's proposed location, including: the legal description of land to be used for the project, including, if the land has already been acquired, the title, deed or document and any authorization relating to a water lot.	N/A	13.2
13(d)	A description of the project's proposed location, including: the project's proximity to any permanent, seasonal or temporary residences and to the nearest affected communities.	N/A	13.2
13(e)	A description of the project's proposed location, including: the project's proximity to land used for traditional purposes by Indigenous Peoples of Canada, land in a reserve as defined in Subsection 2(1) of the *Indian Act*, First Nation land as defined in	N/A	13.2

Section Number	Information and Management of Time Limits Regulations – Schedule 1	Practitioner's Guide to the *Impact Assessment Act* Additional Details	Reference in this Initial Project Description
	Subsection 2(1) of the *First Nations Land Management Act* (Government of Canada 1999), land that is subject to a comprehensive land claim agreement or a self-government agreement and any other land set aside for the use and benefit of Indigenous Peoples of Canada.		
13(f)	A description of the project's proposed location, including: the project's proximity to any federal lands.	N/A	13.2
14	A brief description of the physical and biological environment of the project's location, based on information that is available to the public.	N/A	14
15	A brief description of the health, social and economic context in the region where the project is located, based on information that is available to the public or derived from any engagement undertaken.	N/A	15
Part D – Federal, Provincial, Territorial, Indigenous and Municipal Involvement			
16	A description of any financial support that federal authorities are, or may be, providing to the project.	N/A	16
17	A list of any federal lands that may be used for the purpose of carrying out the project.	N/A	17
18	A list of any jurisdictions that have powers, duties or functions in relation to an assessment of the project's environmental effects.	*This may include permits, licences, or other authorizations that may be required by federal authorities or other jurisdictions.* *A list of any changes to the environment or to health, social or economic conditions that may occur in Canada that are directly linked or necessarily incidental to the involvement of a federal authority that would permit or enable the project to be carried out in whole or in part.*	18

Section Number	Information and Management of Time Limits Regulations – Schedule 1	Practitioner's Guide to the *Impact Assessment Act* Additional Details	Reference in this Initial Project Description
Part E: Potential Effects of the Project			
19(a)	A list of any non-negligible adverse changes that the following components of the environment that are within the legislative authority of Parliament that may be caused by the carrying out of the project: (a) *fish and fish habitat, as defined in subsection 2(1) of the* Fisheries Act (b) *aquatic species, as defined in subsection 2(1) of the* Species at Risk Act (c) *migratory birds, as defined in subsection 2(1) of the* Migratory Birds Convention Act, 1994	N/A	19
20	A list of any non-negligible adverse changes to the environment—that would occur on federal lands—that may be caused by carrying out of the project.	N/A	20
20.1	A list of any non-negligible adverse changes to the marine environment—that are caused by pollution and that would occur outside Canada—that may be caused by the carrying out of the project.	N/A	Non-negligible adverse changes to marine environments are not expected to occur as a result of this project (Figure 1.1).
20.2	A list of any non-negligible adverse changes to interprovincial waters or to *boundary waters* or *international waters*, as those terms are defined in subsection 2(1) of the *Canada Water Act*—that are caused by pollution—that may be caused by the carrying out of the project.	N/A	Non-negligible adverse changes to interprovincial waters or to boundary waters or

Section Number	Information and Management of Time Limits Regulations – Schedule 1	Practitioner's Guide to the *Impact Assessment Act* Additional Details	Reference in this Initial Project Description
			international waters are not expected to occur as a result of this project (Figure 1.1).
21	With respect to the Indigenous Peoples of Canada, a brief description of the impact—that, as a result of the carrying out of the project, may occur in Canada and result from any non-negligible adverse impact on physical and cultural heritage, the current use of lands and resources for traditional purposes or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance—occurring in Canada and resulting from any change to the environment—that may be caused by the carrying out of the project, based on information that is available to the public or derived from any engagement undertaken with the Indigenous Peoples of Canada.	N/A	21
22	A brief description of any non-negligible adverse changes occurring in Canada to the health, social or economic conditions of Indigenous Peoples of Canada, that may be caused by the carrying out of the project, based on information that is available to the public or derived from any engagement undertaken with the Indigenous Peoples of Canada.	N/A	21

Section Number	Information and Management of Time Limits Regulations – Schedule 1	Practitioner's Guide to the *Impact Assessment Act* Additional Details	Reference in this Initial Project Description
22.1	If the project is to be carried out on federal lands or is a *federal work or undertaking*, as defined in subsection 3(1) of the *Canadian Environmental Protection Act, 1999*, a list of any non-negligible adverse effects that may be caused by the carrying out of the project.	N/A	E
23	An estimate of any greenhouse gas emissions associated with the project.	*This should be calculated as the net GHG emissions associated with the project and estimated based on the information available to proponents at this stage. For guidance on the calculation of GHG emissions see the draft Strategic Assessment of Climate Change developed by Environment and Climate Change Canada: https://www.strategicassessmentclimatechange.ca/*	22
24	A list of the types of waste and emissions that are likely to be generated—in the air, in or on water and in or on land—during any phase of the project.	N/A	23
Part F – Summary			
25	A plain-language summary of the information that is required under items 1 to 24 in English and in French.	N/A	APM-REP-05000-0211 and APM-REP-05000-0212

Appendix D: Choosing a Way Forward: The Future Management of Canada's Used Nuclear Fuel

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Choosing a Way Forward

The Future Management of Canada's Used Nuclear Fuel

Final Study

Errata

On page 81 of the Final Study: Choosing a Way Forward Inuit Tapiriit Kanatami (ITK) should be included in the list of Aboriginal organizations which argue that the NWMO Aboriginal Dialogues "are not 'consultation' as required by their interpretation of the law."

VISION, MISSION AND VALUES

VISION

Our vision is the long-term management of Canada's nuclear waste in a manner that safeguards people and respects the environment, now and in the future.

MISSION

The purpose of the NWMO is to develop collaboratively with Canadians a management approach for the long-term care of Canada's used nuclear fuel that is socially acceptable, technically sound, environmentally responsible and economically feasible.

VALUES

The fundamental beliefs that will guide us in our work include:

INTEGRITY
We will conduct ourselves with openness, honesty and respect for all persons and organizations with whom we deal.

EXCELLENCE
We will pursue the best knowledge, understanding and innovative thinking in our analysis, engagement processes and decision-making.

ENGAGEMENT
We will seek the participation of all communities of interest and be responsive to a diversity of views and perspectives. We will communicate and consult actively, promoting thoughtful reflection and facilitating a constructive dialogue.

ACCOUNTABILITY
We will be fully responsible for the wise, prudent and efficient management of resources and be accountable for all of our actions.

Choosing a Way Forward
The Future Management of Canada's Used Nuclear Fuel

Final Study

Minister
Natural Resources Canada
Ottawa, Ontario
K1A 0A6

November, 2005

Dear Minister,

On behalf of the Nuclear Waste Management Organization (NWMO), we are pleased to submit to you our completed study of proposed approaches for the long-term management of nuclear fuel waste.

We submit this report in compliance with sections 12 and 13 of the *Nuclear Fuel Waste Act*.

Further to the requirement of the *Act*, we include in our study the NWMO's recommendation as to which of the proposed approaches should be adopted.

Consistent with our obligations under section 12, we include with this report the comments of the Advisory Council to the NWMO.

In fulfillment of our obligations under section 24 of the *Act*, we are also making this report available to the public.

Respectfully submitted,

K. E. Nash

Ken Nash
Chairman

E Dowdeswell

Elizabeth Dowdeswell
President

Foreword

Three short years ago the NWMO took on the mission of developing collaboratively with Canadians a management approach for the long-term care of Canada's used nuclear fuel. We envisaged an approach that would be socially acceptable, technically sound, environmentally responsible and economically feasible. We were under no illusion that developing a response to this complex issue would be simple. It is after all an unprecedented test of society's ability and willingness to protect people and respect the environment, now and in the future.

Choosing A Way Forward is the fourth major report that we have published over the course of our study. We made a commitment to share our thinking as it evolved and was shaped by our investigations and interaction with Canadians. The first three documents articulated the issues, tested thoughts and reported back what we were hearing. This one reflects a synthesis of a diversity of perspectives from engagement with citizens and specialists and proposes a course of action. We believe our conclusions are responsive to the state of current knowledge and our understanding of the values of those who contributed to the dialogue.

In recommending an Adaptive Phased Management approach, we propose a responsible path forward that intends to meet rigorous standards of safety and security for people and the environment. It embraces the precautionary principle. It is grounded in concepts of continuous learning and adaptive management. We believe this is the strongest possible foundation for managing the risks and uncertainties that are inherent in the very long time-frames over which used nuclear fuel must be managed with care.

In a fundamental way our proposal advances a collaborative process in which citizens always play a legitimate role in making decisions, while at the same time creating conditions for productive movement forward. The nature of the waste, the inevitable uncertainties about performance years into the future, and the care that will be required over many generations, strongly suggest an ethical approach that integrates a continuing understanding of values.

Part One of this report presents our recommendation and outlines the factors that influenced us in reaching our conclusions. Part Two states our legislative requirements and identifies where we demonstrate accountability in meeting the spirit and intent of our founding legislation – the *Nuclear Fuel Waste Act*. Parts Three, Four and Five describe the journey we undertook with Canadians to arrive at this point – the engagement and the assessment. The document concludes with a statement from our Advisory Council.

While the NWMO alone is responsible for the conclusions it has drawn, we took inspiration from those many individuals who have shared their views and perspectives. We count on your enduring vigilance and involvement. Those who participated in specific activities over a period of time, in particular the Roundtable on Ethics and the Assessment Team, deserve special recognition for their essential contributions. Others, such as our international advisors provided informal but important critique and validation.

I particularly want to acknowledge the thoughtful guidance that we have received from our Advisory Council, the encouragement and support of our Board and the unstinting diligence and enthusiasm of the NWMO staff. All were dedicated to a common mission and prepared to synergistically challenge prevailing assumptions.

We were profoundly aware of the imperative to earn the trust of Canadians. Trust matters. To work through and address such a potentially divisive and difficult issue as what to do about the long term management of used nuclear fuel we must trust in each other and our collective ability to come together constructively and cooperatively. The NWMO was motivated to behave ethically and with integrity, to honour our commitments and obligations and to align our interests with the values of Canadians, as best we could. But earning trust takes time. We commit to inviting and valuing all perspectives as we move forward. The path ahead will reflect respect for citizens and the environment and create a capacity and strength to address the obstacles which will inevitably present themselves along the way.

We acknowledge that there will always be some uncertainties. But we are confident that we know enough to take the first steps. We also know that we must do so with flexibility to allow for new knowledge and societal change over time. We are convinced that it is now time to act decisively.

Elizabeth Dowdeswell, President
November 2005

Contents

Transmittal Letter to Minister 3

Foreword 4

Figures and Tables 10

Part One **A Responsible Path: Our Conclusions**

Chapter 1 **A Responsible Path: Our Conclusions** 15

1.1 Introduction 15
1.2 The Foundation 17
1.3 An Important Question of Context – the Future of Nuclear Power 20
1.4 The Technical Possibilities 21
1.5 The Evolution of Another Approach 23
1.6 The Assessment 30
1.7 Further Reflection 32
1.8 The NWMO's Commitment to Implementation 35
1.9 The Recommendation 43
1.10 Concluding Thoughts 45

Part Two **Response to Legislated Study Requirements**

Chapter 2 **Response to Legislated Study Requirements** 47

2.1 Review of Study Requirements 47
2.2 Our Interpretation of "Management Approach" 54
2.3 Study Contributions of the Advisory Council to the NWMO 54

Part Three **What Canadians Said**

Chapter 3 **How We Approached Canadians** 59

3.1 A Responsive Study Process 59
3.2 The Road Traveled – the NWMO's Process of Collaborative Development with Canadians 62

Chapter 4	What People Told Us	71
	4.1 Dialogue 1 – Asking the Right Questions?	71
	4.2 Dialogue 2 – Understanding the Choices	85
	4.3 Dialogue 3 – Choosing a Way Forward	95
	4.4 The NWMO's Observations	113
Part Four	The Assessment	
Chapter 5	Technical Methods Considered in Our Study	115
	5.1 Our Initial Screening of the Options	115
	5.2 Methods Considered in Our Study	117
Chapter 6	Technical Descriptions of Approaches	118
	6.1 The Development of Technical Designs	118
	6.2 Engineering Concepts for the NWMO Study	120
Chapter 7	Economic Regions for Implementation	145
	7.1 What We Can Learn from Economic Regions	145
	7.2 Specification of Economic Regions	146
Chapter 8	Comparison of Benefits, Risks and Costs	154
	8.1 Study Foundations: The Building of an Assessment Framework	154
	8.2 Streams of Analysis	156
	8.3 Assessment of Costs	163
	8.4 Our Assessment Findings	168
	8.5 The Preferred Approach and Possible Future Scenarios	222
Part Five	Implementation	
Chapter 9	Foundation for Implementation	225
	9.1 Key Features of Implementation Plans	225
	9.2 Engaging Communities of Interest	227
	9.3 "Consultation" with Aboriginal Peoples	228
	9.4 The Site-Selection Process	228
	9.5 Managing Implementation	234

Chapter 10	**Governance and Institutions**	**236**
	10.1 The Government of Canada	239
	10.2 Natural Resources Canada	239
	10.3 Canadian Nuclear Safety Commission	240
	10.4 Transport Canada	242
	10.5 Provincial Governments and Regulators	243
	10.6 Major Nuclear Fuel Waste Owners	243
	10.7 Nuclear Waste Management Organization (NWMO)	244
	10.8 Host Communities	249
	10.9 Affected Aboriginal Peoples	249
Chapter 11	**Financial Aspects**	**250**
	11.1 Funding Formula	250
	11.2 Financial Surety	256
Chapter 12	**Services Provided to Other Owners of Nuclear Fuel Waste**	**264**
Chapter 13	**Continuing the Collaborative Process of Dialogue and Engagement**	**267**
	13.1 Setting the Context for Effective Engagement	267
	13.2 Engagement as an Input to Decision-Making	270
	13.3 Incorporating Evolving Best Practices	274
	13.4 Comparing the Management Approaches	274
Chapter 14	**Addressing Social, Economic and Cultural Effects**	**275**
	14.1 The Context	275
	14.2 What are Potential Socio-Economic Effects?	279
	14.3 The Particular Issue of Long-Term Community Sustainability	280
	14.4 Actions to Address Socio-Economic and Cultural Effects	282
Chapter 15	**Research and Intellectual Capacity**	**293**
	15.1 The Important Role of Research	293
	15.2 Research Requirements Common to All Management Approaches	296
	15.3 Research Specific to Individual Management Approaches	298

Chapter 16 **Description of Activities and Timetables** 304
16.1 Option 1: Deep Geological Disposal in the Canadian Shield 304
16.2 Option 2: Storage at Nuclear Reactor Sites 308
16.3 Option 3: Centralized Storage 312
16.4 Option 4: Adaptive Phased Management 315

Appendices
1. NWMO Profile 325
2. *Nuclear Fuel Waste Act* 330
3. Nature of the Hazard 340
4. Status of Used Nuclear Fuel in Canada 350
5. Regulatory Framework 353
6. Nuclear Waste Management in Other Countries 360
7. NWMO's Roundtable on Ethics 364
8. Influences for the Assessment of Management Approaches 370
9. Other Methods Considered 386
10. Used Fuel Scenarios 393
11. Building the Information Foundation – Engagement and Research 399
12. Glossary 428
13. Acronyms 432

NWMO Advisory Council Report
Advisory Council's Transmittal Letter 434
Final Report of the Advisory Council 435

Figures and

Figures and Tables

Figures

Figure 1-1	Nuclear Reactor Sites in Canada	15
Figure 1-2	Activity Flowchart for Adaptive Phased Management	29
Figure 1-3	Governance Framework for the Long-Term Management of Used Nuclear Fuel: Roles & Responsibilities	36
Figure 3-1	NWMO Study Plan	60
Figure 3-2	Development of a Management Approach	61
Figure 4-1	What is Important in a Management Approach: Inputs for the Assessment	79
Figure 6-1	Deep Geological Disposal in the Canadian Shield	122
Figure 6-2	Example of Used Fuel Storage in Bays at Reactor Site	126
Figure 6-3 & 6-4	Example of Used Fuel Storage in Dry Storage at Reactor Sites – Surface Storage Building and Dry Storage Containers	126
Figure 6-5	Centralized Storage – Above Ground	129
Figure 6-6	Adaptive Phased Management: Phase 1 – Preparing for Central Used Fuel Management	142
Figure 6-7	Adaptive Phased Management: Phase 2 – Central Storage and Technology Demonstration	143
Figure 6-8	Adaptive Phased Management: Phase 3 – Long-Term Containment, Isolation and Monitoring	144
Figure 7-1	Option 1: Deep Geological Disposal in the Canadian Shield-Map	147
Figure 7-2	Option 2: Storage at Nuclear Reactor Sites-Map	149
Figure 7-3	Option 3: Centralized Storage (Above or Below Ground)-Map	151
Figure 7-4	Option 4: Adaptive Phased Management-Map	153
Figure 8-1	NWMO Assessment of Management Approaches	157
Figure 8-2	Cumulative Costs: Options 1, 2, 3 and 4 (including Interim Storage, Retrieval and Transportation)	165
Figure 8-3	Total Cash Flow: Option 1 – Deep Geological Disposal in the Canadian Shield (including Interim Storage, Retrieval and Transportation)	166
Figure 8-4	Total Cash Flow: Option 2 – Storage at Nuclear Reactor Sites (New Above Ground Technology) (including Interim Storage, Retrieval and Transportation)	166
Figure 8-5	Total Cash Flow: Option 3 – Centralized Storage (Above Ground) (including Interim Storage, Retrieval and Transportation)	167

Tables

Figure 8-6	Total Cash Flow Option 4 – Adaptive Phased Management (including Interim Storage, Retrieval and Transportation)	167
Figure 10-1	Governance Framework for the Long-Term Management of Used Nuclear Fuel: Roles & Responsibilities	237
Figure 10-2	NWMO Reporting Requirements	246
Figure 12-1	Nuclear Reactor Sites and Used Fuel Storage Facilities in Canada	264
Figure 13-1	Illustrative Dialogue & Engagement Process for Each Decision Point	271
Figure 14-1	Conceptual Schematic of the Relative Employment Trends for Each Option	280
Figure 16-1	Overall Work Schedule for Deep Geological Disposal in the Canadian Shield	304
Figure 16-2	Activity Flowchart for Deep Geological Disposal in the Canadian Shield	305
Figure 16-3	Overall Work Schedule for Storage at Nuclear Reactor Sites	308
Figure 16-4	Activity Flowchart for Storage at Nuclear Reactor Sites	309
Figure 16-5	Overall Work Schedule for Centralized Storage	312
Figure 16-6	Activity Flowchart for Centralized Storage	313
Figure 16-7	Overall Work Schedule for Adaptive Phased Management	316
Figure 16-8	Activity Flowchart for Adaptive Phased Management	317
Figure A3-1	CANDU Fuel Bundle	340
Figure A3-2	Total Activity of Used CANDU Fuel as a Function of Time Out of Reactor	341
Figure A3-3	Sources of Background Radiation Exposure in Canada	342
Figure A4-1	Nuclear Reactor Sites in Canada	352
Figure A8-1	Fairness Influence Diagram	371
Figure A8-2	Public Health and Safety Influence Diagram	373
Figure A8-3	Worker Health and Safety Influence Diagram	375
Figure A8-4	Community Well–Being Influence Diagram	377
Figure A8-5	Security Influence Diagram	379
Figure A8-6	Environmental Integrity Influence Diagram	381
Figure A8-7	Economic Viability Influence Diagram	383
Figure A8-8	Adaptability Influence Diagram	385

Tables

Table 1-1	Option 4: Adaptive Phased Management	24
Table 2-1	Guide to Study Requirements in the *Nuclear Fuel Waste Act*	48
Table 3-1	Phase 1: What We Did to Identify Expectations for the Study	64
Table 3-2	Phase 1: What We Did to Create the Information Foundation for the Study	65
Table 3-3	Phase 2: What We Did to Explore the Fundamental Issues	67
Table 3-4	Phase 3: What We Did to Further the Assessment of Management Approaches	69
Table 3-5	Phase 4: What We Did to Finalize the Study	70
Table 4-1	Perspectives on the Nature & Breadth of Aboriginal Traditional Knowledge	83
Table 4-2	Agreement with Foundation Principles for the Management Approach	97
Table 4-3	Summary Rating of the Importance of Elements of the Approach	108
Table 6-1	Option 1: Deep Geological Disposal in the Canadian Shield (modified AECL concept)	123
Table 6-2	Option 2: Storage at Nuclear Reactor Sites	127
Table 6-3	Option 3: Centralized Storage, Above or Below Ground	130
Table 6-4	Option 4: Adaptive Phased Management	138
Table 7-1	Economic Regions for Possible Implementation of Option 1	148
Table 7-2	Economic Regions for Possible Implementation of Option 2	148
Table 7-3	Economic Regions for Possible Implementation of Option 3	150
Table 7-4	Economic Regions for Possible Implementation of Option 4	152
Table 8-1	Total Life Cycle Cost Estimates for Management Approaches	163
Table 8-2	Fairness	169
Table 8-3	Public Health & Safety	178
Table 8-4	Worker Health & Safety	185
Table 8-5	Community Well-Being	189
Table 8-6	Security	195
Table 8-7	Environmental Integrity	203
Table 8-8	Economic Viability	208
Table 8-9	Adaptability	213
Table 8-10	Test Requirements for Used Fuel Transportation Packages	218

Table 9-1	Describing Affected Communities for the Four Management Approaches	227
Table 11-1	Funding Requirements	251
Table 11-2	Total Life Cycle Cost Estimates for Management Approaches	252
Table 11-3	Total NWMO Costs for Management Approaches, Excluding Interim Storage & Retrieval	253
Table 11-4	Current Projected Fuel Bundles and Percentages by Waste Owners	255
Table 11-5	Trust Fund Requirements	257
Table 11-6	Authorized Withdrawals from *NFWA* Trusts	259
Table 11-7	Summary Information on Nuclear Funding Guarantees	260
Table 12-1	Research and Isotope Producing Reactors in Canada	265
Table 12-2	Canadian Research Reactor Functions and Used Fuel Management Agreements	266
Table 13-1	Engagement as an Input to Decision-Making	272
Table 14-1	Categories of Measures to Address Impacts	276
Table 14-2	The Sustainable Livelihoods Framework	278
Table 14-3	Illustrative Measures for Addressing Socio-Economic and Cultural Effects	283
Table 14-4	Innovations in Addressing Socio-Economic Effects	285
Table 14-5	Measures to Address Potential Socio-Economic Effects by Project Activity	287
Table A3-1	Composition of Fresh and Used CANDU Natural Uranium	341
Table A3-2	Canadian Drinking Water Guidelines – Maximum Acceptable Concentration (Ref. Health Canada, April 2004)	343
Table A3-3	External Radiation from Used CANDU Fuel as a Function of Time	344
Table A4-1	Storage of Used Nuclear Fuel as of December 31, 2004	350
Table A4-2	Projected Total Inventory of Used Nuclear Fuel	351
Table A5-1	Key Federal Legislation Governing Nuclear Waste in Canada	358
Table A6-1	International Nuclear Waste Management Programs	361
Table A9-1	Methods of Limited Interest	389
Table A11-1	Métis National Council – Dialogue Activities	411
Table A11-2	Ontario Métis Aboriginal Association – Community Meetings	414

Part One
A Responsible Path: Our Conclusions

1

Chapter 1 / A Responsible Path: Our Conclusions

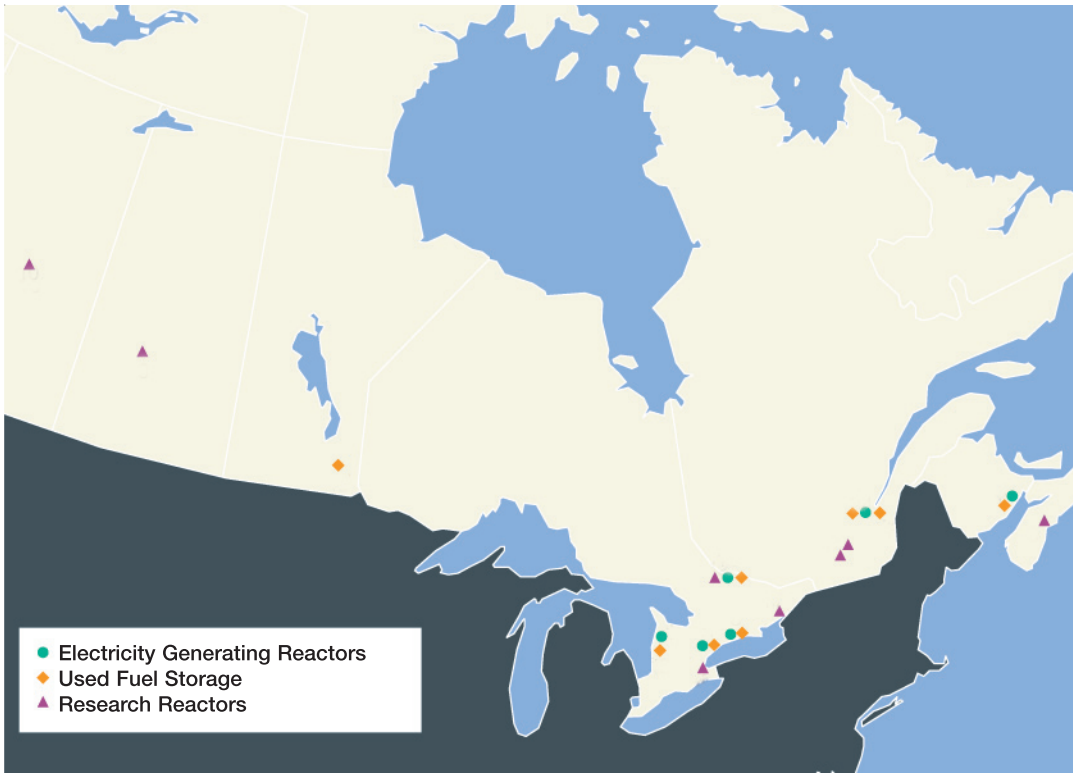
1.1 / Introduction

For decades Canadians have been using electricity generated by nuclear power reactors. When used nuclear fuel is removed from a reactor, it is highly radioactive and requires proper shielding and careful handling to protect humans and the environment. Although the radioactivity decreases with time, used fuel will remain a potential health risk for a very long period, likely hundreds of thousands of years or longer. Consistent with evolving international experience and the regulatory regimes governing management of used nuclear fuel, the NWMO has taken the position that used fuel will need to be contained and isolated from people and the environment essentially indefinitely. (Further elaboration of our understanding of the nature of the hazard is presented in Appendix 3.)

Canada's used fuel is now safely stored on an interim basis at licensed facilities at the reactor sites located in Ontario, Québec and New Brunswick and at the AECL facility in Manitoba. There are also small amounts at several nuclear research facilities throughout Canada. (See Figure 1-1) We currently have about two million used fuel bundles, and we expect to have about 3.7 million bundles if each of the electricity generating nuclear reactors has an average operating life of 40 years. (A more complete status report of the amount and location of Canada's used nuclear fuel can be found in Appendix 4.)

Like many other countries with nuclear power programs, Canada has yet to decide what to do with its radioactive used fuel over the long term. Thirty-two countries operate more than 400 nuclear power reactors. Some have chosen to construct a deep geological repository and are at different stages of site selection. Others are studying the most appropriate approach or have postponed consideration for the time being. (Appendix 6 provides additional information.)

Figure 1-1 Nuclear Reactor Sites in Canada



Notwithstanding considerable research about the science, technology and engineering of possible storage and repository approaches, the task of implementation has proven challenging.

In Canada, an intensive and lengthy period of deliberation was undertaken by the Seaborn Panel. The Panel's specific mandate was to conduct an environmental assessment of an AECL proposal for deep geological disposal. In 1998, they provided insight and direction on key issues that had to be addressed in order to move the decision-making forward. With respect to the AECL disposal concept they concluded that:

- From a technical perspective, safety of the AECL concept has been on balance adequately demonstrated for a conceptual stage of development, but from a social perspective, it has not; and

- As it stands, the AECL concept for deep geological disposal has not been demonstrated to have broad public support. The concept in its current form does not have the required level of acceptability to be adopted as Canada's approach for managing nuclear fuel wastes.

On the matter of criteria for safety and acceptability they concluded that:

- Broad public support is necessary in Canada to ensure the acceptability of a concept for managing nuclear fuel wastes; and

- Safety is a key part, but only one part, of acceptability. Safety must be viewed from two complementary perspectives: technical and social.

A paper documenting the legacy of the Seaborn Panel in pointing to the imperative to consider the ethical and social domains as well as the technical questions on one of the approaches under NWMO's review can be found at **www.nwmo.ca** (background paper #2-8).

The Government considered and responded to the Seaborn Panel Report, and in November 2002 brought into force the *Nuclear Fuel Waste Act* (an Act respecting the long-term management of nuclear fuel waste)(*NFWA*) . (See Appendix 2). As required by that federal legislation, the Nuclear Waste Management Organization (NWMO) was established. Our immediate task was to research, consult widely and make recommendations to the federal government about an appropriate long-term management approach for used nuclear fuel. The precise description of the NWMO's mandate follows in Chapter 2. This report, *Choosing A Way Forward*, documents our process and presents our conclusions and recommendation.

1.2 / The Foundation

This study was built on a firm foundation – a mission statement integrating the elements of sustainable development; a preeminent focus on safety and security; a perspective that takes a long view; a framework of ethics and values; and a recognition of the requirement for citizen engagement.

The NWMO Mission

The purpose of the NWMO is to develop collaboratively with Canadians a management approach for the long-term care of Canada's used nuclear fuel that is socially acceptable, technically sound, environmentally responsible and economically feasible. In a complex sociotechnical system an integrated perspective is essential.

A socially acceptable management approach is one which has emerged from a process of collaborative development with citizens. It must take into account the best available knowledge and expertise, and be responsive to the values and objectives which are most important to citizens. A solid grounding in knowledge, and a fundamental responsiveness to citizens, form the foundation for public confidence.

An environmentally responsible management approach is one in which physical, chemical and biological stresses on the environment, including cumulative effects over long periods of time, and the potential consequences of failure of any part of the containment system, are within the natural capacity of environmental processes to accept and adjust to, thus ensuring the long-term integrity of the environment.

A technically sound management approach is one which is informed by the best technical and scientific knowledge and experience available in Canada and around the world, and which is practicable given our current state of knowledge. At a minimum it must ensure: public health and safety; worker health and safety; security of nuclear materials and the facilities that manage them; and environmental integrity. As well, the approach must meet international safeguards and non-proliferation obligations.

An economically feasible management approach is one that ensures that adequate economic resources are available, now and in the future, to pay the costs of the selected approach. The selected approach ought to provide high confidence that funding shortfalls will not occur to threaten the assured continuation of necessary operations.

Safety & Security

Our primary motivation is safety – to protect people and the environment from highly radioactive used nuclear fuel. We are not confused or conflicted about this objective and common vision. More recently a specific focus on security from harmful acts, events and situations has assumed a higher profile. We must ensure that our security systems and safeguards are compliant with Canada's nuclear non-proliferation policy and international agreements.

While many Canadians use the words safety and security interchangeably, there are widely accepted definitions and understandings on which our laws are based. Essentially nuclear safety deals with accident, whereas security deals with intentional malicious actions perpetrated by a human adversary. The former requires proper operating conditions, prevention of accidents and protection of workers, the public and the environment from undue radiation hazards. Security requires measures to prevent loss or theft or unauthorized transfer of radiation sources or radioactive material.

Canada's commitment to nuclear non-proliferation, that is, to prevent the spread of nuclear weapons to states, is evident in its acceptance of international safeguards. The objective is to detect any diversion of nuclear material from peaceful activities and requires material protection, control and accounting.

We do not live in a risk-free world. A technical method cannot be practically demonstrated over thousands of years prior to implementation. It can only be predicted with greater or lesser confidence. Complex mathematical calculations and numerical analyses alone are not likely to generate required societal confidence.

That said, we must continue to build confidence that the management of used nuclear fuel will meet or exceed rigorous safety and security goals. Scientific and technical work must be, and be perceived to be, of the highest quality. Technically, a compelling case for safety must involve multiple barriers and redundant systems that maintain their integrity over exceedingly

long periods of time. Over the long term, it would be imprudent to rely on a human management system alone with its changing forms of institutions and governance.

From a social perspective, safety and acceptability are intertwined. Society as a whole, and not science alone, needs to judge the benefit or harm. While science can speak to the probability of the occurrence of an event, science cannot speak to social tolerance for its occurrence. What poses risk, how the risk should be measured, and what is considered relevant for measurement are all decisions which are influenced by societal considerations. That is precisely why the NWMO study has been a socially directed process.

The Long View

Perhaps the most significant feature of this issue is the time dimension. Nuclear fuel waste remains a potential health, safety and security hazard for many thousands of years, so the relative performance of any option must look out to these geological time frames. Any decision taken today will be implemented over a number of decades, at least. Undoubtedly the program will encounter major changes in science and technology, institutions, values, political perspectives, and economic and financial considerations.

We are contemplating designing and licensing a system to last for periods longer than recorded history. That could lead to paralysis, encouraging the postponement of making a decision, particularly since any decision will be controversial and politically complex. Furthermore, the technology used to store nuclear fuel waste today is safe, adequate and affordable for some period of time and there appears to be no imminent safety or environmental crisis forcing a decision.

However, the *NFWA* reflects the sentiments and values of Canadian society: namely that this generation of citizens which has enjoyed the benefits of nuclear energy has an obligation to begin provision for managing that waste. That is consistent with the "polluter pays" principle. Used fuel already exists. This generation does not want to leave as a legacy the burden of providing for and funding the management of the used fuel we have created. We should not bequeath hazardous wastes to future generations without also giving those generations the capability to manage the waste in a safe and secure way.

We do not know what technologies may be available to succeeding generations, or what they may choose to do with the wastes that we have generated. We also do not know what the capacity of future generations will be to take an active role in managing this waste. In light of these uncertainties, our obligation is to give them a real choice and the opportunity to shape their own decisions while at the same time not imposing a burden which they may not be able to manage. This means avoiding approaches that are irreversible or overly dependent on strong institutions and embracing those that are precautionary. In essence the precautionary principle places the burden of proof on us to ensure that greater benefit of the doubt will be given to health and the environment. It means planning conservatively by setting aside the financial resources to ensure that future generations will have genuine choice. It means making a commitment to continuous learning today to assist decision making tomorrow.

What we can do is plan for the foreseeable future, act responsibly and confidently with the best science and technology in hand. What we must not do is pretend that we have all the answers for all time. A measure of humility will be essential as we move cautiously but surely toward the goal one step at a time.

Ethics and Values

Given the longevity of the hazard of used nuclear fuel, it is imperative that we consider explicitly how we might meet our obligations to future generations and the environment. Given the nature of the hazard, it is imperative that we consider matters of 'equity' or fairness within the current generation.

We believe that ethics should be embedded in our work. Consequently, ethical principles guided the manner in which we worked and the way in which we assessed the options and determined our recommendation. Intergenerational equity and fairness became much more than matters of academic discussion.

The most important ethical choices to be made are in fact values-based decisions and as such require the involvement of society at large. An ethical process is one that requires engage-

ment of a broad cross-section of society in an informed dialogue on the core human issues to be addressed. An ethical outcome or recommendation is one which is responsive to the values and concerns of society at large.

Ethical questions may not have unambiguous or definitive answers. With no ethical absolute, and in the face of uncertainty, past attempts to resolve them through technical arguments have not been satisfactory. There are inevitable trade-offs among competing objectives. Which objectives are primary? Nonetheless we found common ground. This generation must accept responsibility, not leaving a legacy of waste for future societies. This generation should not make irrevocable decisions, depriving future generations of genuine choice. For this and future generations safety must not be compromised. These declarations are fine in theory, but equally important is how we act on them.

Part of the answer lies in incorporating a future perspective, thinking carefully about how the world might change and how future societies might behave. Another factor is in the design itself – choosing a technology that is capable of providing the requisite level of safety, fully funding future costs, anticipating and mitigating potential environmental and socio-economic impacts and planning for the creation and transfer of knowledge over time. Finally, in a democratic society, the inclusiveness and integrity of the process by which decisions are taken are key.

Citizen Engagement

The NWMO began its study with the understanding that technical and scientific specialists can help us understand the technical adequacy of each of the management approaches available to Canada. They can also help us understand the impacts any approach may have on the environment, and whether the approach is affordable (economically feasible). However, scientific and technical evidence and analysis, while essential, cannot be the sole basis of our choice.

The views of Canadian society in judging benefits or risks, and assessing the social implications of various approaches for long-term management, are critical to the development of a socially acceptable recommendation. Canadians expect that the best scientific and technical knowledge must be brought to bear in identifying and understanding the source and nature of risk and the ways in which safety can be assured. However, the decision as to whether safety has been assured to a sufficient degree to warrant implementation is a societal one. Canadians will be influenced by social notions of what constitutes risk and the safety threshold to be met.

We set aside traditional notions of consultation as they have too often in the past resulted in one-way conversations. We have consistently tried to design processes of dialogue to encourage listening and learning, and genuinely engage those who are interested in this matter. We have tried to be responsive to a variety of views and perspectives. We have been transparent, making all of our information available, at all stages of the process. As can be seen in Part Three of this report, thousands have helped us in the search for societal direction and common ground.

The goal of our Aboriginal dialogues, designed and conducted by Aboriginal peoples, was to build the necessary foundation for a long-term, positive relationship. We have begun the process of learning how to integrate the insights and knowledge of Aboriginal peoples into our work. There is substantive knowledge about the land and ecology in any given location, stemming from long contact with the land. But Aboriginal Tradional Knowledge is also about ways of developing and maintaining effective and respectful relationships – between young and old, within a community, between communities.

We have gained insight from previous attempts at siting facilities for other purposes from managing the wastes in mining communities, and from engagement processes that resulted in positive and continuing benefit to communities. Reactor-site communities were particularly helpful in articulating the current reality. And, whenever possible we tried to catch a glimpse of the future through the eyes of youth.

Sustained engagement with people and communities, whether they welcome, oppose or seek modifications to our observations and conclusions, is vital. We commit to continue building relationships as decisions are taken and implementation begins.

1.3 / An Important Question of Context – the Future of Nuclear Power

Our report would be incomplete if we did not refer to the impassioned arguments we heard about energy policy and the future of nuclear power.

For some it was a technical matter. Knowing the volume and type of waste might be a key element in the choice of technical option. They wanted to make sure that the options were tested against a variety of scenarios ranging from early phase-out to expansion of nuclear power. They sought assurance that an option chosen today would be robust enough to meet the needs of tomorrow, whatever those needs might be. Furthermore, in the choice of options to consider, some felt that source reduction and elimination should be a first step in any waste management program.

There were suggestions to assess the full life cycle of nuclear materials, from mining through to the management of all forms of waste. Some proposed that such an analysis would show that nuclear energy improves the quality of life and may lead to an overall reduction of stress on the environment. Others suspect that if the real costs and benefits of the full lifecycle were tallied nuclear energy generation would be abandoned.

There were some who argued that from a social and ethical perspective it is important to frame the issue very broadly. They wanted to examine the very activity that gives rise to the waste in the first place. While some worried that the identification of a long-term management approach would serve as a de facto licence for the expansion of nuclear energy without adequate public discussion, others acknowledged that it was important for the current economic viability of the industry that decisions be taken.

In this report, the NWMO has not examined nor is it making a judgment about the appropriate role of nuclear power generation in Canada. We suggest that those future decisions should be the subject of their own assessment and public process.

Used fuel exists today and will continue to be produced to the end of the lives of Canada's existing nuclear facilities. The focus of our study is to recommend a responsible path forward for addressing the used fuel that requires management for the long term. Our study process and evaluation of options were intended neither to promote nor penalize Canada's decisions regarding the future of nuclear power.

1.4 / The Technical Possibilities

Sound science and technology must be the starting point for any examination of alternative management approaches. For about four decades, various countries have been investigating numerous technical methods. Deep geological repositories have been the subject of intensive study in Canada, and are in an advanced state of scientific and technical understanding internationally. Storage technologies have been demonstrated at reactor sites for many years.

Our assessments have confirmed that there is reason to be confident that all three technical methods or concepts identified in the *NFWA* are credible and could be designed to be safe for the near term, from a technical perspective. Furthermore, our regulatory regime would demand a comprehensive safety case before licensing.

The word "disposal" has come to mean permanence and irretrievability in the minds of the public, and that raises questions about our stewardship of the waste. For that reason we do not use the word disposal. Yet to others the word "storage" implies a temporary approach that avoids taking a decision, and places a burden on future generations. For purposes of this report we have defined storage as a method of managing the waste in a manner that allows access under controlled conditions for retrieval or future activities while disposal is conclusive without any intention of retrieval or further use.

Additional options that had at some point received international attention were reviewed and found to be lacking in meeting important criteria such as proof of concept or legality. Members of the public had a particular interest in reprocessing of used fuel, as it seemed to be related to desirable environmental concepts of recycling and reuse. Partitioning and transmutation were also of interest for the possibility of reducing the volume and toxicity of the waste to be managed. For a variety of reasons outlined in Chapter 5, we believe that these options are unlikely to be economic, practical or desirable in Canada at this point in time.

For each of the three specific technical methods identified in the *NFWA*, engineering design concepts and cost estimates were developed for the Joint Waste Owners: Ontario Power Generation Inc., NB Power Nuclear, Hydro-Québec and Atomic Energy of Canada Ltd. These design concepts and cost estimates were validated by a third party and are fully described and assessed in Chapters 6 and 8. A brief description of these conceptual designs follows.

Option 1: Deep Geological Disposal in the Canadian Shield

This option involves placing the used nuclear fuel deep underground, relying on natural and engineered barriers to isolate the used fuel from humans and the surface environment over its hazardous lifetime. A deep geological repository would be located in the Canadian Shield at a nominal depth of 500 to 1,000 metres. Fuel would be transported from the existing interim storage facilities at nuclear reactor sites to this central site where it would be packaged in corrosion resistant containers. Over a period of about 30 years, these containers would be placed in rooms excavated deep in the rock. Performance of the repository would be monitored during placement of the used fuel after which the underground excavations would be backfilled and sealed. After closure, maintenance, inspection and security-related operations would be minimal. Such a facility would be designed to be passively safe over the long term, and not rely on institutional controls to ensure safety.

This concept was researched in depth by Atomic Energy of Canada Limited from 1978 to 1996, and reviewed by the Seaborn Panel under the *Federal Environmental Assessment and Review Process Guidelines Order* (1984). The original concept has been further developed based on underground research and experience both in Canada and internationally. It now incorporates provisions for extended monitoring as well as the technology to retrieve used fuel after placement in the repository. Note that the only time we refer to disposal as a possible Canadian approach is in reference to this specific AECL proposal.

Option 2: Storage at Nuclear Reactor Sites

Currently, when used nuclear fuel is removed from reactors it is placed in wet storage for about seven to ten years to reduce its heat and radioactivity. It is then transferred to containers for dry storage in a facility at the reactor site. The design life of the concrete and steel storage containers is about 50 years, although the expected life is estimated to be at least 100 years.

This option for used fuel management would involve either the expansion of existing dry storage facilities or the construction of new, long-term dry storage facilities at each of the seven storage sites in Canada. Over time, used fuel would have to be transferred from the existing interim storage facilities to newly designed storage containers and facilities at the reactor sites with various components designed to last between about 100 and 300 years. We project that storage facilities would need to be completely refurbished or replaced about every 300 years.

This option would require an indefinite cycle of replacement and refurbishing activities, as facilities would be renewed at the reactor sites. Processing buildings, which would also require ongoing maintenance, inspections and security systems, would also be needed for fuel loading and on-site transfer.

Option 3: Centralized Storage, Above or Below Ground

Centralized extended storage would involve creating new, long-term storage facilities at a central location. Conceptual designs have been developed for a storage facility built above or below ground, with options including: casks and vaults in storage buildings, surface modular vaults, casks and vaults in shallow trenches, and casks in rock caverns.

The used fuel would be transported from the seven interim storage sites in Canada to this new central facility.

The various components of the storage facility would have design lives between 100 and 300 years. It is projected that the storage facility would need to be completely refurbished or replaced every 300 years or so. This option for used fuel management would require an ongoing program of regular replacement and refurbishing activities, as the facility would be renewed indefinitely at the central site. Processing buildings, which would require ongoing maintenance, inspections and security systems, would also be needed for fuel loading and on-site transfer.

1.5 / The Evolution of Another Approach

The NWMO recommends an alternative approach – Adaptive Phased Management.

In defining and evaluating the three mandated options, it became clear that each possessed some unique strengths, but also some important limitations. They are not necessarily mutually exclusive. For example, even a timely decision to pursue development of a geological repository would require decades of continued storage before such a facility could be put in operation, followed by additional decades for complete transfer of the fuel. Or, a decision to choose long-term storage at the reactor sites would not preclude future generations from making a subsequent decision to move the fuel to some centralized location, provided funds were made available. As well, potential sites for a deep repository may be found in regions beyond the Canadian Shield in other geotechnically suitable rock formations, such as Ordovician sedimentary rock basins.

Furthermore, Canadians have expressed two complementary objectives. They are prepared to assume responsibility now for dealing with used fuel that has been created, but they also want to preserve the ability of future generations to do what they see as being in their best interests.

The insights from the assessments led us to search for an approach that might better meet Canadian objectives than any of the three options taken in isolation. The challenge of taking the long view demanded by this issue caused us to explore how we could build in sequential decision-making which would preserve flexibility during implementation in the coming years.

Adaptive Phased Management consists of both a technical method and a management system. The key attributes of the approach are:

- Ultimate centralized containment and isolation of used nuclear fuel in an appropriate geological formation;
- Phased and adaptive decision-making;
- Optional shallow storage at the central site prior to placement in the repository;
- Continuous monitoring;
- Provision for retrievability; and
- Citizen engagement.

A more detailed technical description of Adaptive Phased Management can be found in Chapter 6.

The approach builds on the best features of the three approaches outlined in the *NFWA*, and implements them in a staged or phased manner over time. Table 1-1 illustrates three potential phases of concept implementation: preparing for central used fuel management; technology demonstration and optional central shallow storage; and long-term containment, isolation and monitoring in the repository. Each of the three phases has a number of key activities and decision points. While we do not know the precise duration of these activities or the outcome of future decisions, we can provide an indication of a representative schedule for implementation based on the conceptual design work and previous analysis of the three options for used fuel management under study. (See Figure 1-2).

Table 1-1 Option 4: Adaptive Phased Management

Representative Conceptual Design Activities for Adaptive Phased Management	
Concept	A staged management approach with three phases of implementation: • Phase 1: Preparing for Central Used Fuel Management • Phase 2: Central Storage and Technology Demonstration • Phase 3: Long-term Containment, Isolation and Monitoring **Phase 1 (approximately the first 30 years):** Preparing for central used fuel management would comprise the following activities: • Maintain storage and monitoring of used fuel at nuclear reactor sites. • Develop with citizens an engagement program for activities such as design of the process for choosing a site, development of technology and key decisions during implementation. • Continued engagement with regulatory authorities to ensure pre-licensing work would be suitable for the subsequent licensing processes. • Select a central site that has rock formations suitable for shallow underground storage, an underground characterization facility and a deep geological repository. • Continue research into technology improvements for used fuel management. • Initiate the licensing process, which triggers the environmental assessment process under the *Canadian Environmental Assessment Act*. • Undertake site characterization, safety analyses and an environmental assessment for the shallow underground storage facility, underground characterization facility and deep geological repository at the central site, and to transport used fuel from the reactor sites. • Obtain a licence to prepare the site. • Develop and certify transportation containers and used fuel handling capabilities. • Obtain a licence to construct the underground characterization facility at the central site. • Decide whether or not to proceed with construction of a shallow underground storage facility and to transport used fuel to the central site for storage. • If a decision is made to construct the shallow underground storage facility, obtain a construction licence and then an operating licence for the storage facility. **Phase 2 (approximately the next 30 years):** Central storage and technology demonstration would comprise the following activities: • If a decision is made to construct shallow underground storage, begin transport of used fuel from the reactor sites to the central site for extended storage. • If a decision is made not to construct shallow underground storage, continue storage of used fuel at reactor sites until the deep repository is available at the central site. • Conduct research and testing at the underground characterization facility to demonstrate and confirm the suitability of the site and the deep repository technology. • Engage citizens in the process of assessing the site, the technology and the timing for placement of used fuel in the deep repository. • Decide when to construct the deep repository at the central site for long-term containment and isolation. • Complete the final design and safety analyses to obtain the required operating licence for the deep repository and associated surface handling facilities. There may be a need for transportation containers and facilities to produce them; processing facilities to load the fuel into transportation containers; production facilities for storage containers; and processing facilities to transfer the fuel from transportation to storage containers.

Table 1-1 (cont'd) Option 4: Adaptive Phased Management

Representative Conceptual Design Activities for Adaptive Phased Management	
Concept (cont'd)	**Phase 3 (beyond approximately 60 years):** Long-term containment, isolation and monitoring would comprise the following activities: • If used fuel is stored at a central shallow underground facility, retrieve and repackage used fuel into long-lived containers. • If used fuel is stored at reactor sites, transport used fuel to the central facility for repackaging. • Place the used fuel containers into the deep geological repository for final containment and isolation. • Decommission the shallow underground storage facility. • Continue monitoring and maintain access to the deep repository for an extended period of time to assess the performance of the repository system and to allow retrieval of used fuel, if required. • Engage citizens in on-going monitoring of the facility. • A future generation would decide when to decommission the underground characterization facility and any remaining long-term experiments or demonstrations of technology, and when to close the repository, decommission the surface handling facilities and the nature of any postclosure monitoring of the system. There may be a need for production facilities for used fuel containers; processing facilities to transfer the fuel from storage to the deep repository; and production facilities for sealing materials. The current owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transported from the reactor sites to the central facility for long-term management.
Location	The central facility for the shallow rock cavern, underground characterization facility and deep repository could be located in a suitable rock formation such as the crystalline rock of the Canadian Shield or in the Ordovician sedimentary rock basins. These two rock types cover a vast amount of land reaching several provinces and territories. A specific location would need to be identified and approval would be required from the Canadian Nuclear Safety Commission for the construction and operation of the facility. This would also involve an environmental assessment.
Transportation Requirements	The operation of a central facility would involve moving the fuel from existing reactor site storage facilities in certified transport containers to the central site over a period of approximately 30 years. Transportation would require an emergency response plan and adherence to security provisions. The mode of transportation (road, rail or water) would depend on factors such as the location of the central facility. The timing of transportation would depend on whether or not a shallow underground storage facility has been constructed at the central site and other factors. Based on a projected used fuel inventory of 3.6 million fuel bundles, the number of transportation shipments of used fuel from the reactor sites to the central facility would be: • Road: about 53 road shipments/month for 30 years, or • Rail: about 5 rail shipments/month + about 36 road shipments/month for 30 years, or • Water: about 2 water shipments/month + about 36 road shipments/month for 30 years

Table 1-1 (cont'd) Option 4: Adaptive Phased Management

Representative Conceptual Design Activities for Adaptive Phased Management	
Containers	Storage containers at reactor sites would consist of the existing casks, vaults and silos. Containers for long-term isolation in a deep repository are based on a 100,000-year design life. These durable containers are designed to withstand long-term environmental effects such as climate change and glaciation. Facilities would exist at the central site for repackaging the used fuel.
Storage Design Life	Storage containers at the central underground storage facility are based on the existing design of the dry storage container or equivalent with a 100-year design life.
Land Requirement	The land requirement for the surface buildings and associated facilities would be about 2 kilometres x 3 kilometres, or about 600 hectares (1,480 acres). The surface building dimensions would likely be a small fraction of the total land area. The footprint of the shallow underground storage facility would be about 515 metres x 450 metres, or about 23 hectares (57 acres). The footprint for the deep geological repository would be about 1.35 kilometres x 1.36 kilometres, or about 183 hectares (452 acres). The actual size of the deep geological repository would depend on a number of factors such as number of fuel bundles and their heat output, depth of the repository and site-specific factors such as thermal conductivity of the rock mass.
Underground Facility	During the Phase 2 extended storage period, the used fuel would be placed in a series of shallow rock caverns excavated at a nominal depth of 50 metres below surface. During the Phase 3 long-term isolation period, the used fuel would be placed in a network of horizontal access tunnels and rooms excavated in stable rock at a nominal depth of 500 to 1,000 metres below surface. Used fuel containers would be placed within the rooms or in boreholes drilled into the floor of the rooms. Used fuel containers are assumed to be placed in the deep repository over a 30-year operating period.
Repository Sealing System	Clay-based materials would be used to surround and protect the containers, to fill the void spaces in the repository, to limit the movement of groundwater and dissolved material, and to protect workers during container placement operations. These are referred to as sealing systems, and involve materials such as high-performance concrete and swelling bentonite clay.
Geosphere Barrier	The geosphere, or host rock, provides the principal barrier between the used fuel containers and the surface environment. Both the Canadian Shield granite and the Ordovician sedimentary rock basins are examples of naturally occurring geological formations which have long-term stability, good rock strength, and low groundwater flow. Large areas exist with sufficient depth below the surface and lacking in mineral resources that they are very unlikely to be disturbed by erosion or accidental drilling.

Table 1-1 (cont'd) Option 4: Adaptive Phased Management

Representative Conceptual Design Activities for Adaptive Phased Management	
Monitoring	Used fuel would be monitored in the central shallow rock caverns and in the deep repository. During Phase 2, monitoring would be straightforward over the estimated 30-year period since the storage containers are readily accessible. During Phase 3, monitoring over an estimated 240-year period would require more effort and technology since the long-term isolation containers would be backfilled and sealed within the placement rooms. Monitoring would be conducted to confirm the long-term safety and performance of the repository system. Until a decision is made to backfill and seal the access to the deep repository, monitoring would take place in-situ at repository depth. After closure of the deep repository around 300 years, postclosure monitoring of the facility could take place from the surface.
Retrieval	Used fuel would be retrievable at all times. The technology to retrieve used fuel containers from a deep geological repository would need to be further developed and demonstrated at the site. During Phase 2, used fuel retrieval would be straightforward over the estimated 30-year period since the storage containers are readily accessible. During Phase 3, used fuel retrieval over an estimated 240-year period would require more effort and technology since the long-term isolation containers would be backfilled and sealed within the placement rooms.
Illustrative Implementation Schedule	A government decision in 2006 to select this management approach would see an underground characterization facility and possibly a central shallow underground rock cavern storage facility ready by about 2035. The deep geological repository could then ready by about 2065. Following a decision by the federal government, the following activities with their **illustrative** timelines would be undertaken: • Siting of central facility (about 20 years) • Design and construction of the underground characterization facility and the optional shallow underground storage caverns, if required (about 10 years) • Transportation to central facility (over about 30 years) • Placement in deep geological repository (over about 30 years) • Extended monitoring (up to 300 years) • Decommissioning and closure (over about 25 years) • Postclosure monitoring (indefinite) There would be a need to obtain a licence at each phase and demonstrate continuous compliance with the licence (under regulatory oversight).

Table 1-1 (cont'd) Option 4: Adaptive Phased Management

Representative Conceptual Design Activities for Adaptive Phased Management	
Decommissioning	Once a societal decision was made and the necessary approvals were obtained, decommissioning would commence and all underground access tunnels and shafts would be backfilled and sealed. Surface facilities would be decontaminated and dismantled. Closure activities include removal of monitoring instruments and returning the site to greenfield conditions.
Costs	The cost of the Adaptive Phased Management approach is conservatively estimated to be about $24 billion (2002 dollars), including interim used fuel storage and retrieval from reactor sites, transportation costs to the central facility, extended storage in underground caverns, technology research development and demonstration in the underground characterization facility and placement of used fuel in a deep geological repository. These costs include the development and demonstration of the technology to retrieve used fuel from the deep repository, but not the costs to perform retrieval operations from the deep repository. The present value cost based on current long-term economic factors is approximately $6.1 billion (2004 dollars). (www.nwmo.ca/assessments) These costs include construction and operation of the shallow underground storage facility at the central site. If, however, the used fuel remains at reactor sites prior to operation of the deep repository and is not first placed in shallow storage, these costs would be reduced to about $21 billion (2002 dollars) with a present value of about $5.1 billion (2004 dollars).

Figure 1-2 Activity Flowchart for Adaptive Phased Management

That is a very brief sketch of our recommended approach. What follows is the story of why we arrived at that conclusion.

1.6 / The Assessment

As required by the *NFWA*, we have undertaken a comparison of the benefits, risks and costs of each management approach with those of the other approaches, taking into account economic regions in which the approach might be implemented, as well as ethical, social and economic considerations associated with it.

The framework for this comparison emerged from dialogue with citizens over the course of our study. It is designed to capture the objectives that Canadians who participated in the study believe are important in assessing the appropriateness of any management approach for used nuclear fuel for Canada. These key objectives are: fairness; public health and safety; worker health and safety; community well-being; security; environmental integrity; economic viability; and adaptability. The comparison was also intended, as much as possible, to be responsive to the values and ethical principles which citizens suggested should drive decision-making. It was also informed by the knowledge and expertise of specialists.

Our process reflected the lessons learned by the Seaborn Panel about the need to incorporate both technical considerations and social and ethical considerations and the explicit direction in the *NFWA* to treat ethical and social considerations as a key component of any assessment. Social and technical notions of safety and risk were treated in a holistic and integrated way throughout the assessment.

The roadmap for the assessment is described in Chapter 8. It was an iterative process beginning with 10 key questions derived from our conversations with Canadians and the commissioning of background papers, and proceeding through the development of an ethical and social framework; an examination of future scenarios; a multi-attribute analysis; a formal comparative assessment of costs, benefits and risks and continued engagement exercises to validate each step of the process.

Our analysis suggested that:

- Taken individually, no one of the management approaches specified in the *NFWA* perfectly addresses all of the objectives which citizens said are important to address, particularly when both the near term (the next 175 years) and the longer term are considered;

- Each of the three approaches has distinct advantages and limitations in light of our comprehensive framework;

- A management approach which incorporates the most significant advantages of each approach, supported by a phased decision-making process designed to actively and collaboratively manage risk and uncertainties, is expected to perform better on our objectives than the other three approaches; and

- The process of implementation will be a test of the degree to which any of the approaches would ultimately address citizen objectives, values and ethical principles. Therefore, the requirements for an implementation plan form an essential part of our recommendation.

The storage options, Option 2 – Storage at Nuclear Reactor Sites and Option 3 – Centralized Storage, are expected to perform well over the near term (at least within the next 175 years). However, the existing sites were not chosen for their technical suitability as permanent storage sites. Furthermore, the communities hosting the nuclear reactors have an expectation that the used nuclear fuel will eventually be moved.

The NWMO believes that the risks and uncertainties concerning the performance of these storage approaches over the very long term are substantial in the areas of public health and safety, environmental integrity, security, economic viability and fairness. A key contributing factor in this expected performance is the extent to which the storage approaches rely on strong institutions and active management to ensure the safe and effective performance of

the management system. The NWMO expects that these institutions and capacity for active management will be strong over the foreseeable future, but uncertain over the very long term. The NWMO believes that the type of responsible and prudent approach that Canadians have said is required dictates that we not rely on the existence of strong institutions and active management capacity over thousands and tens of thousands of years. On this basis, the NWMO does not suggest either of the storage options as a preferred approach for the long term.

Deep Geological Disposal in the Canadian Shield, Option 1, is judged to perform well against the objectives in the very long term because of the combination of engineered and natural barriers to isolate the used fuel. A key weakness, however, is its lack of adaptability, which is an important objective in the minds of citizens. Over the short term, the approach is judged to be less flexible in responding to changing knowledge or circumstances either concerning the performance of the system itself over time, or more broadly to innovations in waste management technologies. There is some uncertainty about how the system will perform over the very long term because we cannot obtain advance proof of the actual performance of the system over thousands of years. Also, this approach provides comparatively little opportunity for future generations to influence the way in which the used fuel is managed. Its lack of adaptability is a weakness that may ultimately affect the performance of the system over time on the other objectives such as public health and safety and environmental integrity.

We believe that our preferred approach, Adaptive Phased Management, builds upon the advantages of each of the three approaches studied but in addition has important attributes that respond to Canadian concerns and aspirations.

- This approach is designed to be highly adaptive in the near term, the period in which it is reasonable to believe there will be strong oversight institutions and active management capacity. It entrenches an explicit and planned process of social learning and action. Over this period, new learning and technological innovation is easily incorporated into the management plan. Some social uncertainties, such as the role of nuclear generation in the energy mix in Canada's near future, may be resolved. Some technical uncertainties, such as whether evolving technologies (i.e., transmutation) will become practicable, are also likely to be reduced. Some uncertainties over the performance of aspects of the deep geological system are also expected to be reduced with further research, testing and experimentation, particularly at the location where such a facility might be sited;

- This approach clearly identifies the technology associated with a deep geological repository as the appropriate end point. It does not rely upon human institutions and active management for its safe performance over the long term. The approach plans for and puts in place a safe and secure containment option for the used nuclear fuel at each point in the process. It provides real options and contingency plans should implementation through the phases not proceed as planned. In particular it provides the option of more robust and secure interim storage in shallow underground caverns located centrally at the site of the deep repository;

- The approach provides opportunity for citizens, including future generations (at least over the next 300 years), to influence the way in which the fuel is managed;

- The approach provides for research and collaborative decision-making in determining the manner and timing of movement through realistic and manageable phases; and

- The approach suggests a process through which confidence in the technology and supporting systems can be developed before moving to the final phase.

Finally, our analysis indicates that some important issues are not fully addressed through the selection of the management approach itself. They will need to be considered through the collaborative decision-making process, which should accompany the implementation of any approach. These issues include the design of a fair siting process and the determination of safety thresholds that would need to be met before moving to the next phase of implementation.

Dialogue with Canadians has highlighted that an optimal balance must be found between flexibility in the near term, which allows for new learning, and the implementation of an approach which isolates and contains the used fuel in a way which does not require active care by people over the very long term. Adaptive Phased Management is such a balance. Dialogue with Canadians has also highlighted that an optimal balance needs to be struck between moving cautiously, to allow for new learning and social confidence, and sustaining sufficient momentum to carry forward with the implementation of the approach to its completion. Should the implementation period be too protracted, there is a risk that future generations will lose interest and/or otherwise abandon the approach mid-way through implementation with negative impacts on public health and safety as a result. In recommending a stepwise implementation process, which involves potentially affected communities of interest at each major point of decision-making, the NWMO believes that public acceptability will be enhanced, thus expediting implementation.

1.7 / Further Reflection

When we tested this assessment and the NWMO's resulting *Draft Study Report* recommendation with the public, we heard that fundamentally our approach is both reasonable and appropriate. Indeed contributors gave us some solid direction for the implementation phase. (For a comprehensive summary of the input we received, see Chapter 4.) Nevertheless, a number of comments and questions arose, which deserve further reflection and clarification.

Is Adaptive Phased Management not really the same as Option 1, Deep Geological Disposal?

When the two approaches are looked at only through a technical lens, it may appear as if there is nothing new. The end point is a centralized deep geological repository. There the similarity ends.

First, Adaptive Phased Management is both a technical method and a management system. It is really the latter component that we believe is most responsive to citizens and to the times – the way in which a technical method is implemented, the way in which decisions are taken, the provisions for monitoring and review and the scope for ongoing societal involvement. The emphasis is on adaptability. Through a phased process with explicit decision points, new knowledge and technology can be accommodated as can the societal change that will be inevitable over time.

Contingencies against unforeseen events, either natural or man-made, are built in and funded to ensure that it is this generation that is assuming financial responsibility. In particular, an **optional** step of providing shallow underground storage at the central site, could respond to calls for enhanced security or the need or wishes of the reactor-site communities to move the used fuel more quickly. The expansion of possible geotechnical sites will provide greater opportunity to balance the wide range of societal objectives, without compromising safety. At all times the used fuel and the facility would be monitored, with the potential for retrievability of the used fuel preserved.

Finally, these two approaches were derived in very different ways. The disposal option was developed almost exclusively by scientific, technological and engineering specialists. Adaptive Phased Management evolved through a process of engagement with citizens, including specialists. As such, it is built to respond to a broader set of considerations and values, to recognize common ground and to balance competing objectives. Consequently, citizen engagement in monitoring and making decisions about safety and risk are a permanent feature of the recommended approach.

Why such a long timeframe?

Some have been concerned that there will be a loss of momentum – that the recommended approach is really postponing decisions and placing the burden on future generations. They pointed out that an approach that provides the greatest amount of procedural fairness may make the project more vulnerable to future political expediency, loss of technical expertise and financial resources. They want to accelerate the process.

There is no fixed timeframe in our proposal. The timeline for implementation which was contemplated in the *Draft Study Report*, that is three phases that would see the used fuel placed in a repository within 60 to 90 years, was intended to be 'illustrative' only. Assigning nominal time frames was required in order to develop conservative cost estimates. The timeline, particularly in the first phase, did take into account what we know and have experienced with siting, environmental assessment, licensing and construction processes. There are technical requirements that will take time. Although we can learn from other countries, this type of deep geological repository has yet to be constructed and begin operations anywhere. There is no benchmark.

There is no question that an implementation process that meaningfully involves potentially affected citizens, communities of interest and Aboriginal peoples in decision-making may affect the pace and manner of movement through the phases. Nevertheless we believe that this is responsive to the direction we have received during our study and is a requirement for social acceptance. A multi-party process is the most likely way to receive the social licence to proceed.

It should not be assumed that undue costs and time delays are being introduced into the process. Flexibility and adaptability are important in order for confirmatory research, new learning and perhaps new technologies to surface and be used to refine the path forward. A series of smaller steps acknowledges obstacles and unplanned issues that would challenge a rigid process. This process is designed to be resilient and self-correcting, building confidence to tackle further challenges. Flexibility is also driven by the search for the balance we need to strike between taking responsibility for the waste we have created while not foreclosing options for future generations.

Adaptive Phased Management is flexible and can certainly be accelerated should conditions warrant. It will proceed as expeditiously as societal circumstances and successful technology demonstration allow. We believe that momentum will build when the government makes its decision about an appropriate approach. We believe that the financial and technical resources required will be assured early. The first decades will be the most financially intensive. Site selection will always be a contentious process. During our study we have already begun to build the necessary relationships and affirm the principles that are required to make steady progress.

Isn't the optional step of shallow storage just a waste of time and money?

We provide for the option of building a shallow rock cavern storage facility at the chosen site for the deep repository for several reasons. The first is to provide a contingency in the event of unplanned circumstances. For example, there may be a need to move the used fuel from one or several of the current interim storage facilities before the safety of the deep repository has been sufficiently demonstrated. The shallow facility, located at the central site to minimize additional transportation of the used fuel, might then be used to safely and securely store this fuel in the interim period. The fuel will remain easily accessible and monitorable, and

enjoy some incremental security advantage over current interim facilities because the shallow storage facility would be built in ground.

Secondly, it provides for flexibility in the timing of movement of the used fuel from the reactor sites, accommodating regional differences in priorities and the status of particular operations. For example, we understand that the waste owners may have different business planning assumptions about when the used fuel is moved away from their respective reactor sites.

Furthermore, this is an option. Within the first phase of the plan a specific decision will be required as to whether or not to exercise the option. That decision will occur at a time when there will be greater certainty about Canada's nuclear program. We will also have the benefit of further progress in the repository programs in such countries as Sweden and Finland. Additional research on suitable geological formations, both in Canada and in Europe, will be available. Perhaps we can even hope for a world less vulnerable to terrorist threats.

Why not keep the used fuel at the reactor sites and avoid the risks associated with transportation?

The locations of the nuclear power reactors were chosen for reasons specific to the effective and efficient operations of a power plant. These requirements are not the same as those for very long-term storage of used fuel at a deep underground repository, particularly with respect to environmental and security imperatives. Furthermore, from the perspective of fairness, citizens of reactor-site communities did not anticipate or agree that they would assume stewardship of the used fuel permanently. They accepted the need to store the fuel for an interim period of time.

The level of risk associated with a breakdown of institutional oversight and the complexity of managing the used fuel in the very long term is compounded by the existence of seven sites. We expect that centralization over time will mitigate that risk.

The NWMO acknowledges the concerns of many citizens about the transportation of used nuclear fuel. We need to demonstrate the safety of any transportation system to their satisfaction before beginning to transport used nuclear fuel to a centralized long term management facility. We understand that decisions on risk and safety are societal ones.

On the basis of the discussions we have had with regulatory authorities and waste management organizations in Canada and in other countries and the background research we have commissioned, we believe that used nuclear fuel can be transported safely. The design of the transport container, which is the main safety feature in used fuel transport, is subject to high safety standards and rigorous and extensive testing. A range of accident scenarios has been considered and the regulations are under constant review. Radioactive materials have been transported around the world for 40 years. In that time, there have been no accidents that resulted in the release of significant amounts of radioactivity.

Obviously adequate effort, resources, preparation, oversight and continued vigilance will be necessary requirements of any implementation plan.

1.8 / The NWMO's Commitment to Implementation

The long process of designing, building and operating a used nuclear fuel management facility can serve as a bridge to the kind of future that is sought by a community. Ultimately, quality of life, as perceived by the residents, will be a measure of whether or not the NWMO has been able to align its plans and actions with the community's vision.

Any management approach, no matter how well conceived, will fail if it is not also well executed. The process by which a management approach is implemented, and the institutions and systems which are put in place, will be important determinants of the overall effectiveness of the approach and the extent to which it is and continues to be responsive to societal needs and concerns. Just as considerable investment has been made in examining and understanding the technical management options, it will now be essential to demonstrate an investment in the process of implementation.

Over the course of dialogues with the general public, Aboriginal peoples and specialists alike, many focused their comments on the features they believe should be part of the implementation plan that accompanies the management approach selected. Indeed, as we report in Chapter 4, much of the common ground that we uncovered in our study relates to principles and expectations for how decisions will be taken, how citizens will be involved, and how any management approach will be implemented and monitored over time.

Roles and Responsibilities

Canada has an extensive system of governance to oversee the long-term management of used nuclear fuel. This governance framework involves many participants including governmental and regulatory agencies, the waste owners, the potentially affected communities and the NWMO, all of whom will participate in the ongoing decisions, implementation and operations. Figure 1-3 summarizes some of the more significant legislation and highlights key roles and responsibilities.

We draw particular attention to the Canadian Nuclear Safety Commission (CNSC) which is responsible for regulating the use of nuclear energy and nuclear materials to protect the health, safety, and security of Canadians, to protect the environment, and to ensure that Canada's commitments on the peaceful use of nuclear energy are respected. Canada's regulatory framework will provide for the safe, secure construction and operation of the facilities and transportation of the used nuclear fuel, demanding that standards are met or exceeded. Canada's regulatory framework also implements the international obligations made to the International Atomic Energy Agency (IAEA) under *Canada's Safeguards Agreement* pursuant to the international nuclear non-proliferation regime and the *Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management*.

Figure 1-3 Governance Framework for the Long-Term Management of Used Nuclear Fuel: Roles & Responsibilities

Government of Canada
Responsible for:
- Making the decision on the long-term management approach for used nuclear fuel.
- Developing policy, regulating, and overseeing producers and owners of waste to ensure that they comply with legal requirements and meet their funding and operational responsibilities.

Natural Resources Canada
Responsible for:
- Recommending a management approach to the Government of Canada from the options in the NWMO study.
- Administering the *Nuclear Fuel Waste Act*, and monitoring the NWMO and the nuclear fuel waste owners to ensure compliance with the *NFWA*, especially with respect to socio-economic effects.
- Approving the funding formula and annual deposits to the trust funds, ensuring trust funds are established, and required deposits are made by the nuclear fuel waste owners.
- Reviewing NWMO's reports and making public statements.
- Interacting with Aboriginal populations to meet government fiduciary responsibilities related to the *NFWA*.

Canadian Nuclear Safety Commission (CNSC)
Responsible for:
- Regulating the use of nuclear energy and nuclear materials to protect health, safety, security and the environment, and to respect related international obligations.
- Ensuring that Canada's international obligations are met, including safeguard agreements with the International Atomic Energy Agency (IAEA), and the *Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management*.
- Ensuring, prior to licensing, that environmental effects are carefully reviewed through environmental assessments, as required under the *Canadian Environmental Assessment Act*.
- Making determinations on licence applications brought forward by the NWMO for siting, constructing, operating, modifying and decommissioning the long-term management facilities.
- Undertaking ongoing compliance and enforcement of statutory requirements and current licence requirements and conditions, and taking enforcement actions on incidents of non-compliance.

Transport Canada
Responsible for:
- Establising and enforcing requirements to promote public safety during the transport of dangerous goods including radioactive material (in coordination with the CNSC).
- Approving Emergency Response Assistance Plans prior to transport.

Canadian Environmental Assessment Agency
Responsible for:
- Administering the *Canadian Environmental Assessment Act* with which the CNSC must comply before proceeding with each licence application from the NWMO.

Provincial Governments/Regulators
Responsible for:
- Shareholders/owner account-abilities for provincial nuclear power corporations.
- Enforcing provincial statutes that contribute to the regulatory framework that the NWMO must meet.

Major Nuclear Fuel Waste Owners
Responsible for:
- Establishing trust funds to finance the implementation of the long-term management approach selected by government.
- Establishing and maintaining a Nuclear Waste Management Organization.

Currently Canada's owners of used nuclear fuel are: Ontario Power Generation Inc. (owns approximately 90 percent of the used fuel), Hydro-Québec, NB Power Nuclear, and Atomic Energy of Canada Limited.

Figure 1-3 (cont'd) Governance Framework for the Long-Term Management of Used Nuclear Fuel: Roles & Responsibilities

Nuclear Waste Management Organization (NWMO)
Responsible for:
- Preparing the study of long-term management options.
- Consulting with the general public and Aboriginal Peoples.
- Implementing the management approach selected by Government, carrying out the associated managerial, financial and operational activities.
- Reporting regularly to the Minister of Natural Resources Canada and the public.

Advisory Council to the NWMO
Responsible for:
- Examining and providing written comments on the NWMO's study of management approaches and subsequent triennial reports submitted to the Minister of Natural Resources Canada.
- Providing ongoing guidance to the NWMO.

Host Communities
Responsible for:
- Contributing to the design of the implementation plan to ensure it will best meet the needs of the community.
- Participating in implementation of the plan to ensure community needs are met, and in particular, decisions which affect the pace and manner of moving through the phases of work.
- Participating in the design and implementation of measures to address socio-economic and cultural effects of NWMO activities.

Affected Aboriginal Peoples
Responsible for:
- Contributing to the design of the implementation plan to ensure the needs of those impacted will best be met.
- Participating in implementation of the plan to ensure the needs of those impacted are met, and in particular, decisions which affect the pace and manner of moving through the phases of work.
- Participating in the design and implementation of measures to address socio-economic and cultural effects of NWMO activities.

The NWMO will be required to apply to the CNSC for licences to prepare a site, construct, operate, modify, decommission and, when appropriate, abandon a nuclear fuel waste management facility. For centralized options, the NWMO will also be required to obtain a licence to transport waste fuel. In operating a nuclear waste repository, the NWMO will be required to demonstrate at regular intervals that it is meeting all applicable regulations. The necessary decommissioning plan forms the basis for the financial guarantee, which is required to ensure that funds will be available to implement the decommissioning plan and to avoid placing any financial burden on future generations.

The CNSC is defined as a federal authority under the *Canadian Environmental Assessment Act* (*CEAA*) and as such must ensure the requirements of the Act are met before it can proceed to licensing under the *Nuclear Safety and Control Act* (*NSCA*). Transport Canada promotes public safety during the transport of dangerous goods, including nuclear materials and establishes the requirements for emergency response.

After a decision is taken by the Government of Canada, the NWMO will become the implementing agency. It will be directed and governed by the provisions of the *NFWA*, and be subject to a number of federal, provincial and international acts and regulations. It will continue to operate as a not-for-profit corporation.

As required by the *NFWA*, Canada's three nuclear energy corporations, Ontario Power Generation Inc., NB Power Nuclear and Hydro-Québec, established the NWMO in 2002. It is under the governance of the Board

of Directors that the NWMO will carry out the managerial, financial and operational activities to implement the long-term management of nuclear fuel waste. The three member corporations confirmed the objectives of the NWMO and clarified the roles and responsibilities of the member corporations in furthering those objectives. (See Chapter 11.) This includes provisions for cost-sharing the NWMO's annual operating budget up to an annual maximum.

Our founding legislation required the NWMO's governing body to appoint an Advisory Council, and provided specific direction on its membership and responsibilities. The Advisory Council has an ongoing responsibility to examine and to provide written comments on the triennial reports that the NWMO must submit to the Minister of Natural Resources Canada. As set out in the *NWFA*, council membership will change over time as the project proceeds from a study on management options, to a concept chosen by government, and then, to a site-specific project in a known location and region. Once an economic region has been identified for implementing the approach selected by the Government, representatives nominated by those local and regional governments and Aboriginal organizations will be added to the Council.

Canada's four waste owners, currently Ontario Power Generation Inc., NB Power Nuclear, Hydro-Québec and Atomic Energy of Canada Limited, are responsible for establishing trust funds to finance the implementation of the management approach selected by government. Nuclear energy corporations will continue to have the management responsibility of the used fuel while it remains in interim storage at nuclear reactor sites. Nonetheless, it will be essential to have close collaboration among the nuclear corporations, the NWMO and the current host communities so that implementation decisions taken with respect to the long-term management approach seek to avoid or minimize disruptive impacts on the current host communities.

Financing

Financial surety for the management approach means determining what costs can reasonably be expected to occur over the life of the project, along with some contingency for unexpected events, and putting in place the financial mechanisms to ensure the necessary money will be available when it is required. The NWMO will design a system that collects and protects enough funding to ensure that the entire cost of the project can be covered under a variety of social and economic circumstances and within the required time-frame.

Canada has a robust system of legal and regulatory oversight, covering all aspects of the nuclear industry. The standards that have been developed to provide financial surety for the long-term management of used nuclear fuel share many elements of design and implementation with other nations around the world. The CNSC has required financial guarantees, including for decommissioning, of nuclear facility operators as a condition of licensing. We anticipate that similar guarantees may also be required of the NWMO in the future. Decommissioning and waste management guarantees have been provided by all waste owners. Details are provided in Chapter 11.

The issue of liability and insurance provisions for damages to health, environment and property, arising from nuclear materials was a risk consideration that emerged during the engagement process. It is recognized that there are anticipated changes to the *Nuclear Liability Act* that will provide further direction to the NWMO on matters of liability.

The following financial details are addressed in legislation and regulations:

- Methods for collecting and managing funds that will meet the cost estimate forecasts in an equitable manner and within reasonable time-frames;
- Methods for adjusting the rate and size of funds that are collected should circumstances change over time;
- Reasonable determinations of cost estimates, derived financial obligations and forms of financial surety provided;
- Contingency programs that will allow all financial obligations to be met even when unexpected events significantly affect the Canadian market;

- A reporting methodology to verify that appropriate financial practices are implemented and that on-going adjustments are made to both cost estimates and the financial guarantees to ensure they are accurate; and

- Setting limits on liability and insurance requirements for various licensed operations.

The *NFWA* sets out requirements for the establishment of trust funds for the long-term management of Canada's nuclear fuel waste. Trust fund contributions made by each producer will be reviewed as part of the Annual Report to the Minister. Contributions will be continually adjusted to reflect improved projections of overall costs and number of fuel bundles to be produced by each waste owner.

Each waste owner has established an individual trust fund that is held and managed by an independent financial institution. As specified by the *NFWA*, deposits currently totalling $770 million, continue to be made by all four bodies. Experience in other countries has demonstrated the importance of safeguarding these large funds so that they will be preserved for the intended purpose. In Canada the legislation built in explicit provisions that will ensure that these trust funds are maintained securely, reported on and used only for the intended purpose.

A funding formula has been developed to set out the respective percentage of the estimated total cost of management of nuclear fuel waste that is to be paid by each nuclear energy corporation and Atomic Energy of Canada Limited, along with an explanation of how those respective percentages were determined. For all options involving a centralized facility, the overall objective is to share actual costs of long-term management based on the number of fuel bundles. That is, each waste owner would pay the same costs for each fuel bundle subject only to owner-specific costs such as transportation. For storage at nuclear reactor sites, costs would be borne by the waste owner at each specific site. For shared facilities at a central location, costs would be shared based largely on the number of fuel bundles to be managed. In addition, cost-sharing will reflect each waste owner's use of the facility, transportation requirements, and the timing of shipment of the used fuel to the central facility.

The total NWMO costs are presented in two formats – 2002 constant dollars and 2004 present value. A conservative costing of the recommended approach, Adaptive Phased Management, is estimated to be $6.1 billion present value or $24 billion 2002 constant dollars. As required by the legislation the costs of the impact of natural or other events that have a probability of occurring, such as earthquakes, global warming or glaciation have been built in to either the design or research costs.

The NWMO will have an ongoing obligation to assess the accuracy of the cost estimate for the selected management approach, and the sufficiency of contributions to cover cash flow obligations for the life of the project.

The NWMO's Intentions

The richness and the sincerity of the contributions to our study motivate us to make a commitment that complements our recommendation to the Government of Canada. The NWMO will be responsible for implementing the approach chosen and how it does so will be a reflection of its accountability to those who participated in this process.

The NWMO must be prepared to move forward in a timely way to implement the Government's decision. Implementation of any management approach will stretch out for many decades, as the project moves through phases of elaborating the management design, identifying candidate sites, building relationships with affected communities and organizations, evaluating sites for adequacy, characterizing the site, undertaking environmental assessments and regulatory approvals, constructing, monitoring and transporting the used fuel.

As we look ahead to the short-term horizon our activities in the first three years will be focused on a number of fronts. These include initiating the siting process, managing community impacts, furthering technical and scientific research, refining the financial requirements and making the appropriate institutional and governance transition.

In designing implementation plans it is the intention of the NWMO to:

- Communicate a clear decision-making path that assigns accountability;
- Continue to give priority to the values of citizens, including Aboriginal peoples;
- Build on the relationships that we have established;
- Seek to continue real dialogue;
- Focus our engagement on potentially impacted communities of interest;
- Assign importance to societal consideration in the site-selection process;
- Recognize contributions and costs borne by the community through appropriate mitigation measures; and
- Seek to ensure access to the knowledge and resources required to make decisions and sustain operations.

In Chapter 16 we present possible typical schedules of activities associated with each management approach. These can only be fully defined upon a government decision on a management approach. Under the NWMO's leadership, the detailed implementation plans will be designed through dialogue with the many communities of interest who will have important roles to play in overseeing and participating in implementation. We expect to hear a diversity of voices as we seek advice and receive direction on the design of the process and the issues to be explored. Implementation plans will not be static. They must continue to evolve. The unprecedented time horizon brings with it a need for continuous learning, and a commitment to collaboratively define and periodically assess indicators of progress as a means of facilitating adaptation to evolving conditions.

Siting

Although the NWMO is not proceeding with site selection as part of this study, in our public dialogues there was intense interest in the major considerations and principles that might influence our next steps in the site-selection process. We elaborate on these technical and social dimensions in Chapter 9. Safety and security will be fundamental considerations.

The NWMO is committed to seeking an informed, willing community to host the long-term management facility. We do not wish to proceed with siting against the wishes of the local community. Rather, it is against the backdrop of the community's own vision for its future that we would proceed. It is the potential host community that will be best positioned to determine how to ascertain whether it has the permission and trust of its people.

We believe that the objective of fairness would best be achieved if the site-selection process is focused within the provinces that are directly involved in the nuclear fuel cycle. We therefore intend to focus the site-selection process in Ontario, New Brunswick, Québec and Saskatchewan. We recognize that communities in other regions and provinces may come forward with interest in possibly hosting the centralized facility. Such expressions of interest will also be considered. The NWMO will respect Aboriginal rights, treaties and land claims.

The NWMO is committed to developing and implementing a siting process collaboratively with potentially impacted communities of interest. The siting process, and the engagement process which will support it, needs to be the subject of a specific NWMO dialogue immediately following any government decision which involves the centralization of used nuclear fuel.

We propose that the siting process seek to:

- Be open, inclusive and fair to all parties, giving everyone with an interest in the matter an opportunity to have their views heard and taken into account;
- Ensure groups most likely to be affected by the facility, including through transportation, are given full opportunity to have their views heard and taken into

account, and are provided with the forms of assistance they require to present their case effectively;

- Include special attention to Aboriginal communities that may be affected. In particular, the NWMO will respect Aboriginal rights, treaties and land claims;
- Be free from conflict of interest, personal gain or bias among those making the decision and/or formulating recommendations;
- Be informed by the best knowledge – in the natural sciences, the social sciences, Aboriginal Traditional Knowledge, and ethics – relevant to making a decision and/or formulating a recommendation;
- Be in accord with the precautionary approach, which first seeks to avoid harm and risk of harm. If harm or risk of harm is unavoidable, place the burden of proving that the harm or risk is ethically justified on those making the decision to impose it;
- Ensure, in accordance with the doctrine of informed consent, that those who could be exposed to harm or risk of harm (or other losses or limitations) are fully consulted and are willing to accept what is proposed for them;
- Take into consideration, in so far as it is possible to do so, the costs, harms, risks, and benefits of the siting decision, including not just financial costs but also physical, biological, social, cultural, and ethical costs (harm to our values); and
- Ensure that those who benefited most from nuclear power (past, present and perhaps future) are bearing the potential costs and risks of managing used fuel and other nuclear materials.

Governance and Institutions

The enduring nature of the NWMO will enable the insights gained and relationships established during the organization's study phase to provide a foundation for implementation. Our vision and values will continue to guide us as we strive to gain the confidence of Canadians. As the organization prepares itself to take on many and varied tasks over decades it will need to redesign itself. A key aspect of redesigning the institution for the transition to a new role will be acquiring the necessary skills and expertise to fulfill new responsibilities.

From the outset the Board has been mindful of adopting best practices in governance in this special purpose organization, funded by waste producers to fulfill their obligations under the *NFWA* with oversight by the federal government. In preparing for its implementation mandate, the Board and member organizations are currently reviewing the future governance of NWMO, including the membership and composition of the Board of Directors. This was a matter frequently discussed during the NWMO's public engagement.

In recognition of their experience in the first phase, the NWMO will be seeking the views of the Advisory Council regarding future membership and composition of the Council. In light of the future role and expanded responsibilities of the NWMO, reviewing the range of expertise and the terms of reference of the Advisory Council may be desirable.

Governance is a big word. During our public engagement sessions governance and decision-making were prominent topics of discussion. That does not surprise us. Meeting obligations to future generations, long-term stewardship, protecting human health and the environment from hazard and mitigation of risk and uncertainty are not responsibilities to be taken lightly.

Citizen Engagement

Our study has begun a process of dialogue and engagement with specialists and citizens that should continue through the decision-making and implementation stages. Knowledge, experience, values and society's priorities may well change over the period of implementation. In fact, continuous learning and adaptation are integral to Adaptive Phased Management.

Of most importance is that engagement can contribute to an informed citizenry and culture of watchful vigilance. We expect that only through successful engagement and collaborative decision-making in the early stages of implementation can we begin to build trust and confidence in the process. Ultimately, it will be essential in maintaining the momentum for action.

A continuum of engagement activities will be needed to support the decisions being taken at each step. (These steps are outlined in Chapter 13) We must communicate a clear decision-making path with accountabilities. Implementation must involve the identification and adoption of roles and responsibilities within communities of interest, government and industry. We must provide assurance that commitments made will be met, and that contingency plans are known and available should they be required.

Ethically, engagement should ensure that those who most directly could be exposed to harm or risk of harm are involved. We must understand concerns of regions and communities that are affected directly and indirectly. These communities will become active players and problem solvers. Communities must be informed and equipped with resources to participate in discussions and decision-making. Their participation must be based on an understanding of potential risks and the means to manage them, including those from transportation. Communities in the vicinity of any future facility must have opportunities for genuine involvement. They should be informed of issues and participate in decision-making, as well as monitoring. A special responsibility is owed to potentially impacted Aboriginal peoples. Effective engagement is based on principles of openness, transparency, integrity and mutual respect. (A set of understandings is further elaborated in Chapter 13.)

We will build on best practices and the relationships that we have established. Through a diverse engagement program we have sought to come to know and develop an ongoing dialogue with many communities of interest. This has laid the foundation for a longer-term relationship that will be essential as Canada moves through the phases of decision-making and implementation. The dialogue we have begun will continue and grow in the years to come. Our engagement with the Canadian public and with Aboriginal peoples is just beginning.

Addressing Social, Economic and Cultural Effects

Implementation presents a significant opportunity to recognize and support a host community's vision for its social, cultural and economic aspirations. It is the host community that must lead the development of a strategy to manage the changes introduced by hosting the facility. The NWMO has an important role to play in providing the resources and support necessary to address socioeconomic impacts.

There will be a broader set of interests beyond the immediate host community. All potentially affected parties must be afforded fair and equitable treatment in engagement with the NWMO, in assessing potential significant socio-economic effects, and in managing those effects. Reactor-site communities will figure prominently regardless of which management approach is selected. Continued secure storage of the used nuclear fuel at the existing reactor sites is an integral and essential component of Adaptive Phased Management.

Of particular note are Aboriginal communities. We are committed to building a relationship with them based on a recognition of Aboriginal values, mutual trust and respect.

It will be important to design implementation in such a way as to avoid or minimize disruptive impacts on the many affected communities. Where adverse impacts cannot be avoided, implementation must recognize the contributions and costs borne by the community through appropriately designed mitigation measures. Risks can be mitigated not only by a variety of physical design features, but through institutional, informational and social measures. Chapter 14 discusses the nature of potential socio-economic effects and the wide variety of measures available to address them.

The NWMO is committed to a collaborative process of decision-making. Fairness requires that interested citizens understand and participate in making key decisions about how to manage socio-economic effects, through full and deliberate engagement during the different

stages of decision-making and implementation. That will require developing the capacity for community oversight and empowering the community to have influence in the process.

Research and Intellectual Capability

We see continuous learning and adaptability as integral to successful implementation plans.

A program that will evolve over a long period of time will have many opportunities for improvements to increase performance, enhance effectiveness, improve understanding, and address societal concerns. However, to realize these benefits, there needs to be a vibrant and robust research and development effort during management program development and execution.

While the role for research and issues of intellectual capacity were not explicitly required to be part of our study, we believe that there are many important reasons to pursue such a program. This was validated in our engagement process. Citizens and specialists alike spoke of the need for a significant and ongoing investment so that Canada will have the benefit of leading-edge technological innovation while ensuring that institutional memory and capacities of the nuclear workforce not be eroded.

Such a research and development program could guide the program's scope and content, including:

- Enhanced scientific understanding to improve confidence in predictions, reduce uncertainties, and to evaluate potential program improvements;
- The ability to confirm performance during and after program operations;
- The obligation to citizens to clearly demonstrate an ongoing capability to manage the enterprise and to respond to their concerns and desires;
- The ability to make mid-course corrections in response to new information or societal decisions;
- Preparation for facility siting, design, licensing, development, and operations; and
- Assurance of adequate human capacity to manage the program throughout its existence.

In Chapter 15 we provide examples of some areas of research that we believe would be appropriate under any of the four management approaches and comment upon the type of expertise and capabilities that will be required.

For the NWMO to be a successful "learning organization" it will need to commit to acquiring and incorporating new knowledge, be willing to re-evaluate decisions, maintaining the option to change course and be prepared to act on that new knowledge. As participants in the engagement process noted, beyond the required technical expertise, additional research and development should be conducted on a range of non-technical issues of importance as well, including ethics, socio-economics, stakeholder involvement, and public attitudes. It will be important to involve external parties in identifying research of relevance and interest. The research program work should most often be competitively determined and the work carefully peer reviewed. Finally, much work can be done in collaboration with other countries and international organizations.

1.9 / The Recommendation

The following is the NWMO's recommendation to the Government of Canada. With a decision about the basic approach the NWMO will then be able to move forward to meet the objective of safely managing Canada's used nuclear fuel for the long term. We seek to implement the management approach selected by government consistent with the intentions articulated in the previous section of this report.

NWMO's Recommendation

Our recommendation for the long-term management of used nuclear fuel in Canada has as its primary objectives safety – the protection of humans and the environment – and fairness to this and future generations.

Therefore we recommend to the Government of Canada Adaptive Phased Management, a risk management approach with the following characteristics:

- Centralized containment and isolation of the used fuel in a deep geological repository in a suitable rock formation, such as the crystalline rock of the Canadian Shield or Ordovician sedimentary rock;
- Flexibility in the pace and manner of implementation through a phased decision-making process, supported by a program of continuous learning, research and development;
- Provision for an optional step in the implementation process in the form of shallow underground storage of used fuel at the central site, prior to final placement in a deep repository;
- Continuous monitoring of the used fuel to support data collection and confirmation of the safety and performance of the repository; and
- Potential for retrievability of the used fuel for an extended period, until such time as a future society makes a determination on the final closure, and the appropriate form and duration of postclosure monitoring.

The Nuclear Waste Management Organization would implement this comprehensive approach, in compliance with the *Nuclear Fuel Waste Act* (*NFWA*) of 2002, and would:

- Meet or exceed all applicable regulatory standards and requirements for protecting the health, safety and security of humans and the environment;
- Provide financial surety through funding by the nuclear energy corporations (currently Ontario Power Generation Inc., Hydro-Québec and NB Power Nuclear) and Atomic Energy of Canada Limited, according to a financial formula as required by the *NFWA*;
- Seek an informed, willing community to host the central facilities. The site must meet the scientific and technical criteria chosen to ensure that multiple engineered and natural barriers will protect human beings, other life forms and the biosphere. Implementation of the approach will respect the social, cultural and economic aspirations of the affected communities;
- Focus site selection for the facilities on those provinces that are directly involved in the nuclear fuel cycle;
- Sustain the engagement of people and communities throughout the phased process of decision and implementation; and
- Be responsive to advances in technology, natural and social science research, Aboriginal Traditional Knowledge, and societal values and expectations.

1.10 / Concluding Thoughts

The observations made and conclusions reached in this report have evolved from synthesizing the views and aspirations of people, and rigorously examining technical and engineering information. There is a vast amount of accumulated knowledge. What shaped our thinking was a focus on the time dimension of the issue and the pre-eminent requirement of ensuring safety and security for people and the environment over time. We were concerned about fairness in the distribution of costs, benefits and responsibilities within and across generations. We were guided by a mission statement that calls for consideration of social acceptability, environmental responsibility, technical soundness and economic feasibility. We engaged citizens openly and honestly in defining the questions and discussing the possibilities.

Canadians are prepared to take responsibility for the long-term management of our used nuclear fuel. Our recommendation proposes a path to achieve that goal through a risk management approach of deliberate stages and periodic decision points.

- It commits this generation of Canadians to take the first steps now to manage the used nuclear fuel we have created;
- It will meet rigorous safety and security standards through its design and process;
- It allows sequential decision-making, providing the flexibility to adapt to experience and societal change;
- It provides genuine choice by taking a financially conservative approach, and providing for capacity to be transferred from one generation to the next;
- It promotes continuous learning, allowing for improvements in operations and design that would enhance performance and reduce uncertainties;
- It provides a viable, safe and secure long-term storage capability, with the potential for retrievability of used fuel, which can be exercised until future generations have confidence to close the facility; and
- It is rooted in values and ethics, and engages citizens allowing for societal judgments as to whether there is sufficient certainty to proceed with each following step.

We believe that our approach is both responsive and responsible. It is responsive to what we understand to be the values and expectations of Canadians in providing safe and secure isolation of the used fuel for the very long term. It also brings to bear responsibly the knowledge, expertise and wisdom of a variety of specialist communities to help us understand the choices. There is no single formula or lens through which to approach this public policy challenge. It demands the wisdom of Aboriginal elders, the expertise of natural and social scientists and engineers and the informed interest of citizens.

We are resolute in our belief that the knowledge we have today is more than adequate to start down this path, yet humble enough to acknowledge that the future will unfold in ways that may redirect the path to our end goal. We have an ethical obligation to act.

Part Two
Response to Legislated Study Requirements

2

Chapter 2 / Response to Legislated Study Requirements

The *Nuclear Fuel Waste Act* (*NFWA*) (an Act respecting the long-term management of nuclear fuel waste) was brought into force by the Government of Canada in November 2002. The purpose of the *NFWA* is to provide a framework to enable the Government of Canada to make, from the proposals of the NWMO, a decision on the management of nuclear fuel waste that is based on a comprehensive, integrated and economically sound approach for Canada.

The *NFWA* provides explicit direction on parameters that must be included in the NWMO study of management approaches. In this chapter, we discuss these specific parameters and how we sought to address them in undertaking our study.

The *NFWA* is provided in Appendix 2.

2.1 / Review of Study Requirements

In conducting its study, the NWMO has responded to each of the legislated requirements of the *NFWA*. Parts Three, Four and Five seek to make transparent our interpretation of the study requirements and how we discharged our obligations.

As a guide for readers, a locational index is provided in Table 2-1. The table itemizes each section of the *NFWA* that invokes a requirement for our study, and indicates where the requirement is addressed in the chapters that follow.

In many instances, the chapters refer interested readers to additional information available in the appendices to this report and/or supplementary reports that are publicly available for review on the NWMO website: **www.nwmo.ca**.

Table 2-1 Guide to Study Requirements in the *Nuclear Fuel Waste Act*

Study requirements of the *Nuclear Fuel Waste Act* (*NFWA*)	Where these requirements are addressed in the NWMO Study Report
The Study	
12. (1) Within three years after the coming into force of this Act, the waste management organization shall submit to the Minister a study setting out	With the submission of this study to the Minister of Natural Resources Canada, the NWMO is fulfilling its requirement under section 12 (1).
(a) its proposed approaches for the management of nuclear fuel waste, along with the comments of the Advisory Council on those approaches; and	(a) Chapter 5 presents the four approaches for the management of nuclear fuel waste proposed by the NWMO for study. Chapters 6 and 7 provide detailed descriptions of the four approaches. In addition, the NWMO considers implementation plans to be a key component of what constitutes the overall management approach. Implementation characteristics corresponding to the four management approaches are outlined in Part Five of the study, in Chapters 9 through 16. The comments of the Advisory Council on the management approaches studied by NWMO are included in the Council's report, provided at the end of this study report.
(b) its recommendation as to which of its proposed approaches should be adopted. *(The NFWA defines "nuclear fuel waste" as irradiated fuel bundles removed from a commercial or research fission reactor.)*	(b) Chapter 1 presents the NWMO's recommendation on which of the management approaches should be adopted.
12. (2) Each of the following methods must be the sole basis of at least one approach:	Part Four reports on the methods that formed the basis for the management approaches in our study. The detailed descriptions of the management approaches studied by the NWMO, and the underlying technical methods, are presented in Chapter 6. As required by the *NFWA*, we studied individual approaches that had as their sole basis the three technical methods specified for study under the *NFWA*:
(a) deep geological disposal in the Canadian Shield, based on the concept described by Atomic Energy of Canada Limited in the Environmental Impact Statement on the Concept for Disposal of Canada's Nuclear Fuel Waste and taking into account the views of the environmental assessment panel set out in the Report of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel dated February 1998;	(a) Deep geological disposal in the Canadian Shield, as defined in the *NFWA*, formed the basis of "Option 1" in the NWMO's study.

Table 2-1 (cont'd) Guide to Study Requirements in the *Nuclear Fuel Waste Act*

Study requirements of the *Nuclear Fuel Waste Act* (*NFWA*)	Where these requirements are addressed in the NWMO Study Report
The Study (cont'd)	
(b) storage at nuclear reactor sites; and *(c) centralized storage, either above or below ground.*	(b) Storage at nuclear reactor sites formed the basis of "Option 2" in the NWMO's study. (c) Centralized storage, either above or below ground, formed the basis of "Option 3" in the NWMO's study. While we were required by the *NFWA* to study approaches based on the three methods listed above, the *NFWA* allowed us to consider additional management approaches. Consequently, the NWMO studied a fourth management approach, Option 4: Adaptive Phased Management. This approach involves many features of the three technical methods prescribed for study in the *NFWA*.
12. (3) The study must include a detailed technical description of each proposed approach and must specify an economic region for its implementation.	Chapter 6 provides detailed technical descriptions of each proposed approach. Supplementary reports on the detailed technical descriptions for the management approaches are available on the NWMO website. Chapter 7 addresses economic regions for implementation. For each of the four management approaches studied, the NWMO specifies regions that we believe would be potentially suitable locations for implementation. The NWMO acknowledges that decisions on locating a facility will ultimately be based on extensive study of site-specific characteristics of a technical, environmental, scientific and social nature.
12. (4) Each proposed approach must include a comparison of the benefits, risks and costs of that approach with those of the other approaches, taking into account the economic region in which that approach would be implemented, as well as ethical, social and economic considerations associated with that approach.	Part Four outlines how the NWMO responded to the legislated requirement for a comparative analysis of each of the proposed management approaches. As background context to the assessment: • Chapter 5 describes how the NWMO considered the range of possible management options, and selected four management approaches to be the focus of the comparative study. • Chapter 6 describes the salient features and distinguishing characteristics of each of the four approaches studied. • Chapter 7 addresses the economic regions that would be associated with implementation of each of the four approaches. The comparative assessment of benefits, risks and costs is presented in Chapter 8. The first part of Chapter 8 reviews how the NWMO developed the assessment framework that was used to conduct the comparative assessment: • The chapter outlines the collaborative process of identifying the key questions and objectives for the assessment of management approaches, and the methodologies used to assess the four approaches. • We describe how ethical, social, economic and other considerations were embedded into the assessment to form important points of focus in the analysis.

Table 2-1 (cont'd) Guide to Study Requirements in the *Nuclear Fuel Waste Act*

Study requirements of the *Nuclear Fuel Waste Act* (*NFWA*)	Where these requirements are addressed in the NWMO Study Report
The Study (cont'd)	
	• We review how our assessment was further informed by taking into account the economic regions in which the approaches could be implemented. Chapter 8 concludes with a presentation of the NWMO's findings from its comparative assessment of costs, benefits and risks for the four management approaches. The findings of the comparative assessment are presented against each of the objectives established by the NWMO to guide our review. All of the supporting reports, papers and assessment studies are available for review on our website. (www.nwmo.ca)
12. (5) Each proposed approach must include a description of the nuclear fuel waste management services to be offered by the waste management organization under section 7. Section 7 of the *NFWA*: *7. The waste management organization shall offer, without discrimination and at a fee that is reasonable in relation to its costs of managing the nuclear fuel waste of its members or shareholders, to* *(a) Atomic Energy of Canada Limited, and* *(b) all owners of nuclear fuel waste produced in Canada that are neither members nor shareholders of the waste management organization* *its nuclear fuel waste management services that are set out in the approach that the Governor in Council selects under section 15 or approves under subsection 20(5).*	Chapter 12 addresses the issue of services to be provided by the NWMO to other waste owners, beyond the nuclear energy corporations (which are presently Ontario Power Generation, NB Power Nuclear and Hydro-Quebec).

Table 2-1 (cont'd) Guide to Study Requirements in the *Nuclear Fuel Waste Act*

Study requirements of the *Nuclear Fuel Waste Act* (*NFWA*)	Where these requirements are addressed in the NWMO Study Report
The Study (cont'd)	
12. (6) Each proposed approach must include an implementation plan setting out, as a minimum,	Part Five presents implementation plans for each of the four approaches considered. Eight chapters address the elements of implementation required under the *NFWA*, as well as additional elements of implementation that the NWMO considers essential. With regard to elements of implementation that we were required by the *NFWA* to address:
(a) a description of activities; *(b) a timetable for carrying out the approach;*	(a) (b) Chapter 16 describes the activities and timetables associated with implementation of each of the four management approaches.
(c) the means that the waste management organization plans to use to avoid or minimize significant socio-economic effects on a community's way of life or on its social, cultural or economic aspirations; and	(c) Chapter 14 addresses social, economic and cultural effects, and the means by which the NWMO proposes to avoid or minimize significant adverse socio-economic effects on a community's way of life or on its social, cultural or economic aspirations. The NWMO also addresses the objective of seeking sustained long-term positive impacts for communities.
(d) a program for public consultation.	(d) Chapter 13 addresses the programs for public consultation that would form part of the implementation plans. In this chapter, we discuss how we propose to build an engagement strategy to accompany the implementation of the management approaches. We also address other elements of implementation, beyond the minimum requirements specified in the *NFWA*. • Chapter 9 presents what the NWMO believes to be the underlying foundation for implementation. We suggest some overarching principles to guide our implementation processes. We provide some elaboration on the process of siting, and our intent to seek a willing host community. Finally, we descibe some early "next steps" in our implementation workplan. • Chapter 10 outlines the broad scope of institutions and governance that exist to oversee, monitor and contribute to the sequential decision-making processes as implementation unfolds. • Chapter 11 addresses the important financial aspects of implementing and maintaining the management approaches. • Chapter 15 addresses the significance that research and intellectual capacity will have for the continuous learning and adaptability that are integral to implementation plans.

Table 2-1 (cont'd) Guide to Study Requirements in the *Nuclear Fuel Waste Act*

Study requirements of the *Nuclear Fuel Waste Act* (*NFWA*)	Where these requirements are addressed in the NWMO Study Report
Consultation	
12. (7) The waste management organization shall consult the general public, and in particular aboriginal peoples, on each of the proposed approaches. The study must include a summary of the comments received by the waste management organization as a result of those consultations.	Part Three presents our response to this requirement of the legislation. • Chapter 3 describes how the NWMO approached Canadians. We outline how the NWMO invited a continuous dialogue, engaging the general public, Aboriginal peoples, nuclear site communities and many interested individuals and organizations with insights to share. We describe our support of Aboriginal organizations to design and deliver engagement programs within their own communities. We discuss many components of our engagement program, through which we solicited and benefited from comments on the management approaches and the related implementation considerations, as well as the study process and the assessment methodology used in our analysis. • Chapter 4 is a summary of comments received by the NWMO as a result of those consultations. We report on comments received on each of the management approaches that had been the focus of our public engagement to date, and on the broader issues concerning implementation that have arisen in our work, including insights from Aboriginal peoples. Detailed reports on comments from specific dialogues are available on our website, as are the many electronic submissions we received. All provided important guidance as we conducted our assessment, developed a recommendation and formulated implementation plans. • The comparative assessment of the management options and the formulation of our recommended approach, (described in Part Four) were guided by input received from Canadians. • The implementation timetables and plans (described in Part Five) also drew from the insights provided from our dialogue with Aboriginal peoples and the general public.

Table 2-1 (cont'd) Guide to Study Requirements in the *Nuclear Fuel Waste Act*

Study requirements of the *Nuclear Fuel Waste Act* (*NFWA*)	Where these requirements are addressed in the NWMO Study Report
Financial Aspects	
13. (1) The study must set out, with respect to each proposed approach, a formula to calculate the annual amount required to finance the management of nuclear fuel waste. The report must explain the assumptions behind each term of the formula. The formula must include the following terms: *(a) the estimated total cost of management of nuclear fuel waste, which must take into account natural or other events that have a reasonable probability of occurring;* *(b) the estimated rate of return on the trust funds maintained under subsection 9(1);* *(c) the life expectancy of the nuclear reactors of each nuclear energy corporation and of Atomic Energy of Canada Limited; and* *(d) the estimated amounts to be received from owners of nuclear fuel waste, other than nuclear energy corporations and Atomic Energy of Canada Limited, in return for services of management of nuclear fuel waste.*	Chapter 11 discusses the formula to calculate the annual amount required to finance the management of nuclear fuel waste and explains the assumptions behind each term of the formula. The Chapter also addresses the specific requirements for the funding formula as set out in 13 1(a) through (d).
13. (2) The study must set out, with respect to each proposed approach, the respective percentage of the estimated total cost of management of nuclear fuel waste that is to be paid by each nuclear energy corporation and Atomic Energy of Canada Limited, and an explanation of how those respective percentages were determined.	Chapter 11 addresses the respective percentages of the estimated total cost of each management approach that would be paid by each nuclear energy corporation and Atomic Energy of Canada Limited. An explanation of how the percentages were determined is provided.
13. (3) The study must set out the form and amount of any financial guarantees for the management of nuclear fuel waste that have been provided by the nuclear energy corporations and Atomic Energy of Canada Limited under the Nuclear Safety and Control Act.	Chapter 11 sets out the form and amount of financial guarantees provided by the nuclear energy corporations and Atomic Energy of Canada Limited under the *Nuclear Safety and Control Act*. Chapter 11 also addresses other aspects of financial surety, including legislated provisions in the *NFWA* for the establishment of trust funds.

2.2 / Our Interpretation of "Management Approach"

In determining how the NWMO would articulate "management approaches" for consideration in its study, we were guided by the *NFWA* which defines "management" of nuclear fuel waste as the "long-term management by means of storage or disposal, including handling, treatment, conditioning or transport for purpose of storage or disposal." Our interpretation of what is meant by "management approach" is further detailed through the components of implementation plans, required under Section 12 of the *NFWA*. In effect, Table 2-1 describes the various steps taken to assess and recommend a long-term management approach for used nuclear fuel.

Consistent with the *NFWA*, and building upon discussions with Canadians, the NWMO sees the management approach as including both a technical method and an overarching management system. The technical method involves a type of technology, such as continued reactor-site storage or a repository deep in the ground, along with the required support infrastructure that would include transportation systems. The management system includes the institutions, governance, financial arrangements, and managerial and legal frameworks designed to oversee and guide the implementation and operation of the technical method through its operating life. Together, these elements comprise a comprehensive management approach.

In developing the management approach, it is clear that more than technical input is required: not only must technical design attributes be considered, but also the process of implementation – how decisions are taken, how they are reviewed, and the scope of ongoing public involvement. Thus, the design process must consider fully the ethical, social, cultural, environmental and economic dimensions. It must be sensitive to the impacts the approach may have on Canadians' way of life and their aspirations. In bringing together the best insights related to both substantive and process issues, the design of a management approach must draw not only on "western" science (social and natural), but also on Aboriginal Traditional Knowledge. Only through a fully developed management approach may we seek to earn the confidence of Canadians.

2.3 / Study Contributions of the Advisory Council to the NWMO

The Advisory Council to the NWMO was established by the NWMO in 2002, as required by the *Nuclear Fuel Waste Act* (*NFWA*). Membership of the Advisory Council is presented in Appendix 1.

The *NFWA* mandates the Advisory Council to examine and provide to the NWMO its independent written comments on the NWMO study and the management approaches considered in the study. The *NFWA* directs the NWMO to include the independent comments of the Council in our final study that we submit to the Minister of Natural Resources Canada and make public.

In addition to fulfilling this statutory responsibility, the Advisory Council agreed to provide the NWMO with arms-length guidance throughout our three-year study period. Some of these important contributions are discussed below.

The Advisory Council structured its meetings to reflect this dual sense of accountabilities.

Independent Review and Comments

Council members, respecting the Council's statutory responsibility to provide comments on the NWMO study, were conscious of preparing for and reflecting this independence in their operations. For example, the Council:

- Requested regular briefings and progress reports from NWMO management on the findings from public engagement, research and analysis;
- Sought supplementary information from the NWMO, to fully understand key aspects of the study;
- Sought opportunities to meet with invited guests as a means of understanding the breadth of perspectives on the issue of long-term management of used nuclear fuel;

- Attended some of the NWMO's public engagement sessions, to witness the range of comments expressed by Canadians;

- Regularly convened "in camera" sessions for private deliberation amongst members without the presence of NWMO management; and

- Devoted significant time to discussing and preparing its independent comments, through numerous private sessions.

From its inception, the Advisory Council was committed to providing a high level of transparency in its operations.

- The Council requested that formal minutes be taken at its meetings, and directed that the minutes of the Council proceedings be made public through posting on the NWMO website (www.nwmo.ca/advisorycouncil). Background on the Council membership is also maintained on the website.

- The Advisory Council developed a Tracking Matrix, to provide transparency in the nature of the NWMO/Advisory Council interaction over the three-year study period. This Tracking Matrix serves as a joint record of accountability for the Advisory Council and the NWMO.
  - > The Tracking Matrix identifies areas on which the NWMO sought Advisory Council advice, and reports on how the Advisory Council responded; and
  - > It also identifies areas in which the Advisory Council made suggestions or requests of the NWMO, and reports on the NWMO's response.

- The Advisory Council Tracking Matrix is available for review on the NWMO website, at www.nwmo.ca/actracking.

- In January 2005, the Advisory Council published on the website a statement on how it intended to fulfill its legislative mandate by providing independent comment. This early statement signaled the range of considerations that members would be considering in assessing the NWMO study. (www.nwmo.ca/acstatement)

In accordance with the *NFWA*, the Advisory Council provided its written comments on the NWMO study. We enclose these comments at the back of this final study report.

Ongoing Guidance to the NWMO

The second key role of the Advisory Council is one of providing counsel to the NWMO.

Our study of management approaches was enriched by their guidance in many ways. For example:

- We sought Council advice on how to structure our work so that we would make the most effective use of the three-year study period. We benefited from early Advisory Council reviews of our draft workplans and proposed areas of activities in each year of the study;

- We sought the Advisory Council's advice as we developed engagement plans. The Council provided advice on how to achieve effective and full engagement with Aboriginal peoples and the general public;

- We reviewed with the Advisory Council findings from each phase of public engagement, analysis, and assessment, as we considered the implications for our comparative assessment of management approaches;

- We asked the Advisory Council to review drafts of each of our three milestone documents, to suggest opportunities to enhance the clarity, completeness and balance in the reporting of the study findings, including the key issues from the general public and Aboriginal peoples. We asked the Council to advise on the structure and format of the documents, to ensure the documents are effective tools for public engagement; and

- We sought the advice of the Advisory Council on our organization's communications. As part of this, Council members reviewed and commented on NWMO's annual reports from the perspective of ensuring a full and accurate depiction of Council and NWMO activities for the preceding year.

The Tracking Matrix provides an account of the Advisory Council's input into the range of issues on which the NWMO sought guidance. From the NWMO's perspective, the richness of the Council's contributions was broadly based. We share some of our general observations:

The Advisory Council directed significant time and effort to advising us on our engagement activities. Drawing from their respective backgrounds and experiences, Council members advised us on the breadth, focus and structure of engagement plans to support a meaningful dialogue with Canadians. The Council reviewed carefully the findings from all of the NWMO's engagement activities. The decisions of many Council members to attend some of our public engagement sessions, to hear first-hand the range of issues and concerns, is further evidence of the importance assigned by the Advisory Council to the role of public engagement and input in the NWMO study.

Of particular note, was the Advisory Council's focus on the NWMO's engagement with Aboriginal peoples. The Council elected to establish a Sub-Committee on Aboriginal engagement, as a standing committee charged with reviewing and guiding the NWMO's implementation of its Aboriginal engagement program with national and local Aboriginal organizations. The Sub-Committee advised the NWMO on the design of some NWMO-led dialogue initiatives, and reviewed the reports from all of the Aboriginal dialogues. Sub-Committee members sought to ensure that the contributions of Aboriginal Traditional Knowledge would be reflected in the NWMO study.

The Advisory Council considered carefully how the NWMO would be fulfilling its obligation under the *NFWA* to take into account social and ethical considerations, among other factors. Council members followed closely the work of the NWMO's Roundtable on Ethics, and the way in which the NWMO incorporated ethics into its study.

The Advisory Council followed with diligence the analytical review of management options. Members discussed the NWMO's assessment of management approaches through each phase of analysis and public dialogue, and the methodological processes underpinning our analysis. Technical discussions were led by Council members to delve into particular areas of interest. In addition to the regular reports provided by the NWMO, Council frequently tabled information requests with the NWMO. The Council received weekly updates on activities in other jurisdictions. Through briefings, site visits and international meetings, members devoted significant personal time to monitoring closely the way in which other jurisdictions were proceeding with their plans for the long-term management of used fuel.

The Advisory Council urged us bring to bear the vast insights gained over previous years through Canada's study of the long-term management of used nuclear fuel, including the findings of the Seaborn Panel. At the same time, the Council reminded us to recognize and report transparently the remaining areas of uncertainty, and topics on which further social and technical research will be required.

Finally, the Advisory Council contributions to our study reflected the members themselves. Their decisions to devote personal time to meeting more frequently, with the NWMO and privately, than we had envisaged is evidence of their commitment. The nine individuals, with such a diversity of backgrounds and expertise, demonstrated an unwavering commitment to meet, discuss, advise and reflect on our study.

Drawing from their illustrious careers in federal and provincial government, municipal politics, academia, community involvement, non-profit organizations and the private sector, members led a full and intense discussion which resulted in strong contributions throughout our study. Through their questions and challenge, they brought rigour to our process, encouraging our further reflection and, ultimately, greater clarity in the study outcome. The intensity and thoughtfulness evident in the Council dialogue was an important reminder in itself of the value of a broadly-based Advisory Council.

The Advisory Council fulfilled its legislated mandate, and more. For its ongoing assistance and advice the NWMO is grateful. The study and the organization have benefited immensely. At the same time, we recognize the Council must reserve a place for its independent judgment of our work. In its report provided at the back of this document, the Advisory Council provides, in its own words, an account of its activities and its observations on how the NWMO has discharged its mandate over the past three years.

Part Three
What Canadians Said

3

Chapter 3 / How We Approached Canadians

Early on the NWMO adopted as its mission "to develop collaboratively with Canadians a management approach for the long-term care of Canada's used nuclear fuel that is socially acceptable, technically sound, environmentally responsible and economically feasible." This statement is reflected in how we approached Canadians, both in the way we asked for input and then used that input to shape the study.

We began with the understanding that technical and scientific experts or specialists can help us understand the **technical adequacy** of each of the management approaches. They can also help us understand the impacts any approach may have on the **environment**, and whether the approach is affordable (**economically feasible**). However, we understood that it is necessary to move beyond the technical and scientific communities to include the voices of a much wider range of citizens in order to judge the fourth element of our mission, **social acceptability**.

Scientific and technical evidence and analysis, while essential, was not the sole basis of our decision-making. We understood that the views of Canadian society, in judging benefits or risks, and assessing the social implications of various approaches for long-term management, are critical to the development of a socially acceptable recommendation. Canadians expect that the best scientific and technical knowledge is brought to bear in identifying and understanding the source and nature of risk and the ways in which safety can be assured. However, the decision as to whether safety has been assured to a sufficient degree to warrant implementation is a societal one, and will be affected by social judgements of what constitutes risk and safety and thresholds to be met.

We expected the management approach that may be regarded by Canadians as socially acceptable would be the one which factors in the best scientific and technical knowledge available, and is most responsive to the key values and objectives articulated by citizens who participated in our process of collaborative development. This process of working collaboratively with citizens to develop a management approach for Canada was designed to ensure that not only the best scientific and technical knowledge was brought to the study, but also that the values and objectives of citizens were identified and understood, and formed the road map for both the study and recommendation. The social and ethical considerations expressed by citizens were fundamental building blocks for the study.

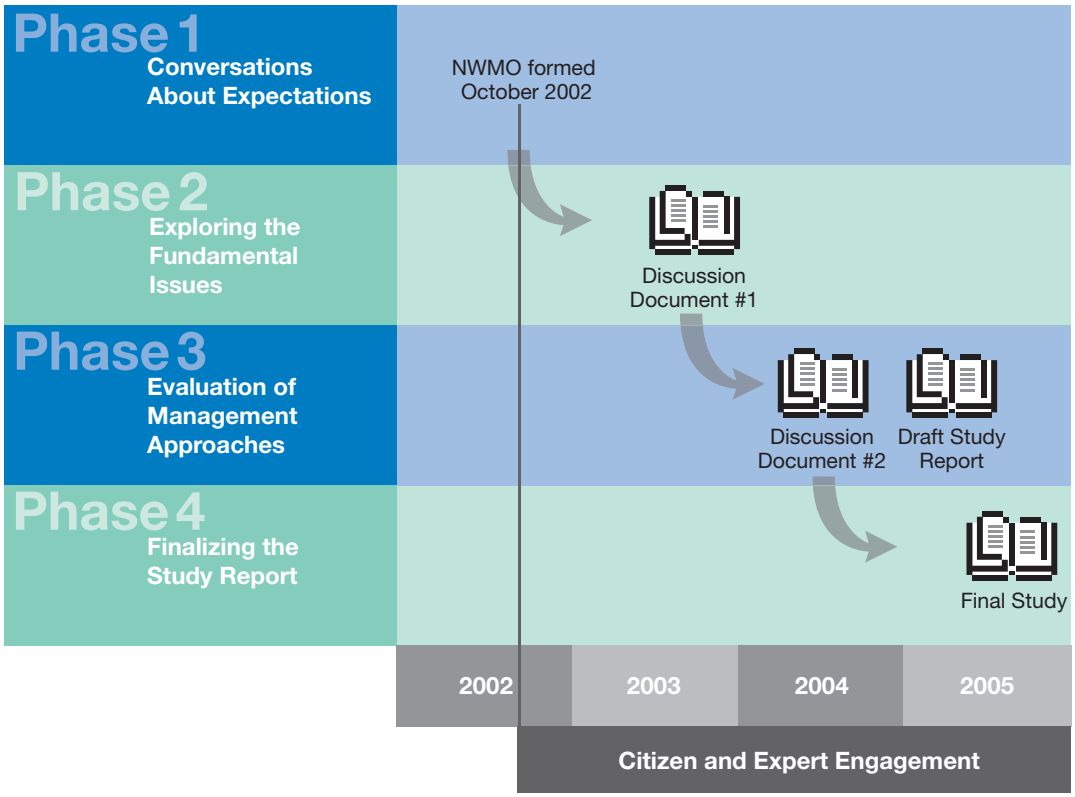
At its simplest, our study process involved asking Canadians to list the values and objectives against which a management approach should be assessed, and then engaging them in a dialogue to assess the approaches against that list. The study was designed so that the approach which emerged as most responsive to these values and objectives would be judged the most socially acceptable of the options studied.

In this collaborative development process, our role was to act as a facilitator of dialogue in an open forum where, as much as possible, all interested Canadians had access to information and the opportunity to put forward their views. The study process was designed so that as many perspectives as possible were considered and used to shape each major decision point.

3.1 / A Responsive Study Process

The three-year NWMO study was designed as a dialogue conducted over four phases as illustrated in Figure 3-1. Each of the four phases focused on a key decision point, and the direction of Canadians was elicited through dialogue before proceeding to the next key decision and phase of work. The four phases were supported by a series of milestone documents to share what we heard from Canadians, how this shaped our thinking, and to elicit public feedback to shape and direct subsequent steps in the study. Through these documents, we sought to make transparent our deliberations, to "think out loud," and to elicit comments and direction.

Figure 3-1 NWMO Study Plan



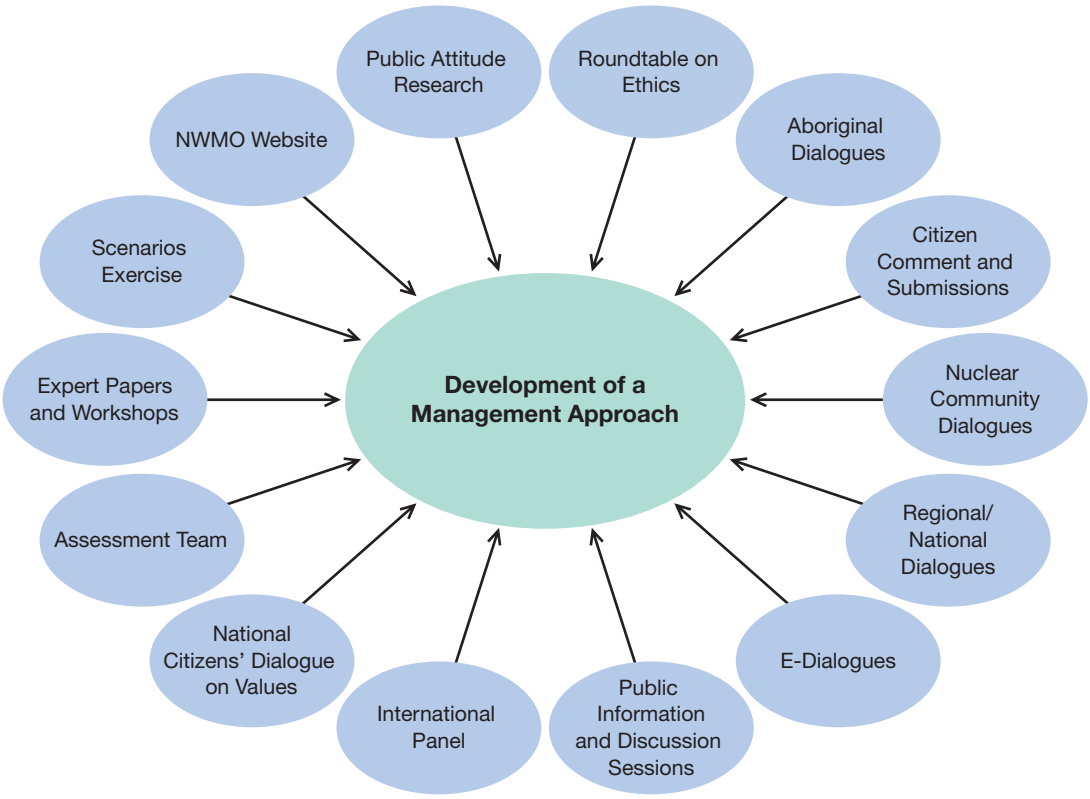
The dialogue process sought direction from Canadians at each of the following points:

- Identifying the questions to be asked and answered in the study, and the key issues to be addressed in the assessment of the management approaches;
- Confirming the range of technical methods to be considered in the NWMO study;
- Assessing the risks, costs and benefits of each management approach through the assessment process; and
- Designing the overarching management structure and implementation plans for each management approach considered in the study.

For this public policy issue, we understood that all Canadians may have an interest. We learned early on, from public attitude research, that the public attaches high importance to this issue, once it is brought to their attention, and expects to play an important role in the study. However, we also learned that most have little knowledge about the issue, and little interest in becoming personally involved. Recognizing that many people would not involve themselves in a discussion about used nuclear fuel, although the inclusion of public input is considered key to a credible study process by the public, we tried to deliberately include a diversity of voices. In this way we attempted to ensure that a broad range of social and ethical considerations were raised for consideration.

We sought this societal direction in part through a dialogue with citizens about the values and objectives that ought to drive decision-making on a waste management approach and the concerns that needed to be addressed. We also sought societal direction through a dialogue with specialists focused on understanding the current state of scientific knowledge related to the long-term manage-

Figure 3-2 Development of a Management Approach
The NWMO has attempted to use a wide variety of techniques to bring a diversity of voices to the study.



ment of used nuclear fuel, and the practicable options available to meet the values and objectives which citizens judge to be important.

Over the course of the dialogue, a broad range of engagement and dialogue techniques were used, including traditional and more innovative approaches. In order to elicit the range of social and ethical considerations which citizens bring to bear on this issue, we used nation-wide surveys, focus groups, issue-focused workshops and roundtables, e-dialogues and deliberative surveys, and public information and discussion sessions. (See Figure 3-2.) Through agreements initiated by the NWMO, 15 national, regional and local Aboriginal organizations conducted a range of dialogue initiatives, which they designed to meet the needs and preferences of Aboriginal participants.

Some of these techniques were used to ensure that we heard from a statistically representative cross-section of citizens, including those who would not otherwise involve themselves in the study. Some of these techniques elicited the concerns of those who are directly interested in the issue. Others provided for more in-depth conversation among those with specialized knowledge. Throughout, our website served as a platform, not only for making publicly available all reports commissioned by the NWMO, but also to share what was said and invite submissions and comment from Canadians on any of these topics. Each dialogue initiative was conducted, and reported on, by third parties in order to ensure the accuracy and transparency of the reporting.

In order to explore the state of scientific knowledge (both natural science and social science) related to the long term management of used nuclear fuel, and the practicable options from which to choose, we commissioned a series of background papers, each prepared by a specialist in that field and peer reviewed.

Specialists also prepared illustrative conceptual engineering designs and cost estimates for each of the short listed options in the study. These conceptual designs formed the basis for much of the broader public discussion.

The process through which the NWMO sought to elicit societal direction at each major step was designed to be responsive to what Canadians said an appropriate study process should embody:

- The study process must be grounded in knowledge and expertise;
- The study must solicit and consider a wide range of perspectives;
- The NWMO should "think out loud" and engage citizens in dialogue at multiple points in the process;
- The process must be fair, transparent and trustworthy;
- The process must make information accessible to members of the public who currently know little about this issue; and
- The process must use a variety of methods to engage citizens.

The NWMO study process is briefly outlined, by phase, in the following section. To August 31, 2005, more than 50,000 people expressed interest in our study by visiting our web site. We conservatively estimate that more than 18,000 citizens contributed,[1] including more than 500 specialists in scientific (natural and social sciences) and technical disciplines related to the management of used nuclear fuel.

3.2 / The Road Traveled – the NWMO's Process of Collaborative Development with Canadians

Phase 1 – Conversations About Expectations

The NWMO began by listening to Canadians about their expectations and objectives for the study. We asked them to tell us:

- How should the study be conducted?
- What questions should be asked and answered in the study? and
- Which options should be investigated and included in the study?

As part of this 'listening and learning', we launched a number of initiatives, including a set of early conversations with Canadians, to begin to appreciate expectations both for the process to be used and the issues to be explored in the study. These initiatives are discussed further in Table 3-1. We also commissioned a series of papers by specialists and convened workshops to initiate some focused discussions on specific topics. (See Table 3-2.)

One of the major initiatives we launched in this phase was a Scenarios Exercise. Given the very long time-frames over which used nuclear fuel remains hazardous to people and the environment, decisions we make today will surely have repercussions for generations to come. Although we cannot know what future societies will look like, we can try to anticipate what they may look like by envisioning a broad range of possibilities. Envisioning possible futures that we might attempt to plan for in the decisions we make today was the objective of the Scenarios Exercise.

[1] This estimate is based on the sum of: the number of unique visitors who visited the NWMO web site more than once (9,925), plus the number of citizens who were randomly selected and participated in public attitude research (3 nation wide surveys (2,600 x3) and 54 focus groups (8 x 54)). This figure does not include authors of papers which appear on the NWMO website, submissions, or participants at open houses, dialogue sessions, e-dialogues, Aboriginal dialogues, or web surveys since we are unable to confirm how many of these participants may have also visited the website more than once.

In partnership with Global Business Networks, we convened a Scenarios Team consisting of 26 individuals drawn from a range of interests and locations across Canada. Four workshops of several days each were held over the course of several months. At the end of the exercise, the group had described four detailed scenarios for the time-frame of 25 years from now, 12 much less detailed scenarios for the 175-year time-frame, 16 sets of conditions for the 500-year time-frame, and a number of simple "what-ifs" for the 10,000-year time-frame. A sub-set of these scenarios later came to form an important component of the assessment of approaches.

People needed good information as a foundation to become involved in the study. We commissioned a series of papers by specialists, which were peer-reviewed and then posted on our website. We asked more than 100 specialists from a wide diversity of disciplines to help us understand the state of scientific and technical knowledge in Canada and abroad on issues related to the study. These specialists also helped us to understand that although there is much that we know, there are still some areas of uncertainty.

This was the first step in creating an information foundation for the study. Over the course of the study, as information gaps were identified through public dialogue, additional expert papers were commissioned and workshops convened. Our information base expanded as Aboriginal peoples began to contribute their knowledge, wisdom and insight to the study. Citizens from communities that currently store used nuclear fuel shared their experiences 'living' with used nuclear fuel. The information foundation was also augmented by other citizens from the perspective of public values, objectives and experience.

Table 3-1 Phase 1: What We Did to Identify Expectations for the Study

- **Face to face meetings.** We traveled across the country for face-to-face conversations with more than 250 individuals and groups involved in this issue including: people from communities that are currently storing used nuclear fuel; political representatives at all levels of government; Aboriginal leaders; nuclear power plant workers, youth, environmental organizations, industry specialists, faith communities, government agencies and parliamentarians;
- **Letters and submissions.** We encouraged letters, submissions and comments from interested Canadians, through regular mail and through the NWMO website (via formal submissions or deliberative surveys);
- **Key Concepts exploration.** We commissioned a series of papers designed to describe key concepts often used in the exploration of difficult public policy issues, to help guide and inform our examination and assessment of used fuel management approaches. These papers suggested important questions for the study to ask and answer. The concepts explored included: risk and uncertainty; security; the precautionary approach; adaptive management; and sustainable development;
- **Traditional Knowledge Workshop.** We convened a workshop involving a variety of traditional knowledge holders to explore the contributions of Aboriginal Traditional Knowledge to our study;
- **Technical Methods exploration.** We commissioned background papers from specialists to describe the range of technical methods available, and the practicability and promise which each holds;
- **Future Scenarios exploration.** We conducted a major scenarios exercise, which included a series of four workshops. A diverse group of individuals drawn from many interests was brought together with the task of identifying a range of plausible futures and conditions which might need to be faced in managing used nuclear fuel over the long term, and the questions those scenarios raise for the study;
- **Roundtable on Ethics.** We convened a roundtable of specialists in ethics, who met over the course of the study to help identify the ethical issues associated with the long-term management of used nuclear fuel and the conduct of the study;
- **Nuclear Host Community workshop.** We convened a workshop with opinion leaders in communities that currently host interim storage facilities to explore ways to facilitate effective and responsive dialogue at the community level;
- **Aboriginal dialogues.** We began the process of creating agreements with national Aboriginal organizations and some regional and local organizations to design and implement their own dialogue processes as a means of providing input to the NWMO's study;
- **Sustainable Development workshop.** We convened a workshop with senior practitioners in sustainable development to discuss what might be the key environmental questions that need to be addressed respecting the management of used nuclear fuel;
- **Science and Technology workshop.** We convened a workshop of 50 scientific and technical specialists to discuss the key technical questions that need to be addressed respecting the management of used nuclear fuel, as well as the range of technical methods available, their promise and practicability;
- **Public attitude research.** We undertook public attitude research with a representative cross-section of Canadians, including: 14 focus groups; and a nation-wide telephone survey involving 2,600 Canadians; and
- **Political Representatives briefing.** We conducted meetings with political representatives at all levels of government in Canada, and with international agencies involved in this issue.

Reports of these initiatives can be viewed at **www.nwmo.ca/backgroundpapers** and **www.nwmo.ca/dialoguereports**. A detailed listing is contained in Appendix 11.

Table 3-2 Phase 1: What We Did to Create the Information Foundation for the Study

Approximately 70 papers were commissioned on the following topics:

- **Social and Ethical Dimensions.** The papers were designed to suggest social and ethical dimensions of managing radioactive waste;
- **Health and Safety.** The papers were designed to provide information on the status of relevant research, radiological protection technologies, standards and procedures to reduce radiation and security risk associated with radioactive waste management;
- **Science and Environment.** The papers were designed to provide information on the status of relevant research on ecosystem processes and environmental management issues, including: research into our understanding of the biosphere, subsurface biosphere and geosphere; natural and anthropogenic analogues; chemical toxicity potential; and implications of climate change and of microbiological factors on the long-term management of used nuclear fuel;
- **Economic Factors.** The papers were designed to provide insight into the economic factors and financial requirements for the long-term management of used nuclear fuel, including: an examination of economic regions; status of financing systems for high-level radioactive waste management around the world; examination of economic considerations and analytical tools for the economic assessment of approaches;
- **Technical Methods.** The papers were designed to provide general technical descriptions of the three methods for the long-term management of used nuclear fuel as defined in the *Nuclear Fuel Waste Act*, as well as other possible methods and related system requirements. These include: overview of reactor site storage, centralized storage, geological repository systems, other potential management options; the status and economic and radiological implications of reprocessing, partitioning and transmutation of used nuclear fuel; transportation systems, storage, disposal and transportation containers, transportation issues and considerations; exploration, from a geoscientific perspective, of the suitability of other geomedia beyond that specified in the *Nuclear Fuel Waste Act* for implementation of a deep geological repository concept; and potential design changes associated with implementation in other geomedia;
- **Conceptual Engineering Designs and Cost Estimates for Alternative Management Approaches.** The NWMO received and posted to the website a series of technical and engineering reports from the Joint Waste Owners: Ontario Power Generation, Hydro-Québec, NB Power Nuclear and Atomic Energy of Canada Limited. The Joint Waste Owners commissioned engineering consulting firms to develop preliminary conceptual engineering designs for the three technical methods identified in the *Nuclear Fuel Waste Act*, and to develop associated transportation infrastructure and cost estimates for those designs. Upon receipt of this material, the NWMO commissioned a third-party review of the work, including examination of the key engineering design assumptions and cost estimation process; and
- **Institutions and Governance.** The papers were designed to outline the current legal, administrative and institutional requirements that may be applicable to the long-term management of used nuclear fuel in Canada, including legislation, regulations, guidelines, protocols, directives, policies and procedures of various jurisdictions. These include: a compendium of current legislation, regulatory documents, treaties, guidelines, and plans; status of Canadian expertise and capabilities; review of the *Canadian Environmental Assessment Act* process, Canadian Nuclear Safety Commission licensing process, the Non-Proliferation Treaty; Nuclear Liability; methodologies for assessing used nuclear fuel options; and education and training in nuclear waste management in Canada and abroad.

These background papers can be viewed at **www.nwmo.ca/backgroundpapers**. A detailed listing is contained in Appendix 11.

Phase 2 – Exploring the Fundamental Issues

The second phase of the study was launched with the release of our first discussion document *Asking the Right Questions?* We reported back to Canadians what we had heard, and on this basis how we planned to proceed with the study. This discussion document identified:

- Our plan to break the study into 'bite-sized pieces', each of which would form the focus of a broad dialogue with Canadians and be the subject of a discussion document;
- A list of 10 questions which we heard that Canadians want asked and answered in the study, and which should set the agenda for the study; and
- The short list of technical methods that we heard hold the most promise, drawn from a list of 14 technical methods, representing the range of choices considered internationally for the management of used nuclear fuel.

We launched a number of initiatives to engage citizens and specialized groups in discussion on four questions: Have we described the problem correctly? Have we identified appropriate ways to deal with the problem? Are we asking the right questions? Is our proposed decision-making process understandable and appropriate?

One of the most significant initiatives was a National Citizens Dialogue on Values. (See Table 3-3.) From the outset, we identified the need for the study to be driven by the values of Canadians. To gain a more in-depth understanding of citizens' values, and to identify them explicitly, we launched a collaborative research project with the Canadian Policy Research Networks.

A representative cross-section of citizens from coast to coast participated in the dialogue. In total, 462 Canadians gathered in 12 cities across Canada between January and March 2004, to talk with each other about the key characteristics they feel are important in a long-term management approach. This 'deliberative' dialogue identified one over-arching requirement and six 'fundamental values,' which later came to form foundation elements in the assessment framework.

A second major focus of activity in this phase of the study was the development of an Assessment Framework reflecting the values and concerns of Canadians. This framework was needed to undertake a rigorous comparative analysis of alternative management approaches. A multi-disciplinary Assessment Team assembled by the NWMO created the framework, based on the 10 questions outlined in our first discussion document. The team was asked to apply the framework, in a preliminary manner, to the short list of options specified in the *Nuclear Fuel Waste Act*.

The Assessment Team conducted its work over a six-month period, meeting as a group for a full week once each month. The framework and the preliminary assessment were major inputs to our second discussion document. They were subjects of extensive dialogue with Canadians in Phase 3.

Table 3-3 Phase 2: What We Did to Explore the Fundamental Issues

- **Discussion Document.** The NWMO reported on what it had heard to date, how it incorporated what it had heard in its work going forward, and sought clarification and correction, with the release of its first discussion document, *Asking the Right Questions?* (**www.nwmo.ca/askingtherightquestions**);
- **National Citizens' Dialogue on Values.** We held an in-depth exploration of values through a National Citizens' Dialogue with a cross-section of citizens, to identify and explore the values which we share as Canadians, and which should drive decision-making on this issue;
- **Letters and submissions.** We received letters, submissions and comments from interested Canadians through regular mail and through the NWMO's website (via formal submissions or deliberative surveys).
- **Dialogue workshops.** We convened workshops with citizen groups and organizations involved in this issue and individuals and organizations with an interest in public policy at both national and regional levels (National Stakeholder and Regional Dialogues);
- **Aboriginal dialogues.** We sought advice and guidance through dialogues designed and implemented by Aboriginal Peoples. (**www.nwmo.ca/aboriginaldialogues**);
- **Youth forum.** We convened a workshop with young people involved in the nuclear industry (Roundtable Dialogue with Youth at the International Youth Nuclear Congress);
- **Public attitude research.** We commissioned public attitude research with a representative cross-section of Canadians, including: six focus groups and a nationwide telephone survey involving 2,600 Canadians;
- **Workshops and meetings upon request.** We held a number of workshops and meetings to outline our work to date, answer questions and receive comment upon request of various interested individuals and groups;
- **Political Representatives briefing.** We held ongoing meetings with political representatives at all levels of government in Canada, and with international agencies involved in this issue; and
- **Preliminary Assessment paper.** We created a multi-disciplinary team to develop an assessment framework based on the direction that had emerged from dialogue with Canadians, and to apply this framework in a preliminary way to the management approaches under study. The framework and preliminary assessment were subjects of extensive dialogue in Phase 3. (**www.nwmo.ca/assessments**)

Reports of these initiatives, unless otherwise indicated, can be viewed at **www.nwmo.ca/dialoguereports**.
A detailed listing is contained in Appendix 11.

Phase 3 – Evaluating Management Approaches

The third phase of the study was launched with the release of our second discussion document *Understanding the Choices*. Through this document we reported to Canadians what we had heard in the previous phase, and how we planned to proceed with the assessment of approaches. This discussion document:

- Reported on further learning about the values and priorities of Canadians concerning the long-term management of used nuclear fuel, and insights from dialogues convened around the first discussion document;
- Provided more complete descriptions of the approaches that had become the focus of the study; and
- Outlined a proposed framework to be used for the assessment of management approaches, composed of citizen values, ethical principles and specific objectives. This framework was designed to build on the 10 questions that had been identified through conversations with Canadians and largely confirmed through subsequent dialogue.

With the release of this document, we asked Canadians if the proposed assessment framework was sufficiently comprehensive and balanced. (See Table 3-4.) That is, did the framework reflect the values and objectives of Canadians? We also asked interested Canadians to help apply the framework to the approaches and identify the relative strengths and limitations of each of the approaches. In dialogue leading up to the second discussion document, we had begun to hear that the way in which any management approach is implemented is very important, perhaps as important as the approach itself. For this reason, we also posed the following question to Canadians, "Are there specific elements that you feel must be built into an implementation plan?"

To continue the dialogue, we collaborated with the independent consulting firm DPRA Canada, to organize a series of 120 public information and discussion sessions in 34 locations, including every province and territory, across Canada. These sessions were advertised broadly to invite all interested Canadians to meet with us, learn about the study, and contribute to the assessment of the approaches.

We also reconvened some of the individuals and groups who had met to discuss our first discussion document. These National and Regional Stakeholder Dialogue workshops convened by the independent consulting firm Hardy, Stevenson and Associates Ltd., brought together people from specialized organizations and groups, such as environmental groups, learned societies, the nuclear industry, faith communities and others involved in this issue.

Finally, we further explored the strengths and limitations of the approaches under study by commissioning a group of specialists to use the framework outlined in the second discussion document, and modified through dialogue, to conduct a rigorous assessment of the management approaches under study. This additional and complementary assessment work, conducted by independent consultants well known in this area (Golder Associates Ltd., Gartner Lee Ltd.), extended the assessment to include consideration of illustrative economic regions in which each of the approaches might be sited and more formal quantification of risk.

Table 3-4 Phase 3: What We Did to Further the Assessment of Management Approaches

- **Discussion Document.** The NWMO reported on what it had heard to date, how it had incorporated what it had heard in its work, and sought clarification and correction, with the release of its second discussion document, *Understanding the Choices*. (**www.nwmo.ca/understandingthechoices**);
- **Public information and discussion sessions.** We convened a series of 120 public information and discussion sessions across Canada, which invited interested Canadians to meet to discuss the second discussion document;
- **Letters and submissions.** We received letters, submissions and comments from interested Canadians through regular mail and through the NWMO website (via formal submissions or deliberative surveys);
- **Aboriginal dialogues.** We sought advice from Aboriginal Peoples through dialogues they designed and implemented. (**www.nwmo.ca/aboriginaldialogues**);
- **E-Dialogues.** We commissioned three e-dialogues on the difficult topic of risk and uncertainty as it applies to the long-term management of used nuclear fuel. These involved two learned panels, and a series of e-roundtables among graduate students and other young people;
- **Nature of the hazard workshop.** We convened a workshop which brought together a variety of individuals with knowledge in natural science, social science and Aboriginal Traditional Knowledge, to discuss how the nature of the hazard inherent in used nuclear fuel might best be characterized;
- **Dialogue workshops.** We convened a series of workshops with citizen groups and organizations involved in this issue (National Stakeholder and Regional Dialogues);
- **Nuclear Host Community meetings and workshops.** We convened a series of meetings and workshops with individuals in communities that currently host nuclear waste management facilities;
- **Public Policy Roundtable.** We convened a roundtable with key public policy analysts and opinion leaders;
- **Political Representatives briefing.** We held ongoing meetings with political representatives at all levels of government in Canada, and with international agencies involved in this issue;
- **Public attitude research.** We commissioned public attitude research with a sampling of Canadians, including 10 focus groups, as well as deliberative surveys on our website;
- **Open Houses.** We held open houses in communities that currently host interim storage facilities.
- **Workshops and meetings upon request.** We held a number of workshops and meetings to outline our work to date, answer questions and receive comment upon request of various interested individuals and groups;
- **Comparative Assessment of Costs, Benefits and Risks papers.** We commissioned a team of specialists to use the Assessment Framework developed by the Assessment Team, based on direction which had emerged from public dialogue, to conduct a rigorous and integrated assessment of the management approaches under study with respect to economic regions. (**www.nwmo.ca/assessments**);
- **Supplementary Risk Study.** We commissioned specialists to supplement the analysis with additional work to examine the management approaches from the perspective of risk. (**www.nwmo.ca/assessments**); and
- **Discussion Document.** The NWMO outlined its thinking on its proposed recommendation to government, its thoughts on how this recommendation is responsive to the advice and guidance of Canadians, and sought comment before formulating its final recommendation with the release of this document, the *Draft Study Report – Choosing a Way Forward*. (**www.nwmo.ca/draftstudyreport**)

Reports of these initiatives, unless otherwise indicated, can be viewed at **www.nwmo.ca/dialoguereports**.

Phase 4 – Finalizing the Study Report

With the release of the *Draft Study Report*, the fourth and final phase of our study began. (See Table 3-5.)

In this phase, we continued our dialogue with interested Canadians, specifically to receive comment and suggestions and to hear concerns about the NWMO's proposed recommendation. This dialogue surfaced issues of both substance and clarification as input to the refinement of the final recommendation and report. We outline the insights from the dialogue in the refinement of the final recommendation and report in the next chapter.

Among the significant initiatives in this phase of work was the convening of workshops with interested individuals, citizen groups and organizations who had been involved in earlier phases of the study. These workshops, convened by the independent consulting firm Stratos, were designed to discuss and hear comment and direction concerning the NWMO's planned recommendation and report.

Table 3-5 Phase 4: What We Did to Finalize the Study

- **Dialogue workshops.** We convened workshops with interested Canadians who had previously contributed to our study in five provinces – New Brunswick, Québec, Ontario, Manitoba and Saskatchewan – to examine and comment on the *Draft Study Report*;
- **Letters and submissions.** We received letters, submissions and comments from interested Canadians through regular mail and through the NWMO website (via formal submissions or deliberative surveys);
- **Aboriginal dialogues.** We sought advice and guidance from Aboriginal peoples at the national, regional and local levels, as their dialogue process continued;
- **Nuclear host community workshops.** We convened a workshop with opinion leaders in communities that currently host interim storage facilities;
- **Elders' forum.** We convened a gathering of 22 Aboriginal elders and 19 youth supporters to discuss the draft recommendation and work going forward;
- **On-line public forum.** We convened an electronic forum to answer questions and hear discussion and comment about the *Draft Study Report*;
- **Public attitude research.** We commissioned public attitude research with a representative cross-section of Canadians, including: 24 focus groups and a nationwide telephone survey involving 2,600 Canadians;
- **Workshops and meetings upon request.** We held a number of workshops and meetings to outline our recommendation, answer questions and receive comment upon request of various interested individuals and groups;
- **Open houses.** We held open houses in communities that currently host interim storage facilities for used nuclear fuel.
- **Political representatives briefings.** We held ongoing meetings with political representatives at all levels of government, and with international agencies involved in this issue; and
- **Final Report.** This phase culminates with the delivery of this report and recommendation to the Government of Canada on a preferred approach for the long-term management of used fuel.

Reports of these initiatives can be viewed at **www.nwmo.ca/dialoguereports**. A detailed listing is contained in Appendix 11.

Chapter 4 / What People Told Us

During almost three years of dialogue with Aboriginal peoples, the public and specialists, the NWMO received very specific direction on both the way in which we should assess the management approach options, and the advantages and limitations of each as judged by interested Canadians. After reviewing each of the three options which formed the focus of the study, many suggested to us that an additional option should be considered, an option that would attempt to capitalize on the advantages of the other three. We heard that the way in which a management approach is implemented is as important to its acceptability as the technology used. We received very specific direction on the requirements of an appropriate implementation plan. Finally, we received comment on a preliminary description of the Adaptive Phased Management approach which is recommended in this report. This chapter closes with a brief discussion of how the NWMO has responded to the issues and concerns raised in the design of the approach which is recommended in this document.

4.1 / Dialogue 1 – Asking the Right Questions?

What is Important in a Management Approach?

We asked citizens to help us understand the values and objectives which any used nuclear fuel management approach for Canada should address. The following is a summary of what people told us. It is compiled from the consultants' reports of findings from dialogue activities, and submissions to our website.

Basic Points of Debate

Over the course of our dialogue with Canadians much common ground has emerged. This common ground reflects a set of values and objectives that we as citizens appear to share and which can form a basis on which to move forward on this issue. We also heard people actively debate some questions which, for them, are fundamental to the choice of a management approach for used nuclear fuel. Around these questions, the common ground is less apparent.

We report below on some fundamental questions on which we heard the views of Canadians diverge. For the most part, these questions are beyond the mandate of our study. However, the divergence of view on these questions infuses many of the comments we heard about the management approaches. The differences in perspective on these questions are important influencing factors, which the study must recognize, although it cannot directly address.

Some have suggested that this divergence is a result of the imperfect distribution of knowledge among those who have engaged in the study. If all had the same level of knowledge and understanding, the argument goes, the diversity of opinion would be much reduced. They suggest that public education and communication will bring us together.

Others have suggested the source of divergence is more fundamental, and reflects real and substantial differences in perspective. Our efforts to both create a balanced portrayal of information and to broadly communicate this information to the interested public, leads us to believe that the divergence in perspective on these issues, specifically the future of nuclear energy

in Canada, is substantial and warrants further exploration in a separate public policy forum.

Should the nuclear generation of electricity be continued?

From the inception of our study, a number of people told us that the assessment of management approaches needs to be undertaken in the context of a broader public policy debate about energy. Nuclear energy as a way of generating power, some argue, needs to be fully assessed in comparison with other ways of generating power. Others go further in arguing that discussions about the long-term management of nuclear fuel waste cannot be reasonably separated from discussion about the rest of the nuclear fuel cycle, including the mining of uranium ore.

Many of those who advocate for such a broad framing of the issue suspect that nuclear energy generation would be abandoned if the costs and benefits of the full life cycle were examined. For these people, until such an assessment is made, concern about the appropriateness of nuclear energy will continue to be a stumbling block to the discussion of waste management approaches.

Not all Canadians we spoke with shared this view. Many took an opposite view, and suggested that an assessment of energy generating methods would show nuclear energy to be a responsible choice, a form of energy that improves the quality of life of people around the world today and will continue to do so in the future. These Canadians did not see the nuclear energy question as an issue that must be addressed before waste management approaches are considered.

Finally, some suggested that since waste exists, it must be dealt with, irrespective of the future of nuclear power in Canada. For these people, the question of whether nuclear generation should continue is irrelevant to our study.

Do we have sufficient knowledge to proceed with decision-making?

All those with whom we spoke agree that Canada, and other countries, have assembled a large body of knowledge to help inform decision-making on the long-term management of used nuclear fuel. This is particularly the case when we compare the body of knowledge on this issue with the amount of knowledge that supports many other kinds of social decisions that we make with relative ease. We have a large group of scientific and technical specialists in Canada, many of whom are internationally renowned, to help us make wise decisions on this issue. Our knowledge is substantial. On this we have heard broad agreement.

Where we have heard active debate is on the question of whether this large body of knowledge is sufficient to proceed with decision-making now, particularly whether it is sufficient to make a decision on an 'ultimate solution' which will have implications for many generations to come. It is the time dimension of this issue, the fact that the used nuclear fuel must be effectively contained and isolated from people and the environment for a very long period of time, which gives rise to an important question. Given the long period of the hazard, and the fact that we have much knowledge although some uncertainties remain, what does a cautious approach dictate? And, what does responsible action require?

It is important to note that those who are most closely involved in the design of the management options and who have been at the forefront of scientific and technical exploration and testing, are confident in both the safety of the various technical methods for managing the fuel, assuming they are operated as designed, and our capacity to proceed with whichever Canadians may judge to be appropriate.

For which vision of the future should we be planning?

It is apparent that some have a more optimistic perspective on what the future holds than do others. This is evident in how Canadians have viewed the appropriateness of each of the approaches. If you feel that social structures may collapse in the future, you are more likely to consider a management approach that does not rely on social institutions to contain and isolate the material than on approaches that require institutional oversight. Similarly, if you believe that science will discover new and better management approaches in the future, then you are less likely to want to seal used nuclear fuel away and make it inaccessible. It is apparent from our conversations with Canadians that there is no one single view of the future that we all share, and feel should be the focus of planning.

The Common Ground: An Assessment Framework

With the release of our first discussion document, we concluded that we had identified the range of questions (see the "10 Questions" outlined in Figure 4-1) which should be asked and answered in the study.

With the release of our second discussion document, we largely heard that, using the 10 questions as a foundation, we had identified the range of values and objectives that should be considered in assessing options and identifying a preferred approach.

In general, dialogue participants from across the country expressed comfort with the breadth and depth of the values, ethical principles and objectives which make up the Assessment Framework and which should drive the assessment of the options. Participants found that the framework is balanced, and did a good job of reflecting what Canadians view as the important considerations for selecting a long-term approach for the management of used fuel.

Many participants told us they were pleased to see that the societal values and ethical considerations were being applied alongside the more conventional technical and financial considerations. For many this was viewed as a positive step forward, and begins to address one of the key findings of the Seaborn Panel's report that the long-term management solution must not only be technically feasible but also socially acceptable. There also appeared to be widespread recognition among participants that finding a long-term solution for the management of used fuel is both controversial and difficult. As a public policy issue this is a complex and multi-dimensional challenge and the development of an Assessment Framework that incorporates all considerations will provide a foundation for a more complete and more objective assessment of options. Several participants noted that the inclusion of societal values and ethical considerations was a significant improvement over other past efforts to manage used nuclear fuel.

While there is much common ground on what is important for a management approach in terms of values, ethical principles and objectives, it is apparent from our dialogues with Canadians that we don't all agree what fulfillment of that value, principle or objective would look like. This forms part of the social dilemma to be addressed in the selection of a management approach, and is outlined in more detail in the commentary that follows. This commentary is designed to briefly highlight what participants in dialogues said about each of the elements of the framework.

Citizen values which should inform the selection of a preferred approach:

Safety from harm

An overarching requirement. First and foremost, human health and the environment must be as safe as possible from harm, now and for the future.

Safety from harm was identified by participants as being the most important value. Regardless of which management approach is selected, people told us that the approach must, to the greatest extent possible, ensure that no harm is done. People had various definitions for safety, but most expressed very clearly and strongly that safety for all people (public and workers), and for our environment is critical. They said safety must be assured for both today and the future.

As will become evident in the discussion of the perceived advantages and limitations of the management approaches, there were different interpretations of how to best achieve safety. Some participants felt that the used fuel should remain at the reactor sites, where it is above ground and easily accessible. In this way, society would be constantly reminded of the used fuel, and monitoring and safeguards would be easily maintained, thus ensuring a high level of safety to people and the environment. At the other end of the spectrum, some participants felt that because of uncertainty regarding the stability of future society and the potential lack of commitment of future societies to properly manage the used fuel, the best way to ensure safety would be to place the used fuel in a repository below ground and to seal it for all time.

Responsibility

We need to live up to our responsibilities to ourselves and to future generations, and deal with the problems we create.

People told us that responsibility is an important value to guide the selection of a management approach. There appeared to be a consensus that we have an obligation to take action now to properly care for and manage the used fuel. However, there was no agreement as to what type of action Canada needs to take.

For many, taking responsibility means ensuring that we fully understand the nature of the waste management challenge, assess a full range of options, ensure that the necessary studies, procedures and protocols are in place, confirm that the current interim storage of wastes is safe and reliable, and ensure that the funds are in place to accommodate any future action for the long-term management of the used fuel. This does not include taking responsibility for a final decision now, but suggests leaving it to future generations to determine. For these people, our responsibility is to ensure that the conditions are in place to accommodate any future decision without placing future generations at risk from a safety or a financial perspective.

Others felt very strongly that it is our generation's responsibility to make a final decision that will ensure the long-term management of used fuel. We have the knowledge and capacity now to take this action, and we should use it. This includes selecting a management approach that completely addresses the final management of used fuel, and doing this within a relatively short period of time. From this perspective, our responsibility is to ensure that we resolve this matter and not leave it as a burden for future generations.

Adaptability

We need to build in capacity to respond to new knowledge.

People told us that adaptability is very important. One of the significant themes that emerged is that people generally are optimistic that society will continue to learn and discover new ways to do things. Of particular importance is that the selected management approach anticipates and is able to accommodate the potential for new information and technological advancement. No management approach should preclude consideration of new information, and any strategy must allow for a change in approach if any new information means that the used fuel can be better managed.

Some participants suggested that technological advancement might mean that the used fuel can efficiently and effectively be re-used as a future energy source. In anticipation of this, the selected management approach must allow for the used fuel to be accessible and retrievable. Thus, we should not make a decision today that would preclude the possibility of applying new knowledge for managing this material. Several suggested that part of our responsibility is to investigate and research emerging technologies and to assess their potential for the future management of used fuel.

Stewardship

We have a duty to use all resources with care and to conserve, leaving a sound legacy for future generations.

Participants talked to us about the need to use our resources wisely to ensure that they will be available for possible future use. Some suggested that stewardship means that Canadians have a responsibility to manage used nuclear fuel in other countries that has been produced by Canadian nuclear technology. A minority went as far as to suggest that full stewardship would imply that Canada should provide support and assistance to less fortunate countries for the proper management of their used fuel. Others, including the majority of participants in Aboriginal dialogues, argued strongly that our responsibility extends only to the used nuclear fuel that we have created and used in Canada.

Accountability and Transparency

Governments are ultimately accountable for the public good concerning safety and security, but must involve citizens, experts and stakeholders in any decision-making. Honour and respect must be shown for all.

Participants consistently commented on the importance of being able to have confidence that those entrusted with the responsibility of protecting the public interest are doing a good job. Decisions must be made in the long-term public interest, and not for political expedience or short-term profit. These decisions must involve the public. To be accountable, any individual or organization must be seen to be focused on the public interest and open to scrutiny.

Consistently throughout the dialogue, concern was expressed by some participants about the track record of the nuclear industry and government in terms of accountability and transparency. Many examples were brought forward of incidents in which the industry and/or government have acted in what is perceived to be a self-interested and secretive manner. For these participants, this is a key area in which trust must be built before proceeding with any approach for the long term management of used nuclear fuel. The fact the Board of Directors of the NWMO is composed only of waste producers causes some to question the extent to which such an organization can be fully accountable to the public interest.

Knowledge

We need to continue to invest in informing citizens, and in increasing knowledge, to support decision-making now and in the future.

Participants suggested that knowledge is also of great importance. In order for Canada to make a wise decision on the future management of used fuel, Canadians need to be aware and informed. Some participants identified the need to build awareness and public understanding of the challenges associated with used nuclear fuel management. Others commented that with the many demands that face most Canadians, it would likely be very difficult if not impossible to raise awareness of and knowledge about this issue.

Overall, participants suggested that complete, objective and balanced information and research must be provided. The potential for new knowledge and learning, including from Aboriginal Traditional Knowledge, needs to be recognized and accommodated in our recommendation to government.

Inclusion

The best decisions reflect broad engagement and many perspectives; we all have a role to play.

Participants identified the active involvement by all interested parties in the development and selection of a management approach as a fundamental requirement. Many felt that the selection of a management approach for used fuel should not be made in isolation by experts and politicians. The development of the approach must allow for all Canadians to provide views and opinions.

Ethical principles which should inform the selection of a preferred approach:

Respect for Life

in all its forms, including minimization of harm to human beings and other sentient creatures; Respect for People and Cultures.

Participants in the dialogues were largely unanimous in identifying Respect for Life as the most significant ethical principle to guide decision-making. Many equated this principle with the Safety From Harm value. Both suggest that whatever action is taken to manage the used fuel, it must respect all forms of life.

From the perspective of many participants, demonstrating Respect for People and Cultures is intimately related to demonstrating a respect for life more generally.

Respect for Future Generations

of human beings, other species, and the biosphere as a whole.

No ethical principle generated more discussion among participants than that of Respect for Future Generations. Many suggested that we should not prejudge the needs and capabilities of the future. Rather than acting in a paternalistic way, we should leave the choice of what to do with the used fuel for them to determine. There was a strong sense among some of the participants that the used fuel may represent a potential resource for future generations, and the decisions and actions taken by this generation should not foreclose future opportunities. In this context, our generation would show respect for the future by ensuring that the used fuel is properly cared for but remains available for possible future use.

Others, although fewer, argued that the principle clearly means that this generation must take all the necessary action to not leave to future generations a burden or a problem that we created. In particular, because of uncertainty about the stability of future societies and uncertainty regarding their technological and financial capabilities, we need to make a final decision to ensure that the used fuel created by this generation is fully and properly managed.

Justice

across groups, regions and generations; Fairness – to everyone affected and particularly to minorities and marginalized groups.

Most participants linked the principles of Justice and Fairness together. Some suggested that fairness and justice are difficult to define in the context of this issue, and are subject to multiple interpretations. How is fairness to be determined? Who determines it? What is geographic fairness? Is it possible to be fair (equally fair) to everyone who may be affected by the decision? And, how do we make sure that those who are most vulnerable, that is minorities and marginalized groups, are not unfairly burdened by any decision made? In this context some participants suggested that regardless of the selected management approach there will be some who will benefit and some who will bear the costs.

Some participants suggested that, when all the values, principles and objectives are taken into consideration, some difficult trade-offs will have to be made. When making these trade-offs, many expect that fairness cannot be assured. In particular, they suggested that in order to ensure safety from harm, fairness might need to be compromised.

Sensitivity

to the differences in values and interpretation that different individuals and groups bring to the dialogue.

Many participants commented on the importance of a wide cross-section of Canadians being engaged in decision-making on this issue, and the importance of understanding and considering the views, opinions and concerns that all people have regarding the future management of Canada's used fuel.

Objectives which should inform the selection of a preferred approach:

Public Health and Safety

To ensure public health and safety.

Public health and safety was uniformly considered the most important of the objectives, and has been the focus of discussions throughout the study. For many participants, this is the key issue to be addressed and other values and objectives are only important to the extent that they contribute to ensuring the health and safety of individuals and the population. Some participants told us that public health and safety necessarily encompasses 'worker health and safety' and 'community well-being.' Others told us that 'security' and 'environmental integrity' are also an integral part of a broader notion of safety, a notion focused on keeping the used fuel contained, and ensuring people are not harmed. Participants in focus groups in particular identified this as the only "must have" element of a management approach.

Fairness

To ensure fairness (in substance and process) in the distribution of costs, benefits, risks and responsibilities, within this generation and across generations.

Consistent with discussion of the ethical principle of the same name, Fairness was viewed as an important objective against which any management approach should be measured. It was the subject of much discussion and difference of view, about how fairness should be judged.

Worker Health and Safety

To ensure worker health and safety.

Many dialogue participants commented on the importance of Worker Health and Safety, and the need to consider separately the health and safety of the public and the health and safety of workers. Generally, participants felt it is appropriate that the standard of judgment for these two be different since workers willingly and appropriately take on greater risk as a result of their occupation.

Community Well-Being

To ensure community well-being.

Many participants struggled with the question of what constitutes a "community." Participants suggested that it should not be defined as just the community that might host a management facility, but should include any community of interest or group of individuals that might be affected either directly or indirectly by the management approach. This would include communities along potential transportation routes, the current reactor site communities, and any community, organization or group (i.e., an environmental group) that may be affected from an ecological, economic and social perspective. Participants in the Aboriginal dialogues expressed particularly strong concern about the need to define "community" broadly. There was also much discussion, without resolution, concerning how we might balance the needs and demands of different "communities" when these demands inevitably conflict.

Security

To ensure security of facilities, materials and infrastructure.

Participants felt that security is an important objective. Many saw security as what is required to respond to the citizen value of Safety from Harm and also to the ethical principle of Respect for Life. As such, it is an important companion to safety.

Participants offered a range of opinions as to how security is best assured in discussion of the different management approaches.

Environmental Integrity

To ensure environmental integrity.

In talking about the objective of Environmental Integrity, many people told us they consider this a necessary component of ensuring public health and safety. For many, it is not conceivable that we would be able to achieve Public Health and Safety without Environmental Integrity.

Economic Viability

To design and implement a management approach that ensures economic viability of the waste management system while simultaneously contributing positively to the local economy.

Participants commented on the importance of ensuring that adequate funding be in place to implement the approach, regardless of the management approach selected. Many commented, however, that management costs should not drive the selection of an approach at the expense of the other objectives, particularly public health and safety and community well-being.

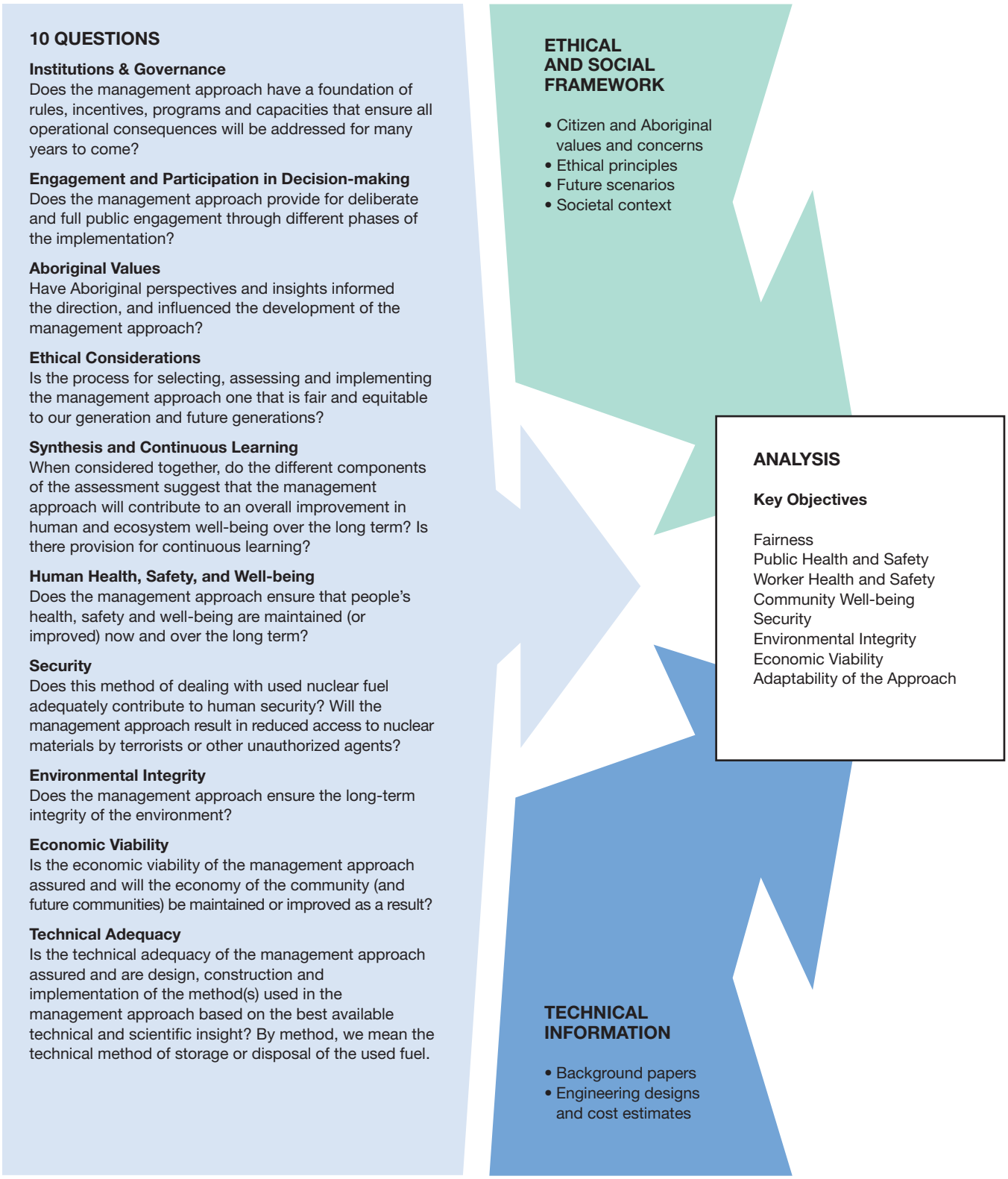
Adaptability

To ensure a capacity to adapt to changing knowledge and conditions over time.

As discussed in the context of the citizen value of Adaptability, there was much discussion of the need to treat adaptability as an objective for any management approach. It is viewed as being a fundamental requirement. Some participants expressed optimism that as a society we will continue to learn and develop new technology. As a result, the future may well hold the key to a better solution over the long term for the management of the used fuel. The approach that is selected must recognize and accommodate the potential for new knowledge to influence the final solution.

Some participants commented that adaptability is important in that it allows for contingencies within a management approach that can both anticipate and address changing conditions, the significance of which are unknown to us today. The potential for climate change and future societal breakdown were often cited as two examples of changing conditions that need to be considered in the assessment of management approaches.

Figure 4-1 What is Important in a Management Approach: Inputs for the Assessment



Early Insight from the Aboriginal Dialogues

Aboriginal peoples are an important community of interest for this study, as reflected in specific direction to the NWMO through the *Nuclear Fuel Waste Act* (*NFWA*) to seek the comment of Aboriginal peoples. Over the years, Aboriginal leaders have consistently asked to have the opportunity to study the question of management of nuclear waste and to be part of the related decision-making processes. They have pointed out the strongly held values of Aboriginal peoples regarding the environment. They have also expressed a concern that Aboriginal peoples may be unfairly called upon to shoulder a responsibility for an issue that was not of their making and for which they have received few past benefits. There has been a real fear that depressed Aboriginal communities would be specifically targeted and attempts made to offer short-term financial and employment benefits that in the long term would be replaced by environmental and social problems of a far greater magnitude.

We have heard from Aboriginal leaders that the best way of moving forward will be found when Aboriginal Traditional Knowledge and "western" scientific thinking are brought together into the deliberations as respected partners. We have been urged to take the long view and at a minimum to think of the impact of our actions seven generations hence.

The goal of our Aboriginal dialogue is to build the needed foundation for a long-term, positive relationship between the NWMO and the Aboriginal peoples of Canada. As such, the Aboriginal dialogues reflects the beginning of an ongoing process of engaging with Canada's Aboriginal community.

From inception, we followed a strategy of providing support to Aboriginal organizations to design and implement dialogue processes which in their view would work most effectively. Initially, we established agreements with national organizations as a means of achieving the broadest exposure possible. As the study progressed we established agreements with more and more regional and local organizations to strengthen direct contact at the local level. All of this stands as experience to draw upon in the years ahead.

Over the course of these meetings, some individuals and groups suggested that the pace of our study did not leave sufficient time to allow participants to digest the complexity of the issue. Some argued for a higher level of resources to enhance their capacity and to allow for more independent technical expertise to be at their disposal. Yet others voiced concern that we have not adequately drawn on, and provided information about, previous involvement by First Nations with the uranium and nuclear industry. The observations summarized below are drawn from the many reports that Aboriginal groups have filed with us. These reports are all available in their entirety on the NWMO website. (**www.nwmo.ca/aboriginal dialogues**)

Many of the observations and insights offered during the various elements of the Aboriginal dialogues are similar to those gathered during our broader public dialogue. In particular:

- The highest priority concern expressed is for safety and security for people and the environment.

- The issue of fairness in the distribution of costs, benefits, risks and responsibilities was often mentioned; the particular expression of this in the Aboriginal dialogues is described further below.

- Many Aboriginal participants spoke in favour of reducing the use of energy in general and nuclear energy in particular. They argued that the waste management issue cannot be fully resolved without a broad discussion of energy policy and the long-term role of nuclear energy. Further, they suggested there is a need to address the full cycle of nuclear materials from mining through long-term management of waste, including low and intermediate level radioactive wastes. An underlying issue here was a concern that resolution of the used-fuel management issue would open the door for expansion of nuclear energy.

- Significant concern was expressed about the risks associated with transportation.

- Many also voiced a discomfort with the make-up of the NWMO Board, arguing that its composition by appointees from the waste owners diminishes the credibility of the organization.

- Waste importation is not acceptable to most Aboriginal peoples and there is concern that this is not explicitly rejected in the *Nuclear Fuel Waste Act*. Some concern was expressed that the North American Free Trade Agreement might force Canada to import nuclear waste from the United States, and this could be extended to bring in waste from other countries. Some called for a specific law against implementation.

- Many were supportive of maintaining a capacity for retrievability in the hopes that ways of reducing the risk or further using the used fuel would be discovered in the future. They also confirmed the need to leave options open so future generations could re-visit today's decision and make decisions that were right for them.

- The need for education and more transfer of knowledge about the issue of long-term management of used nuclear fuel was a strong theme. Many called for a more effective balance of perspective from within and outside the nuclear industry than had been noted to date. The Elders' Forum called for creation of a scholarship to support long-term Aboriginal knowledge and skill enhancement on this issue. They also emphasized the need to focus learning and exchange activities at the grass roots level.

- There is a belief that more research is needed on such topics as the nature and extent of associated risks, the nature of potential costs and benefits (social, cultural, environmental, economic), methods for eliminating the hazardous nature of nuclear fuel waste, development of alternative energy sources, and improving and demonstrating the performance of storage containers. As well, there are calls for conducting research and monitoring of international research efforts concerning advanced technologies for the reprocessing, partitioning and transmutation of wastes as well as Traditional Knowledge and its application.

A number of contributions were also offered that reflect a special perspective that derives from the particular history, experience, and concerns of Canada's Aboriginal community.

The Issue of "Consultation"

This is a complex legal issue concerning how Aboriginal peoples see "consultation" under the Canadian Constitution. The Assembly of First Nations, the Métis National Council, Congress of Aboriginal Peoples, Ontario Aboriginal Métis Association, Union of New Brunswick Indians, the Federation of Saskatchewan Indian Nations, the East Coast First People's Alliance, the Western Indian Treaty Alliance, and the Atlantic Policy Conference of First Nation Chiefs all argue that our Aboriginal dialogues are not "consultation" as required by their interpretation of the law.

Fairness in the Distribution of Costs, Benefits, and Risks

The Aboriginal community is concerned that the costs, benefits and risks related to this issue be fairly distributed. Many suggested that urban dwellers will argue that a more northern and rural location, where most Aboriginal communities are found, would be a preferable site for waste management facilities because it would be considered "remote" from concentrations of population and therefore safer. However, in their view this kind of attitude unfairly characterizes the north as "empty" of people when in fact it is the home of Aboriginal peoples and other northerners.

Many Aboriginal peoples feel that few if any benefits realized by nuclear energy have accrued to them. In fact, some feel they have been negatively impacted by components of the nuclear fuel cycle, such as uranium mining. For them, the idea that traditional Aboriginal territory

would be targeted for hosting a waste management facility is both unfair and unacceptable.

However, others see the potential for gain from a waste management facility in terms of long-term economic and social stability and have expressed an interest in perhaps further exploring the idea. But, they need to be assured the safety and security for people and the environment can be maintained; this is a non-negotiable requirement.

In addition to the above perspectives, concern was expressed that financial leverage may be used to persuade an economically depressed Aboriginal community to accept the used nuclear fuel. This would be unfair and inappropriate.

Trust and Integrity

Some expressed a deep suspicion towards government, the nuclear industry, the power utilities, the Nuclear Waste Management Organization, and this Dialogue. Many Aboriginal peoples commented on their experiences with various industries and government, saying they had lost trust in these institutions, and in some cases even feared harm would come to their communities and traditional territory from a nuclear waste management system.

However, others argued that it was now time to re-engage but on the right foot, to contribute to finding the needed strategy for managing used nuclear fuel over the long term, and working collaboratively based on mutual respect and integrity. As part of this concern, the need to include all components of the Aboriginal community was voiced.

Recognition of Aboriginal Rights, Treaties and Land Claims

Many participants in the Aboriginal dialogues expressed concern that the *NFWA* does not mention, and that we have not made explicit, reference to respecting Aboriginal rights, treaties and land claims. For these individuals, a first step in establishing the needed trust would be a formal commitment on the part of the NWMO to respect Aboriginal rights, treaties and land claims.

Aboriginal Traditional Knowledge

In September 2003, we convened a workshop to examine how Aboriginal Traditional Knowledge could be brought to bear on our task. In subsequent phases of the Aboriginal dialogues, the results of the workshop were extended as participants added insight.

We have learned that Aboriginal Traditional Knowledge includes both an understanding of nature and of human relationships. It sees humans as part of the environment and spirituality a component of all relationships.

It honours the wisdom of elders, whether they be from Aboriginal or non-Aboriginal communities. It looks to collective benefits for both the short and long term, and uses the concept of considering implications of today's actions for at least seven generations. Table 4-1 offers two perspectives on the nature and breadth of Aboriginal Traditional Knowledge that came to us through the Dialogues.

Table 4-1 Perspectives on the Nature & Breadth of Aboriginal Traditional Knowledge

The Centre for Indigenous Environmental Resources in Winnipeg identifies four aspects of Traditional Wisdom and Knowledge:

- **Process related insight.** This is about who talks, when to talk, how to talk, and the appropriate protocols for relationship building and decision-making;
- **Special knowledge related to the land.** This is site specific, and can be held by not only indigenous people but also by anyone who has long lived on the land;
- **Values.** These reflect the special importance of the environment, recognition that humans are part of that environment and a commitment to a holistic perspective that sees the encompassing system as much as the component parts; and
- **Spirituality.** This serves as a weave across everything, but there is no single expression.

In work commissioned by the Métis National Council, Métis Traditional Knowledge is described as "a complexity of inherent and intrinsic wisdom" held and expressed in four realms, or four "wisdoms" that include:

- **Wisdom of Life –** encapsulates the wisdom of Métis women, as nurturers of life;
- **Wisdom of Earth –** encapsulates the wisdom of Traditional Resource Users, offering the complementary wisdom to Western scientific knowledge; touching on the ecological, geological and biological sciences from a Métis, applied perspective;
- **Wisdom of Community –** Métis community collective wisdom, gathered through dialogue, social interaction, relationships among family and friends, relationships in business; and
- **Wisdom of the Spirit –** encapsulates the Traditions and Culture of the Métis Nation, including adornment (sash), music (fiddle), dance, visual and performing arts.

Participants in our Aboriginal Traditional Knowledge Workshop identified five values or principles associated with Traditional Management Practice:

Honour the wisdom that can be garnered from speaking to the elders in both the Aboriginal and non-Aboriginal community.

Respect the opinions and suggestions of all who take the time to provide insight into the process.

Conservation, particularly as it applies to consumption of electricity.

Transparency, particularly when NWMO (the producer of the problem) has to suggest the solution.

Accountability so those responsible (whether for the concept or delivery) are held to high account by the public for actions, given the nature of the problem.

These principles served as significant influence on development of the NWMO assessment framework, particularly the ethical principles.

Applying these principles (for example in any NWMO process) would involve the elders and wisest speaking first, praying for assistance to make good decisions, constantly growing and evolving with new insights, involving the whole community, and considering the conse-

quences of decisions we make today on seven generations into the future. It would recognize that people are part of and guardians of the land, understand and apply the consequences of breaking traditional law, and ensure strong accountability is integrated into the management strategy. This would involve consideration of the biophysical, economic, social, cultural and spiritual aspects of the environment while maintaining an emphasis on interrelationships.

Traditional Knowledge provides rules for protecting the land while using it; clarifying and enhancing relationships amongst users; assisting in the development of technologies to meet the subsistence, health, trade and ritual needs of local people; and helping to create a world view that incorporates and makes sense of all of these in the context of a long-term, holistic perspective in decision-making.

Many Aboriginal peoples expressed a frustration that they did not see in the work of the NWMO, a concrete reflection of Aboriginal Traditional Knowledge. They pointed out that an intellectual understanding of another culture is not the same as respecting that other culture, accepting differences and applying the insights from it.

From another perspective, a number of Aboriginal peoples expressed that the treatment of Aboriginal Traditional Knowledge by the NWMO serves to create a sense of paternalism. From their point of view there seems to be a calculated overemphasis that masks any sense that Aboriginal peoples have insight and knowledge simply as people in their own right.

For the NWMO, with its roots in western culture, there is still much to learn about Aboriginal Traditional Knowledge and how it can be respectfully and effectively integrated into decision-making processes.

The Issue of Responsibility

There were two distinct aspects of "responsibility" expressed in the Aboriginal dialogues. First, there is an absolute consensus that Aboriginal peoples have a special relationship with the "land" and a strong commitment to honour and protect the environment is attached.

Quite distinct from that sense of responsibility is the attitude of Aboriginal peoples towards the issue of managing used nuclear fuel. On this topic, the Aboriginal community is split. On the one hand, some pointed out that Aboriginal peoples were not involved in the decision of whether or not to proceed with the creation of used nuclear fuel in the first place, and thus the responsibility for addressing the used fuel issue is not theirs.

However, others spoke of the responsibility of Aboriginal peoples and all Canadians to manage these wastes because of the overarching implications for people, regardless of origins, and the environment. They signalled a desire to play a part in designing the management strategy. Even though nuclear fuel waste was not created by Aboriginal peoples, they see the need for action sooner rather than later to address the issue.

Continuity of Engagement

Regardless of positions taken on the work of the NWMO, there was a consistent call for an ongoing effective engagement program to help design and implement the way forward. There was some call for creating an independent oversight capacity for Aboriginal peoples covering any plan that is put into effect. All emphasized the need for information that is culturally and linguistically appropriate to ensure effective engagement and a dominant theme was an emphasis on the need to engage directly with the local communities that might be affected by any management strategy.

Many said that there is a need to involve Elders because of their wisdom and experience, and young people since they will be the ones addressing this matter in the future. There was a call for "building bridges for young people to develop their views, to carry traditional ways in new and different ways."

A majority of the participating Aboriginal groups, either formally or informally, expressed concerns that representation of Aboriginal peoples within NWMO teams and as staff people is inadequate. They would like to see this addressed as we proceed to implementation.

4.2 / Dialogue 2 – Understanding the Choices

The Advantages and Limitations of the *Nuclear Fuel Waste Act* Options

We asked Canadians to help us understand the advantages and limitations of the three management approaches under study, as they saw them. The following is a summary of what people told us about the strengths and limitations of each of the management approaches identified in the *Nuclear Fuel Waste Act*. This summary is compiled from the individual reports from dialogue activities concerning our second discussion document, including: workshops; information and discussion sessions; Aboriginal dialogues; e-dialogues; public attitude research; and submissions to our website.

Option 1: Deep Geological Disposal in the Canadian Shield

The management approach is:

- Long-term management of used nuclear fuel through containment and isolation in a deep geological repository in the granitic rock of the Canadian Shield;
- Used nuclear fuel is transported from the nuclear reactor sites to a central location for long-term management;
- The deep geological repository is based on the concept described by Atomic Energy of Canada Limited in the Environmental Impact Statement on the Concept for Disposal of Canada's Nuclear Fuel Waste, and modified to take into account the views of the Environmental Assessment panel as reported in February 1998;
- Following an interim period of monitoring, the repository is closed, without the intent to retrieve the used fuel.

Strengths of the Approach

Several advantages were suggested concerning this management approach including: the opportunity to isolate the used fuel from people and the environment in a permanent or definitive way, and the opportunity to remove the burden of management from future generations.

Many participants identified the potential of this management approach to provide high levels of safety to both people and the environment. Those that held this view indicated that the placement of the used fuel bundles at depths of 500 to 1,000 metres, in a highly stable and consistent geological setting, has the potential to provide the greatest certainty that the used fuel will not cause harm over the long term. Except for the possible future development of cost-effective and proven technologies that would completely neutralize the used fuel, this management approach was suggested by many to be the best opportunity to isolate or remove the used fuel from human beings and the environment.

Many participants felt that through proper siting, site-specific studies, and appropriate engineering and construction, the used fuel could be placed and left for the long term without contaminating ground or surface water. Through the multiple barriers and passive containment associated with this approach many felt it would be safer than the storage options. Additionally, the fact that the used fuel would be sealed underground is seen to greatly minimize the potential for access by terrorists who wish to either sabotage the repository or use the used fuel for an undesirable purpose. Some also suggested the robustness of this approach against accidental human intrusion as an additional advantage.

For some participants, an advantage of this approach is that it allows for a permanent solution now as opposed to storage approaches which "defer a final solution to the future." Developing the repository, whether it is used immediately or at some time in the future, would be a proactive and responsible action taken by this generation to resolve the issue surrounding the management of the used fuel. In other words, some considered this approach fairer to future generations than the other two approaches. Some suggested the approach could

be modified to allow for retrievability and additional monitoring. This, in order to allow future generations the option to retrieve the fuel for another purpose or to permanently seal the repository at an appropriate time.

Some participants suggested the deep geological disposal management approach is more cost-effective than the other two management approaches. While the preliminary cost estimates for all three methods are generally similar, over the long term deep geological disposal is more cost-effective since it avoids the ongoing maintenance, monitoring and administrative costs associated with the long-term storage options. For this method, costs are relatively well known and time limited. Funding of the approach would not require trust funds designed to be available for thousands of years, as would the storage approaches. Therefore, with this option financial surety is greater.

Many participants suggested that "proper siting" of a deep geological facility would involve locations away from large population centres. As with the centralized storage method, there is an opportunity to select a site that would maximize economic and human benefits, and involve impacted communities in site selection and facility design. Some participants, including some in the Aboriginal community, suggested that this option has the potential to bring long term, stable jobs and income to a community.

Limitations of the Approach

Overall, the limitations of this approach as seen by participants, focus on the need to transport waste potentially long distances and on the fact that because the method is designed to ensure the waste is sealed and isolated it is relatively more difficult to monitor and retrieve the waste.

For many participants, transportation of the used fuel, whether by road, rail or water, was viewed as a very significant limitation of this management approach. For some participants, transportation related risk was considered to be so significant that this alone should make deep geological disposal or centralized storage unacceptable. Participants expressed concern about the potential for radiation exposure and/or surface and groundwater contamination due to a transportation related accident or spill.

Many participants suggested that maintenance of road and rail facilities in rural and northern areas would be a concern. If roads were not well maintained, this could increase the potential for accidents. Concern was also expressed about whether or not there would be adequate emergency preparedness and response personnel and equipment to respond to any accident or spill in rural and northern areas.

Many participants also expressed concern that the transportation of used nuclear fuel would offer an easy target for terrorists who wanted to sabotage or attempt to acquire the used fuel for some undesirable purpose.

As part of the conversation on this issue, some participants in the dialogues raised an alternative perspective for considering the transportation issue that some other participants found helpful. The suggestion was that the risk of moving used fuel, and its potential to cause harm in the event of an accident or sabotage, needed to be placed into context. In particular, the risk associated with the transportation of used fuel should be compared to experience in the management of other dangerous goods that are transported daily across this country. Such a comparison, it was suggested, would demonstrate that transportation of this material, with appropriate equipment, procedures and emergency preparedness and response programs in place, offered minimal real risk and may well have less risk than the transport of other dangerous materials that occur on a regular basis.

Participants suggested that it might be difficult to win the support of surrounding communities for any site that is selected as well as communities along transportation routes. Some said there is a risk of widespread public protest and municipal opposition which may make it difficult to develop and implement either a deep geological disposal or centralized storage management approach.

Some participants expressed concern about the safety of the facility itself. As a first of a kind project, there is no definitive proof that the concept will perform as promised. These participants suggested there is no location at which this method has yet been implemented and demonstrated to work. For some participants, even the current deep geological initiatives in Sweden and Finland were not consid-

ered as sufficient proof of concept. They were concerned that if an accident or breach does occur, it would be difficult, perhaps impossible, to take the necessary action to contain radioactivity. Furthermore, monitoring of the performance of the method would be difficult and unreliable. It might not be possible to detect and correct any problems within the repository in time.

Some participants suggested that since one cannot guarantee long-term safety, committing to this management approach as the final fate for the used fuel would be an irresponsible action. Because long-term safety is unknown, future generations may be placed at risk and left a significant financial and management burden.

Some participants took issue with the deep geological disposal approach in that sealing away the used nuclear fuel would deprive future generations of the opportunity to use the remaining energy within the fuel bundles, and take advantage of new technologies to make the used fuel safe and secure. Retrieval from a deep geological disposal facility is expected to be costly and potentially risky from a health and safety perspective.

Some also felt that this method is irresponsible because it reflects an inappropriate "out of sight, out of mind" attitude. Storing the waste on the surface, on the other hand, symbolizes our explicit duty to take care of the waste we have created. Similarly, for some the lack of a requirement for institutional control is a disadvantage of this approach because attention to the facility may diminish over time and with this a decline in institutional vigilance.

Some participants said it is misleading to believe that the number of sites in which used nuclear fuel is stored will be reduced, at least in the short term. Since the used fuel will still need to be stored at the seven existing sites for a period of time before it can be moved, the development of a deep geological disposal or centralized storage facility will mean that Canada would have eight locations containing used fuel, one more than the seven required for the storage at reactor sites approach. This additional site, some argue, increases the potential risk.

Participants in locations removed from the reactor sites, particularly some of the participants attending discussion sessions in Northern Ontario, opposed the deep geological disposal management approach on the basis of fairness. These participants stated that the reactor communities, which have received the economic benefits of nuclear power generation, should now bear the responsibility for the care and management of the used fuel. To site a disposal facility in Northern Ontario, which some suspect would be the likely location for a deep geological disposal facility on the Canadian Shield, it is argued would be unfair because these communities have not received any direct benefits from nuclear power. For similar reasons residents of Arctic areas, particularly the Inuit, are opposed to storing or transporting nuclear waste in the Arctic. Many participants across Canada recognize the potential for economic, social and cultural unfairness should a northern community end up hosting a management facility. Many called for careful assessment of these implications and the collaborative development of a plan and an agreement to address them.

Many participants in the Aboriginal dialogues suggested that deep burial was repugnant to their sense of the earth which they consider sacred. However others struggled with this, recognizing that leaving it where it is would also pose risk to the environment. Yet others expressed the view that returning the waste to the earth is both safe and consistent with their values. Some participants simply expressed a concern that it would bring significant environmental degradation with little associated benefit. Concern about groundwater quality, rock integrity, and earthquakes was often cited. Finally, some participants opposed this option on the basis of their past experiences with buried chemical waste and/or mine sites that had been abandoned and contaminated the surrounding environment.

Option 2: Storage at Nuclear Reactor Sites

The management approach is:

- Long-term management of used nuclear fuel in storage facilities, at or just below surface, at each nuclear reactor site in Canada; and
- Storage facilities are maintained, rebuilt and operated in perpetuity at each reactor site.

Strengths of the Approach

Overall, the strength of this approach, as seen by participants, focuses on an understanding that this technology exists today, it involves minimal transportation, and it allows the used fuel to be easily accessed and monitored.

Most participants in our dialogues felt strongly that regardless of the management approach that is selected, it must allow the potential for future generations to have access to the used fuel. Some of these participants favoured easy accessibility so that future generations could use the used fuel as an energy source. Others expressed faith in technological advancement producing new technologies that will neutralize the used fuel and render it harmless. For those holding either view, storage at the reactor sites offered an advantage over the two other management approaches. Many suggested that since we don't know what solutions may be developed in the future, there is still much to learn regarding nuclear energy technology. Making a final decision should be deferred for a reasonable period of time. If the used fuel were to be used in the future for either purpose, then storage of some type would be preferred to final disposal.

Similarly, many commented on the "flexibility" of the option as an advantage. The approach is seen to be the most flexible of the three because the used nuclear fuel is easily accessible.

A significant advantage cited by most participants is that there is no need to transport the used fuel to another location. Many expressed concern about the risks of transporting used fuel. For them, the potential for exposure to radiation from a transportation accident is a significant limitation of the other two management approaches. The fact that this approach would require no off-site transport is therefore viewed as a major advantage.

Some argued that existing storage facilities at the reactor sites have been proven safe with little potential to cause harm to people or the environment. Further, the reactor site communities have considerable familiarity and experience with all aspects of the nuclear industry. As a result, the community will likely be less concerned or fearful of the long-term storage of this material and therefore may be more likely or willing to accept this management approach. Some participants in the Aboriginal dialogues argued that leaving used nuclear fuel at the reactor sites raises fewer environmental justice issues than the other approaches.

Some participants also considered long-term storage at reactor sites to be fair in that there is no need to determine a location for the management facility. Some commented that the reactor communities have benefited from the operation of the nuclear power plants through jobs and other economic and community benefits. It was suggested that it would only be right that those communities also take on the burden of caring for and managing the used fuel. Some also commented that these communities, because of the presence of nuclear power plants, possess knowledgeable and competent management, scientific and security expertise that will be available to provide the high levels of oversight necessary to ensure the safety of the used nuclear fuel.

Because storage is on the surface, many said it has the advantage of being easier to monitor. It provides more certainty in terms of knowledge because the technology is well understood. As well, the environmental characteristics of the existing sites are well known.

Some also suggested that since "it doesn't put all eggs in one basket" if there is an environmental problem it would be easier to fix the individual site affected. In this way it is seen to be a method with greater adaptability.

Some participants in the Aboriginal dialogues favoured long-term storage at reactor sites, provided that waste be stored near population centres rather than in a "remote" location in order to ensure continued attention.

Limitations of the Approach

Overall, the limitations of this approach, as seen by participants, focus on the active management role that future generations would be expected to perform, and uncertainty that these future generations would be willing or able to do so. Fairness is also a concern to the extent that existing host communities did not agree to long-term management when the facilities were sited.

Many participants expressed the view that long-term storage of used fuel at the reactor sites was impractical. While it was suggested that short-term storage for the next 50 to 100 years might be acceptable, committing to this management approach for a period of thousands of years did not make sense. For this management approach to succeed, one needs to assume that future generations would be willing to take on the responsibility for oversight, monitoring and maintenance. For many participants, this is a highly questionable assumption.

Some participants felt that the costs for this management approach are too open-ended and therefore potentially excessive. In the event that future technological solutions do not materialize, the ongoing costs to manage the used fuel may become too much for future society to bear. Pressure to reduce funding for the maintenance of this management approach or to redirect funding to other priorities was considered to be real possibilities, which in turn would undermine the long-term safety of the management approach.

Contrary to the optimistic views expressed by some participants that future societies will thrive and technology will offer potential for more acceptable used fuel management solutions, some participants offered a pessimistic view. In particular, participants cited potential political and social instability and change as significant limitations of this approach. It was suggested that history is full of examples of civilizations that have either disappeared or significantly changed over time. Our current form of government, economic and social institutions cannot be guaranteed to exist for several hundreds, let alone thousands, of years. Because of this uncertainty, many felt that it would be irresponsible to not determine a final solution for the management of the used fuel. Leaving used fuel in storage over the long-term could well place both people and the environment at risk.

Some participants felt that the selection of this approach would be an abdication of our responsibility to take the necessary action to properly manage the used fuel. In their view, selecting this approach would be "not making a decision" since the final decision would be deferred to the future.

Some suggested that because this management approach would mean that there would be multiple storage sites, the potential exists for uneven application of procedures and risk management measures across the sites. This might compromise safety. In effect, participants said that the more sites that require management, the greater the potential for error or breach. Due to the multiple sites, it may also be more difficult to assure security.

Some participants also noted that the reactor sites are all located on bodies of water that serve as sources of drinking water, recreation and economic opportunities. The development of long-term storage facilities in close proximity to these water bodies represents an additional potential risk to people and the environment. In the very long term, sites adjacent to tidal water may be vulnerable to glaciation or if sea level rise occurs.

Finally, some participants commented that the initial siting decision for nuclear power plants and the acceptance of those communities did not extend to these sites being used for long-term storage of used nuclear fuel. Some participants felt that these locations do not offer the appropriate conditions for long-term management of used fuel. Requiring these communities to continue storing the used fuel over the long term would be unfair.

Option 3: Centralized Storage

The management approach is:

- Long-term management of used nuclear fuel in a storage facility, above or below ground, at a central site in Canada;
- Used nuclear fuel is transported from the nuclear reactor sites to the central location for long-term management; and
- The storage facility is maintained, rebuilt and operated in perpetuity at this central site.

Strengths of the Approach

Overall, the strengths of this approach, as identified by participants, are similar in some respects to those raised concerning long-term storage at reactor sites, and deep geological disposal.

One of the significant advantages identified with this approach, similar to deep geological disposal, is that used nuclear fuel would be removed from the existing reactor sites and put in a single location, specifically selected and built for the purpose of long-term storage. A single location would be easier to monitor and, particularly if built below the surface, would be more secure than multiple sites. It would also be more cost efficient.

Many participants suggested that, similar to deep geological disposal, an advantage of this approach is the opportunity to remove the used nuclear fuel from population centres and to a more remote location.

As with the deep geological disposal approach, the development of a centralized storage facility offers the potential for jobs, investments, purchasing of goods and supplies, and other economic benefits to residents, businesses and municipal governments who might be involved in the new facility.

The siting of a centralized storage facility, many participants suggested, may be easier than the siting of a facility for deep geological disposal because this approach does not rely on the geological conditions of a site in order to contain and isolate the used nuclear fuel. When compared to deep geological disposal, which would require highly specific siting requirements, centralized storage could be established in many different settings.

Because of this potential siting flexibility, some participants felt that the chances of there being a willing host community for the centralized storage facility would be greater than for a deep geological facility. Some suggested that the facility might also be located in an area that had clearly enjoyed the benefits of nuclear power, which would make such a siting decision fairer.

As with storage at the reactor sites, centralized storage would meet the preference of many participants for a management approach that is flexible, and that can adapt to new knowledge and events. With this approach, there would be no final fate decision; the stored used fuel would be accessible and retrievable either to take advantage of new nuclear waste management technologies or for future use as an energy source.

The used nuclear fuel would also be easily monitored. From the perspective of some participants, an advantage of this approach is also that it keeps the used fuel visible. In addition to visibility, the requirement for on-going attention and care would therefore allow future generations to actively manage the material to ensure safety, and would ensure high standards of management and monitoring are maintained over time. It would also serve as an incentive to spur research into emerging technologies for the future management of the used fuel.

Limitations of the Approach

Overall, the limitations of this approach, as identified by participants, are similar in some respects to those raised concerning both long-term storage at reactor sites and deep geological disposal.

This approach, like reactor site storage, requires future generations to maintain the commitment to manage, and care for the used fuel. Some participants repeated their skepticism that future generations would continue to fund and manage the used fuel. They believe the ongoing commitment to the approach cannot be guaranteed over time. The stability of future society, government institutions, and societal values and priorities are highly questionable.

The continued and periodic repackaging required by this approach was suggested as presenting an increased health and safety risk to workers, and to the public at large should there be a lapse in diligence.

As an above ground facility, the approach is considered to be more vulnerable to security threats. It is also more vulnerable to the long-term implications of climate change, and glaciation.

For those participants who feel there is an urgent need to develop a final solution for the management of the used fuel, centralized storage possesses the same drawbacks as the reactor site storage approach. Considering the long time period over which the used fuel would remain a hazard to people and the environment, this management approach does not provide the final solution which some participants seek. Rather, it "defers to the future" final decisions about how the used fuel will be managed. Integral to this is the potential that the siting decision would need to be made twice, doubling any unfairness in the siting process. Lack of action on a final solution by our generation "would be irresponsible."

Many participants wondered whether a willing host community could be found for a centralized storage facility. Even if a community did express willingness to accept a facility, it was felt that surrounding areas and communities along transportation routes are likely to be less willing or even be opposed.

Many participants expressed concerns about the transportation of the used fuel to a centralized storage location. Many communities along a transportation route could be affected. Public anxiety over risks associated with transportation may make it difficult or impossible to implement the approach.

Finally, some participants felt that centralized storage might represent the greatest potential for risk to people and the environment of the three management approaches. By bringing all the used fuel to one central location, the potential impact from a catastrophic event (terrorism, sabotage or meteor strike) would be much greater than any comparable event at a facility managing less used fuel, or with deep geological disposal. In this regard, if centralized storage is selected, most participants favour shallow burial of the storage facility over surface storage.

Striking the Right Balance

As participants described advantages and limitations for each of the approaches under study, they also recognized that deciding among the approaches would be difficult. This is because no one of the approaches fully meets all the values and objectives that had been identified as important for a management approach for Canada. They identified which aspects of the decision required a difficult choice.

Balancing Security with Accessibility

Some participants argued for the importance of sealing used nuclear fuel underground, as the deep geological disposal approach would provide the best means of achieving safety and security. The used nuclear fuel would be more effectively isolated from people and the environment, and it would also be more secure from human intrusion. However, it makes retrieving and monitoring the waste difficult.

A number of participants argued for keeping the waste accessible, which is a feature of the storage approaches. Accessibility makes it easy to monitor the waste, and quickly take corrective action should a problem occur. It allows for implementation of new technologies or access if a new use for the waste is found. However, this accessibility would make keeping the waste secure more difficult.

Choosing among the methods, involves choosing between maximizing security or maximizing accessibility to the used nuclear fuel.

Balancing the Minimization of Transportation with the Removal of Used Fuel from Population Centres

Many participants expressed concern about the prospect of transporting used nuclear fuel. For many, an important limitation of the centralized storage approach and the deep disposal approach is the requirement that used nuclear fuel be transported, potentially for substantial distances, to the site. They expressed concern that an accident may result in the release of radioactive material, posing a risk to the health of people and the environment. Concern was also expressed that transport shipments may provide a target for terrorists. Concern about transportation was expressed in all dialogues and all parts of the country. It was also a particular concern raised by Aboriginal peoples.

Many of the same participants also expressed concern about storing used nuclear fuel over the long term near large population centres, as the reactor site storage approach would involve. For these participants, an important advantage of the centralized storage approach and the deep geological disposal approach is the opportunity to remove the waste from current reactor sites to a more remote location, away from population centres.

Some Canadians feel used nuclear fuel should be removed from population centres, while others would like to see handling and transportation of the waste be minimized to reduce possibility of accident. An additional challenge is to allow for the inevitable migration of population over the very long period of time involved.

Choosing among the methods involves choosing between minimizing the transport of used fuel and maximizing the remoteness of any waste management facility.

Balancing Timely Decision-Making with Future Flexibility

Most participants told us they feel strongly that the generation which enjoyed the benefits should implement a solution and not transfer this problem to future generations. Some of these participants argued that we have the knowledge and capacity today to put in place a definitive solution that would relieve the burden of managing this waste from future generations. It would be irresponsible not to take this definitive action now, they said.

Other participants argued that the action we take today should not preclude future generations making their own decisions. Although we have much knowledge today, continued research may surface new or better options in the future. It would be irresponsible to put in place a management approach today which precludes future generations from taking advantage of "inevitable" new learning in the future.

Choosing among the methods, involves choosing between implementing a definitive solution today or building in flexibility to allow future generations to influence the way in which the material is managed.

Balancing Fairness to Current Host Communities with Fairness to Future Host Communities

Over the course of the dialogues participants wrestled with the issue of fairness concerning the siting of any facility which may ultimately be required. Many expressed the perspective that it would be unfair to expect a community that had not received any benefit from nuclear energy to become the site of a long-term waste management facility. Many said that although current reactor site communities may have received the greatest benefit from nuclear energy, they should not be expected to host a long-term management facility because it goes beyond the terms of their original agreement to host the existing interim management facility.

Participants in the Aboriginal dialogues, as well as other participants living in northern areas, articulated similar concerns, saying that locating a facility in the "north" would be unfair given that few benefits have accrued to them.

Choosing among the methods, involves balancing consideration of the fairness to current host communities with consideration of the fairness to future host communities.

Expanding the Options

After looking at the strengths and weaknesses of each of the options individually, many participants suggested that an 'obvious' additional approach be considered, one that builds on the advantages of the various approaches. These participants variably referred to this hybrid approach as: centralized storage at a long-term geologically suitable location, fully retrievable deep geological disposal, convertible geological storage, underground centralized storage, and, centralized storage at a deep geological disposal site.

The hybrid approaches suggested tend to share the following characteristics:

- Extended storage of used fuel at the reactor sites, for a definite period of time. The used fuel is currently safely stored in these facilities, and would continue to be so for some time to come;
- Consolidating the used fuel at one central location, on the surface or in shallow underground storage as a preliminary step;
- A period of learning. Emerging technologies may offer potential to either neutralize the radionuclides in the used fuel or allow for the safe and cost-effective reuse of the waste. It would also allow us to learn from the experience of other countries that are in the process of implementing long-term used fuel management approaches. In addition, there may be greater certainty about the future of nuclear power in Canada;
- Development of a deep geological repository either to be used for deep underground centralized storage or as final disposal, if needed;
- A period of relatively easy access and retrievability; and

- Staged decision-making. After a definite period of time, decide whether to continue to store the used fuel at the surface or shallow underground, or whether and when to place it in a deep geological storage or disposal facility.

Hybrid approaches tended to be a focus of discussion among participants who see value in the management approach being both flexible and adaptable, and ultimately definitive.

Participants who see less value in adaptability were less likely to suggest such a hybrid approach. As discussed earlier, some participants expressed the view that prompt implementation of the deep geological disposal approach would best ensure the safe management of the used nuclear fuel, and additional research is unlikely to surface better management approaches or new uses for the fuel. Participants with this view were more likely to see a hybrid approach as potentially introducing unnecessary delays, uncertainty and costs in implementation.

A Matter of Implementation

Throughout the NWMO dialogues, participants talked to us about the type of implementation plan that should accompany any management approach selected. They recognized that the decision-making and implementation processes for Canada's used nuclear fuel will involve at least many decades. They said it will be important that a management approach be implemented in a way that continues to be responsive to the values and objectives of Canadians.

We heard from dialogue participants that any management approach for Canada should have the following characteristics:

- Begin the initial steps toward implementation now;
- Ensure that safety for people and the environment is the primary consideration, including security and safeguards performance;
- Ensure implementation in as fair a way as possible;
- Accommodate new learning;
- Provide for a staged approach that provides for ongoing reviews and adjustments to decisions;
- Provide opportunities for future generations to influence the implementation;
- Prepare future generations for their responsibilities;
- Monitor emerging research and technical developments in Canada and internationally, including opportunities to reduce the inherent hazard associated with used nuclear fuel;
- Communicate clearly the decision-making process and authorities;

- Ensure that the system of governance combined with the capacity to deliver is trustworthy, accountable and inclusive;
- Involve democratic and accountable institutions, accessible to citizens;
- Ensure that citizens are informed, and have a voice at each stage in the process;
- Engage and understand concerns of regions and communities that are affected directly and indirectly;
- Build a good understanding of potential risks and the means to manage them, including those related to transportation;
- Include a "community commitments" plan that would include monitoring, economic benefits and property value protection agreements for any host community. This should be established before beginning siting of any facility;
- Develop contingency plans including those for emergencies. In addition to ensuring that all communities have trained personnel, ensure equipment and financial resources to support all emergency response in the host community and along transportation routes;
- Provide surety that sufficient funds will be secured, protected and available to fund the long-term management approach selected by government;
- Ensure that the amount of money spent is commensurate with the risk this material poses vis-à-vis other problems our society needs to address;
- Develop a monitoring program, which encompasses quality control and quality assurance standards in collaboration with impacted communities; and
- Be sensitive to the broader and dynamic policy context.

4.3 / Dialogue 3 – Choosing a Way Forward

After listening to Canadians about the strengths and limitations of the three options, and hearing interest in the notion of a fourth option which combines the strengths of each of the three options, the NWMO developed the Adaptive Phased Management approach and launched a dialogue with Canadians about its appropriateness.

With the release of the *Draft Study Report*, the NWMO outlined its intention to recommend Adaptive Phased Management as the preferred approach to the Government of Canada. In the three months of dialogue which followed, and through a variety of dialogue initiatives, people told the NWMO that the Adaptive Phased Management approach is a reasonable and appropriate approach for Canada. However, there are two elements of the approach which were the most questioned: the provision for shallow centralized storage as an option on the path to a deep repository; and, the extended time period of implementation.

As identified at the beginning of this chapter, many participants continued to voice their strong belief that any recommendation about long-term management approaches must be developed in the context of a discussion of the future of nuclear energy. Similarly, we were urged to turn to history to draw lessons from Canada's experience in developing the full nuclear fuel cycle.

The discussion which follows draws from the summary of dialogue initiatives prepared by the independent consulting organizations which conducted them on behalf of the NWMO. The discussion also draws upon the large number of meetings and dialogue sessions designed and implemented by Aboriginal organizations as part of the study. These reports can be viewed in their entirety at www.nwmo.ca/dialogue reports.

Overall Appropriateness of Adaptive Phased Management Approach

Overall, the Canadians who engaged in our dialogues considered the Adaptive Phased Management approach to be appropriate and reasonable for Canada.

The approach contains a number of design elements that provide people with the comfort they need to accept Adaptive Phased Management as an appropriate approach. First, the approach represents action toward a solution. For most participants, it is not appropriate to continue to stockpile used fuel with no long-term solution and there is a widespread desire to see action now. Additional design elements which provide comfort include:

- The approach can take advantage of future scientific advancements (impacting the treatment of the waste and, to a lesser extent, its method of storage);
- The waste will be monitored;
- The waste will continue to be retrievable long into the future;
- The waste will be centrally located and isolated from contact with people and the environment; and
- The lack of certainty and "guaranteed" safety of many design elements are balanced by flexibility, interim decision making, and ongoing public involvement.

A minority of those who participated in dialogues, and many Aboriginal peoples, disagreed with the nature of the NWMO recommendation, arguing in support of continued surface storage at nuclear reactor sites or centralized storage, either above or below ground. For the most part these individuals prefer further interim measures pending a cessation of nuclear power or at least a debate on the future of nuclear energy. As well, a small number of participants noted that they did not see a material difference between the NWMO's draft recommendation of Adaptive Phased Management and the Deep Geological Disposal in the Canadian Shield option.

We were urged by some to portray the recommendation not as a solution, but rather as the best way to move ahead, given our current knowledge.

Appropriateness of Individual Elements of Adaptive Phased Management Approach

In order to understand the strengths and limitations of the Adaptive Phased Management approach, Canadians were asked to comment on individual elements of the approach. The discussion which follows summarizes what we heard about: the foundation principles on which the Adaptive Phased Management approach is built; the individual process elements associated with the approach; and, the technical elements fundamental to the approach.

Foundation Principles

The Canadians who engaged in our dialogue told us the foundation principles of the approach are appropriate. In these principles, the NWMO is seen to have reflected the common ground of Canadians. (See Table 4-2.)

As an illustration of the perceived appropriateness of the principles, in a nation-wide survey of 2600 Canadians an overwhelming majority agreed that the principles the NWMO has used as the basis from which to build the Adaptive Phased Management approach are appropriate. Nine in ten or more agreed:

- First and foremost the management approach should keep the waste safe and secure.
- The approach should be built on the best technical and scientific knowledge and expertise available in Canada and around the world.
- The approach should ensure that the companies who created the waste have set aside enough funds to pay the costs of managing the waste.
- The approach should be fair to future generations, as well as distribute costs, benefits and responsibilities fairly across communities and regions.

- The approach should be responsive to the values and objectives that are important to citizens.

Process Elements

The Adaptive Phased Management approach contains process elements fundamental to many dialogue participants' belief that the approach is appropriate and reasonable for Canada. While many suggested they lack the information and expertise to assess whether the technical elements are sufficient to provide long-term safe storage, they were reassured of the adequacy of the overall approach on the basis of several of its process elements. Continuous learning, flexibility, and the ability to monitor and retrieve the waste tend to be embraced as essential design elements in order that safety be protected.

Adaptive and/or Flexible

Almost universal among the participants in our 24 focus groups was their strong faith in future science to discover a better way to manage the used fuel than disposing of it underground. Many participants even suspected that the NWMO may never be required to implement Phase 3 of the Adaptive Phased Management approach. The fact that the approach allows for continuous learning, or keeping up to date with the latest technologies, and adaptation long into the future was a very strongly supported design element.

In the six dialogue workshops, each typically lasting one full day and an evening, most participants identified adaptability and/or flexibility as a strong process element. Many interpreted flexibility as a sign of prudence, caution and evidence that the NWMO was not putting all its eggs in one basket, but was prepared to continue to look for and integrate improvements while reacting to the unexpected. Flexibility is a feature that helps them have confidence in the approach. Many of the reports from dialogues among Aboriginal peoples also suggest that an approach which attempts to build in, at a fundamental level, flexibility and adaptability is more appropriate than an approach which does not.

However, there was also a significant number of participants in these dialogue workshops for whom "flexibility" was an indication of indeci-

Table 4-2 Agreement with Foundation Principles for the Management Approach

FOUNDATION PRINCIPLES	% who agree with the statement
Should be safe and secure to protect people and the environment	98
Must take advantage of the best technical and scientific knowledge and expertise available in Canada and around the world	97
Must be fair to future generations	97
Must be responsive to the values and objectives that are important to citizens	96
Must ensure that the companies who created the waste have set aside enough funds to pay the costs of managing the waste	96
Must be fair in how it distributes costs, benefits and responsibilities to different regions and communities	90

Question: The NWMO adopted several principles to guide the recommended option for the long term management of used nuclear fuel waste, please tell me whether you strongly agree, agree, disagree or strongly disagree with each of these principles. Table shows percent who 'strongly agree' or 'agree'. From a telephone survey of 2600 Canadians. (Veraxis July 2005)

sion, the potential for delay and a license for future decision makers to allow for incomplete implementation. These individuals wanted to be assured that flexibility would be accompanied with clear timelines to see the project through. This was especially true for those cynical of government and institutions.

When asked, as part of our nation-wide survey, how important this element would be to any appropriate approach for Canada, nine in ten or more said it is important, and therefore appropriate:

- 92 percent said it is important that the approach be 'flexible enough to adapt to new learning, and new developments in science and technology', assigning a score of six to nine on a nine point scale of importance;
- 90 percent said it is important that the approach be 'flexible enough to respond to the needs and concerns of society as these may change over time', assigning a score of six to nine on a nine point scale of importance.

Phased Implementation

A large majority of participants in all the dialogues expressed general comfort with the fact that the proposed approach is to be implemented in a phased manner, citing the view that it is both pragmatic and appropriate to take decisions in a staged, adaptive manner. Some participants embraced the phased character as a sign of clear milestones and evidence that a deliberate schedule would be followed. Participants also identified that each phase ends with clear decision points, leaving future generations with appropriate choices of how and when to proceed. Participants suggested phased decision-making has the following positive attributes:

- Provides opportunities for continuous learning from the experiences of other countries, leading to adjustments in design details;
- Provides opportunities for future generations to be proactively engaged in the management of the used nuclear fuel;
- Allows for the emergence of new technologies and approaches that might make geological containment and isolation unnecessary;
- Provides time for development and implementation of appropriate regulatory regimes and governance structures;
- Allows for decisions to move as quickly or as slowly as necessary; and
- Provides time for capacity building and informed decision-making among youth, potential host communities, and involved others and avoids predetermined outcomes that might undermine community support.

Participants supporting this key aspect often attached a proviso that phased decision-making and adaptive management not lead to a protracted implementation process that risks not being completed. They suggested that delays in implementation could have serious negative consequences, including:

- Risk that project intent is lost or changed, or the project itself is shelved entirely at a future date;
- Risk that existing reactor sites become *de facto* permanent storage sites;
- Risk that the interim shallow underground storage facility at the central site becomes the *de facto* permanent storage facility, rather than the deep repository;
- Loss of existing technical expertise on used fuel management;
- Increased risk of cost overruns; and
- Increased risk of political or environmental crises.

In order to minimize the risk of these consequences, participants suggested the NWMO undertake to:

- Place greater focus and emphasis on identifying activities that will need to take place during the first decade of implementation, and begin implementation as soon as possible;
- Identify and outline the short-term, discrete decision points (e.g. what they are, what must be decided, when, by whom, with what implications)
- Design decision points to coincide with the electoral cycle;
- Recommend dates/upper time limits by which key milestones must be met; and
- Bring youth – the future generations – into the decision-making process.

A small minority of participants in these dialogues were opposed to a phased implementation approach, arguing that the deep repository technology is well in hand and preferring fixed milestones for implementation.

In our nation-wide survey, eight in ten or more suggested it is important for the approach to be implemented in a phased manner:

- 84 percent said it is important that the approach 'include phased decision-making', with a score of six to nine on a nine point scale of importance.

In short, although a phased approach is considered appropriate by most participants in our dialogue, it is apparent that people want reassurance that implementation of this type of process will not lead to disorganization, stalemate and an inability to carry through to completion. Transparency and accountability related to implementation, participants told us, are also areas for which reassurance and confidence need to be established.

An Extended Timeframe for Implementation

Most participants told us they consider the idea of an extended timeframe for implementation to be appropriate. However, there was much discussion in the dialogues about just how long this timeframe ought to be and how to ensure that momentum can be maintained through to full implementation.

An extended timeline for implementation is seen as a signal that a cautious and considered approach to the management of used nuclear fuel is being taken, with sufficient time for new learning and technologies. An extended timeline is "pragmatic" in that it recognizes the many issues that will need to be addressed, and the difficulty in pre-judging the time needed to achieve informed consent by a willing host community and/or Aboriginal peoples.

Reports from Aboriginal dialogues suggest that design features such as flexibility, continuous learning adaptability and implementation over an extended timeframe, as fundamental drivers of the waste management approach, are preferred over an approach which does not embrace these considerations as its platform for action.

The presentation of the Adaptive Phased Management approach in the *Draft Study Report* suggested that implementation may extend over a period of as much as 300 years. For most participants, however, a timeframe of 300 years is difficult to comprehend. In the same way that many had trouble imagining a problem that would last thousands of years, many had trouble imagining a solution that would take 300 years to implement. Few who participated in the dialogues picked up on the fact that the deep repository would be fully implemented by year 90, with the remaining years in the timeline filled by ongoing monitoring and accessibility. However, for some even 90 years was too long a period for implementation of the deep geological repository.

Many felt that a less protracted timeline should be possible. This included those who said that a site could be chosen and built more quickly, as well as those who recommended doing away with the optional step of centralized shallow storage. These individuals tended to be among those who are convinced of the safety and security of the deep geological repository

and are ready to proceed with it. The desire of some for a condensed timeline also reflects a concern that a long timeline is a license for inaction (by government, the industry) and further delay (by interest groups and the industry) and risks abandonment of the project by a future society. Over the course of the dialogue participants suggested there are risks in not moving as quickly as possible, including:

- Technical knowledge and expertise necessary to implement the management approach might be lost;
- Financial risks will be greater as the long-term sustainability of existing nuclear utilities is uncertain;
- Political interest and will to act may be more difficult to incite and sustain over the longer term;
- Existing storage facilities may become full, leaving no place to store the used fuel, and were never designed to safely secure the used fuel over an extended period; and
- Institutional and social capacities could decline rather than expand over even the short to medium term, putting the safety and security of the public and the environment at risk.

Participants told the NWMO it will be important to put mechanisms in place to minimize and/or address these risks.

Technical Elements

Participants in the dialogues were asked to comment on the appropriateness of each of the technical elements of the Adaptive Phased Management approach.

The Ultimate Goal of a Deep Geological Repository

The vast majority of participants in the dialogues embraced the suggestion that used nuclear fuel should be dealt with in one single location. There were some who suggested that greater security would be achievable if the waste was stored in multiple locations, but these participants were a small minority.

The vast majority of participants in the dialogues felt that the deep geological repository was an appropriate end goal to work toward. Their belief that this is a reasonable end point was qualified by strong feeling that this solution is not ideal (as compared to a neutralization or recycling solution). It was also qualified by the need for an assurance that the deep repository would only be arrived at through the kind of process identified by the NWMO as part of the Adaptive Phased Management approach. Particularly important are assurances that the waste will be monitored and retrievable, and that continuous learning will be applied on an ongoing basis.

People who participated in the dialogue workshops suggested that a deep geological repository is appropriate as an end goal on the following basis:

- Is known to be technically sound, as concluded by AECL and the Seaborn Panel;
- Provides for institutional control through centralized storage;
- Allows for protection of human populations and the environment by providing storage at depth, multiple barriers, and chemical isolation;
- Is the most cost effective option;
- Provides the greatest levels of security in both the medium and very long time periods;

- Is technically practicable because Canada has large areas of suitable geological formations; and

- Best addresses the public's primary concerns related to safety and security of present and future generations.

Some participants who supported this aspect of the recommendation stressed their support was contingent on finding a technically appropriate site within a willing host community. Others said they supported the recommendation insofar as it addressed only the used nuclear fuel arising from existing Canadian nuclear reactors.

Support for this aspect of the recommendation was not universal. A minority of participants and many Aboriginal peoples suggested they do not accept deep geological storage, in part, because they object to the use of nuclear power. These individuals fear that any long-term storage solution will make it easier for proponents of nuclear power to justify an ongoing nuclear power generation program. However, not all opponents of nuclear power took this view. Many individuals who would like to see an end to nuclear power generation also found the Adaptive Phased Management approach to be reasonable and appropriate for the waste that currently exists.

Some also expressed concern that "out of sight" will mean "out of mind". These individuals tended to be the most optimistic that science will achieve a neutralization or recycling solution, but feared that the necessary effort to achieve that solution will not be made when a storage option exists. Some also expressed concern that "out of sight" could result in less rigorous application of safety and monitoring of the waste. Finally some participants, including many Aboriginal peoples, explained their opposition to this element of the approach as an objection to placing this very hazardous material in the ground, Mother Earth.

In short, for most participants a deep geological repository is an appropriate end state for the used nuclear fuel, with important provisos including implementation of many of the process elements discussed earlier.

Transportation to a Central Location

Transportation to the central location required by this approach is seen as the technical element which has the potential to affect the greatest number of people. Like all other elements of the recommended approach, participants sought assurances that public safety will be protected. Participants also suggested that transparency will be particularly important on this issue, as will assurances that the combination of technical and precautionary elements will provide the absolute highest achievable standard of safety.

A very small minority of participants expressed a very high level of concern about transportation of used nuclear fuel to the point of favouring surface storage at existing reactor sites as a means of avoiding or limiting the transportation of used nuclear fuel.

The Rationale for the Provision for Shallow Rock Cavern Storage

Of all the technical elements of the Adaptive Phased Management approach, the provision for centralized shallow rock cavern storage as an optional stepping stone on the path to implementation of a deep geological repository received the greatest questioning. Many questioned its purpose and necessity. Participants wondered whether this facility was necessary citing reasons of cost, the potential for time delay and the fear that this may become the (insufficient) final option in an effort to cut corners at a later stage. Among other comments expressed were a concern that the facility is not deep enough to be safe and secure, and a concern that the additional handling of the fuel which this step would involve would unduly increase risk of contamination and accident.

In the focus groups, those who questioned the value of provision for this facility tended to be the same participants who took issue with the inclusion of flexibility in implementation. They also tended to be the individuals who thought the siting process and initial licensing (for construction) could be accelerated and were more prepared to accept the deep geological disposal option (Option 1) as an appropriate management approach. Some others felt that the "go slow" approach which provision for this facility would allow was appropriate and added

to their sense of comfort with the NWMO's proposed recommendation. These tended to be the individuals for whom the process elements of flexibility in the manner of implementation, continuous learning and adaptability were especially important. For them, the provision for the optional shallow storage facility provides additional evidence of careful decision making, monitoring of the waste and containment facilities and a prolonged period in which to seek better solutions.

Participants in the dialogue workshops also offered very mixed views about this aspect. Many called on the NWMO to clarify the rationale and justification for this provision. Others commented that the provision for the optional shallow underground storage was prudent since it would allow more time for citizens to understand the issues and develop confidence in the approach before proceeding, and more time to explore new waste management technologies and/or uses for the fuel. Participants who supported this aspect of the recommendation did so by noting:

- Early centralization will increase security over the used nuclear fuel;
- As an activity undertaken in parallel with the development of the deep geological repository, it will minimize the time required until all the material is located safely in the deep geological repository;
- It will allow for demonstration of the required technologies and raise public confidence;
- It will assist in site identification activities as fewer sites will have appropriate formations for both shallow storage as well as permanent, deep geological isolation;
- It will allow for more timely decommissioning and clean up should decisions be taken not to refurbish existing nuclear reactor faculties;
- It will provide citizens with a familiar and comfortable analogue to the current approach to the management of household wastes (i.e. collection, centralization, and final disposal); and
- It provides a relatively low-cost mechanism for building capacities and confidence and improving decision-making with respect to ultimate deep geological containment and isolation.

A minority of participants objected to the provision outright, arguing that centralized shallow storage was unnecessary and could work against the NWMO's long-term goals with respect to security and environmental integrity in managing the used nuclear fuel:

- Used nuclear fuel is currently being safely stored at existing reactor sites;
- The technological know-how already exists to ensure confidence in a deep geological repository approach, while a comparable body of knowledge on shallow storage would need to be developed at the expense of time and additional financial resources;
- This approach may maximize rather than minimize used fuel handling and related public and occupational exposures; and
- Concern that this could lead to the worst possible outcome – used nuclear fuel abandoned in unsuitable containers, in unsuitable formations, out of view, and forgotten about by future generations.

The Rationale for Alternate Geological Media

A large minority of participants in the dialogue workshops specifically questioned the NWMO's proposal that geological media other than the rock of the Canadian Shield, in particular forms of sedimentary rock, may be appropriate for the deep repository. A few raised questions and concerns with respect to the areas of Canada the NWMO has identified as geologically appropriate. Some participants said that

Ordovician sedimentary rock should not be considered because insufficient research has been conducted, particularly in comparison with research already completed on granite-type formations such as the Canadian Shield.

Retrievability of the Waste

Technical design features that allow the waste to be retrieved were important to almost all participants and a fundamental source of assurance that the waste would be appropriately handled through the Adaptive Phased Management approach. Most participants supported this aspect of the recommendation noting that:

- The used fuel must be accessible if monitoring indicates that problems exist;
- The used fuel is a potential energy resource for future generations; and
- Future technologies could emerge to better manage the used fuel.

A small minority of participants indicated they did not support the provision for retrievability, arguing that:

- A lasting solution would put the used fuel effectively out of reach for all time;
- Used fuel should not be retrieved for reuse. Retrieval for the purposes of reprocessing, partitioning and transmutation will increase rather than decrease the generation of hazardous radioactive materials and the risk to public and workers;
- This provision increases costs unnecessarily. It makes the deep geological repository more expensive and more technically difficult to construct and operate; and
- Controlling access to the repository would be more difficult and an ongoing concern.

Monitoring

Participants' support for continuous monitoring of the used fuel over extended periods of time was nearly universal. Given the importance participants placed on maintaining the ability to monitor the used fuel over time, several commented that the NWMO needs to elaborate on the nature and extent of monitoring which it envisions in the implementation of the Adaptive Phased Management approach. Participants said monitoring is an important aspect of the recommendation for the following reasons:

- Is essential to ensure the long-term protection of human and ecological health;
- Will provide the public with assurances that the facility continues to be safe;
- Will allow future generations to measure and assess their stewardship over the used nuclear fuel;
- Will allow for continuous learning and provide for well-informed decision-making; and
- Is a precondition to future retrieval of the material, regardless of the intended purpose.

A small minority of participants objected to long term monitoring, particularly if it were to be intrusive in nature. They argued that intrusive monitoring may detract from the integrity of the storage system and is, in fact, unnecessary given that breaches of containment are very unlikely.

Comment on Implementation Requirements of Adaptive Phased Management Approach

Participants in the dialogue generally identified five issues as important to appropriate implementation of Adaptive Phased Management or any management approach selected:

- Governance
- Citizen engagement
- Siting
- Research and intellectual capability
- Financing.

Many participants suggested there are interrelationships among issues of siting, governance and citizen engagement. They said that proper resolution of outstanding issues in these areas would be essential to building and maintaining trust and achieving successful outcomes as the process moves forward.

Governance

Many participants asked who would oversee implementation of the project and how Canadians would be assured that it was being done safely. In general, they expressed a desire to know how governance would be applied. There is concern about who has authority and who gets to make the decisions. They suggested these are critical questions which will need clear and compelling answers.

In this context, concern was expressed that the Government should not be left to manage the implementation. There were numerous suggestions that this work was too important to be subject to the risk that comes with changes in political leadership, or subject to the politics and fortunes of political parties. However, the same individuals often argued that ultimate accountability must lie with the government.

Similarly, it was clear that participants did not want implementation to be managed by the nuclear energy producers. There was concern that management by the producers would lead to a tendency to seek ways to cut costs to the detriment of safety. Some participants were also concerned that the nuclear energy producers could eventually be privatized, further weakening the extent to which implementation would be applied with the public's best interest in mind.

Governance of the NWMO and related decision-making processes were issues of major importance to many in the dialogue workshops. Participants suggested it is important to know what roles the following groups will play in decision making: citizens in potential host communities; local governments; Aboriginal peoples; cottage associations; business associations; communities on transportation routes; citizens of broader regional administrative bodies or districts; and citizens of the province under consideration. Many participants were critical of the current composition of the NWMO Board of Directors. Several noted that sound corporate governance principles include the need for independent directors.

Reports from Aboriginal dialogues include strong calls for Aboriginal participation in NWMO governance processes, as well as appropriate consultation as is due to them and outlined in the Constitution.

Several participants were concerned about decision-making processes at the federal and provincial levels following a government decision on an approach. They wanted reassurance action will in fact be taken.

Over the course of dialogue, participants identified a number of questions and considerations that they believe the NWMO will need to address in the future concerning governance and decision-making including:

- In practice, how will members of a potential host community express consent: through elected bodies or plebiscite?
- How can a community have a strong voice given the limited powers and jurisdiction of municipal governments as compared to the provincial and federal governments?
- What level of input, consent, or assurance should be given to adjacent communities and those along the transport route?
- How will conflicts between competing interests within and between communities be addressed?

- What type of community and intervener funding will be needed, including the hiring of independent experts?

- Will a contract or agreement be signed with the community or will special legislation be passed that would offer legal recourse to the host community and other affected communities?

In the electronic forum which was conducted following the release of the *Draft Study Report*, concern was also expressed about who would be responsible for impacts if there were transportation accidents or failure of containment at the central site.

Citizen Engagement

There was a widespread desire to maintain transparency and sustained citizen engagement and education throughout implementation in order to ensure proper accountability. These are considered crucial to build public confidence and support in implementing the NWMO recommendation, and to allow informed decision-making by communities. Citizen engagement is seen by many as a check and balance to ensure that the waste is not "out of mind" and that appropriate decisions are made throughout. It was felt that rigorous timelines and proper safety are more likely to be achieved when citizens remain engaged.

Many people encouraged the NWMO to, as much as possible, explicitly lay out how it intends to continue the process it has begun with its study through to the implementation of the management approach itself.

Siting

There was general agreement that a willing community should be sought to host the waste with the caveat that any willing host community must also be proven to be technically appropriate. There was a universal expectation that any region or community that accepts the waste will receive incentives in the form of jobs, and financial compensation, but that finding a willing host would be very challenging. There was some belief that an area could be found that is sufficiently remote to not be in anyone's community. Participants in Aboriginal dialogues suggested, with their traditional territories in mind, there is no such place.

Among key issues of concern to participants in the dialogue workshops in particular were how the boundaries of "willing host communities" will be defined, and how the "willingness" of the community would be measured. Participants widely called on the NWMO to provide sufficient time and resources to build the capacities of potential host communities to make informed decisions.

Participants stressed the importance of initiating siting related activities without delay, following government decision on an approach. One of the first tasks recommended for NWMO attention was the development of a clear, transparent, and agreed set of criteria for assessing the suitability of potential sites. Participants advised the NWMO to look carefully at lessons learned from past siting exercises involving hazardous waste and low-level nuclear waste.

Many participants expressed concern that the NWMO will be unable to identify a willing host community. A few suggested, in part for this reason, that the waste stay at the existing reactor sites and/or that the NWMO explore creating a new purpose-built (and therefore willing) community around a suitable geological location on Crown lands.

Reports from Aboriginal dialogues underline the high level of concern which many Aboriginal peoples have that their territory and traditional way of life will be impacted by any site that is selected, and that this impact will not be appropriately recognized, factored in to decision-making and addressed.

Research and Intellectual Capability

There was some feeling in the focus groups that it is not enough to be responsive to advances in technology, but that implementation should also include ongoing funding of advanced research to seek a recycling, reuse or neutralization solution that would make deep geological storage unnecessary. These people wanted assurance that, even though the Adaptive Phased Management approach represents responsible action today, a search for a better solution will continue to be a priority.

Participants at four of the six Dialogue workshops placed particular importance on issues related to research and intellectual capacity. They argued that implementation of the NWMO recommendation will require knowledge and expertise be available over a very extended period, and therefore a significant and ongoing investment in both the natural and social sciences. Participants also noted that the institutional memory and capacities of the nuclear workforce are eroding, many knowledgeable individuals have left the industry and/or are about to retire and there are few new entrants. They said it will be important for the NWMO to outline an appropriate research and intellectual capability development program to support the proposed recommendation.

Financing

Dialogue participants were concerned about whether sufficient funds can be set aside and/or preserved to fully fund implementation of the approach. They supported the NWMO's approach to making conservative cost estimates, so that availability of funds will not unduly influence future choices. And they acknowledged the financial surety provisions established through the *NFWA* but noted that much needs to be done for the public to have confidence that sufficient resources will be available for full implementation of the approach.

Participants were especially concerned about the availability of sufficient financing to allow for complete implementation should the nuclear utilities not be sustainable over the longer term, should a future government decide to use the monies in the trust funds for other purposes, or should the funds set aside not fully cover the implementation costs. A number of Aboriginal participants also suggested that there is inadequate proof of financal surety over the long term and expressed doubt in the comprehensiveness of the cost estimates. Participants also expressed concern that sufficient funds be set aside to include activities such as research and development, citizen dialogue and engagement, host community capacity building in support of informed consent, and mitigation for host communities.

Some participants were of the view that the Adaptive Phased Management approach and phased decision-making, accompanied with the need to build capacities for long-term monitoring and stewardship by a willing host community, make it particularly difficult to project future financing needs.

Additional Comment Concerning the Importation of Waste

Finally, throughout the dialogues participants regularly made the point that they did not want to see Canada become the 'dumping ground' for nuclear waste from other countries. They wanted some assurance that 'just because Canada develops a very good solution, it will not mean that our governments would be willing to provide a North American or global repository'.

Summary Findings from Nationwide Telephone Survey

In the nation-wide telephone survey of 2,600 Canadians conducted by the NWMO after the release of the *Draft Study Report*, we invited comment on the nature of the draft recommendation. Respondents were read a list of fourteen elements of the Adaptive Phased Management approach and asked how important they considered each to be. Responses, which are summarized in Table 4-3 below, indicate that each of the elements of the Adaptive Phased Management approach is considered important. The research indicates that elements which involve meeting scientific and technical criteria and taking advantage of technological innovation are considered of primary importance. For instance, 95% said that it is important that any location chosen for the centralized facility must meet scientific and technical criteria, and 93% said that it is important that the approach be able to adapt to new learnings in science and technology. Similarly, 94% said that it is important the approach include monitoring of the used fuel over an extended period of time.

Community input and meeting social requirements are also high priorities. Ninety-one percent of respondents said that it is important that the approach be implemented in collaboration with the community in which the used fuel management facility will be located. Ninety percent said it is important that the site selected meet social and ethical requirements. On-going public participation is key as 88% said that the process should seek to site the facility only in willing communities and 87% said that ongoing public involvement is important.

While still considered of high importance by a large majority of respondents, the elements that ranked comparatively lower than others are those that specify a long time frame for disposal and continued access for retrieval.

There are no significant differences between residents in communities currently storing used nuclear fuel and residents in the rest of Canada. Support for these management attributes is high across both populations for all measures.

The research indicates there are few differences among population sub-groups on the potential benefits of, or concerns about, the proposed approach and on the importance placed on the fourteen management approach elements.

In past public attitude research on the topic of the management of used nuclear fuel, differences have been noted in opinion between men and women, between Northern and Southern Ontario residents, and between supporters and opponents of nuclear energy. In this research, slight differences were also noted. Women tend to attribute significantly higher importance than men to the process of decision making and to the management approach responding to social, ethical and community concerns. For instance, women are significantly more likely than men to say the following are important elements:

- Phased decision making;
- Having a long time frame for implementation;
- Involving the public;
- Being flexible enough to respond to the needs and concerns of society as they may change over time;
- Providing future generations with choice in how the approach is implemented;
- Being willing to locate the facility in a willing community;
- Focusing the site selection process on the provinces that are directly involved with nuclear waste/power;
- Requiring the site to meet social and ethical criteria;
- Requiring the site to collaborate with the site community on major decisions;
- Ensuring the repository contributes in a positive way to the community in which it is located.

Table 4-3 Summary Rating of the Importance of Elements of the Approach

REACTION TO CHARACTERISTICS OR ATTRIBUTES OF THE APPROACH	% who consider the characteristic important
Requires the site to meet scientific and technical criteria	95
Includes monitoring of the used fuel over an extended period	94
Flexible enough to adapt to new learning, and new developments in science and technology	92
Requires decisions about the site to be made in collaboration with the community where the repository is sited	91
Requires the site to meet social and ethical requirements	90
Provides future generations with genuine choice in how the approach is implemented	90
Flexible enough to respond to the needs and concerns of society as these may change over time	90
Will seek to locate the facility in a community that is willing to accept it	88
Ensures the operation of the repository contributes in a positive way to the community in which it is located	87
Involves the public at each step	87
Focuses the site location process on the provinces that are directly involved with nuclear energy and nuclear fuel – Saskatchewan, Ontario, Québec and New Brunswick	85
Includes phased decision making	84
Includes opportunity to retrieve the used fuel over an extended period	74
Has a long time-frame for implementation	73

Question: Now I would like to learn your reaction to different characteristics or attributes of the approach. On a scale of one to nine where one means not at all important and nine means extremely important, how important is it to you that this approach...
Table shows percent who rate the characteristic 6, 7, 8, or 9 on a 9 point importance scale.
From a telephone survey of 2600 Canadians. (Veraxis July 2005)

However, it is not the case that women dismiss scientific and technical considerations at the expense of social ones. Women and men both tend to place high importance on the following elements:

- Being flexible enough to adapt to new learning, and new developments in science and technology;
- Including monitoring of the used fuel over an extended period of time;
- Including the opportunity to retrieve the used fuel over an extended period of time;
- Requiring the site to meet scientific and technical criteria.

Focusing on Ontario residents, the province in which most of the used nuclear fuel is created and currently stored, residents of Northern Ontario appear to be significantly less supportive of things nuclear than are residents of Southern Ontario. They are also more likely to believe, incorrectly, that the task of the NWMO is to situate the waste in Northern Ontario. Nonetheless they tend to place importance on similar elements of the Adaptive Phased Management approach as do Southern Ontario residents.

There are also small differences in perspective associated with attitudes to nuclear energy. Those who are more opposed to nuclear energy generation place a greater value on involving the public at each step, on requiring that the waste management process meets social and ethical criteria and on requiring decisions about where to locate the site be made in collaboration with the community where the repository is located.

Among the other question areas included in the survey, respondents were asked to react to a number of statements which have been made by participants in earlier NWMO dialogues. The research indicates:

- Eighty percent of Canadians agree that 'since our generation was the one which caused the nuclear waste, we should be the ones to decide on and implement an approach to manage it'.
- Believing that we should act now to decide on management strategies is not incompatible with the belief that 'since nuclear waste remains hazardous for a long time, we should let future generations decide how they wish to deal with it'. Fifty-seven percent of Canadians agree that we should let future generations decide.
- Half of those who believe we should begin implementation now also believe that future generations should have the chance to decide how they wish to deal with it. Roughly speaking, more than 40% of Canadians believe both views. Twenty-five percent think we should be the ones to decide on and implement an approach and not allow future generations a decision role.
- Canadians are relatively optimistic about the ability of science and technology into the future. Just over half of Canadians (55%) believe that 'scientific research will soon produce a technology that will render nuclear waste safe by eliminating its radioactivity and allowing it to become part of the natural environment again'. Forty percent disagree.
- Canadians feel relatively confident in the long-term ability of our society to manage nuclear waste. Just over one-third of Canadians (35%) believe 'that future societies will be less able to deal with this waste than we are today'. Conversely, a strong majority of Canadians (62%) have faith in the ability of future societies.

Perspectives from Aboriginal Peoples

Reaction voiced in the Aboriginal dialogues to the NWMO's Adaptive Phased Management approach varied from cautious support by some, hesitation to make comment by others, and opposition from yet others.

Cautious Support with Caveats

The Inuit Tapiriit Kanatami (ITK), Métis National Council (MNC), the Ontario Métis Aboriginal Association, La Ronge Community Workshop, Northern Saskatchewan, and the Western Indian Treaty Alliance all signalled qualified support for an Adaptive Phased Approach. For the ITK, the appeal of the approach comes from the long-term phasing, the time provided for further discussion while the waste is held at reactor site locations, and an overall focus that is away from Inuit lands. They are not committed to eventual deep isolation and containment. For the MNC, it "best reflects the Métis world view" and concern for human health, environmental security, security at the site, responsibility for the site, transportation, and cost efficiency of concept. However, they strongly emphasized that implementation should be results driven, not timeline driven. Through the OMAA dialogue and prior to knowledge of the proposed fourth option, a majority indicated support for continued reactor site storage followed by centralized storage with deep burial last. With review of Adaptive Phased Management, OMAA was supportive. They noted that it "allows for scientific progress, easy retrieval, and highlights environmental issues." Further, they found that it "seems to take the process along a path that Traditional Knowledge would approve." In the La Ronge Community Workshop which included Métis, First Nations, municipal, and mining company participants, general support was reported. The Western Indian Treaty Alliance argued strongly for a simple approach that would move to deep isolation and containment as soon as possible.

Within this envelope of cautious support, the majority argue for a limit to the production of nuclear waste and a shift to other forms of energy.

No Comment

A number of Aboriginal organizations did not feel they were in a position to make a proper evaluation of the recommended approach. These included the Assembly of First Nations, Atlantic Policy Conference of First Nation Chiefs, Union of New Brunswick Indians, and Federation of Saskatchewan Indian Nations. Some of these also argued that full "consultation" had not yet taken place and therefore they were unwilling to offer an assessment of Adaptive Phased Management.

Opposition

Two organizations voiced opposition to Adaptive Phased Management, the Native Women's Association of Canada (NWAC) and the Congress of Aboriginal Peoples (CAP). NWAC's opposition is based on 1) lack of awareness on behalf of Aboriginal peoples in the communities that may be directly impacted, 2) the risks outweigh benefits for a remote community, 3) transportation poses unknown risks, 4) incorporation of Traditional Knowledge is as yet unknown, 5) waste importation may occur, 6) there is no assurance that the amount of waste will ever be limited, 7) there is no discussion of pursuing alternative energy options, and NWMO is "suspect" because it is driven by the waste producers themselves. In the case of CAP, they see the recommendation as a simple reworking of the AECL deep disposal concept which they find not proven from a safety perspective and unacceptable.

Additional reaction precipitated by the NWMO's study was voiced in the Aboriginal dialogues in passage of a number of resolutions. The Inuit Tapiriit Kanatami passed a resolution, in June 2004, in opposition "to the storage/disposal and transport of nuclear fuel waste in areas adjacent to Inuit owned lands, on Inuit co-managed lands and land governed by Inuit Land Claim Agreements". The Nishnawbe Aski Nation, in July 2005, passed a resolution "that the Nishnawbe Aski Nation Chiefs in Assembly declare the lands and communities of the Nishnawbe Aski Nation a 'Nuclear Waste Free Zone' ".

A report summarizing the NWMO's Aboriginal dialogues is found on our website at www.nwmo.ca/aboriginaldialogues. The report reviews the overall goals and objectives,

the evolving context and role of the Aboriginal community in this country, the 15 national and regional/local organizations that participated, the observations that they offered, and the lessons learned as input for continued dialogue in the future.

Perspectives from Communities Currently Storing Used Nuclear Fuel

The NWMO received several submissions on the *Draft Study Report* from organizations and elected representatives of communities where used nuclear fuel is currently stored including the Canadian Association of Nuclear Host Communities. Some of these submissions were supported by formal council resolutions. General agreement was expressed with the assessment undertaken by the NWMO that none of the three original management options identified in the *NFWA* completely achieves the objectives set out by the NWMO or as expressed by Canadians. General agreement was also expressed that Adaptive Phased Management, if implemented properly and in a timely manner, will provide a technically effective, flexible and balanced approach for the long-term management of Canada's used nuclear fuel. However, some concerns were expressed about the way in which the approach might be implemented.

These concerns focus on three areas: the extended length of time the used nuclear fuel will remain in these communities before being moved to a centralized facility; the need to clarify the role these communities will play in implementation decision-making; and, the manner in which potential impacts on these communities associated with the implementation of the approach will be addressed:

- There is a concern that based on the expected timetable for implementation of the Adaptive Phased Management approach, used nuclear fuel may be kept at these sites for as long as 90 years if a decision were made not to proceed with a centralized shallow storage facility before implementing the deep repository. This would have the used fuel remain at these sites for a much longer period than originally expected.

- There is a concern that these communities will not be appropriately recognized nor compensated for the extended storage of the used fuel in their community involved in the Adaptive Phased Management approach. Compensation is expected based on potential impacts and risks in implementing the recommended approach, including costs associated with emergency preparedness, security measures, municipal infrastructure (roads, water, sewer, etc.) and community impacts.

- There is a concern that adaptability and phased decision-making may lead to delay in removing the used fuel from the communities. There is a concern that difficulties in finding a willing host community in a timely manner, and/or opposition to transportation may derail implementation indefinitely. In the worst case, there is concern that delayed or deferred decision-making could result in storage at existing reactor sites as the default long-term management approach.

- There is a concern that existing reactor sites may not have the capacity to store current and future used nuclear fuel waste for the extended periods which may be involved with this approach.

Communities have, therefore, said it is important that:

- A detailed implementation schedule be developed with key milestones/ decision points clearly identified, and the Government of Canada, the waste owners and the NWMO should formally commit to adhering to this schedule. This is suggested as a means to ensure that the used nuclear fuel does not remain at the existing reactor sites for an indefinite period of time or that on-site storage becomes the management approach by default. The NWMO should identify and assess the factors that may delay or defer key milestones and decision points, as well as appropriate contingency plans and mitigation measures.

- These communities be afforded full opportunity and necessary resources to participate in implementation, including discussions concerning mitigation measures, and/or mechanisms for addressing socio-economic effects in the implementation of the approach.

- The NWMO confirm and document that the existing reactor sites have adequate storage capacity for current and future used fuel inventories over the extended period of storage required by the approach. The NWMO needs to assess the impact of any delays on the capacity for used nuclear fuel storage at existing reactor sites.

- More stringent monitoring practices be implemented at the interim storage facilities during this extended storage, especially as these facilities age.

- Transportation issues be studied and addressed in greater detail as planning and implementation work continues.

- Monitoring of international developments continue that may permit improvements in Canada's plans for used fuel management.

- The NWMO study acknowledges that the siting process is linked to a broader discussion of the future of nuclear energy.

Formal Resolutions from Other Communities and Organizations

Within the period of the NWMO's study, a number of other communities adopted formal resolutions focused on opposition to the transportation of nuclear waste near or through their community. These communities are: the City of Temiskaming Shores; and, the City of North Bay. These communities are also on record supporting "the creation of an independent commission involving the public and all levels of government (municipal, provincial and federal) to re-examine our nation's radioactive waste management options and report to each level of government, including a body of the federal Parliament, on its findings".

Among other communities of interest, Nuclear Waste Watch – a coalition of more than 30 environmental organizations – has indicated that it does not support proceeding with the Adaptive Phased Management Approach. Key among its reasons is the assertion that no commitment should be made to a long-term management approach before a commitment is made to the early phase-out of nuclear power.

4.4 / The NWMO's Observations

The question of what constitutes 'responsible action' in the long-term management of used nuclear fuel has been central to the complex and, at some times, impassioned discussion we have had with Canadians. We have heard participants in our dialogues propose values and objectives to guide our decision-making and serve as a platform for moving forward. As a true product of collaborative development, these values and objectives reflect the common ground of individuals and groups with many diverse perspectives on this issue. They suggest the terms and conditions of a collective journey to implement a long-term management approach for Canada which acknowledges both the areas in which we all agree and are prepared to proceed quickly and the areas in which greater confidence needs to be gained before, or over the course of, proceeding.

We have heard that people wish to proceed. In fact, they expect to immediately begin the process of implementing a long-term management approach for Canada. While some are very comfortable to move quickly to implement a final or definitive solution, we have heard from others they are only prepared to proceed with caution. These people would like the opportunity to learn more, understand better, and build greater confidence in decisions before they are taken, particularly if these decisions are difficult to reverse.

We believe that the evidence of common ground that has emerged from the dialogues provides the foundation for the Adaptive Phased Management approach to be taken. This approach has a clear direction and end in mind, which has built in to it flexibility to further explore the areas where citizens wish to gain greater confidence. At each point in the process, the safety of people and the environment needs to be demonstrated, and contingency plans put in place. A clear and appropriate decision-making process guides the journey, and strong and independent oversight will help ensure that we continue to progress towards our goal. It was this understanding, and the detailed guidance from dialogue participants as highlighted in this chapter, which formed the foundation for our recommended approach.

In the dialogues following the release of our *Draft Study Report* most dialogue participants, with the exception of those who feel no long-term approach is appropriate without first phasing out nuclear power, told us that overall the Adaptive Phased Management Approach is a reasonable and appropriate approach for Canada. However, we also heard that more information needs to be provided about elements of the approach, some important questions need to be answered, and some concerns about the approach addressed. In this final report, we attempt to respond to many of these requests, questions and concerns. We also lay out a process through which remaining questions and concerns will be collectively explored and addressed through implementation. The discussion of the Adaptive Phased Management approach in this report also incorporates the numerous suggestions and guidance for implementation provided through the dialogue.

Part Four
The Assessment

4

Chapter 5 / Technical Methods Considered in Our Study

Section 12(2) of the *Nuclear Fuel Waste Act* (*NFWA*) specifies three technical methods to be the basis of approaches considered by the NWMO. The *NFWA* also allows us to consider other management approaches.

5.1 / Our Initial Screening of the Options

For about four decades, various countries have been investigating many possible methods to manage used nuclear fuel and other long-lived highly radioactive wastes over the long term.

In our first discussion document, *Asking the Right Questions?*, we reviewed 14 different options that have been considered internationally in recent years. We categorized them in three ways:

- Methods requiring review as specified by the *NFWA*;
- Methods receiving international attention; and
- Methods of limited interest.

These options were subject to review by our Assessment Team and by Canadians who offered views and perspectives through technical workshops, formal comments and discussion in public dialogues. In the sections below we highlight our general findings concerning these three categories of methods for managing used nuclear fuel.

Methods Requiring Review

The *NFWA* requires that we study, at a minimum, management approaches based on the following individual technical methods:

- Deep geological disposal in the Canadian Shield;
- Storage at nuclear reactor sites; and
- Centralized storage, either above or below ground.

While we do not intend to dismiss future options and possibilities, it is clear that the three long-term management methods specified in the *NFWA* are of immediate interest to Canada. These three methods are also being assessed in detail and, in some cases, being implemented in other national radioactive waste management programs around the world.

Methods Receiving International Attention

We looked at the following methods currently receiving international attention:

- Reprocessing, partitioning and transmutation;
- Placement in deep boreholes; and
- The international used nuclear fuel repository concept.

These options were screened out of our comparative assessment for reasons outlined below. Our Assessment Team noted, however, that Canada may wish to maintain some interest in each of these options by undertaking research and/or tracking related international developments.

Reprocessing, Partitioning and Transmutation

Reprocessing is the application of chemical and physical processes to used nuclear fuel for the purpose of recovery and recycling of fissionable isotopes. Partitioning involves a further series of physical and chemical processes to separate various isotopes from used nuclear fuel for further conditioning, treatment or long-term management. Transmutation involves the transformation of radioactive isotopes from used nuclear fuel into non-radioactive or stable isotopes by bombarding the target isotopes with neutrons or other particles.

Reprocessing used nuclear fuel and partitioning and transmutation technologies were considered in light of ongoing international work to understand their potential for managing used nuclear fuel over the long term. Our research into these areas was further motivated by the high level of interest registered by Canadians

in knowing more about the possibility of "recycling" or "reusing" used fuel, practices that we have come to expect in many other areas of our life. Intrigued by international work on transmutation as a potential for reducing the long-term hazard of used nuclear fuel, Canadians expressed a desire for us to report back on our findings and determinations concerning these options.

It is unlikely that Canada would need to implement reprocessing in the near future. Canada is a leader in uranium mining and our uranium reserves are far from being depleted. The cost of reprocessing used nuclear fuel is high and is not about to be exceeded in the near future by the cost of mined natural uranium.

While some countries including the United Kingdom, France, Russia and Japan continue to reprocess used fuel, other countries such as the United States, Germany and Switzerland have issued a ban or moratorium on reprocessing.

For a number of reasons, reprocessing as a management approach for used nuclear fuel is considered to be highly unlikely as a viable scenario for Canada at this time.

The necessary facilities are expensive, and inevitably produce residual radioactive wastes that could be more difficult to manage than used nuclear fuel in its un-reprocessed form. Reprocessing also requires a commitment to a continuing nuclear fuel cycle, and it potentially separates out material that could be used in the production of nuclear weapons in the course of the process.

Reprocessing is usually carried out on a commercial scale. If in the future a decision is made to further process CANDU fuel for the purpose of reducing the volume of high-level radioactive waste and toxicity of the fuel, there would need to be significant advances in the area of partitioning and transmutation which is still in an early development stage.

Partitioning and transmutation introduces the requirement for reprocessing at the back-end of the nuclear fuel cycle. It also necessitates a commitment to the continued use of nuclear energy by current and future generations. While it might reduce the volume and the toxicity of the used nuclear fuel to be managed, it would not avoid the need for long-term management of the residual high-level radioactive wastes that would be produced.

Partitioning and transmutation continues to be the subject of international study, particularly in France, where substantial funds have been committed to examining its feasibility as a complementary option for managing used fuel in the future. Based on this research, the scientific and technical foundation is not yet sufficiently advanced for implementation and long-term management of the residual radioactive materials would still be required. In a recent report, the French *Office parlementaire d'évaluation des choix scientifiques et technologiques, Assemblée nationale* noted that, "transmutation at an industrial scale is not foreseeable at best before 2040."

The possibility of transmuting various radioactive isotopes has only been demonstrated in the laboratory. It is too soon to demonstrate that it would be commercially feasible with the volume of used nuclear fuel which exists in Canada.

The NWMO recommends keeping a "watching brief" on the findings concerning partitioning and transmutation.

Systematic monitoring of this technology and other areas of evolving scientific research will continue to be an important function of the NWMO, to stay abreast of current developments concerning the long-term management of used nuclear fuel.

For a fuller discussion on this topic, see Appendix 9, and NWMO background papers on reprocessing, partitioning and transmutation, available at www.nwmo.ca/partitioningandtransmutation and www.nwmo.ca/implicationsrpt.

Placement in Deep Boreholes

Deep borehole placement of radioactive waste has been examined in a number of countries, including Sweden, Finland and Russia. The concept would involve placing used fuel packages in very deep boreholes drilled from the surface to depths of several kilometres, with

borehole diameters typically less than one metre. The packages would be stacked on top of one another in each borehole, separated by layers of sealing material such as bentonite or cement. Boreholes could be drilled in many types of rock.

Monitoring and retrieval of used fuel packages in deep boreholes would be very difficult. Furthermore, a number of significant technical questions remain regarding the mechanical integrity of the used fuel packages under high stress and temperature conditions both during and after placement, necessitating significant further research and development. Deep borehole placement is currently viewed as a possible method for the disposal of small quantities of radioactive waste but would be difficult to implement as a management option for large quantities of used nuclear fuel.

International Repository Concept

The NWMO looked at the concept of an international repository (or even a regional repository), both in the case where the repository would be located in another country and where Canada would be the host. The assessment of an international repository option would have to include all the attendant costs, benefits, and risks of the particular site and related infrastructure (including transportation) and this would be linked to all of the implicated societies and cultures. While the transboundary movement of used fuel would not be against any international treaty, in some cases it might violate the self-sufficiency principle which guides the radioactive waste management activities of most countries with substantial nuclear reactor programs (i.e., those who produce the used fuel will assume full responsibility for its long-term management). The international repository option might become more attractive for some countries over the next few years, but it is not a decision that would be made solely by Canada. It will be important for Canada to continue to monitor developments in this area of radioactive waste management.

Methods of Limited Interest

The NWMO found eight methods to be of limited interest (see Appendix 9). We screened these methods out as potential options based on the following criteria:

- Contravention of international treaties (e.g., the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter); and/or
- Insufficient proof-of-concept to undertake an adequate assessment at the conceptual design level.

Further rationale for screening out these methods is provided in Appendix 9.

Our judgement of these methods is consistent with assessments undertaken in other countries. We recognize, however, that Canada may wish to maintain interest in some of these methods by undertaking research and/or tracking related international developments.

The NWMO has received additional suggestions from Canadians on long-term management options for used nuclear fuel, but they too did not become a focus of our work due to insufficient proof of concept.

5.2 / Methods Considered in Our Study

From our initial review of 14 options, we narrowed the choices to four, which became the focus of our study.

As required by the NFWA, we studied individual approaches based on each of the three technical methods specified for study:

Option 1: Deep geological disposal in the Canadian Shield;

Option 2: Storage at nuclear reactor sites; and

Option 3: Centralized storage, either above or below ground.

In addition, we have studied a fourth option, Adaptive Phased Management, which in part involves many features of the three technical methods listed in the *NFWA*.

These four options are described in detail in the following chapter.

Findings of the comparative assessment of the four options are summarized in Chapter 8.

Chapter 6 / Technical Descriptions of Approaches

The *Nuclear Fuel Waste Act* (*NFWA*) required the NWMO to develop detailed technical descriptions for each management approach the organization studied.

6.1 / The Development of Technical Designs

The three methods outlined in the *NFWA* are well understood and are each considered from a technical perspective to be credible and viable. Used fuel storage technologies have been demonstrated for many years at reactor sites where used fuel is cooled and then safely managed in interim storage facilities. Deep geological disposal has been the subject of intensive study in Canada for many decades, and is in an advanced state of scientific and technical understanding internationally.

Deep Geological Repository

In 1978, the governments of Canada and Ontario established the Canadian Nuclear Fuel Waste Management Program to study and advance the technology for storage, transportation and permanent disposal of Canada's nuclear fuel waste. Since that time, the research and development program has been primarily directed at developing the technology for deep geological disposal in the crystalline rock of the Canadian Shield. Although crystalline rock was the primary focus of the disposal research and development program in Canada, the 1977 study by Kenneth Hare recognized, based on studies and experience in other countries, that there are other potentially suitable rock types, including sedimentary rock and salt.

Conceptual designs have also been developed for the transportation of used nuclear fuel. The status of these systems in Canada and abroad have been summarized in background papers available online at www.nwmo.ca/backgroundpapers.

Since 1978, Canada has invested more than $800 million in used fuel technology development. Ontario Power Generation Inc. (OPG), on behalf of the nuclear fuel waste owners, has been ensuring that Canada has the capability to implement a deep geological repository program, should the federal government choose this technology. OPG has been managing the technology development program since 1996, addressing the technical issues raised during the federal review of Atomic Energy of Canada Ltd.'s (AECL's) 1994 disposal concept. These issues were reported on by the Seaborn Panel in 1998 and were derived primarily from the findings of their Scientific Review Group (1995) and others during the federal review. Progress has been documented in a series of annual reports. Key technical and design changes to the Canadian concept include a more robust long-lived used fuel container capable of withstanding the effects of glaciation, and design improvements for monitoring and retrieval of used fuel in a deep geological repository. (See repository technology development reports at www.nwmo.ca/repositorytechnology).

In 2004, OPG's Deep Geologic Repository Technology Program had an annual budget of $7.6 million. The main objectives of the research and development program were to further develop safety assessment, geoscience and engineering methods, models and tools required to assess the feasibility and safety of the deep geological repository concept. OPG is maintaining the technical expertise to initiate a siting program, as required. Research and development is also being conducted by technical experts at AECL and Canadian universities, as well as by the consulting community in Canada and abroad. Typically, over 30 technical reports and publications are produced each year in research areas such as:

- Used fuel container development;
- Copper corrosion modelling and experimental studies in crystalline rock and in sedimentary rock;
- Sealing material properties and behaviour under repository conditions;
- Rock mass characterization and monitoring instruments and methods;
- Repository design development (e.g., in-floor, in-room, long-tunnel placement);

- Modeling climate change for evaluating deep geological repositories;
- Modeling regional groundwater flow and transport in Canadian Shield;
- Potential impacts from long-term climate change, glaciation modeling and permafrost studies;
- In-situ transport studies and geosphere model development;
- Used fuel dissolution studies and vault model development;
- Evolution of a deep geological repository in crystalline rock;
- Evolution of a deep geological repository in sedimentary rock;
- Postclosure safety assessment studies and safety model development; and
- Canadian contribution to international waste management studies and analyses.

These research and development activities are designed to improve understanding of the expected evolution of a deep geological repository over very long periods of time (around one million years) and to provide confidence in the safety case for placing used nuclear fuel in such a repository.

Formal co-operation and information sharing agreements are in place between OPG and radioactive waste management organizations in Sweden (SKB), Finland (Posiva) and Switzerland (Nagra). These countries are considering used fuel repository concepts and geomedia (i.e., crystalline rock and/or sedimentary rock formations) similar to the Canadian repository concept. Several of the programs are advanced with respect to repository design, siting and approvals. Finland and Sweden plan to have repositories in service by 2020. In the event that the Government of Canada selects an approach with a deep geological repository, these countries are about 15 to 20 years ahead of a Canadian facility. Our country can learn from the siting and repository development experiences elsewhere. Appendix 6 provides an overview of activities in other jurisdictions.

Representatives from Canada participate in the international radioactive waste management program of the OECD Nuclear Energy Agency. Members of this group include waste owners and national regulators from all the major nuclear energy countries. In December 2003, OPG signed a five-year agreement with SKB to participate in research and repository technology demonstration activities at the Äspö Hard Rock Laboratory (HRL) in Sweden. Canadian participation in international co-operation projects such as Äspö enhances the technology base in Canada and helps improve our understanding of key processes in a deep repository.

Storage Technology

Facilities for interim wet and dry storage of used fuel have been well researched, designed, constructed, licensed and operated both in Canada and internationally for many decades. All of the nuclear waste owners (OPG, Hydro-Québec, NB Power Nuclear and AECL), have designed, developed and implemented licensed interim storage technology at the reactor sites in Canada. For example, there are licensed dry storage facilities at the Pickering and Bruce Power nuclear generating stations, and a licence to construct a dry storage facility at Darlington was issued by the Canadian Nuclear Safety Commission on August 11, 2004. While these facilities have been designed for interim storage for approximately 50 years, conceptual designs for long-term storage have been developed and submitted to the NWMO. (See conceptual design reports at **www.nwmo.ca/conceptual designs**). The waste owners are also conducting studies into the integrity of used fuel bundles under storage conditions over hundreds of years.

Internationally, many decades of research into the science and engineering aspects of storage and repositories have advanced our understanding of these different technical methods for used fuel management. Today, storage and repositories both represent viable, safe options from a technical perspective for the management of used nuclear fuel.

6.2 / Engineering Concepts for the NWMO Study

The conceptual engineering designs adopted for study by the NWMO were commissioned by the Joint Waste Owners: Ontario Power Generation Inc., Hydro-Québec, NB Power Nuclear and Atomic Energy of Canada Limited.

Consulting firms were asked to develop preliminary conceptual engineering designs and cost estimates for the three technical methods identified in the *NFWA*, and also to develop associated used fuel transportation infrastructure and cost estimates for those designs. Three possible modes of travel were considered: (1) road; (2) rail, which requires road shipments from the rail/road transfer facility to the central facility; and (3) water, which requires road shipments from the water/road transfer facility to the central facility. The conceptual designs and cost estimates include the following work elements: siting, safety assessment, security, safeguards, system development, public affairs, facility design and construction, facility operation, environmental assessment and monitoring, decommissioning and closure. These conceptual designs were intended to be "typical" of these technical options, and were not intended to be fully developed project plans or recommendations. The conceptual engineering designs are available online at www.nwmo.ca/conceptualdesigns.

Cost summary reports are available at www.nwmo.ca/costsummaries.

The reference conceptual designs and cost estimates were based on a 2001 projected used fuel inventory which assumed that the Pickering, Bruce and Darlington reactors in Ontario would operate for an average lifetime of 40 years, the Point Lepreau reactor in New Brunswick would operate for 25 years, and the Gentilly reactor in Québec would operate for 30 years. Under this assumption, the current fleet of commercial nuclear reactors in Canada would produce a used fuel inventory of approximately 3.6 million bundles. If all existing nuclear reactors operate for an average lifetime of 40 years, the projected used fuel inventory would be 3.7 million bundles, which is less than a three percent difference from the reference used fuel inventory associated with the conceptual designs and cost estimates for the various management approaches. Sensitivity analyses of cost estimates have also been conducted for average reactor lifetimes of 30 years and 50 years.

The NWMO commissioned a third-party review of this body of work to examine the appropriateness of key engineering design assumptions and the cost estimation process. The review concluded that both the designs and the cost estimates have been prepared with an appropriate estimating methodology and they are suitable for the options review and directional decision-making requirements of the NWMO. (www.nwmo.ca/engineeringreview and www.nwmo.ca/costreview)

The NWMO also had the possibility of considering and presenting other approaches for the long-term management of Canada's used nuclear fuel.

Following significant analytical work and input from the public, we identified an additional option for study. We present Option 4: Adaptive Phased Management (our recommended approach) as an adaptive risk management approach that draws on many of the features of the other three options, and which we believe would ensure a high degree of safety and security for the long term, while providing the flexibility and adaptability that Canadians have said is essential.

The initial high-level description of Option 4 is based on the conceptual engineering designs for storage at nuclear reactor sites, centralized storage and a deep geological repository. Option 4 was submitted to engineering consulting firms to review the technical feasibility of the concept and to develop a preliminary cost estimate for the approach. Their reports are available at www.nwmo.ca/assessments.

Distinguishing features of each of the four methods studied are shown in the following tables.

References to implementation timelines in the sections below should be considered as possible timelines, assumed for conceptual design, cost estimating and concept analysis purposes only.

Option 1: Deep Geological Disposal in the Canadian Shield

Option 1: Deep Geological Disposal in the Canadian Shield

The management approach:

- Long-term management of used nuclear fuel through containment and isolation in a deep geological repository in the crystalline rock of the Canadian Shield;
- Used nuclear fuel is transported from the nuclear reactor sites to a central location for long-term management;
- The deep geological repository is based on the concept described by Atomic Energy of Canada Limited in the 1994 Environmental Impact Statement on the Concept for Disposal of Canada's Nuclear Fuel Waste, and modified to take into account the views of the environmental assessment panel as reported in February 1998; and
- Following an interim period of monitoring, the repository is closed, without the intent to retrieve the used fuel.

A deep geological repository relies on natural and engineered barriers to isolate the used fuel from the surface environment over its hazardous lifetime. Within the disposal concept, a repository is a facility deep underground where used fuel is placed for final containment and isolation. The concept is illustrated in Figure 6-1.

During the period 1978 to 1996, Atomic Energy of Canada Limited (AECL) researched the idea of a deep geological repository for used CANDU fuel, under the Canadian Nuclear Fuel Waste Management Program. Subsequently, the Seaborn Panel reviewed that concept under the *Federal Environmental Assessment and Review Process Guidelines Order* (1984). The Panel listened to a broad range of stakeholders, including members of the public. In its final 1998 report, the Panel recommended technical changes to the AECL concept to address their comments. Since then, the Joint Waste Owners have continued researching and advancing the original concept.

The approach described here is based on the AECL design and further developed taking into account recommendations of the Seaborn Panel, as well as further repository conceptual design experience in Canada and internationally. The main changes to the 1994 AECL conceptual design include:

- Selection of copper (instead of titanium) as the reference corrosion barrier for used fuel containers with a 100,000 year design life (consistent with the reference repository containers selected for the Finnish and Swedish radioactive waste management programs);
- Inclusion of an inner steel vessel to the copper used fuel container to provide the necessary structural support so that the container can withstand the effects of glaciation and other environmental effects;
- Selection of 100 percent bentonite (instead of 50 percent bentonite / 50 percent sand) as the reference buffer sealing material surrounding the container to address the issue of microorganisms in the repository and to remove the potential of microbiologically influenced corrosion of the copper container;
- Development and selection of a larger (324 bundle instead of 72 bundle) used fuel container to enable a more practical rate of placement of containers in a deep repository;

- Development of three conceptual designs for used fuel container placement in a deep repository: (1) in room, (2) in floor borehole and (3) horizontal tunnel, in order to enable flexibility of repository design to accommodate site-specific conditions;

- Inclusion of an underground characterization facility at the site of the deep repository to conduct site-specific research, development and technology demonstration prior to operation of the deep geological repository;

- Continued monitoring of used nuclear fuel for an extended period of time (up to 70 years) after placement of used fuel containers in the deep repository; and

- Development of an engineering design to retrieve used fuel from a deep repository of used fuel. Container retrieval technology is currently being demonstrated at the Äspö Hard Rock Laboratory in Sweden.

The illustrative timelines and activities associated with the concept are summarized in Table 6-1.

The detailed technical description of the conceptual designs used in the NWMO assessment is provided at: www.nwmo.ca/geologicaldisposal.

Figure 6-1 Deep Geological Disposal in the Canadian Shield

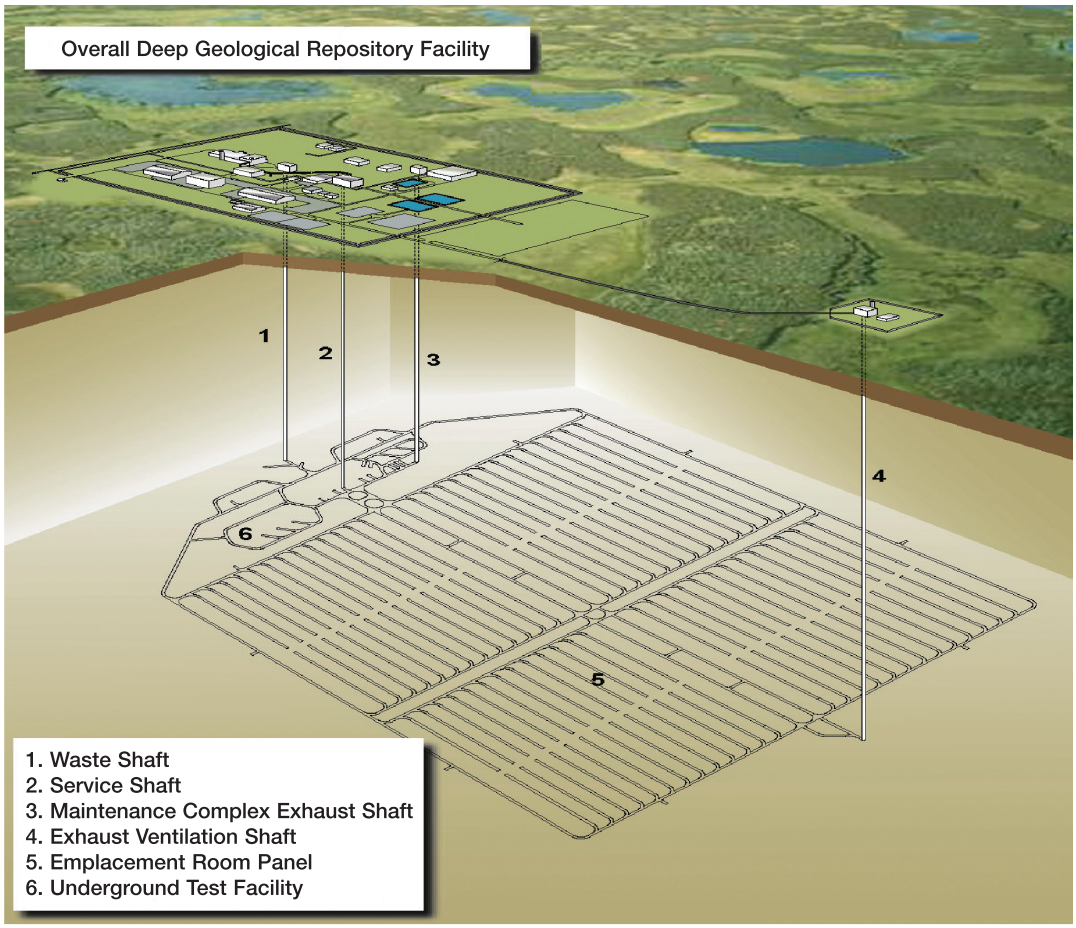


Table 6-1 Option 1: Deep Geological Disposal in the Canadian Shield (modified AECL concept)

Representative Conceptual Design Activities for Deep Geological Disposal in the Canadian Shield	
Concept	A long-term management approach based on a central deep geological repository located in the Canadian Shield at a nominal depth of 500 to 1,000 metres below surface. Used fuel would be transported from existing interim storage facilities at nuclear reactor sites, to a central location. At the central facility, the used fuel would be transferred into corrosion-resistant containers that would be placed in rooms excavated deep in the rock over a period of about 30 years. There would be a need for transportation containers and facilities to produce them; processing facilities to load the fuel into transportation containers; production facilities for deep repository containers; processing facilities to transfer the fuel from transportation to deep repository containers; and production facilities for sealing materials. Once all of the used fuel is transferred to the deep repository, it would be monitored over time prior to final backfilling, sealing and closure of the facility. Following closure of the deep repository, maintenance, inspection and security-related operations would be minimal. Such a facility would be designed to be passively safe over the long term and not rely on institutional controls to ensure safety. The current owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transported from the reactor sites to the central facility for long-term management.
Location	The facility would be located in the crystalline rock of the Canadian Shield, a vast rock formation stretching across parts of several provinces and territories. A specific location would need to be identified and licences would be required from the Canadian Nuclear Safety Commission for the construction and operation of the facility. This would also involve an environmental assessment.
Transportation Requirements	The operation of the centralized facility would involve moving the fuel from existing reactor site storage facilities in certified transport containers to the central site over a period of approximately 30 years. Transportation would require an emergency response plan and adherence to security provisions. The mode of transportation (road, rail or water) would depend upon the location of the central facility and other factors. Based on a projected used fuel inventory of 3.6 million fuel bundles, the number of transportation shipments of used fuel from the reactor sites to the central facility would be: • Road: about 53 road shipments/month for 30 years, or • Rail: about five rail shipments/month + about 36 road shipments/month for 30 years, or • Water: about two water shipments/month + about 36 road shipments/month for 30 years
Containers	At the central facility, used nuclear fuel would be placed in durable corrosion-resistant containers. This type of container can be designed to last a minimum of 100,000 years, and is capable of withstanding the hydraulic pressures of glaciations. Facilities would exist at the central site for repackaging the used fuel.
Storage Design Life	None. Concept does not include new storage facilities.

Table 6-1 (cont'd) Option 1: Deep Geological Disposal in the Canadian Shield (modified AECL concept)

Representative Conceptual Design Activities for Deep Geological Disposal in the Canadian Shield	
Land Requirement	The land requirement for the surface buildings and associated facilities would be about two kilometres x three kilometres, or about 600 hectares (1,480 acres). The surface building dimensions would likely be a small fraction of the total land area. The footprint for the deep geological repository would be about 1.35 kilometres x 1.36 kilometres, or about 183 hectares (452 acres). The actual size of the deep geological repository would depend on a number of factors such as number of fuel bundles and their heat output, depth of the repository and site-specific factors such as thermal conductivity of the rock mass.
Underground Facility	A network of horizontal tunnels and rooms would be excavated in stable rock about 500 to 1,000 metres below the surface. Used nuclear fuel would be packaged in durable containers and placed within the rooms or in boreholes drilled into the floor of the rooms. Used fuel containers are assumed to be placed in a deep repository over a 30-year operating period.
Repository Sealing System	Clay-based materials would be used to surround and protect the containers, to fill the void spaces in the repository, to limit the movement of groundwater and dissolved material, and to protect workers during container placement operations. These are referred to as sealing systems, and involve materials such as high-performance concrete and swelling bentonite clay.
Geosphere Barrier	The geosphere, or host rock, provides the principal barrier between the used fuel containers and the surface environment. The crystalline rock of the Canadian Shield is a naturally-occurring geological formation which has long-term stability, good rock strength, low groundwater flow, and is sufficiently below the surface and lacking in mineral resources that it is very unlikely to be disturbed by erosion or accidental drilling.
Monitoring	The facility would be monitored for an extended period of time to confirm the performance and safety of the system prior to final sealing, decommissioning and closure of the repository. Extended monitoring of the used fuel containers, sealing systems, rock around the repository, underground water flows and the natural environment would be conducted to confirm the long-term safety and performance of the system. In addition, some preventive maintenance might be required. For costing purposes it was assumed that extended monitoring at repository depth would occur over approximately 70 years, although it could be shorter or longer.
Retrieval	The technology to retrieve used fuel containers from a deep geological repository would need to be further developed and demonstrated at the site.

Table 6-1 (cont'd) Option 1: Deep Geological Disposal in the Canadian Shield (modified AECL concept)

Representative Conceptual Design Activities for Deep Geological Disposal in the Canadian Shield	
Illustrative Implementation Schedule	A government decision in 2006 to develop a deep geological repository would see the new facility ready in 2035, at the earliest. Following a decision by the government, the following activities with their illustrative timelines would be undertaken: • Siting (which would take about 15 years); • Design and construction (about 15 years); • Operation (about 30 years to place the fuel plus 70 years of additional monitoring); • Decommissioning (about 12 years); and • Closure (about 13 years). There would be a need to obtain a licence at each phase and demonstrate continuous compliance with the licence (under regulatory oversight).
Decommissioning	Once necessary approvals were obtained, decommissioning would commence and all underground access tunnels and shafts would be backfilled and sealed. Surface facilities would be decontaminated and dismantled. Closure activities include removal of monitoring instruments and returning the site to greenfield conditions.
Costs	The cost of a deep geological repository for used nuclear fuel is estimated to be $16.2 billion (2002 dollars), including interim used fuel storage and retrieval from reactor sites, and transportation costs to the central facility. These costs include the development and demonstration of the technology to retrieve used fuel from the repository, but not the costs of performing the retrieval operations. The present value cost based on current long-term economic factors is approximately $6.2 billion (2004 dollars). (**www.nwmo.ca/disposalcosts**)

Option 2: Storage at Nuclear Reactor Sites

Option 2: Storage at Nuclear Reactor Sites

The management approach:

- Long-term management of used nuclear fuel in storage facilities, at or just below surface, at each nuclear reactor site in Canada; and
- Storage facilities are maintained, rebuilt and operated in perpetuity at each reactor site.

Figure 6-2 Example of Used Fuel Storage in Bays at Reactor Site

Figure 6-3 & 6-4 Example of Used Fuel Storage in Dry Storage at Reactor Sites – Surface Storage Building and Dry Storage Containers

Initially, used fuel is removed from the reactor and placed in wet storage bays at the reactor site (see Figure 6-2). After a period of about seven to 10 years out-of-reactor, used fuel can be placed in dry storage at the reactor site, as illustrated in Figures 6-3 and 6-4. The long-term management approach builds on the current dry storage technology at the reactor sites.

The illustrative timelines and activities associated with the concept are summarized in Table 6-2.

The detailed technical descriptions, presented for the conceptual designs, are provided at: www.nwmo.ca/reactorstorage.

Table 6-2 Option 2: Storage at Nuclear Reactor Sites

Representative Conceptual Design Activities for Storage at Nuclear Reactor Sites	
Concept	Long-term storage at existing reactor sites would involve the expansion of existing dry storage facilities or the establishment of new, long-term dry storage facilities at each of the seven used fuel storage sites in Canada. In the latter case, used fuel would be transferred from the existing interim storage facilities to newly designed storage containers and storage buildings for long-term management. Storage would require an ongoing program of regular replacement and refurbishing activities, as facilities would be renewed indefinitely. Processing buildings would also be required to load the fuel and provide for its on-site transfer. The storage facilities would require ongoing maintenance, inspections and security systems. The current owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transferred to the long-term storage facilities at the reactor sites.
Location	Long-term storage would need to be established at the seven licensed Canadian reactor sites: • Whiteshell Laboratories, Manitoba • Bruce Nuclear Power Station, Ontario • Pickering Nuclear Power Station, Ontario • Darlington Nuclear Power Station, Ontario • Chalk River Laboratories, Ontario • Gentilly Nuclear Power Station, Québec • Point Lepreau Nuclear Power Station, New Brunswick This would involve identifying specific storage locations at each reactor site, and obtaining the necessary licences from the CNSC for the construction and operation of the facility, and potential environmental assessments.
Transportation Requirements	No off-site transportation of used fuel is required for extended storage at nuclear reactor sites. There are both surface and below-surface design options for reactor site storage, involving the use of casks, vaults and/or silos. The alternative conceptual designs considered reflect the different methods currently used for interim storage at each location in Canada.
Containers	There are both surface and below-surface design options for reactor site storage, involving the use of casks, vaults and/or silos. The alternative conceptual designs considered reflect the different methods currently used for interim storage at each location in Canada.
Storage Design Life	Eventually the storage containers and buildings would need to be replaced. This would involve construction of new storage buildings, transfer of the used fuel from the long-term storage containers to new packages, and transfer of the containers to the new building. The old buildings and waste storage containers would need to be refurbished or demolished. These activities would take approximately 30 years, and repackaging of the fuel storage system is assumed to be repeated every 100 years. Based on current design assumptions, complete refurbishment of all components of the storage facility would be required every 300 years. For design purposes, the assumed service lives for the various storage facility components are: • Casks 100 years • Fuel module 300 years • Fuel basket 300 years • Trench chamber 200 years • Storage building 100 years • Processing building 50 years It is recognized that new designs may make possible extended service lives of the facilities.

Table 6-2 (cont'd) Option 2: Storage at Nuclear Reactor Sites

Representative Conceptual Design Activities for Storage at Nuclear Reactor Sites	
Land Requirement	The land requirement for the surface storage buildings and associated facilities would vary for each reactor site depending upon the number of fuel bundles and the design of the storage facility. The maximum land requirement is expected to be less than about 200 metres x 200 metres, or about four hectares (10 acres).
Underground Facility	One of the possible reactor site concepts involves storage slightly below ground, in shallow trenches.
Repository Sealing System	None. There would not be a deep repository to be sealed.
Geosphere Barrier	Geosphere would not be used to provide a significant long-term isolation barrier.
Monitoring	Once all the used fuel from the reactor site was placed in the long-term storage facility, it would require ongoing monitoring to ensure that facility was being safely maintained, and to ensure preventive maintenance and repair is completed as required.
Retrieval	Storage would be designed to allow the safe retrieval of used fuel at any point during the life of the facility.
Illustrative Implementation Schedule	A government decision in 2006 to adopt storage at nuclear reactor sites, followed by immediate implementation would mean facilities at each site would be ready between 2016 and 2020. (The range reflects the different design options at the various reactor sites.) The long-term storage facilities would likely require complete refurbishment or replacement by the year 2300. While the design of a new long-term storage facility may vary at each reactor site, following a decision by the government, the following activities with their illustrative timelines would be undertaken: • Siting and approvals (up to five years) • Design and construction (about five years) • Initial fuel receipt (transfer of fuel from existing interim storage to new long-term storage facilities would occur over a period of approximately 35 to 40 years) • Extended monitoring (beyond 50 years) • Building refurbishment and fuel repackaging (beyond 50 years) There would be a need to obtain a licence at each phase and demonstrate continuous compliance with the licence (under regulatory oversight).
Decommissioning	Storage facilities and their components would be decommissioned and replaced, depending on the service lives of the various storage components. The duration of the decommissioning activities is approximately 30 years for each facility repeat event (~ every 300 years).
Costs	Depending on the specific design, preliminary estimates suggest this approach would cost between $17.6 billion and $25.7 billion (2002 dollars) for one 300-year cycle. Regardless of the storage options selected, the costs for reactor site extended storage would continue indefinitely. The present value cost of the first repeat cycle is approximately $2.3 to $4.4 billion (2004 dollars) based on current long-term economic factors. The calculation of costs beyond 300 years requires the use of long-term economic forecasting with its inherent uncertainties. (**www.nwmo.ca/reactorcosts**)

Option 3: Centralized Storage, Above or Below Ground

Option 3: Centralized Storage, Above or Below Ground

The management approach:

- Long-term management of used nuclear fuel in a storage facility, above or below ground, at a central site in Canada;
- Used nuclear fuel is transported from the nuclear reactor sites to this central location for long-term management; and
- The storage facility is maintained, rebuilt and operated in perpetuity at this central site.

One example of a centralized above ground storage facility is shown in Figure 6-5.

The illustrative timelines and activities associated with the concept are summarized in Table 6-3.

The detailed technical descriptions presented for the conceptual designs, are provided at www.nwmo.ca/centralstorage.

Figure 6-5 Centralized Storage – Above Ground

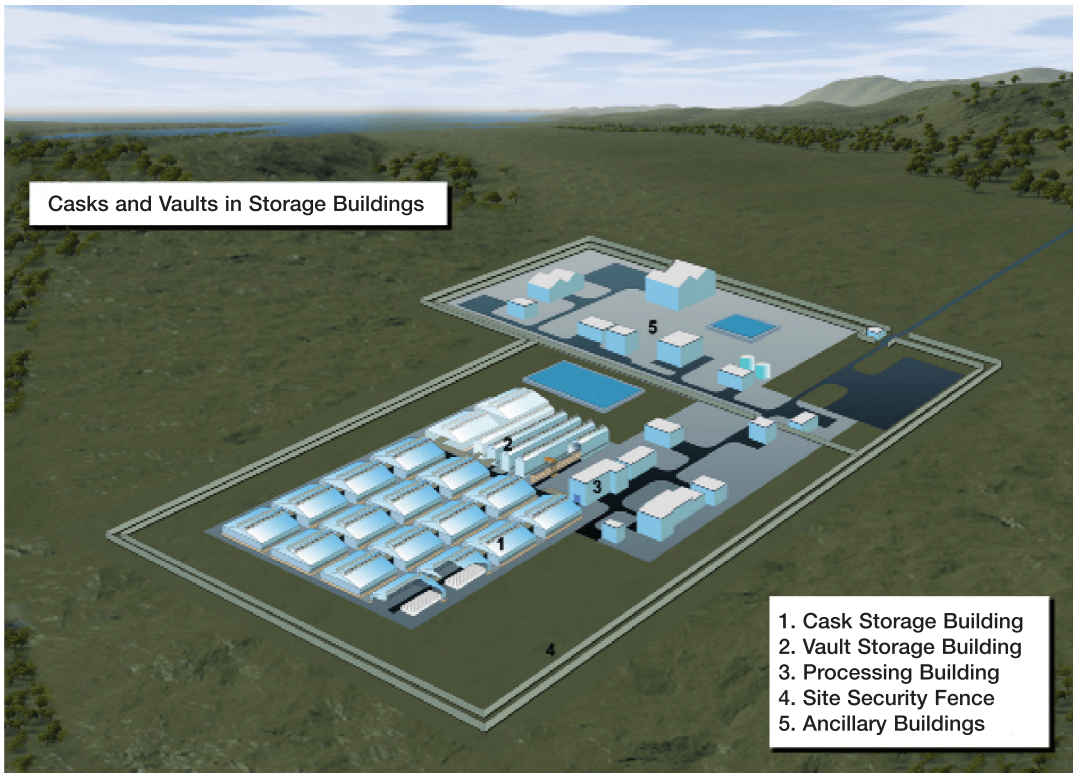


Table 6-3 Option 3: Centralized Storage, Above or Below Ground

Representative Conceptual Design Activities for Centralized Storage	
Concept	Centralized extended storage involves creating new, long-term storage facilities at a central location. Used fuel would be transferred from the seven interim storage sites in Canada to a newly designed facility. Conceptual designs have been developed for a central storage facility built above ground, or below ground. There would need to be transportation containers and facilities to produce them; processing facilities to load the fuel into transportation containers; production facilities for storage containers; and processing facilities to transfer the fuel from transportation to storage containers. Storage would require an ongoing program of regular replacement and refurbishing activities, as facilities would be renewed and expanded indefinitely. Once all the used fuel is transferred to the long-term storage facilities, ongoing maintenance, inspections and security systems would be required. The current owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transported from the reactor sites to the central facility for long-term management.
Location	Centralized storage could be built at a nuclear reactor site, but for assessment purposes, it is conservatively assumed that the central storage facility would be located at an undeveloped site, and the facility would be expanded as needed. A specific location would need to be identified, and approvals would be required from the CNSC for the construction and operation. This would also involve an environmental assessment.
Transportation Requirements	The operation of a centralized long-term storage facility would involve moving the fuel from existing reactor site storage facilities in certified transport containers to the central site over a period of approximately 30 years. Transportation would require an emergency response plan and adherence to security provisions. The mode of transportation (road, rail or water) would depend upon the location of the central facility and other factors. Based on a projected used fuel inventory of 3.6 million fuel bundles, the number of transportation shipments of used fuel from the reactor sites to the central facility would be: • Road: about 53 road shipments/month for 30 years, or • Rail: about five rail shipments/month + about 36 road shipments/month for 30 years, or • Water: about two water shipments/month + about 36 road shipments/month for 30 years

Table 6-3 (cont'd) Option 3: Centralized Storage, Above or Below Ground

Representative Conceptual Design Activities for Centralized Storage	
Containers	Four alternatives have been developed for the Joint Waste Owners as representative of a range of possible designs for the centralized long-term storage facility concept. In all cases, the used fuel would be contained in either concrete and steel casks or vaults. Two alternatives would use buildings on the surface. The other two alternatives would be underground. One option would be just below the surface and mounded over, while the other option would be about 50 metres below ground in bedrock. The four design alternatives for centralized storage are: • Casks and vaults in storage buildings. • Surface modular vaults. • Casks and vaults in shallow trenches. • Casks in rock caverns. Facilities would exist at the central site for repackaging the used fuel.
Storage Design Life	The storage containers and storage facilities are designed to last at least 100 years. Based on current design assumptions, complete refurbishment of all components, and repackaging of the entire fuel storage system is assumed to be repeated every 300 years. For design purposes, the assumed service lives for the various storage facility components are: • Casks 100 years • Fuel module 300 years • Fuel 300 years • Trench chamber 200 years • Storage building 100 years • Processing building 50 years It is recognized that new designs may make possible extended service lives of the facilities.
Land Requirement	The land requirement for the storage buildings and associated facilities would vary for each central storage alternative. For the surface storage alternatives, the land requirement would be about 1,080 metres x 865 metres, or about 93 hectares (230 acres). For the underground storage alternatives, the footprint of the storage caverns would be about 515 metres x 450 metres, or about 23 hectares (57 acres).
Underground Facility	No deep facility. The possibility exists to construct shallow rock caverns below the surface.
Repository Sealing System	None. There would not be a deep repository to be sealed.
Geosphere Barrier	Geosphere would not be used to provide a significant long-term isolation barrier.
Monitoring	The operation would require ongoing preventive maintenance and repair, as well as continuous monitoring to ensure that facility safety was being maintained.
Retrieval	The long-term storage facilities would be designed to allow safe retrieval of used nuclear fuel at any point during the service life of the facility. If the storage systems did not perform as expected, they could be repaired, or the fuel could be transferred to a new storage facility.

Table 6-3 (cont'd) Option 3: Centralized Storage, Above or Below Ground

Representative Conceptual Design Activities for Centralized Storage	
Illustrative Implementation Schedule	If the government decided in 2006 to adopt centralized storage, the storage facilities could not likely be ready for operations before 2023. Such facilities would require refurbishment or replacement by about the year 2300. Following a decision by the government, the following activities with their illustrative timelines would be undertaken: • Siting (up to 10 years) • Design and construction (about 10 years) • Initial fuel receipt (up to 40 years) • Extended monitoring (beyond 50 years) • Building refurbishment and fuel repackaging (beyond 50 years) There would be a need to obtain a licence at each phase and demonstrate continuous compliance with the licence (under regulatory oversight).
Decommissioning	Storage facilities and their components would be decommissioned and replaced, depending on the service lives of the various storage components. The duration of the decommissioning activities is approximately 30 years for each facility repeat event (~ every 300 years).
Costs	Depending on the specific design, preliminary estimates suggest this approach would cost between $15.7 and $20.0 billion (2002 dollars) for one 300-year cycle, including interim used fuel storage and retrieval from reactor sites and transportation costs. The present value impact of the first cycle is approximately $3.1 to $3.8 billion (2004 dollars) based on current long-term economic factors. The calculation of costs beyond 300 years requires the use of long-term economic forecasting with its inherent uncertainties. (www.nwmo.ca/centralstoragecosts)

Option 4: Adaptive Phased Management

Option 4: Adaptive Phased Management (Recommended Approach)

The management approach:

- Long-term management of used nuclear fuel through an adaptive path which provides for:
  - > centralized containment and isolation of the used fuel in a deep geological repository in a suitable rock formation, such as the crystalline rock of the Canadian Shield or Ordovician sedimentary rock;
  - > flexibility in the pace and manner of implementation through a phased decision-making process supported by a program of continuous learning, research and development;
  - > provision for an optional step in the implementation process in the form of shallow underground storage of used fuel at the central site, prior to final placement in a deep repository;
  - > continuous monitoring of the used fuel to support data collection and confirmation of the safety and performance of the repository; and
  - > potential for retrievability of the used fuel for an extended period, until such time as a future society makes a determination on the final closure and the appropriate form and duration of postclosure monitoring.
- Used nuclear fuel is transported from the nuclear reactor sites to a central location for long-term management.

After significant analysis, public engagement and careful examination of the three options specified for study in the *NFWA*, the NWMO puts forward a fourth option – Adaptive Phased Management, as our recommended approach for long-term management of used nuclear fuel.

Adaptive Phased Management includes features from the other three technical methods. It proposes a path forward toward a determinate end point, the placement of used nuclear fuel in a deep geological repository for safe, secure long-term management. The approach builds on the continued development of the deep geological repository concept and takes into account the 1998 recommendations of the Seaborn Panel, as well as recent geological repository conceptual design experience in Canada and internationally.

The features of Adaptive Phased Management were drawn from the strengths of each of the other three options. The management approach is derived from a comprehensive comparative assessment of the options (as discussed in Chapter 8) and supported by the NWMO's engagement process (discussed in Chapter 4). Here we provide further information and rationale for these features of Adaptive Phased Management.

Centralized Containment and Isolation

Given the very long time period during which used nuclear fuel remains a potential health, safety and security hazard to humans and the natural environment, and based on our research in Canada and internationally, the NWMO has concluded that the most appropriate end point for used fuel should be containment and isolation. The appropriate location would be a deep geological repository in a suitable rock formation, such as the crystalline rock of the Canadian Shield or Ordovician sedimentary rock.

The rationale for a single centralized facility for long-term containment and isolation is based on a number of factors including cost, siting practicalities, safety, security and input from citizens. As discussed in Chapter 8, the costs to site, design, license and construct a facility to receive used fuel and place it in a deep geological repository are significant. It would not be cost-effective to develop multiple sites and facilities within Canada.

The risk of societal change and institutional breakdown over the long term would be mitigated by centralization. The management of one site is expected to be less complex than trying to provide security at several sites, although we recognize that our recommended approach will result in an additional site in Canada with used fuel while the material is being transported from the reactor sites to the central facility. The comparative analysis indicates that safety and security are improved with a central facility over the long term.

Potentially Suitable Host Rock Formations

The NWMO's rationale for including both the crystalline rock of the Canadian Shield and Ordovician sedimentary rock as potentially suitable host rock formations for a deep geological repository is given in our background paper *Adaptive Phased Management Technical Description*, which is available at **www.nwmo.ca/phasedmanagement** (background paper 6-18). In summary, the NWMO based its rationale on the following information:

- In 1977 the independent expert group chaired by Kenneth Hare identified several potentially suitable rock types in Canada for a deep geological repository for used nuclear fuel which included salt, crystalline rock, sedimentary rock and volcanic tuff. The Hare report indicated that the Canadian repository research and development (R&D) program should study several different rock types but that resources should not be spread too thinly. The report suggested that the primary R&D effort should focus on crystalline rock, but careful attention should be paid to work being conducted in other countries on other rock types.

- Since 1978, the Canadian repository R&D program has been primarily directed towards the crystalline rock in the Canadian Shield, including development of the Underground Research Laboratory by AECL near Lac du Bonnet, Manitoba. The potential suitability of the crystalline rock of the Canadian Shield for a deep geological repository has been extensively documented in AECL's 1994 Environmental Impact Statement and associated geoscientific and safety assessment reports. As well, there has been extensive documentation of the potential suitability of crystalline rock in other countries such as Sweden, Finland and Switzerland.

- Since the 1980's, there have been a limited number of Canadian studies on the potential for sedimentary rock as the host rock formation for a deep geological repository. The principal findings from these studies are that sedimentary rock formations have favourable geotechnical properties, they are relatively simple, homogeneous and thick, plus there are a large number of potential candidate sites for a deep repository.

- Several countries including Switzerland, France, Spain and Japan are studying both crystalline rock and sedimentary rock for their repository programs.

- From a geoscientific perspective, sedimentary rock formations such as the Ordovician (age 470 to 430 million years) have low hydraulic conductivity which means the flow of groundwater in the formations is very slow and the movement of dissolved material is dominated by diffusion. Also, sedimentary formations such as clay possess an ability to self-seal fractures and faults, and the clay minerals would retard the migration of many dissolved minerals.

- Ordovician sedimentary rock formations can be found in Canada at sufficient depth below surface and have sufficient thickness to meet technical siting criteria for a deep geological repository.

- In 2004, the NWMO commissioned a high-level review of potential changes to the conceptual design and costs of constructing a deep geological repository for used nuclear fuel in Ordovician sedimentary rock. The review found that construction of a deep geological repository in sedimentary rock is feasible and that the costs would be similar or less than a deep repository constructed in crystalline rock. (See background paper 6-13, *Conceptual Designs for Used Fuel Management in Sedimentary Rock*.)

There are several independent geoscientific arguments suggesting that Ordovician shales and limestones may provide a highly suitable environment to host a deep geological repository for used nuclear fuel in Canada. The prospect of successfully preparing a convincing safety case for a used fuel repository in Ordovician shales and limestones is substantial.

Based on the information available to the NWMO, both the crystalline rock of the Canadian Shield and Ordovician sedimentary rock are considered to be potentially suitable for a deep geological repository for used nuclear fuel. However, more research and development work on sedimentary rock needs to be completed to determine the suitability of these formations. The results from detailed site-specific characterization activities obtained during the site investigation, site selection and licensing phase would be required to confirm the technical suitability of any host rock formation for a deep geological repository.

Flexibility in the Pace and Manner of Implementation

Implementation of the Adaptive Phased Management approach is based on a series of steps or stages with key decisions supported by new knowledge, information, research and development. The NWMO does not consider "flexibility" to be an indication of indecision or an excuse to delay implementation. Rather, flexibility in the pace and manner of implementation recognizes that it is both pragmatic and appropriate to make these key decisions in an adaptive manner based on the best available information at the time of the decisions. Flexibility also provides Canadians with genuine choice with respect to how we arrive at the end point of Adaptive Phased Management.

In this chapter, we present one possible way of proceeding down the path of moving used fuel from nuclear reactor sites to an optional centralized underground storage facility in shallow rock caverns, followed by transfer to a final deep repository at the same site. At the same time, we acknowledge the potentially long timelines associated with implementation. During this period, there would be opportunities to adjust the timing as appropriate with the benefit of new information, continuous learning, monitoring of research and technological developments and discussion of timelines most appropriate for communities affected by the transition to long-term management.

Clearly, there are many **decisions** that may influence the implementation period for Adaptive Phased Management and the timelines for the key activities. Some of these decisions include:

- The selection of a preferred site for central, long-term management of used nuclear fuel.

- A decision about whether or not to construct an interim shallow underground storage facility at the central site and transport used fuel to the central facility while awaiting development of the deep repository.

- A decision about when to construct the deep geological repository and ancillary facilities.

- A decision about when to close the deep geological repository and decommission the surface facilities.

Further discussion of these decisions and the possible drivers for these decisions can be found in Chapters 13 and 16.

The **illustrative** and conservative timelines and activities associated with the concept are summarized in Table 6-4. Figures 6-6, 6-7 and 6-8 show three possible phases of implementation for Adaptive Phased Management.

It is important to note that the schedule and duration of activities for Adaptive Phased Management are illustrative for conceptual design, cost estimating and concept analysis purposes and would depend on a number of factors during implementation including the outcome of future decisions which cannot be know at this time. Other implementation schedules for Adaptive Phased Management are also possible and are discussed in Chapter 16. A detailed schedule of implementation activities and timelines would need to be developed following a decision by the Government of Canada on the preferred long-term management approach.

Provision for an Optional Shallow Underground Storage Facility

Adaptive Phased Management includes an option for shallow underground storage of used fuel at the central site while awaiting the development of the deep geological repository at the same site. This feature of the management approach is **optional** and one of the key decisions which must be made during the first phase of implementation is whether or not to proceed with this interim step of used fuel storage at the central facility.

For conceptual design, cost estimating and option comparison purposes, the NWMO has conservatively assumed that a decision is made to construct the shallow underground storage facility for used fuel. However, it is important to note that the factors which would influence the decision could be social, economic or technical (see discussion of key decisions for Adaptive Phased Management in Chapters 13 and 16). These include:

- A strong indication from some or all of the reactor site communities of a need to move used fuel off site, perhaps as a result of reactor decommissioning activities;

- Unforeseen developments that increase the desirability of centralizing used fuel for reasons of enhanced security;

- Unforeseen developments in technological innovation; and

- The time it takes to demonstrate the safety of the deep repository.

In simple terms, if there is an overriding need to move used fuel from the reactor sites to a central facility before the deep repository is operational, then the shallow underground storage facility would be constructed. If the need for storage at a central facility is not strong, then the storage facility would not be constructed and the used fuel would remain at the reactor sites until the deep repository is operational. Adaptive Phased Management would enable this choice to be made from social, technical and economic perspectives. The option of shallow underground storage provides a contingency in the event of unplanned circumstances.

Continuous Monitoring of Used Fuel

Used fuel will continue to be monitored throughout all phases of implementation of Adaptive Phased Management. Used fuel monitoring could be done over an extended period of time without affecting the integrity of the containment and isolation system. Monitoring would be done primarily to confirm the safety and performance of the management system, and to support various decisions during implementation. For example, the duration of in-situ monitoring of used fuel in the deep repository would affect the timing of the decision to close the deep repository and continue with postclosure monitoring from the surface.

Potential for Retrievability of Used Fuel for an Extended Period

Adaptive Phased Management enables used fuel to be retrievable at all times, both during storage and during placement in a deep geological repository. This feature of the approach has been provided to ensure that the used fuel is accessible should monitoring activities indicate that there are problems with the management system, or if there is a clearly justifiable reuse for the material, or should future technologies emerge to better manage used fuel over the long term.

A more detailed technical description of Option 4 is found in the NWMO background paper 6-18 *Adaptive Phased Management Technical Description*, which is available at www.nwmo.ca/phasedmanagement.

The detailed assessment of Option 4, based on conceptual designs, is available at www.nwmo.ca/assessments.

Table 6-4 Option 4: Adaptive Phased Management

Representative Conceptual Design Activities for Adaptive Phased Management	
Concept	A staged management approach with three phases of implementation: • Phase 1: Preparing for Central Used Fuel Management • Phase 2: Central Storage and Technology Demonstration • Phase 3: Long-term Containment, Isolation and Monitoring **Phase 1 (approximately the first 30 years):** Preparing for central used fuel management would comprise the following activities: • Maintain storage and monitoring of used fuel at nuclear reactor sites. • Develop with citizens an engagement program for activities such as design of the process for choosing a site, development of technology and key decisions during implementation. • Continued engagement with regulatory authorities to ensure pre-licensing work would be suitable for the subsequent licensing processes. • Select a central site that has rock formations suitable for shallow underground storage, an underground characterization facility and a deep geological repository. • Continue research into technology improvements for used fuel management. • Initiate the licensing process, which triggers the environmental assessment process under the *Canadian Environmental Assessment Act*. • Undertake site characterization, safety analyses and an environmental assessment for the shallow underground storage facility, underground characterization facility and deep geological repository at the central site, and to transport used fuel from the reactor sites. • Obtain a licence to prepare the site. • Develop and certify transportation containers and used fuel handling capabilities. • Obtain a licence to construct the underground characterization facility at the central site. • Decide whether or not to proceed with construction of a shallow underground storage facility and to transport used fuel to the central site for storage. • If a decision is made to construct the shallow underground storage facility, obtain a construction licence and then an operating licence for the storage facility. **Phase 2 (approximately the next 30 years):** Central storage and technology demonstration would comprise the following activities: • If a decision is made to construct shallow underground storage, begin transport of used fuel from the reactor sites to the central site for extended storage. • If a decision is made not to construct shallow underground storage, continue storage of used fuel at reactor sites until the deep repository is available at the central site. • Conduct research and testing at the underground characterization facility to demonstrate and confirm the suitability of the site and the deep repository technology. • Engage citizens in the process of assessing the site, the technology and the timing for placement of used fuel in the deep repository. • Decide when to construct the deep repository at the central site for long-term containment and isolation. • Complete the final design and safety analyses to obtain the required operating licence for the deep repository and associated surface handling facilities. There may be a need for transportation containers and facilities to produce them; processing facilities to load the fuel into transportation containers; production facilities for storage containers; and processing facilities to transfer the fuel from transportation to storage containers.

Table 6-4 (cont'd) Option 4: Adaptive Phased Management

Representative Conceptual Design Activities for Adaptive Phased Management	
Concept (cont'd)	**Phase 3 (beyond approximately 60 years):** Long-term containment, isolation and monitoring would comprise the following activities: • If used fuel is stored at a central shallow underground facility, retrieve and repackage used fuel into long-lived containers. • If used fuel is stored at reactor sites, transport used fuel to the central facility for repackaging. • Place the used fuel containers into the deep geological repository for final containment and isolation. • Decommission the shallow underground storage facility. • Continue monitoring and maintain access to the deep repository for an extended period of time to assess the performance of the repository system and to allow retrieval of used fuel, if required. • Engage citizens in on-going monitoring of the facility. • A future generation would decide when to decommission the underground characterization facility and any remaining long-term experiments or demonstrations of technology, and when to close the repository, decommission the surface handling facilities and the nature of any postclosure monitoring of the system. There may be a need for production facilities for used fuel containers; processing facilities to transfer the fuel from storage to the deep repository; and production facilities for sealing materials. The current owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transported from the reactor sites to the central facility for long-term management.
Location	The central facility for the shallow rock cavern, underground characterization facility and deep repository could be located in a suitable rock formation such as the crystalline rock of the Canadian Shield or in the Ordovician sedimentary rock basins. These two rock types cover a vast amount of land reaching several provinces and territories. A specific location would need to be identified and approval would be required from the Canadian Nuclear Safety Commission for the construction and operation of the facility. This would also involve an environmental assessment.
Transportation Requirements	The operation of a central facility would involve moving the fuel from existing reactor site storage facilities in certified transport containers to the central site over a period of approximately 30 years. Transportation would require an emergency response plan and adherence to security provisions. The mode of transportation (road, rail or water) would depend on factors such as the location of the central facility. The timing of transportation would depend on whether or not a shallow underground storage facility has been constructed at the central site and other factors. Based on a projected used fuel inventory of 3.6 million fuel bundles, the number of transportation shipments of used fuel from the reactor sites to the central facility would be: • Road: about 53 road shipments/month for 30 years, or • Rail: about 5 rail shipments/month + about 36 road shipments/month for 30 years, or • Water: about 2 water shipments/month + about 36 road shipments/month for 30 years.
Containers	Storage containers at reactor sites would consist of the existing casks, vaults and silos. Containers for long-term isolation in a deep repository are based on a 100,000-year design life. These durable containers are designed to withstand long-term environmental effects such as climate change and glaciation. Facilities would exist at the central site for repackaging the used fuel.

Table 6-4 (cont'd) Option 4: Adaptive Phased Management

Representative Conceptual Design Activities for Adaptive Phased Management	
Storage Design Life	Storage containers at the central underground storage facility are based on the existing design of the dry storage container or equivalent with a 100-year design life.
Land Requirement	The land requirement for the surface buildings and associated facilities would be about two kilometres x three kilometres, or about 600 hectares (1,480 acres). The surface building dimensions would likely be a small fraction of the total land area. The footprint of the shallow underground storage facility would be about 515 metres x 450 metres, or about 23 hectares (57 acres). The footprint for the deep geological repository would be about 1.35 kilometres x 1.36 kilometres, or about 183 hectares (452 acres). The actual size of the deep geological repository would depend on a number of factors such as number of fuel bundles and their heat output, depth of the repository and site-specific factors such as thermal conductivity of the rock mass.
Underground Facility	During the Phase 2 extended storage period, the used fuel would be placed in a series of shallow rock caverns excavated at a nominal depth of 50 metres below surface. During the Phase 3 long-term isolation period, the used fuel would be placed in a network of horizontal access tunnels and rooms excavated in stable rock at a nominal depth of 500 to 1,000 metres below surface. Used fuel containers would be placed within the rooms or in boreholes drilled into the floor of the rooms. Used fuel containers are assumed to be placed in the deep repository over a 30-year operating period.
Repository Sealing System	Clay-based materials would be used to surround and protect the containers, to fill the void spaces in the repository, to limit the movement of groundwater and dissolved material, and to protect workers during container placement operations. These are referred to as sealing systems, and involve materials such as high-performance concrete and swelling bentonite clay.
Geosphere Barrier	The geosphere, or host rock, provides the principal barrier between the used fuel containers and the surface environment. Both the Canadian Shield granite and the Ordovician sedimentary rock basins are examples of naturally occurring geological formations which have long-term stability, good rock strength, and low groundwater flow. Large areas exist with sufficient depth below the surface and lacking in mineral resources that they are very unlikely to be disturbed by erosion or accidental drilling.
Monitoring	Used fuel would be monitored in the central shallow rock caverns and in the deep repository. During Phase 2, monitoring would be straightforward over the estimated 30-year period since the storage containers are readily accessible. During Phase 3, monitoring over an estimated 240-year period would require more effort and technology since the long-term isolation containers would be backfilled and sealed within the placement rooms. Monitoring would be conducted to confirm the long-term safety and performance of the repository system. Until a decision is made to backfill and seal the access to the deep repository, monitoring would take place in-situ at repository depth. After closure of the deep repository around 300 years, postclosure monitoring of the facility could take place from the surface.

Table 6-4 (cont'd) Option 4: Adaptive Phased Management

Representative Conceptual Design Activities for Adaptive Phased Management	
Retrieval	Used fuel would be retrievable at all times. The technology to retrieve used fuel containers from a deep geological repository would need to be further developed and demonstrated at the site. During Phase 2, used fuel retrieval would be straightforward over the estimated 30-year period since the storage containers are readily accessible. During Phase 3, used fuel retrieval over an estimated 240-year period would require more effort and technology since the long-term isolation containers would be backfilled and sealed within the placement rooms.
Illustrative Implementation Schedule	A government decision in 2006 to select this management approach would see an underground characterization facility and possibly a central shallow underground rock cavern storage facility ready by about 2035. The deep geological repository could then ready by about 2065. Following a decision by the federal government, the following activities with their **illustrative** timelines would be undertaken: • Siting of central facility (about 20 years) • Design and construction of the underground characterization facility and the optional shallow underground storage caverns, if required (about 10 years) • Transportation to central facility (over about 30 years) • Placement in deep geological repository (over about 30 years) • Extended monitoring (up to 300 years) • Decommissioning and closure (over about 25 years) • Postclosure monitoring (indefinite) There would be a need to obtain a licence at each phase and demonstrate continuous compliance with the licence (under regulatory oversight).
Decommissioning	Once a societal decision was made and the necessary approvals were obtained, decommissioning would commence and all underground access tunnels and shafts would be backfilled and sealed. Surface facilities would be decontaminated and dismantled. Closure activities include removal of monitoring instruments and returning the site to greenfield conditions.
Costs	The cost of the Adaptive Phased Management approach is conservatively estimated to be about $24 billion (2002 dollars), including interim used fuel storage and retrieval from reactor sites, transportation costs to the central facility, extended storage in underground caverns, technology research development and demonstration in the underground characterization facility and placement of used fuel in a deep geological repository. These costs include the development and demonstration of the technology to retrieve used fuel from the deep repository, but not the costs to perform retrieval operations from the deep repository. The present value cost based on current long-term economic factors is approximately $6.1 billion (2004 dollars). (www.nwmo.ca/assessments) These costs include construction and operation of the shallow underground storage facility at the central site. If, however, the used fuel remains at reactor sites prior to operation of the deep repository and is not first placed in shallow storage, these costs would be reduced to about $21 billion (2002 dollars) with a present value of about $5.1 billion (2004 dollars).

Figure 6-6 Adaptive Phased Management: Phase 1 – Preparing for Central Used Fuel Management

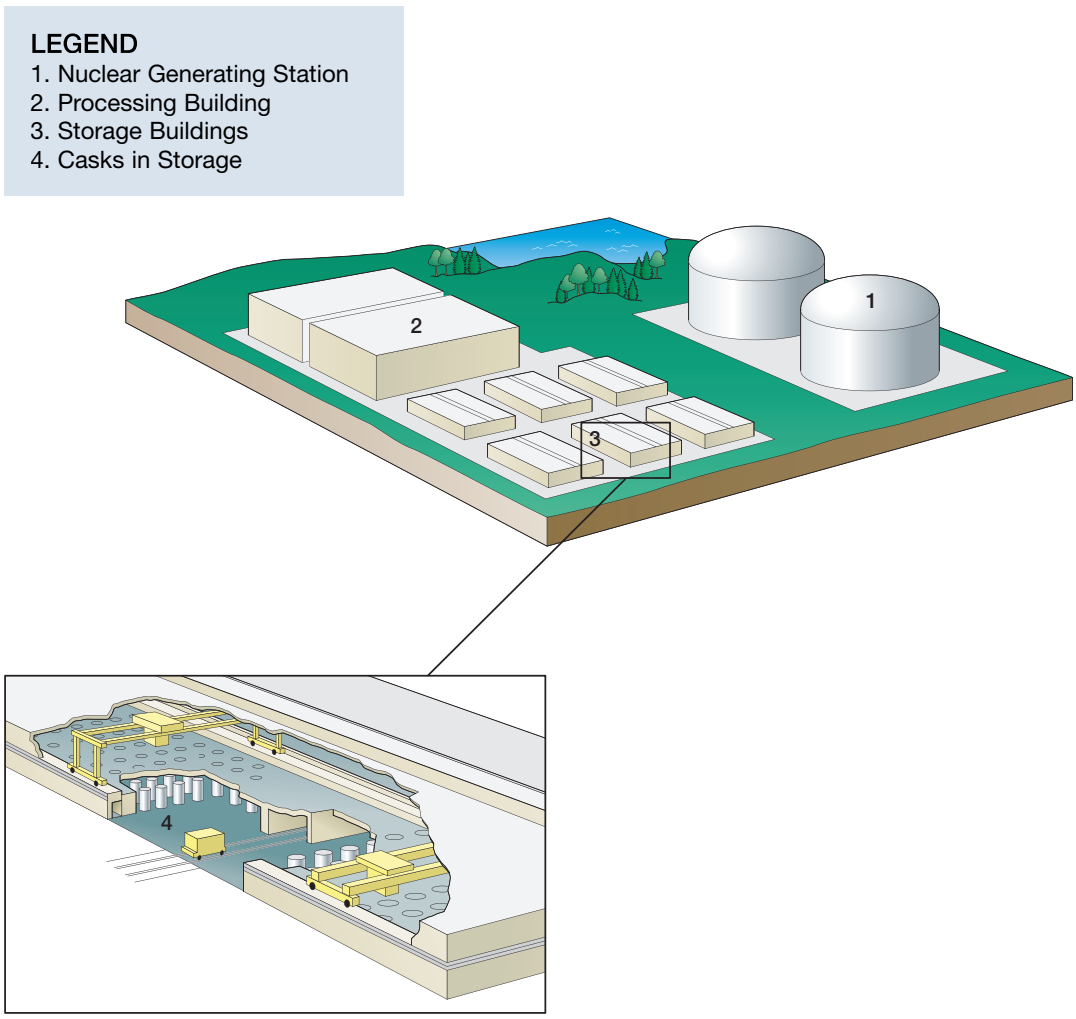


Figure 6-7 Adaptive Phased Management: Phase 2 – Central Storage and Technology Demonstration

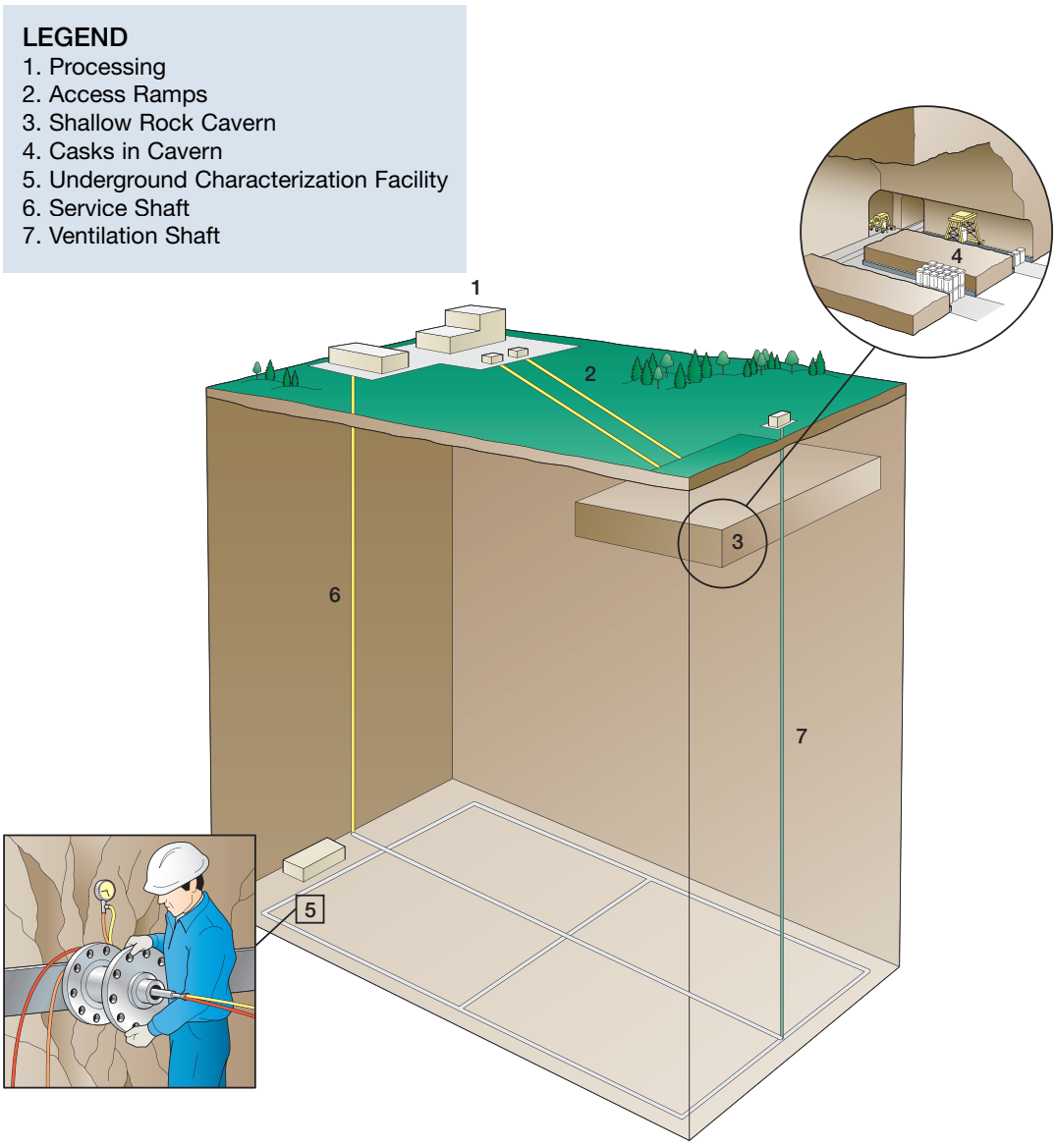
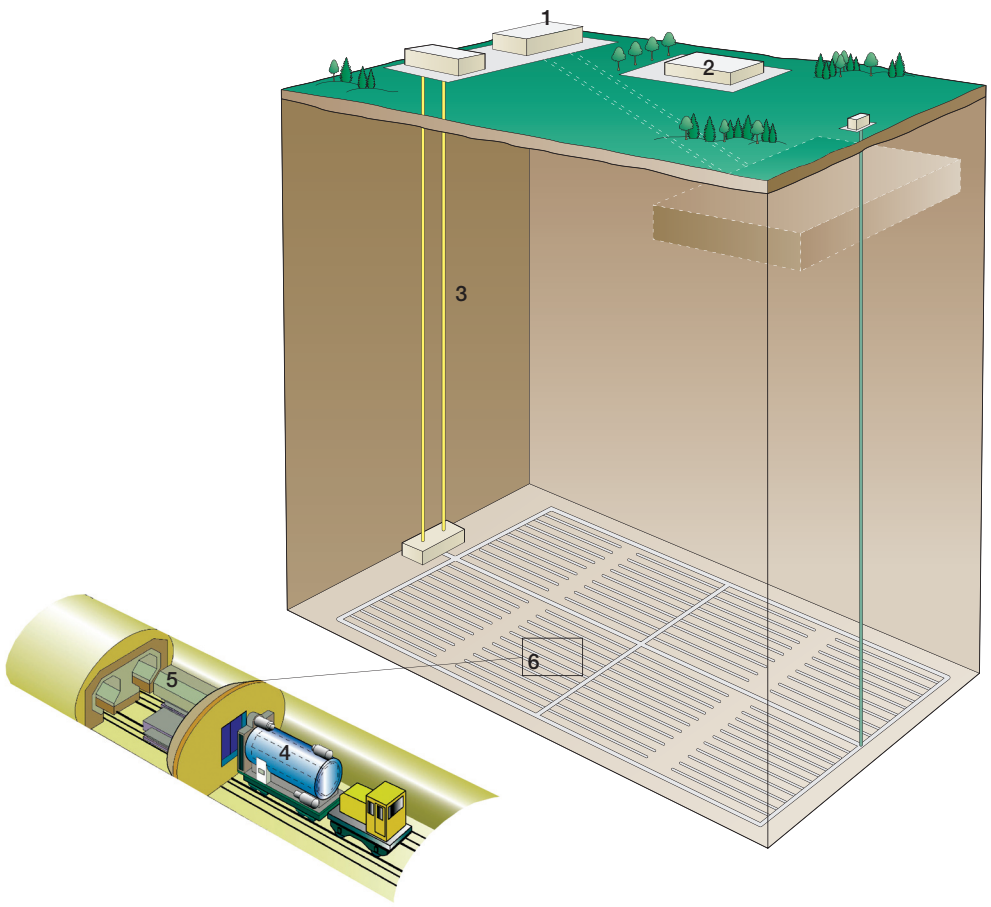


Figure 6-8 Adaptive Phased Management: Phase 3 – Long-Term Containment, Isolation and Monitoring

LEGEND
1. Repackaging Building
2. Sealing Materials Plant
3. Waste Shaft
4. Transport Cask
5. Jacketed Used Fuel Container
6. Placement Rooms



Chapter 7 / Economic Regions for Implementation

Although the NWMO is not proceeding with site selection as part of this study, we have an obligation under the *Nuclear Fuel Waste Act* (*NFWA*) to address economic regions for implementation of each approach studied.

The *NFWA* defines an 'economic region' as that described by Statistics Canada in its Guide to the Labour Force Survey, published on January 31, 2000. Economic regions are broad-based geographic units, generally composed of several census divisions within a province, used for compiling statistics and analysis of regional economic activity.

The 2000 Survey described 73 regions. Presently, there are 76 economic regions in Canada, including the Yukon, Northwest Territories and Nunavut.

Having listened to Canadians, we believe that the objectives of safety and fairness should be central in guiding decisions regarding location for the management approach. These objectives underlie our proposals regarding the specification of economic regions and our proposed siting considerations.

The *NFWA* does not require the NWMO to identify a particular region for implementing each management approach. This is appropriate for a number of reasons:

- Storage at nuclear reactor sites (Option 2) would, by definition, require implementation in a number of different regions. Similarly, centralized approaches (Options 1, 3 and 4) through their transportation requirements, would involve implementation in more than one region;

- Siting characteristics for any centralized facility would need to take into account, among other things, the suitability of a location in terms of its geotechnical and environmental characteristics. These characteristics differ vastly within regions, making it difficult to propose economic regions without site investigation. Screening out economic regions during the conceptual study phase, without the benefit of site characterization, would risk prematurely eliminating potential candidate regions from consideration; and

- Finally, we believe that the preferred site for any new facility must take into account many social, environmental, physical and technical factors that will determine its suitability for ensuring the objectives of safety and security. Narrowing the number of economic regions at this time may unduly remove communities that might otherwise wish to be considered as potential host locations.

7.1 / What We Can Learn from Economic Regions

The NWMO has done its best to specify regions that have potentially suitable locations for implementing different types of management approaches, and has done so to the extent practicable at this time.

It is useful to examine economic regions to understand how implementation might differ according to location. We examined in some depth the implications of situating a facility in different types of regions that reflect a diversity of human and biophysical characteristics. We looked at a range of economic regions, for purely illustrative purposes, as a means of understanding the costs, benefits and risks associated with locating a facility in regions with different physical, demographic and socio-economic features. We discuss this work in Chapter 8.

Through our analysis, we have seen that there is often as much variation within an economic region, as between regions, making it difficult to generalize about the suitability of one region over another.

A given economic region can exhibit vast differences in geology, environmental conditions, demographics and socio-economic composition. It is difficult to generalize beyond a certain point about the suitability of a particular region. For example, it is possible that an economic region might include areas of stable geology and areas that would be considered seismically unstable. In such cases, it would be

inappropriate to exclude from consideration the region in its entirety.

Economic regions are not designed around meaningful boundaries for purposes of engaging in discussion about possible host communities. They do not reflect political or legal boundaries. Nor do they represent boundaries of traditional Aboriginal territories, or our country's ecozones. As a population, we do not organize our communities around the units of economic regions. We may have just as much or more in common with communities in neighbouring regions, as with communities located in other areas within our own defined economic region.

Ultimately, decisions on locating a facility will be made based on site-specific characteristics, and not economic regions. Following a government decision on a management approach, implementation planning will transition from this discussion of broad economic boundaries to one that considers specific siting characteristics defined for a fully specified project. Decisions will be guided by principles, objectives and processes that are developed collaboratively between the NWMO and interested locations. For further discussion on the proposed siting process, see Chapter 9.

7.2 / Specification of Economic Regions

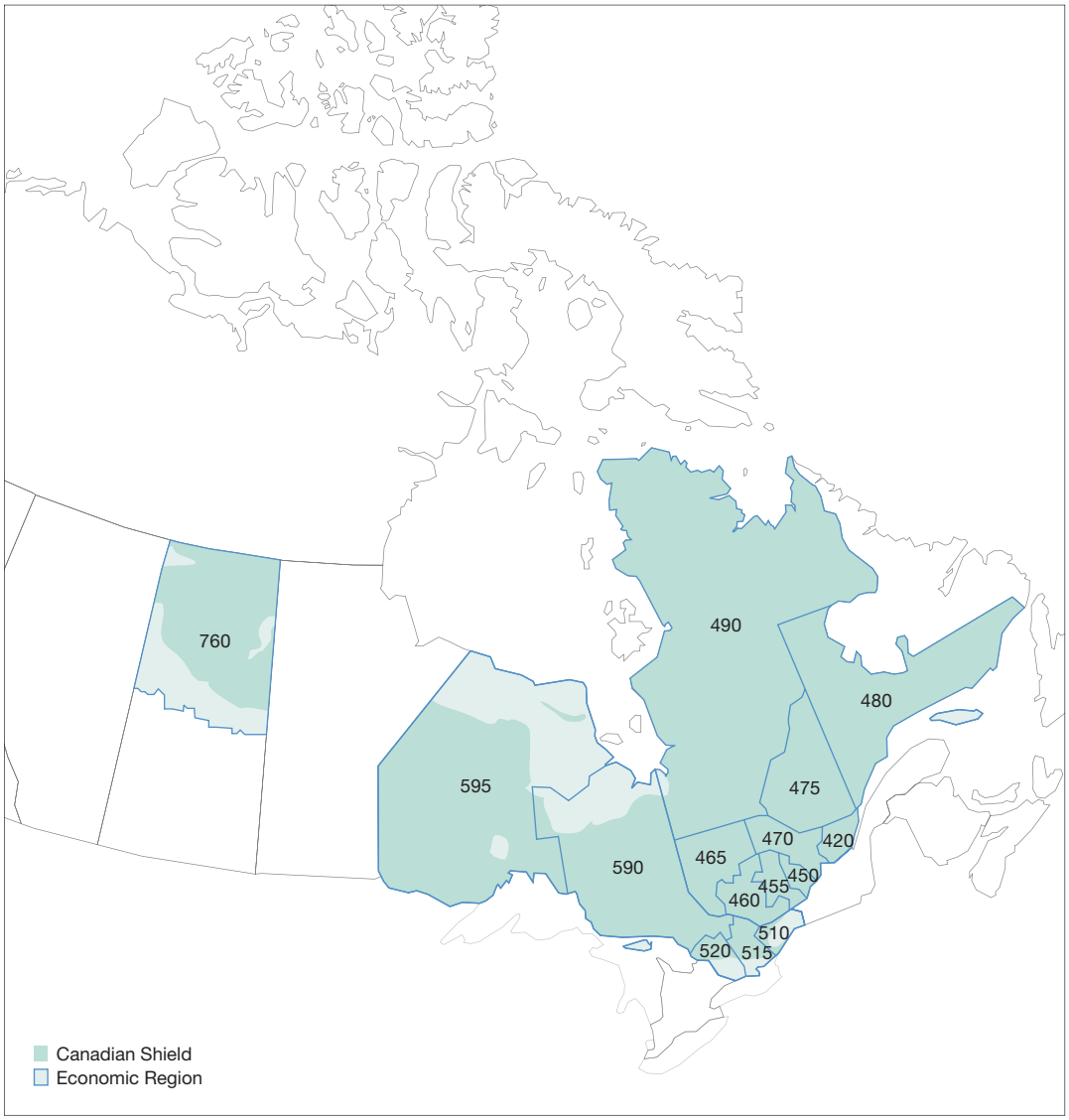
We believe that the objective of fairness would best be achieved if the site selection process were focused within the provinces that are directly involved in the nuclear fuel cycle.

Accordingly, in specifying economic regions for centralized facilities for initial consideration, we have proposed that the process of implementation be in the provinces that have benefited from activity associated with the nuclear fuel cycle.

This includes the three provinces that generate electricity from nuclear power and consequently create used nuclear fuel as a by-product (Ontario, New Brunswick and Québec), as well as Saskatchewan, which has benefited economically from mining the uranium that is used to make nuclear fuel. We believe that these provinces have a greater responsibility than do other provinces and territories to manage the waste stream arising from the nuclear process.

We recognize that communities in other regions and provinces, beyond the four nuclear provinces, may come forward with an interest in hosting a facility for the long-term management of used nuclear fuel. Provided that a site is shown to meet the established safety and other regulatory requirements, such regions would not be denied the opportunity to be considered as a potential host.

Figure 7-1 Option 1: Deep Geological Disposal in the Canadian Shield-Map



Option 1: Deep Geological Disposal in the Canadian Shield

The *NFWA* definition of disposal confines this approach to the economic regions lying in the Canadian Shield.

Thus, Option 1: Deep Geological Disposal in the Canadian Shield, brings the focus of potential implementation to the 21 economic regions which encompass the crystalline rock of the Canadian Shield, which stretches across six provinces and two territories. More specific examination of the regions, against siting principles and scientific and technical siting requirements, would determine the potential suitability of these regions for implementation of Option 1.

Figure 7-1 and Table 7-1 specify the economic regions that we propose be considered for possible implementation of Option 1: Deep Geological Disposal in the Canadian Shield.

Table 7-1 Economic Regions for Possible Implementation of Option 1

The economic regions specified below may be suitable for implementation of Option 1: Deep Geological Disposal in the Canadian Shield.

QUÉBEC:
420: Québec
450: Lanaudière
455: Laurentides
460: Outaouais
465: Abitibi-Témiscamingue
470: Mauricie
475: Saguenay-Lac St. Jean
480: Côte-Nord
490: Nord-du-Québec

ONTARIO:
510: Ottawa
515: Kingston-Pembroke
520: Muskoka – Kawarthas
590: Northeast
595: Northwest

SASKATCHEWAN:
760: Northern

Option 2: Storage at Nuclear Reactor Sites

Under Option 2: Storage at Nuclear Reactor Sites, used nuclear fuel would be stored at the sites presently hosting nuclear reactors. Therefore, implementation of long-term storage at nuclear reactor sites would be specified for the six economic regions in which the existing seven nuclear reactor sites are located.

Figure 7-2 and Table 7-2 specify the economic regions that would be considered for possible implementation of Option 2: Storage at Nuclear Reactor Sites.

Table 7-2 Economic Regions for Possible Implementation of Option 2

The NWMO proposes specification of the following economic regions for possible implementation of Option 2: Storage at Nuclear Reactor Sites.

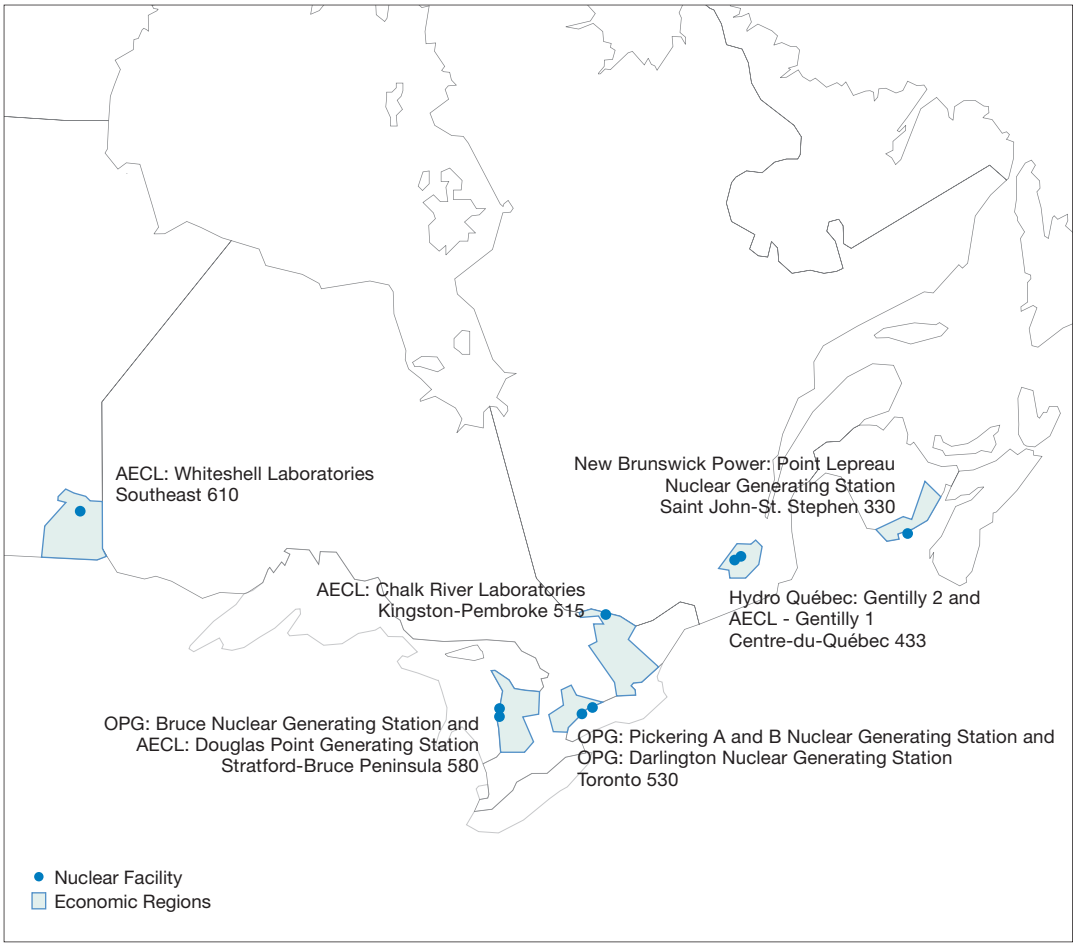
QUÉBEC:
433: Centre-du-Québec (Gentilly Reactors)

ONTARIO:
515: Kingston-Pembroke (Chalk River Laboratory Reactors)
530: Toronto (Pickering and Darlington Reactors)
580: Stratford-Bruce Peninsula (Bruce Power Reactors; AECL Douglas Point Reactor)

NEW BRUNSWICK:
330: Saint John-St. Stephen (Point Lepreau Reactor)

MANITOBA:
610: Southeast (Whiteshell Laboratories)

Figure 7-2 Option 2: Storage at Nuclear Reactor Sites-Map



Option 3: Centralized Storage (above or below ground)

The *NFWA* does not set out any criteria that would restrict the siting for Option 3 geographically. By its nature, centralized storage may be designed to be built above ground as well as slightly below ground surface anywhere in Canada.

Not reliant on specific geological requirements to enable safe operation of this type of facility, other than required soil characteristics to support the storage facilities and associated infrastructure, this concept offers considerable flexibility in siting. The starting point is the complete set of 76 economic regions in Canada.

More specific examination of the regions, against siting principles and scientific and technical siting requirements, would determine the potential suitability of these regions for implementation of Option 3.

Figure 7-3 and Table 7-3 specify the economic regions that we propose be considered for possible implementation of Option 3: Centralized Storage (above or below ground).

Option 4: Adaptive Phased Management

Phase 1 of Option 4 involves interim storage at nuclear reactor sites.

Phases 2 and 3 of this staged management approach would require selecting a site that would support a deep geological repository. The same site must also be suitable for shallow underground interim storage.

Sites to be considered would need to have the robust rock formations required to safely contain and isolate used fuel perpetually, as envisaged in the design concept.

Canada is fortunate in that its vast geological

Table 7-3 Economic Regions for Possible Implementation of Option 3

The economic regions specified below may be suitable for implementation of Option 3: Centralized Storage, Above or Below Ground.

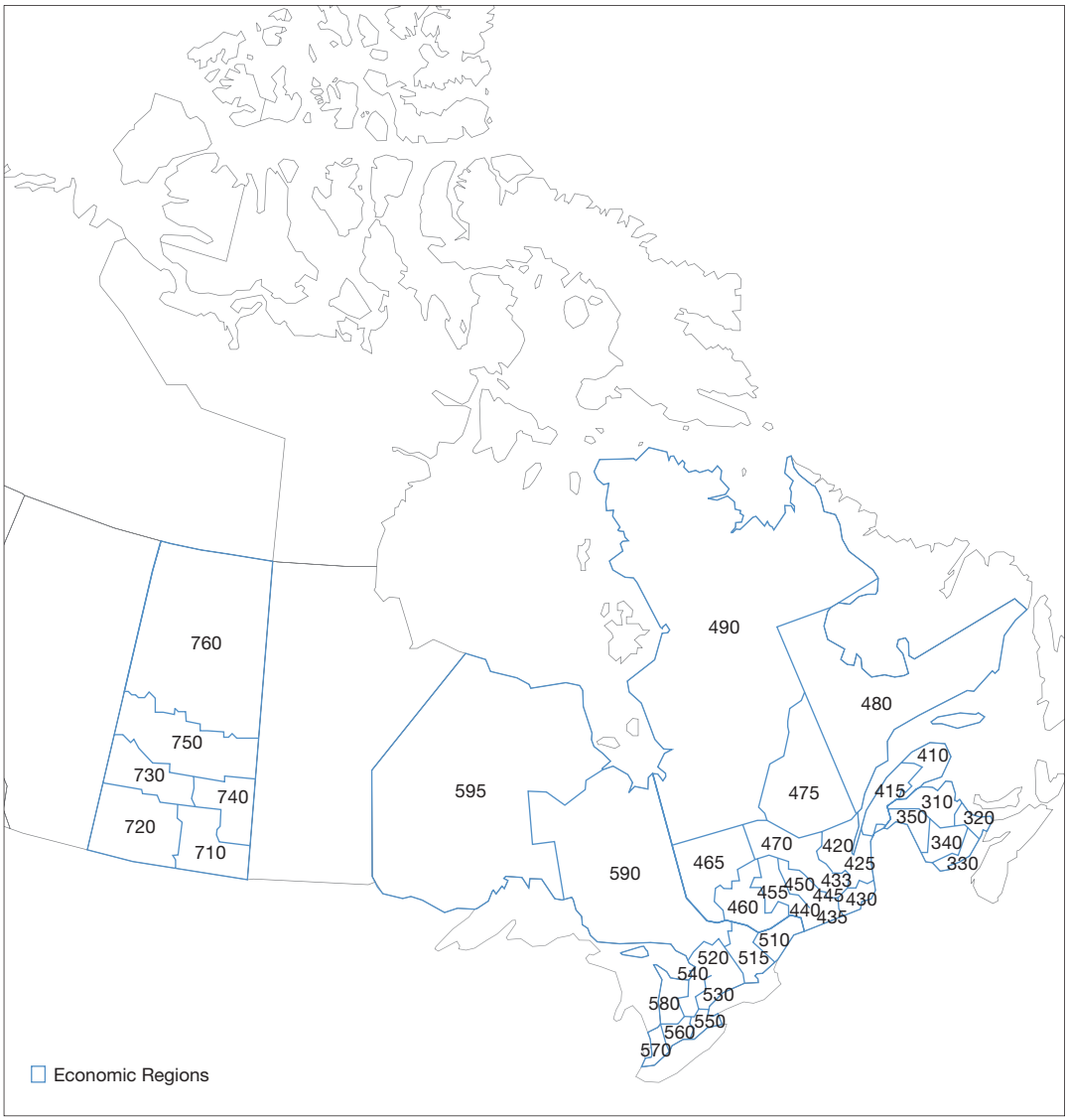
NEW BRUNSWICK:
310: Campbellton – Miramichi
320: Moncton – Richibucto
330: Saint John – St. Stephen
340: Fredericton – Oromocto
350: Edmundston – Woodstock

QUÉBEC:
410: Gaspésie – Îles-de-la-Madeleine
415: Bas-Saint-Laurent
420: Québec
425: Chaudière – Appalaches
430: Estrie
433: Centre-du-Québec
435: Montérégie
440: Montréal
445: Laval
450: Lanaudière
455: Laurentides
460: Outaouais
465: Abitibi-Témiscamingue
470: Mauricie
475: Saguenay – Lac-Saint-Jean
480: Côte-Nord
490: Nord-du-Québec

ONTARIO:
510: Ottawa
515: Kingston – Pembroke
520: Muskoka – Kawarthas
530: Toronto
540: Kitchener – Waterloo – Barrie
550: Hamilton – Niagara Peninsula
560: London
570: Windsor – Sarnia
580: Stratford – Bruce Peninsula
590: Northeast
595: Northwest

SASKATCHEWAN:
710: Regina – Moose Mountain
720: Swift Current – Moose Jaw
730: Saskatoon – Biggar
740: Yorkton – Melville
750: Prince Albert
760: Northern

Figure 7-3 Option 3: Centralized Storage (Above or Below Ground)-Map



resources present many options for locating a deep underground repository. Most notably, the 21 economic regions on the Canadian Shield may offer candidate sites. In addition, other rock formations such as the Ordovician sedimentary formations may prove to offer other robust sites for hosting a facility.

Figure 7-4 illustrates the economic regions that we believe present potentially suitable rock formations to support Phases 2 and 3 of implementation.

More specific examination of the regions, against siting principles and scientific and technical siting requirements, would determine the potential suitability of these regions for implementation of Option 4.

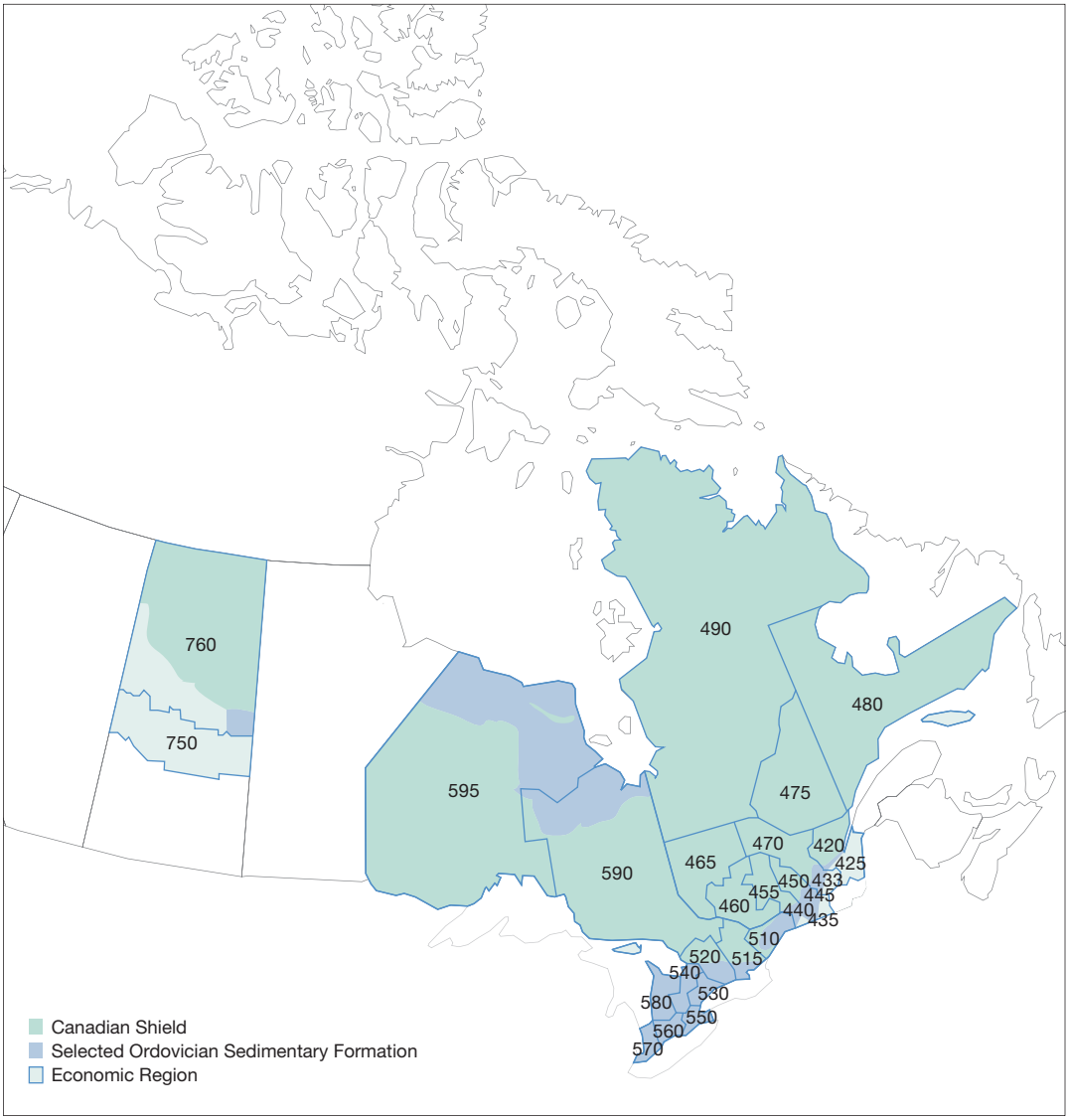
Table 7-4 specifies the economic regions that we propose be considered for possible implementation of Option 4: Adaptive Phased Management.

Table 7-4 Economic Regions for Possible Implementation of Option 4

The economic regions specified below may be suitable for implementation of Option 4: Adaptive Phased Management

Economic regions at nuclear reactor sites: **Phase 1 Implementation**	Economic regions with rock formations potentially suitable for a centralized deep repository: **Phase 2 and 3 Implementation**	
	Economic regions with potentially suitable rock formations, within provinces associated with the nuclear fuel cycle:	
List A: 6 Regions at Nuclear Reactor Sites **QUÉBEC:** 433: Centre-du-Québec (Gentilly Reactors) **ONTARIO:** 515: Kingston – Pembroke (Chalk River Laboratory Reactors) 530: Toronto (Pickering and Darlington Reactors) 580: Stratford – Bruce Peninsula (Bruce Power Reactors; AECL Douglas Point Reactor) **NEW BRUNSWICK:** 330: Saint John – St. Stephen (Point Lepreau Reactor) **MANITOBA:** 610: Southeast (Whiteshell Research Laboratory)	**List B:** On the Canadian Shield: **QUÉBEC:** 420: Québec 450: Lanaudière 455: Laurentides 460: Outaouais 465: Abitibi – Témiscamingue 470: Mauricie 475: Saguenay – Lac St. Jean 480: Côte-Nord 490: Nord-du-Québec **ONTARIO:** 510: Ottawa 515: Kingston/Pembroke* 520: Muskoka – Kawarthas 590: Northeast 595: Northwest **SASKATCHEWAN:** 760: Northern	**List C:** On Selected Ordovician Sedimentary Formation: **ONTARIO:** 510: Ottawa** 515: Kingston – Pembroke* 520: Muskoka – Kawarthas** 530: Toronto* 540: Kitchener – Waterloo – Barrie 550: Hamilton – Niagara 560: London 570: Windsor – Sarnia 580: Stratford – Bruce Peninsula* 590: Northeast** 595: Northwest** **QUÉBEC:** 420: Québec** 425: Chaudière – Appalaches 433: Centre-du-Québec* 435: Montérégie 440: Montréal 445: Laval 450: Lanaudière** 455: Laurentides** 460: Outaouais** 470: Mauricie** **SASKATCHEWAN:** 750: Prince Albert 760: Northern ** * Economic Region already captured in List A. ** Economic Region already captured in List B.

Figure 7-4 Option 4: Adaptive Phased Management-Map



The NWMO specifies economic regions for implementation of:

- Phase 1: Regions presently hosting nuclear reactors
  - Economic regions with nuclear reactor sites.

- Phases 2 and 3: Regions with potentially suitable rock formations in the nuclear provinces, for example:
  - On the Canadian Shield; or
  - On selected Ordovician Sedimentary basins.

Although the NWMO has reviewed and identified a number of economic regions as required by the *Nuclear Fuel Waste Act*, we are not recommending the use of economic regions as the basis for siting a central facility for Options 1, 3 or 4.

Chapter 8 / Comparison of Benefits, Risks and Costs

In this chapter, we highlight the major exercises which the NWMO used to:

- Translate the direction of citizens into a concrete framework which could be used for assessment,
- Apply this framework to assess the used fuel management options, and
- Refine the assessment in light of comment and feedback by citizens.

Section 12(4) of the *Nuclear Fuel Waste Act* (*NFWA*) outlines the comparative assessment that the NWMO must undertake in considering the different management approaches. In response to the Act, Section 8.1 of this chapter describes the steps taken to develop the assessment framework within which we assessed the management approaches. Section 8.2 describes the systematic streams of analysis that we applied in examining the costs, benefits and risks of the management approaches and Section 8.3 reports on the results of our assessment. We conclude this chapter with a summary of the NWMO's assessment of the management approaches against the framework developed.

8.1 / Study Foundations: The Building of an Assessment Framework

The Challenge and Response

At the request of the federal and Ontario governments, and after a more than 20 year research program, a concept for the management of used nuclear fuel in Canada was developed by Atomic Energy of Canada Limited (AECL). This concept was subjected to a ten-year public environmental assessment and review process which, in 1998, culminated in a report known as the "Seaborn Report" after its chairman, Blair Seaborn. Among the key conclusions of the report were the following:

- "From a technical perspective, safety of the AECL concept has been on balance adequately demonstrated for a conceptual stage of development. But from a social perspective, it has not."
- "As it stands, the AECL concept for deep geological disposal has not been demonstrated to have broad public support. The concept in its current form does not have the required level of acceptability to be adopted as Canada's approach for managing nuclear fuel wastes."

The panel identified the absence of an ethical and social framework within which to assess options as an important issue.

The Government of Canada response to the report of the Panel articulated a policy framework for management of radioactive waste and provided direction for federal nuclear waste management policy, leading to the implementation of the *Nuclear Fuel Waste Act* (*NFWA*) in 2002. This Act put into law the requirement that the companies which produce used nuclear fuel must conduct a study of at least three options: deep geological disposal in the Canadian Shield; storage at nuclear reactor sites; and, centralized storage, either above or below ground. Importantly, among the requirements of this study was the following:

> 12. (4) Each proposed approach must include a comparison of the benefits, risks and costs of that approach with those of the other approaches, taking into account the economic region in which that approach would be implemented, as well as ethical, social and economic considerations associated with that approach.

Reflecting the lessons learned by the Seaborn Panel about the need to give weight to both technical considerations and social and ethical considerations in the determination of a management approach, and the explicit direction in the Act to treat ethical and social considerations as a key driver of any assessment, the

NWMO took upon itself a specific mission. This mission was to develop collaboratively with Canadians a management approach for the long-term care of Canada's nuclear fuel that is socially acceptable, technically sound, environmentally responsible and economically feasible. The NWMO has attempted to respond to these requirements by implementing a study, and assessment, which is broadly directed by the social and ethical concerns of citizens from its outset while being informed by the knowledge and experience of scientific and technical specialists in Canada and abroad.

As discussed in more detail in Chapter 3, we designed our study process to, as much as possible, be directed by the values, expectations and concerns of Canadians. To fully understand these values, expectations and concerns as they apply to the management of used nuclear fuel, the NWMO's study attempted to explore these considerations in an iterative way, with greater depth and detail as the study process and the NWMO's thinking evolved. As the core element of the study, the assessment of management approaches was also designed to be grounded in the values, expectations and concerns of Canadians while being informed by the knowledge and expertise of specialists. As reported in Chapter 4, this interplay between a broad dialogue with Canadians and the analysis of specialists began in 2002 and continued through to the writing of this report.

In practical terms, the NWMO attempted to develop a framework for assessment which integrates the broad range of social and ethical concerns with technical considerations. Early in the study, the NWMO's Roundtable on Ethics suggested that the best way of building such an integrated framework, which includes an appropriate treatment of ethical considerations, was to embed both ethical considerations and public values in the framework rather than separately from technical considerations. As the Seaborn Panel suggested earlier, and as the NWMO came to understand, social and technical notions of the core concepts of the assessment, such as what constitutes 'safety' and 'risk', are so intertwined they cannot be usefully separated for the purpose of development and application of an assessment framework. Social and technical perspectives on safety and risk, including the concept of 'social safety' as identified by the Seaborn Panel, must be treated in a holistic and integrated way throughout the assessment.

As a result, in the NWMO's assessment, ethical and social considerations have been considered in the context of the main substantive areas of the study. Ethical and social considerations factor into the determination of the objectives used in the assessment; for example community well-being, fairness and adaptability. They have also factored into the identification of the influences for performance of each objective; for example interspecies distributional fairness, intergenerational distribution of costs, and community social/cultural quality. Finally, ethical and social considerations factor prominently in the key dimensions of implementation; for instance accountability, continuous learning, engagement and participatory decision-making.

Roadmap for the Assessment

Three key inputs to the assessment emerged from the dialogue with Canadians early in the study process. As illustrated in Figure 8-1, these were:

- A set of ten key questions which should be asked and answered in the study;
- Elements of an ethical and social framework, including a list of citizen and Aboriginal values, a list of ethical principles suggested by the NWMO's Roundtable on Ethics, and a set of future scenarios identified from a multi-party scenario exercise as those which ought to be planned for in any decisions we make today; and,
- A body of technical and scientific (social and natural science) knowledge and expertise relevant to the long term management of used nuclear fuel.

Through further dialogue mid-way through the study, these inputs were:

- Distilled to a core list of eight key objectives designed to reflect the priorities and concerns of citizens as expressed in dialogue. These objectives are: fairness; public health and safety; worker health and

safety; community well-being; security; environmental integrity; economic viability; and adaptability of the approach.

Using this foundation as guidance:

- A formal assessment framework was developed and applied in a preliminary way using a multi-attribute utility analysis methodology;
- Then a more formal comparative assessment of costs, benefits and risks was conducted using the same framework;
- This was supplemented by topical analysis, including a study on risk;
- An examination of implementation considerations emerged as a critical component of the analysis.

The assessment framework, and the preliminary assessment were the subject of dialogue with Canadians and resulted in additional comment and input to the more formal comparative assessment of costs, benefits and risks. Further dialogue and engagement assisted in the identification of the range of strengths and limitations of each management approach and important implementation considerations. The objectives, as they were elaborated over the course of the study, are described in detail in Appendix 8.

The discussion of the comparative strengths and limitations of the management approaches under study with interested Canadians continued with the release of the NWMO's *Draft Study Report* which included a preliminary description of the Fourth Option – Adaptive Phased Management approach. Through a number of major engagement activities with Canadians we invited comment on the appropriateness of the recommendation as input to our assessment.

Our analytical work was informed by a number of commissioned background papers and workshops. In total, we commissioned approximately 70 background papers to support our study. We engaged more than 115 scientific and technical advisors, and more than 94 advisors on governance, institutional and legal matters. As well, we engaged more than 300 knowledge specialists in public policy issues, the environment, Aboriginal Traditional Knowledge and social sciences. A list of these background papers and reports from workshops is provided in Appendix 11, and are available on the NWMO website.

The short list of options which became the focus of the assessment was the result of a preliminary screening of a longer list of options. A description of these options is contained in Appendix 9. The results of this preliminary screening, and the short list, were confirmed through dialogue as: Deep Geological Disposal in the Canadian Shield; Storage at Nuclear Reactor Sites; and Centralized Storage. This short list of options mirrors those specified in the *Nuclear Fuel Waste Act* as the ones which must be considered in the study.

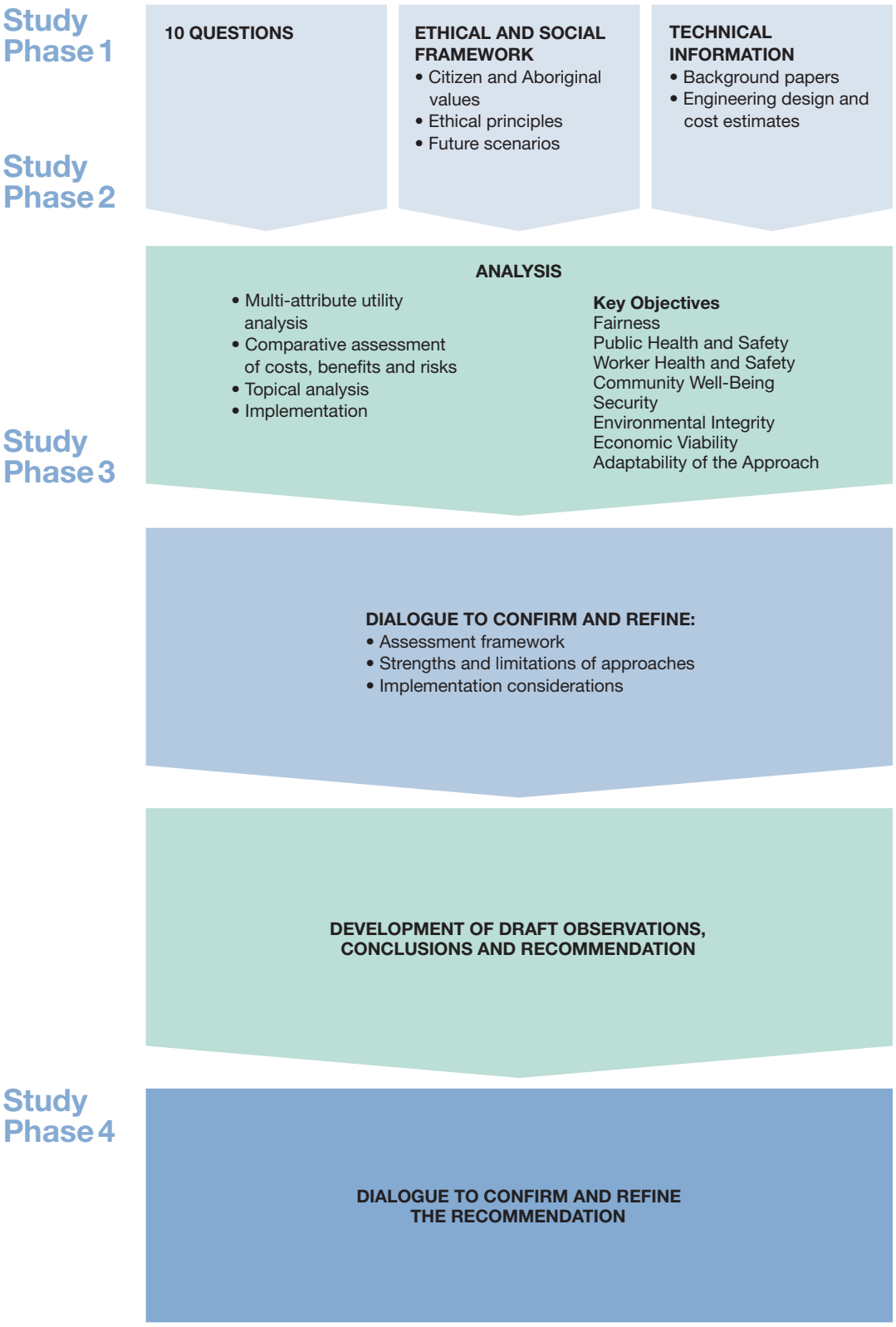
The multiple analytical processes and streams of analysis used in the assessment are discussed in more detail in Section 8.2.

8.2 / Streams of Analysis

The NWMO commissioned different, separate and complementary analyses to aid our understanding of the costs, benefits and risks of the management approaches in the study. For the purpose of all of these streams of analysis, the volume of used nuclear fuel which needs to be managed was assumed to be limited to the projected inventory from the existing fleet of reactors. In other words, the analyses were conducted using the facts as we know them at this time concerning the volume and nature of used fuel to be managed. It is possible that decision-makers may make decisions which cause the future to unfold in a way which is different from this 'reference scenario'. For this reason, this chapter concludes with a brief discussion concerning how well the preferred management approach might respond to a range of possible future scenarios in order to assess its robustness against such policy induced changes.

The basis for all of the assessments were the conceptual engineering designs for each of the management approaches and cost estimates prepared for the Joint Waste Owners, which were reviewed and validated by a third party and accepted by the NWMO.

Figure 8-1 NWMO Assessment of Management Approaches



Multi-Attribute Utility Analysis: Examining the Options Against Multiple Goals

The NWMO convened a group of individuals to work as an Assessment Team. These individuals were chosen for their diverse experiences and complementary skills in addressing complex public policy issues. Their skills ranged from environmental assessment and risk management to economic, financial and social policy analysis.

The team tackled a range of social, technical, environmental and economic aspects of used nuclear fuel management. They translated the 10 questions identified early in the study into a formal assessment framework that features eight objectives and a list of specific influencing factors based on the values and direction of Canadians identified through our engagement activities.

We asked the Assessment Team to develop and apply, in a preliminary way, a rigorous methodology for the assessment of management approaches. Consistent with the framework outlined in our first discussion document, the team selected a methodology that would allow for the integration of social and ethical objectives and principles, along with technical, economic, financial and environmental considerations.

The choice of the methodology was guided by the goals described above and influenced by a need to explicitly address multiple objectives in developing an approach for dealing with used nuclear fuel. These multiple objectives became evident in our first discussion document, *Asking the Right Questions? The Future Management of Canada's Used Nuclear Fuel*. The 10 questions listed in that report cover a broad range of objectives. Because of these multiple objectives, attention was restricted to a class of assessment methodologies known as "multi-objective" or "multi-criteria" decision tools, distinguished by their capacity to explicitly represent and work with multiple objectives.

Multi-attribute utility analysis (MUA) was selected because of its ability to aid in discriminating among options through a process of transparent deliberation. Multi-attribute utility analysis provides a step-by-step process for constructing and applying a decision model. It can be used to help identify a most preferred option, to rank options, to screen options down to a short list for more detailed analysis, or to distinguish acceptable from unacceptable choices. Many technical requirements (governing scoring, scaling, weighting, and aggregating) must be satisfied to ensure that rankings produced by the model logically flow from the judgments of the team. The evolved theory and long experience with MUA together provided a strong basis for the selection of this methodology.

Over the past two decades, numerous applications of multi-attribute utility analysis have been conducted in Canada, Great Britain, the United States and in many other countries, to assist decision-making in both the private and public sectors. A key characteristic of multi-attribute utility analysis (as well as other multi-objective approaches) is its emphasis on the judgments of the decision-making team that the analysis is intended to serve. The fact that multi-attribute utility analysis makes those judgments open and explicit was considered a strong advantage. Since the judgments and assumptions are represented as inputs to a decision model, interested parties can explore whether changes would alter conclusions.

The framework developed by the Assessment Team featured eight objectives: fairness; public health and safety; worker health and safety; community well-being; security; environmental integrity; economic viability; and adaptability. For each objective, factors that may influence the capacity to perform well against the objective were identified and mapped. The resulting "influence diagrams" created for each of the eight objectives, acted as a road map for the assessment. (See Appendix 8.) The focus of this analysis was on the objectives and factors that distinguished the management options from one another.

The team recognized that the management of used nuclear fuel must consider both a short and long-term perspective. Used nuclear fuel has the potential to affect humans and the environment for a very long period, likely hundreds of thousands of years or longer. No assessment of benefits, risks and costs can be complete without considering a range of time periods. Two time periods were used by the team for evaluating options:

Near Term, which was defined as roughly the first 175 years.

- The 175-year time horizon coincides with the seven generations concept that emerged from Aboriginal Traditional Knowledge as a target time horizon that we should use when considering the implications of today's decisions;
- It also coincides with the period during which site identification, development, licencing, operation and closure of a repository could occur. It represents a reasonable dividing line between the active period and the long-term, follow-on period;
- From a societal perspective, it is reasonable to assume the continuity of current institutional and economic structures and activities during this period;
- From a technical perspective, this time horizon marks the limit to which engineering predictions and the characteristics of human-made objects can be reasonably forecast. During such a period, environmental conditions, although undoubtedly changing, can be reasonably assumed to maintain some similarity to those of today; and
- From a scientific perspective, a period of about 175 years marks a defensible and fairly distinct division in the nature of the hazard to humans and biological life posed by nuclear fuel waste. It is the period when the used fuel bundles have been out of reactor for many decades and will have cooled substantially. By about this time, the short-lived radioisotopes, including many of the highly dangerous ones that account for most of the radioactivity contained in the waste when it is first removed from the reactor, will have decayed to insignificant levels. What will remain is the hazard from long half-life elements and isotopes that are present in much smaller quantities but remain dangerous for a very long time. During a 175-year period, the overall radioactivity of used fuel drops to about one-hundred thousandth of the level it was when removed from the reactors, but still poses a significant long-term hazard.

Long Term, which was roughly defined as the period beyond 175 years.

- In this time period, both Aboriginal Traditional Knowledge and future scenarios work conducted by the NWMO suggest it is not prudent to assume that social, institutional, or environmental conditions will closely resemble those of today;
- Although it is possible to predict the geological characteristics of rock with some confidence, the vagaries of environmental conditions above ground, combined with human-induced or natural stresses on the environment make any assessment of the human-ecological interactions extremely speculative; and
- The radioactivity of nuclear fuel wastes will continue to decline, but isotopes of iodine, chlorine, caesium, strontium and plutonium will remain radioactive and continue to pose health risks that continue to decline over time.

Three management options for used nuclear fuel were assessed using the framework. The individuals who comprised the Assessment Team did not assess each of the management options on the objectives in precisely the same way. In fact, the ranges in scores assigned by team members was quite wide, in most cases. The broad range of scores on many objectives reflected differing views among members of the Assessment Team concerning future environmental and social conditions in Canada, as well as questions regarding how well the approaches might actually perform.

The work of the Assessment Team also involved the conduct of a sensitivity analysis. This analysis included an assessment of the management approaches against plausible future alternatives. These scenarios were identified

through a major NWMO scenarios exercise earlier in the study. Additional scenarios were considered by the NWMO. All are described in Appendix 10.

Through this assessment, the Assessment Team began to articulate strengths and limitations of each approach, and present this material as a basis for public discussion.

This analysis found that no single option on its own perfectly met all the objectives that Canadians said were important. The Assessment Team work brought into focus some of the difficult choices and trade-offs to be addressed as part of the assessment of the approaches.

The results of this assessment were published in our second discussion document in 2004, *Understanding the Choices* (www.nwmo.ca/understandingthechoices). Through this document, we sought public review of this assessment framework and we received comments that validated the appropriateness of the eight objectives. Accordingly, we adopted those objectives as the basis upon which we assessed the different management options. The full report of the Assessment Team is available at www.nwmo.ca/assessmentteamreport.

Broadening the Discussion of Strengths and Limitations

Given the intensive nature of the process used by the Assessment Team, the NWMO sought to broaden the discussion of the strengths and limitations of the approaches by involving interested Canadians in various parts of the process. This was used as a means of 1) exploring the appropriateness of the individual parts of the process; 2) increasing understanding of the process used so that members of the public would be better able to scrutinize, comment and add substantively to the discussion. As part of this effort, we attempted to replicate parts of the assessment process with various dialogue initiatives.

In the National and Regional Stakeholder dialogues, one full day of each two day session was devoted to familiarizing participants with the Assessment Team process and taking them through exercises which simulated some key aspect of the process. Approximately 90 individuals participated in these illustrative exercises. Additional sessions were conducted upon request.

In the nation-wide Public Information and Discussion sessions, to which all interested Canadians were invited, the objectives used by the Assessment Team and methodology were described, as well as the key findings concerning the relative advantages and limitations of each of the approaches which emerged from this assessment. Participants in these sessions were asked to comment on the appropriateness of the objectives, and the appropriateness and inclusiveness of the advantages and limitations which emerged from the assessment. Participants were encouraged to add to the list of advantages and limitations and suggest additional objectives which ought to be considered. More than 900 individuals participated in these sessions.

Focus groups and a nation-wide survey were also used to explore the appropriateness of the objectives used for the assessment. In total, more than 2800 individuals participated in this research.

Comparative Assessment of Costs, Benefits, and Risks

The assessment of the management approaches against the objectives was tested and enhanced using an expert multi-disciplinary team assembled by Golder Associates Limited and Gartner Lee Limited. These firms brought together a group of specialists knowledgeable in a range of scientific and engineering disciplines relevant to the long term management of used nuclear fuel and with direct experience in the field of nuclear waste management in Canada and/or abroad. This team included technical specialists as well as specialists in the natural and social sciences.

The objective of this work was to develop and implement a methodology to undertake a comparative assessment of benefits, risks and costs of the management approaches, taking into account illustrative economic regions and building off of the work of the Assessment Team.

Against the same eight objectives used by the Assessment Team, a comparison of the

management approaches was undertaken on costs, benefits and on risks and uncertainty, looking at:

- Both near- and long-term time considerations; and
- Impacts of different site locations based on economic regions.

This assessment involved the following activities:

- Design and development of methods and tools for assessing the benefits, risks and costs of alternative approaches to the management of used nuclear fuel in Canada;
- Identification and development of background information for "illustrative" economic regions that would allow a comparison of the benefits, risks and costs for each approach with those of other approaches, taking into account the economic regions in which the approaches could be implemented. Note that the NWMO has not sought to select a specific site or single economic region for implementation of a management approach in this study. However, to meet the requirements of the legislation, we had to consider how the costs and benefits and risks might be affected when different types of economic regions are taken into account:
  - Economic regions were selected for purposes of analysis which covered a range of physical and socio-economic conditions, illustrative of different regions of the country; and
  - Illustrative economic regions were chosen to highlight how approaches might perform in regions with different physical and socio-economic foundations. Economic regions with different population densities, different distributions of economic activity and differing transportation requirements associated with implementing an approach were examined. This analysis was designed to highlight considerations that would arise in diverse economies, environments and population centres in an illustrative way for the analysis. It was not an attempt to pre-qualify or select sites for possible implementation.
- Examination of the numerous influencing factors for each of the eight objectives that were identified in the preliminary comparative assessment for further detailed analysis;
- Identification of measures and indicators for each of the influencing factors studied in detail for use in the comparative assessment. They were selected to allow the evaluation of the performance of the four approaches against each of the eight objectives, using quantitative measures for influencing factors where these are available and providing qualitative discussion on other influencing factors, where feasible;
- Analysis of the approaches across the applicable illustrative economic regions, using information from the chosen measures and indicators. For each option, the assessment looked at possible impacts, the consequence of impacts and the likelihood and timing when such an event might occur; and
- Assessment of the benefits, risks and costs using information from the above analysis. The analysis developed and applied appropriate and proven models that are capable of estimating effects within the social and environmental framework of the assessment, taking into account economic regions.

A detailed financial model of each management approach was developed to help assess "economic viability." These financial models describe the management phases and apply specific costs for labour and materials over a timeline extending out thousands of years. The models enabled testing of alternative costing assumptions. As well, the assessment of the community well-being objective was divided into two parts.

- First, economic relationships were modelled for 11 different illustrative economic regions. A unique input-output model was developed for each illustrative economic region, which enabled the study team to consider impacts on employment, income and taxes from the possible introduction of any of the management approaches. In addition, a qualitative assessment of other community values was conducted based on a combination of published literature and the study team's own extensive experience with nuclear and mining industry developments in both urban and rural regions of Canada; and

- The second part of the community well-being assessment involved application of the "Sustainable Livelihoods Framework" to each of the 11 illustrative economic regions. This framework allows an objective assessment of specific "capitals" including social, human, physical, financial, and natural. The intent of this quantitative analysis was to provide an indication of how each illustrative economic region ranks in its ability to adapt to the opportunities and challenges posed by the introduction of any of the management approaches.

The analysis introduced further information on how each approach was expected to perform against the eight objectives. It contributed further qualitative insights, to help broaden our understanding of costs, benefits and risks. Importantly, it included socio-economic analysis of the implications for the different types of economic regions that might host the facilities. This allowed us to consider how the location of a facility or facilities might affect benefits, risks, and costs. The detailed findings from this comparative assessment are available on our website. (www.nwmo.ca/assessments)

Topical Analysis

The NWMO assessment was also enhanced by a number of topical analyses. For instance, an analysis was conducted to estimate the potential risk associated with each stage of development of the options and main areas of potential risk were identified. Detailed findings from this and other topical analyses are available on our website. (www.nwmo.ca/backgroundpapers)

A Fourth Option Emerges

As we reflected on the assessment and listened to the commentary received from our engagement process with the general public and Aboriginal peoples, a fourth option began to emerge.

The three methods that we were required to study are well understood and are credible and viable from a technical perspective. Deep geological disposal is in an advanced state of scientific and technical understanding internationally. Used fuel storage technologies have been safely demonstrated for many years at reactor sites in Canada. However, as we listened to the public and Aboriginal peoples and considered the findings of our research, we understood that the most profound challenge does not lie solely in finding an appropriate technical method, but also in the manner in which the management approach is implemented.

The fourth option – Adaptive Phased Management – emerged from our observations.

With the emergence of the Fourth Option, work was then completed to extend the comparative assessment of costs, benefits and risks to the new hybrid option. Elements of the original conceptual engineering designs prepared for the Joint Waste Owners were used to create a preliminary design and cost estimate for the Fourth Option, which was used as the basis of the assessment.

8.3 / Assessment of Costs

Before presenting the findings from the assessment, the following discussion presents a comparison of costs of each of the management approaches, as required by the *Nuclear Fuel Waste Act*.

Table 8-1 presents the total (undiscounted) costs for each management approach as well as the present value cost for each management approach.

Cost estimates for Options 1, 2 and 3 were developed through work commissioned by the Joint Waste Owners – Ontario Power Generation Inc., Hydro-Québec, NB Power Nuclear, and Atomic Energy of Canada Limited. The Joint Waste Owners commissioned engineering consulting firms to develop preliminary conceptual engineering designs for the three technical methods identified in the *Nuclear Fuel Waste Act*, and also to develop associated transportation infrastructure and cost estimates for those designs. For each option specified in the Act, preliminary cost estimates were commissioned for siting, construction, operation, monitoring, closure and where applicable, closure and decommissioning of nuclear waste management facilities and for the transportation of used nuclear fuel. (www.nwmo.ca/costsummaries)

The NWMO commissioned a third-party review of this body of work for Options 1, 2 and 3. Independent consultants were asked to examine the key engineering design assumptions and cost estimation process. (www.nwmo.ca/engineeringreview) Their observations and conclusions were:

- All of the conceptual designs are credible, technically feasible and suitable for the intended purpose, which is to assess the options and arrive at a recommended approach;
- The conceptual designs are well developed and documented, and prepared in a manner consistent with established engineering practice; and

Table 8-1 Total Life Cycle Cost Estimates for Management Approaches

MANAGEMENT APPROACH	Total Cost (2002B$) (out to 350 years)	Total Cost (2002B$) (out to 1,000 years)	Present Value (Jan 2004 B$)
Option 1: Deep Geological Disposal in the Canadian Shield	16.2	16.3	6.2*
Option 2: Storage at Nuclear Reactor Sites			
Current Technology	17.6		2.3
New Above Ground Technology	25.7	68.4	4.4
New Below Ground Technology	21.6		3.6
Option 3: Centralized Storage			
Casks/Vaults in Storage Buildings	15.7		3.1
Surface Modular Vaults	20.0	47.0	3.8*
Cask/Vaults in Shallow Trenches	18.7		3.6
Casks in Rock Caverns	17.1	40.6	3.4*
Option 4: Adaptive Phased Management			
With Shallow Underground Storage	24.4	24.4	6.1*
Without Shallow Underground Storage	22.6	22.6	5.1*

JWO cost estimates are based on 3.7 million fuel bundles and an average reactor life of 40 years. Golder estimates are based on 3.6 million fuel bundles.
Estimates for Options 1, 2 and 3 out to 350 years were prepared by consultants for the Joint Waste Owners (www.nwmo.ca/costsummaries).
Estimates for Options 1, 2 and 3 out to 1,000 years were prepared by Golder Associates Ltd. and Gartner Lee Ltd. (www.nwmo.ca/assessments).
Estimates for Option 4 were prepared by Golder Associates Ltd. and Gartner Lee Ltd. (www.nwmo.ca/assessments).
*Present value calculations performed by Golder Associates Ltd. and Gartner Lee Ltd., are for 1000 year total estimates.
All remaining present value figures were ta en from Joint Waste Owners cost estimates using 350 year total cost estimates.
o te 1000 year cost estimates were produced from an illustrative sample of all possible management approaches, for comparative purposes only.

- Design details are consistent with the conceptual nature of the work and there is no reason to suspect that an appropriate final design could not be developed for an approach selected from the designs reviewed.

The third-party review of the cost estimates for Options 1, 2 and 3 concluded that they have been prepared with an appropriate estimating methodology and are suitable for the options review and directional decision-making requirements of the NWMO. (**www.nwmo.ca/costreview**) Specifically, the review of cost estimates included a professional opinion that the accuracy of these estimates was assessed as being within the range of plus or minus 33 percent including all the contingency allowances. These estimates were considered suitable for their purpose in assessing the magnitude of the cost of the scenarios and their alternatives.

Based on this work, the NWMO adopted these cost estimates for Options 1, 2 and 3, as thorough and reasonable cost estimates for the options based on a conceptual stage of design. A cost estimate for Option 4 was created by extracting costs from like activities in Options 1, 2 and 3.

Although definitive costs are not yet known, estimates include costs for:

- Public Health and Safety. Costs of radiation protection are accounted for in the economic costs of all approaches through facility designs and monitoring programs using today's technology and standards. There are no differences among economic regions;

- Worker Health and Safety. Costs for worker safety, including radiation protection and conventional occupational health and safety protection, are accounted for in the economic costs of all management approaches through facility designs and monitoring programs;

- Security. Costs for security are accounted for in the economic costs of all four approaches through facility designs and monitoring programs;

- Environment. Costs for environmental integrity are accounted for in the economic costs of the management approaches through facility designs and monitoring programs;

- Citizen engagement. Costs for public engagement and consultation are provided for in the cost estimates;

- Research. The cost estimates include provision for ongoing research; and

- Transportation costs. The incremental transportation costs for Deep Geological Disposal in the Canadian Shield, Adaptive Phased Management, and Centralized Storage (above or below ground) have a similar range, and vary across economic regions by up to about $1 billion (2002 dollars, not discounted). Incremental transportation costs are greater for economic regions located farther from the majority of the used nuclear fuel, which is in southern Ontario. There are no transportation costs associated with Storage at Nuclear Reactor Sites. A representative transportation cost for the other three approaches is in the range of $1.2 billion (2002 dollars, undiscounted).

The cost estimates used in evaluating each of the studied management approaches were prepared at a conceptual level, and do not include specific allocations for all labour requirements, ancillary facility operations or physical retrieval of placed fuel. The cost estimates include a contingency of approximately 20 percent, to cover possible changes in concept implementation. More detailed conceptual designs and cost estimates will be prepared during the normal course of implementation following a decision by the Government of Canada. These cost estimates and a more detailed discussion of provisions for financial surety are provided in Chapter 11.

We have reported on costs in two ways: present value and undiscounted total costs. Both convey key information for understanding the economic aspects of each option. For purposes of defining funding requirements an acknowl-

edged and accepted practice is based on the use of present value estimates. For purposes of understanding socio-economic impacts, it is instructive to also look at the undiscounted cash-flow profiles for each management approach. In examining the projected timing and repeat cycles of investments associated with building, refurbishing and maintaining a facility, the magnitude of socio-economic impacts on communities from the project over time can better be appreciated. This assists in anticipating and planning for the benefits and challenges associated with managing those cyclical changes within the community hosting the facility.

Figures 8-2 to 8-6 illustrate the undiscounted cash-flow profiles for each management approach to Year 1000. These cash flows do not include costs for interim storage, retrieval and transportation.

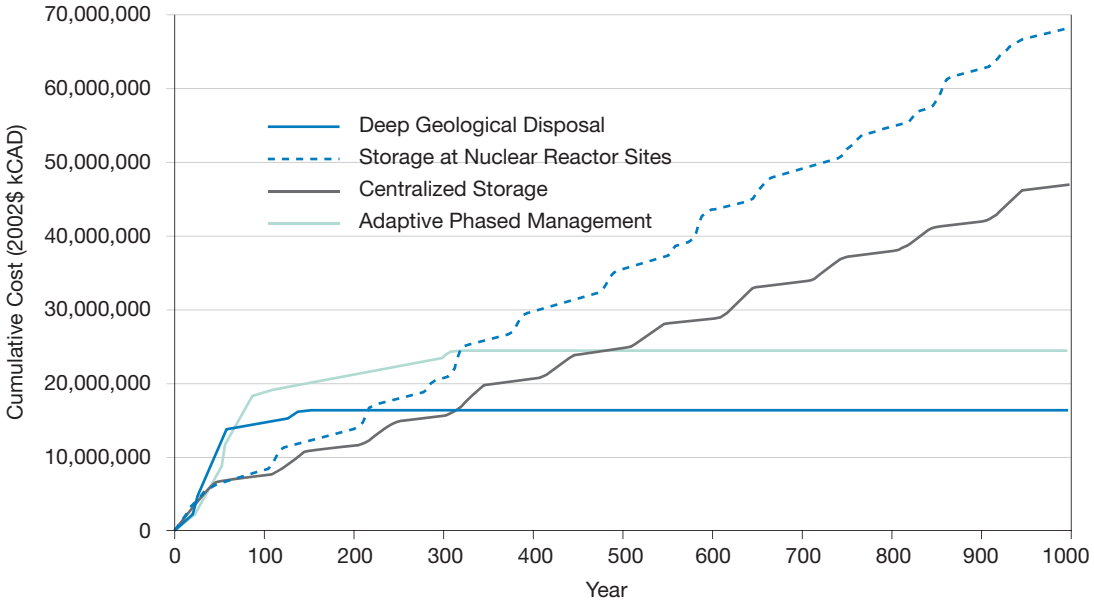
Key observations include:

- Option 1: Deep Geological Disposal in the Canadian Shield has the highest short-term cumulative cost ($10.1 billion in 2002 dollars, not discounted), up to Year 59, the time when all facilities (for all four approaches) are filled with used nuclear fuel, while Option 3: Centralized Storage (below ground) has the lowest cumulative cost ($2.6 billion in 2002 dollars, not discounted) for the same period.

- Option 4: Adaptive Phased Management has the highest cumulative cost ($16.95 billion in 2002 dollars, not discounted) up to Year 175 while Option 3: Centralized Storage (below ground) has the lowest cumulative cost ($6.6 billion in 2002 dollars, not discounted) for the same period.

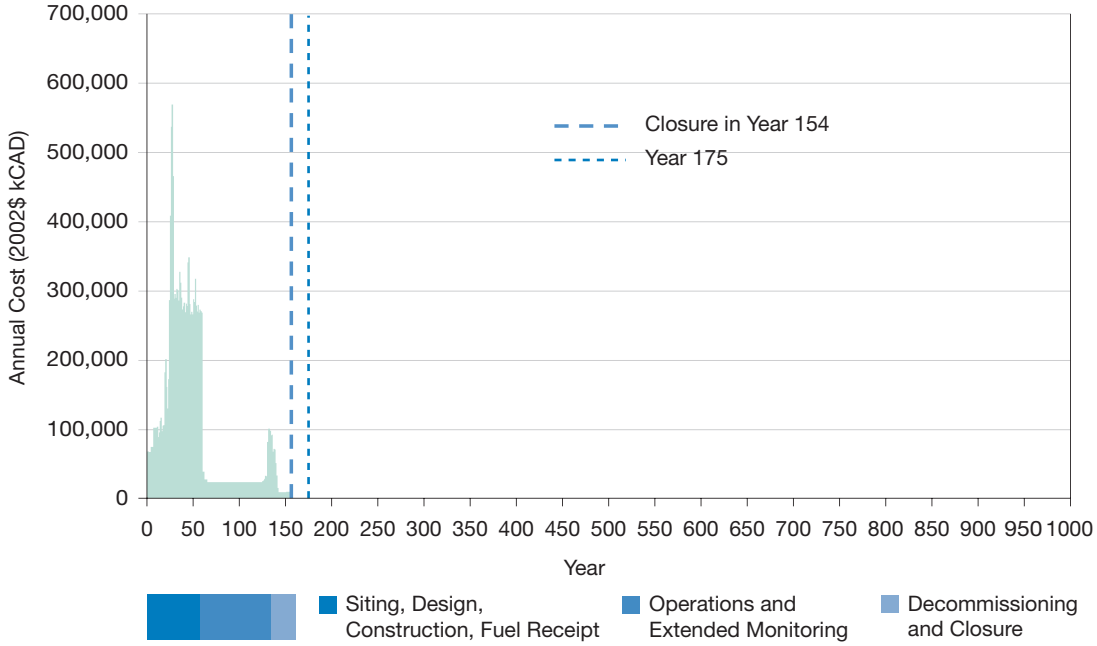
- Option 2: Storage at Nuclear Reactor Sites has the highest cumulative cost ($67 billion in 2002 dollars, not discounted) up to Year 1,000 (i.e., the "long-term" period selected for this study), while Option 1: Deep Geological Disposal in the Canadian Shield has the lowest cumulative cost ($12.7 billion in 2002 dollars, not discounted) over the same period.

Figure 8-2 Cumulative Costs: Options 1, 2, 3 and 4 (including Interim Storage, Retrieval and Transportation)



Note: No allowances for postclosure monitoring

Figure 8-3 Total Cash Flow: Option 1 – Deep Geological Disposal in the Canadian Shield (including Interim Storage, Retrieval and Transportation)



Note: No allowances for postclosure monitoring

Figure 8-4 Total Cash Flow: Option 2 – Storage at Nuclear Reactor Sites (New Above Ground Technology) (including Interim Storage, Retrieval and Transportation)

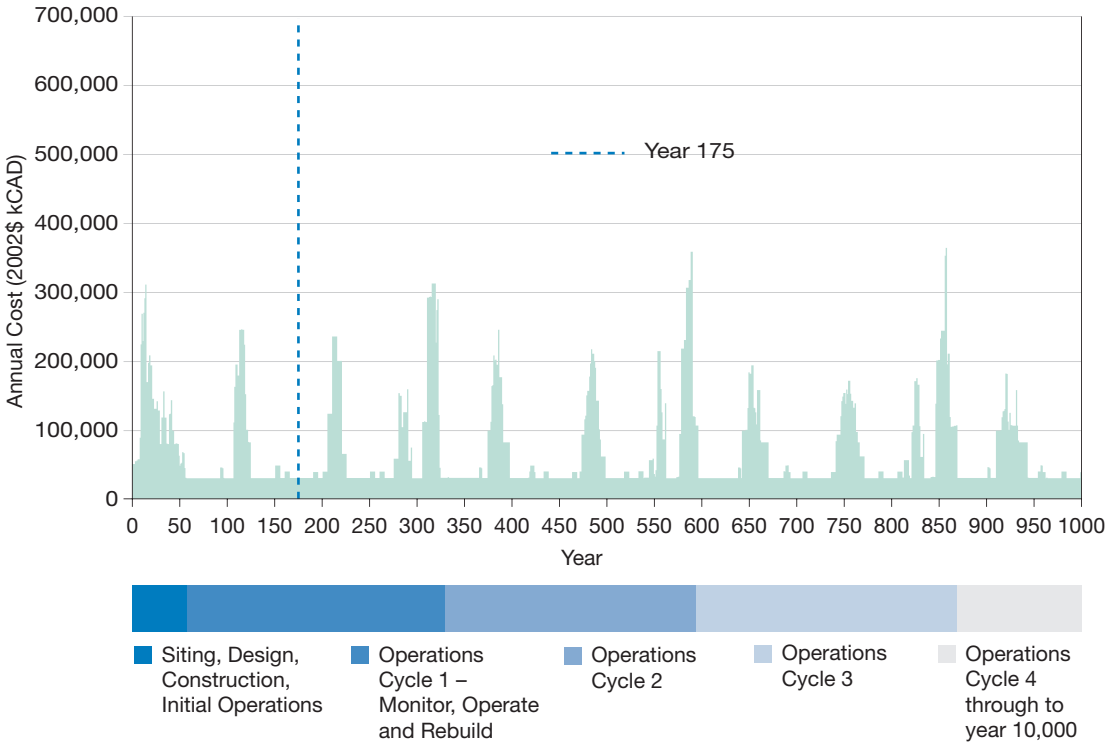


Figure 8-5 Total Cash Flow: Option 3 – Centralized Storage (Above Ground) (including Interim Storage, Retrieval and Transportation)

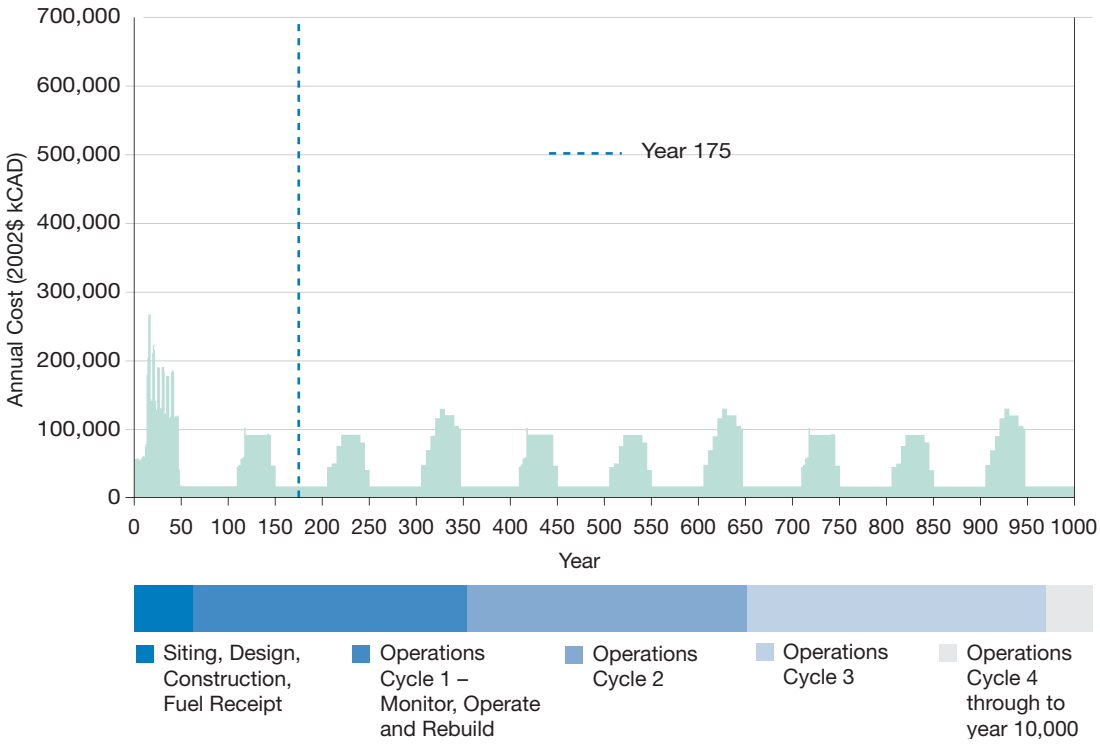
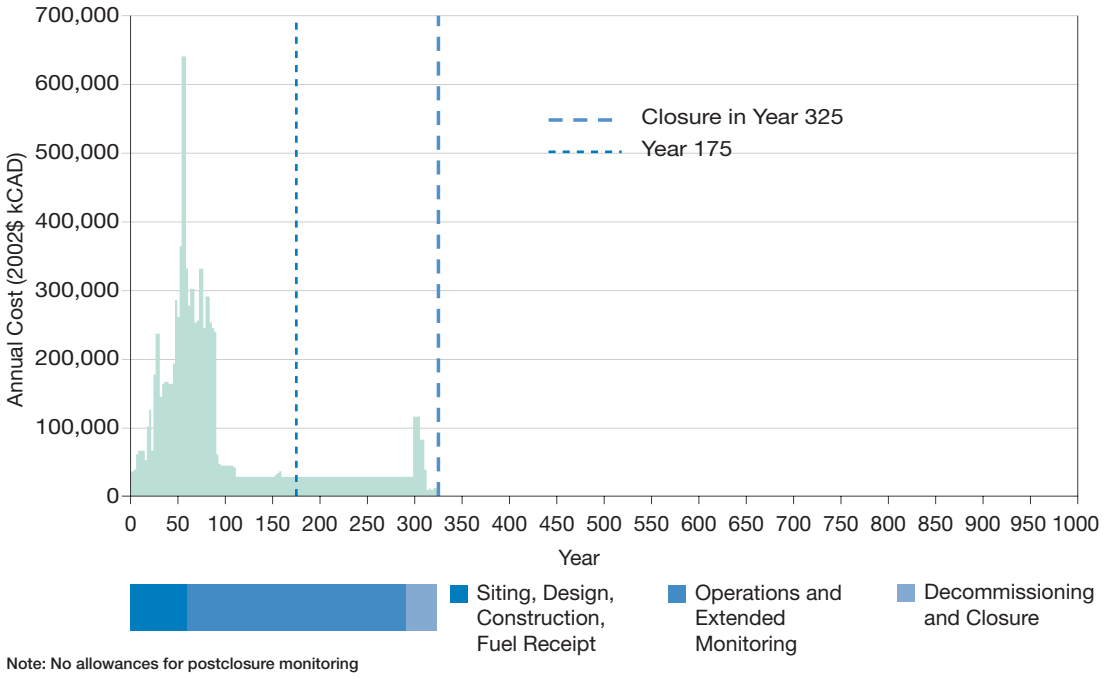


Figure 8-6 Total Cash Flow: Option 4 – Adaptive Phased Management (including Interim Storage, Retrieval and Transportation)



Note: No allowances for postclosure monitoring

8.4 / Our Assessment Findings

As required in the *NFWA*, we have compared the benefits, risks and costs of each management approach, taking into account economic regions in which that approach might be implemented, as well as ethical, social and economic considerations associated with that approach.

In this section, we present the key findings from our comparative assessment as we examined each of the four options against the eight objectives established for our study. We identify the benefits and areas of risk and uncertainty.

The assessment draws upon a wide variety of reports, background papers, dialogues and assessments conducted over the course of the study, all of which are available on the NWMO website. What follows is the NWMO's assessment of the options, informed by interpretation and conclusions of these reports, papers, dialogues and assessments.

Analysis of Objective 1 – Fairness

Our objective:
To ensure fairness (in substance and process) in the distribution of costs, benefits, risks and responsibilities, within this generation and across generations.
The selected approach should produce a fair sharing of costs, benefits, risks and responsibilities, now and in the future. In addition, fairness means providing for the participation of interested citizens in key decisions through full and deliberate public engagement during different phases of decision-making and implementation.

In our assessment of fairness, we considered issues of both substantive and procedural fairness.

Substantive fairness focuses on the content or substance of the approach. It includes consideration of how the costs and benefits associated with the approach would be distributed among different people and between humans and other species. It also includes consideration of intergenerational fairness. A key question for intergenerational fairness is the balance struck between the desire that the current generation take responsibility for resolving the problem once-and-for-all versus the desire not to overly constrain future generations by the choices we make today.

Procedural fairness focuses on the processes used and is mainly a function of the degree to which the approach would allow for the participation of concerned citizens in key decisions about how the approach would be implemented. This, in turn, depends in part on the opportunities for decision-making provided by the approach and the availability of information that would be helpful for driving those decisions.

Comparative Assessment

Table 8-2 presents our assessment of the relative benefits and risks and uncertainty for each of the four options studied.

Table 8-2 Fairness

	BENEFITS	RISKS & UNCERTAINTY
All approaches	All four management approaches have elements that support a strong claim to having distributed risks, costs, and benefits fairly across generations and within generations.	There are important but different uncertainties associated with each of the options in terms of intergenerational fairness.
Option 1: Deep Geological Disposal	Results in the eventual permanent placement of the used nuclear fuel, which reduces or may eliminate the necessity for long-term institutional and operational continuity and financial surety. As a consequence, after placement and closure, provision of long-term resources and funding are not required. It therefore places the responsibility on the current generation for ensuring that the long-term management facility is in place. It supports intergenerational fairness in limiting the burden on future generations to take further actions in managing the fuel. In the near term, provides the opportunity for public participation in locating the facility at a new central site. In the near term, it offers a significant economic boom to a host region and province. In the longer term, as a single centralized facility, it limits exposure to hazards and is designed to be passively safe which should limit overall risks and uncertainty.	In the longer term, provides little flexibility for future generations to influence the management of used nuclear fuel or to make fundamental changes without incurring considerable additional costs. Depending upon the economic region selected, could be in a region not having benefited from the production of nuclear energy. This risk is considered to be greater than for Option 3 and Option 4 because the requirement to site the facility in the Canadian Shield necessarily narrows the focus for siting which may result in a less fair distribution of the costs and risks. More communities will be affected since this option involves transportation of used nuclear fuel; however many if not all of these would likely have benefited from the power, at least indirectly. This risk is judged to be very small. In the short term, may be difficult to find an accepting host community or region. There is some uncertainty associated with how the system will perform over the long term. In the unlikely event of a breach of containment, it may be difficult for a future generation to detect the breach in a timely way and take corrective action. Although it offers a significant economic boom to a host region and province, this is expected to be followed by a rapid decline (bust) after construction of the deep repository and placement of fuel in it.

Table 8-2 (cont'd) Fairness

	BENEFITS	RISKS & UNCERTAINTY
Option 2: Storage at Nuclear Reactor Sites	In the short term, these communities have benefited from jobs and economic spin-offs associated with the nuclear plant and there is some element of fairness in having these same communities manage the waste from this activity while they receive benefits. Provides flexibility for future generations to influence the management of used nuclear fuel. It is easier to monitor human and environmental effects, to take corrective action, should it be required, and take advantage of new learning. Reactor site community residents have experience in living and working in communities with nuclear facilities. In the near term, the infrastructure, including skilled workers, and well-developed security systems, is in place to support nuclear facilities. No transportation of used nuclear fuel would be required, as the used fuel would remain next to where it is generated and so other communities would not be affected. The science and technology required are well in-hand. Offers financial and economic benefits to six economic regions simultaneously with the greatest benefit occurring in south-central Ontario, where the majority of used nuclear fuel is currently located.	Places responsibility on future generations to take responsibility for managing the used fuel consumed by this generation through the requirement to actively manage the waste to ensure safety over tens of thousands of years. Social, technological and moral liabilities are placed on future generations who will have to address the current generation's used nuclear fuel, and ensure the ongoing financial surety to safely manage the operations in perpetuity. With multiple sites to be managed, the potential costs and risks passed on to future generations could be higher than with one centralized facility. Creates obligations for existing reactor site communities for the ongoing, long-term management of used nuclear fuel. This function was not envisioned when the reactor sites were chosen initially, nor was it understood by the communities and businesses that have chosen to locate in the vicinity of these facilities. In order for future generations to receive some advantage from the ability to access the waste and make incremental improvements should they wish, it will be necessary to ensure strong institutions and financial surety mechanisms continue to be in place over the very long term. This is an area of high uncertainty. Other parts of the province, if not country, have benefited from nuclear power and would not be sharing equally in the costs of managing the used fuel. Few if any contingency plans/options should current site(s) become compromised. Even though the benefits accruing to the community are cyclical (following the pattern of ongoing facility replacement, which is required with this approach), these cycles are far enough apart that the host region(s) cannot avoid a "boom and bust" type cycle and the attendant costs.

Table 8-2 (cont'd) Fairness

	BENEFITS	RISKS & UNCERTAINTY
Option 3: Centralized Storage	Provides flexibility for future generations to influence the management of used nuclear fuel. It is easier to monitor human and environmental effects, to take corrective action, should it be required, and take advantage of new learning. The science and technology required are well in-hand. Provides the opportunity for public participation in locating the facility at a new central site. In the near term, provides for a facility that is purpose-built for long-term management. As a single centralized facility, it limits the exposure of populations to hazards. Provides flexibility for future generations to influence the management of used nuclear fuel. Provides more options where facility can be sited, since host geology is not a critical factor for this approach.	Places responsibility on future generations to manage the fuel consumed by this generation through the requirement to actively manage the waste to ensure safety over tens of thousands of years. Social, technological and moral liabilities are placed on future generations who will have to address the current generation's used nuclear fuel, and ensure the ongoing financial surety to safely manage the operations in perpetuity. In order for future generations to receive some advantage from the ability to access the waste and make incremental improvements should they wish, it will be necessary to ensure strong institutions and financial surety mechanisms continue to be in place over the very long term. This is an area of high uncertainty. Even though the benefits accruing to the community are cyclical (following the pattern of ongoing facility replacement, which is required with this approach), these cycles are far enough apart that the host region(s) cannot avoid a "boom and bust" type cycle and the attendant costs. Depending upon the community selected, it could be in a region not having directly benefited from the production of nuclear energy. This risk is considered to be less than for Option 1 because of the greater flexibility in siting the facility which may result in a fairer distribution of benefits, cost and risks. More communities will be affected since this option involves transportation of used nuclear fuel, however many if not all of these would likely have benefited from the power, at least indirectly. This risk is judged to be very small.

Table 8-2 (cont'd) Fairness

	BENEFITS	RISKS & UNCERTAINTY
Option 4: Adaptive Phased Management	Places the majority of responsibility on the current generation for ensuring that a long-term management facility is in place. Supports inter-generational fairness in limiting the burden on future generations to take further actions in managing the fuel. Responds to the sentiment of Canadian society, that the generations of citizens benefiting from nuclear power and creating the associated wastes have an obligation to provide a lasting means for managing that waste while at the same time preserving options for future generations to make decisions that they believe are in their own best interests. It calls for the construction of permanent facilities early in the implementation process in order to ensure that this generation has provided for viable long-term management facilities to reduce the burden on future generations. It calls for an extended period of flexibility in decision making in moving from current reactor site storage to eventual placement in a centralized deep repository and the potential sealing of this repository. This will leave room for future generations to influence the final stages of implementation, particularly over the period in which it is reasonable to expect that societal institutions will remain strong. Provides for an extended validation and optimization program, to enhance ultimate performance of the facility. Through proactive contingency planning, it ensures there are safe and secure storage facilities available for management of the used fuel at each point in the process. Implementation is phased, allowing for time to learn and benefit from new science and emerging findings on technology and to continue to gauge the risk and uncertainty in light of new knowledge associated with moving through the phases. This includes leaving the decision to a future society regarding the best time for closing and sealing the deep repository.	This approach attempts to balance the uncertainties and potential implications to fairness associated with Option 1 and with Option 3. It attempts to optimize flexibility in the near term, and ensure there is an option in place to contain and isolate the waste in the very long term, which does not rely upon human intervention. However, in so doing, it carries the risks of flexibility in the near-term period, although these risks are expected to be less than in the storage approaches because the period of risk is timed to coincide with the period in which it is reasonable to believe we are in the best position to actively manage this risk. In the very long term, it also carries the risks associated with the repository system, although these risks are expected to be less as a result of the planned extended period of technology investigation, testing and confirmation and the adaptive staging embodied in this approach. Depending upon the community selected, it could be in a region not having directly benefited from the production of nuclear energy. The flexibility of geologic media, some of which can be found closer to existing reactor sites, allows greater flexibility in siting and potentially a fairer distribution of benefits, costs and risks compared with Option 1. Transportation of the used nuclear fuel will involve more communities in the risk associated with the implementation of the approach. However, it is expected that this risk will be small. The fundamental importance of collaborative decision-making at multiple points in the implementation, which is embodied in this approach, is also expected to ensure that fairness issues associated with siting, as these are understood by those most directly affected, will be identified and explicitly addressed before any site decision is made.

Table 8-2 (cont'd) Fairness

	BENEFITS	RISKS & UNCERTAINTY
Option 4 (cont'd): Adaptive Phased Management	As a blend of a flexible centralized storage facility over the next 300 years, coincident with an extended period of proof of concept activities, and final placement of used nuclear fuel in a deep repository, this approach is judged to provide the fairest distribution of benefits and risks within this generation and across generations. Involves the creation of a long-term facility that could be located away from existing communities. Provides the potential for the location of this facility to maximize fairness since the restrictions on the host geology for the deep repository are substantially less than for Option 1.	

Summary Findings

Option 4 is judged to be the strongest of the options on the objective of fairness on both of its dimensions: substantive and procedural fairness.

Intergenerational Fairness

Concerning intergenerational fairness, all four management approaches have elements which support a strong claim to having distributed risks, costs, and benefits fairly across generations although there are important but different uncertainties associated with each of the options.

Option 1 provides for intergenerational fairness in placing the responsibility on the current generation – the generation benefiting from nuclear power – for ensuring that the long-term management facility is constructed and available to take the used fuel. Once the deep repository is closed, there are few if any requirements of future generations to ensure the continued isolation and containment of the waste. However, there is some uncertainty associated with how the system will perform over the very long term. In the unlikely event of a breach of containment, it would be difficult for a future generation to detect the breach in a timely way and take corrective action.

In contrast, Option 2 and Option 3, the storage options, provide for intergenerational fairness in offering a high degree of flexibility to future generations in terms of making their own decision about how best to manage the nuclear fuel. It would be easier to monitor human and environmental effects, to take corrective action should it be required, and take advantage of new learning. However, there is some uncertainty associated with whether societal capacity to actively manage the facility will endure for the thousands of years required with these approaches. Should this capacity not exist in the future, then the storage options will have left an unmanageable and unfair burden on future generations.

Option 4 provides some balance between these two potential contributors to intergenerational fairness, and for this reason is judged to be the strongest of the approaches on this dimension:

- It calls for the construction of facilities early in the implementation process in order to ensure that this generation has provided for viable long-term management facilities;
- It calls for an extended period of flexibility in decision-making in moving from current reactor site storage to eventual placement of used fuel in a centralized deep repository and in the potential sealing of this repository. This, in order to leave room for future generations to influence the final stages of implementation, particularly over the period in which it is reasonable to expect that societal institutions will remain strong;
- Through proactive contingency planning, it ensures there are safe and secure storage facilities available for management of the used fuel at each point in the process, including a facility which is designed to be passively safe should future societies be unable or unwilling to actively manage the used nuclear fuel; and
- Implementation is phased, allowing for time to learn and benefit from new science and emerging findings on technology. It also allows time to continue to gauge the risk and uncertainty in light of new knowledge associated with moving through the phases. In particular, a future society will determine the best time for closing and sealing the deep repository.

Interspecies Distributional Fairness

Concerning interspecies distributional fairness, all four management approaches are expected to be constructed and operated using best management practices. This is expected to minimize adverse effects on humans, non-human biota and the environment. In this respect, all four management approaches are judged to have a claim to be fair in terms of interspecies distributional fairness.

The key to ensuring interspecies distributional fairness is being able to prevent, effectively monitor, detect and mitigate adverse consequences in a timely manner. The question of whether one of the options is better than the others on this dimension, as with intergenerational fairness, requires judgment as to the magnitude of the uncertainties associated with: the capacity of future generations to actively manage a storage facility; and, the probability that a sealed deep repository will experience a major breach of containment.

It must be noted that Option 1 and Option 3, the approaches that involve the centralization of waste in a single facility, involve transportation and its associated risks and uncertainties. We expect that used nuclear fuel can be transported safety with little if any adverse effects to humans, non-human biota and the environment. We judge this to be a small incremental risk associated with these approaches. Option 4 attempts to provide a balance between the two major uncertainties mentioned above and for this reason is judged to be the strongest of the options on interspecies distributional fairness.

Distributional Fairness

Implementation of any of the four management approaches is expected to bring significant employment and income (wealth) benefits to the local host economic region, the host province, and to Canada as a whole. The degree of benefit does vary considerably between the four management approaches, as outlined in the previous tables. Although we believe it will be important for any management approach selected to be implemented in a way which contributes to the wealth of the host community and region, and all reasonable efforts should be made in this regard, we believe the wealth benefits associated with each of the options should not drive the selection of the management approach.

Many of the same factors pertaining to intergenerational and interspieces fairness have a similar impact in consideration of distributional fairness. Although flexibility for future generations is preserved with the storage approaches, the distribution of costs is highly skewed to future generations. For both the storage options, social, technological, and moral liabilities are placed on many future generations who will have to deal with the current generation's used nuclear fuel. With the Deep Geological Disposal approach, the distribution of costs is skewed toward current generations, however future generations are bequeathed a lesser ability to easily actively manage their risk through monitoring the used fuel and taking corrective action should it be required.

Transportation is a consideration in terms of the geographic distribution of benefits and risks. For the options which require transportation of used nuclear fuel to a centralized site, Option 1 and Option 3, communities along the transportation route(s) would be expected to incur some added risks but few, if any, benefits as transportation services and infrastructure may originate from outside these regions. However, these risks are limited in time duration and are expected to be very low. As such, this is not judged by the NWMO to be a determining factor.

The options which require centralization of the waste have the potential of involving a community which has not directly benefited from the production of nuclear energy but

would be expected to incur some costs or risk associated with the long term management facility. Option 3 and Option 4, however, allow for a greater choice of sites because they can be built in a wider variety of geological media compared with Option 1.

Option 4, as a blend of a flexible centralized storage facility over the next 300 years, coincident with an extended period of proof of concept activities, and final placement of used nuclear fuel in a deep repository, is judged to provide the fairest distribution of benefits and risks within this generation and across generations.

Participation

Procedural fairness is influenced by the degree to which the approach would allow for the participation of concerned citizens in key decisions about how the approach would be implemented. This includes consideration of the opportunities for decision-making provided by the approach and the availability of information that would be helpful for driving those decisions.

Storage at reactor sites is viewed as least fair for several reasons. Perhaps most importantly, this storage approach would obligate existing reactor sites with on-going, long-term management of used nuclear fuel. This function was not envisioned when the reactor sites were initially chosen, nor was it understood by the communities and businesses that have chosen to locate in the vicinity of these facilities.

By contrast, the centralized approaches involve facilities that could be located away from existing communities, thus lessening the unfairness of involuntarily subjecting many people to additional risks. The opportunity for public participation in the locating of a centralized storage or deep disposal facility is seen to be a positive attribute with regard to fairness, assuming that the siting process will be a voluntary one. Option 4 shares the same benefits as Option 1 and Option 3, and is therefore judged to be among the strongest on this fairness dimension.

Analysis of Objective 2 – Public Health and Safety

Our objective:
To ensure public health and safety.
Public health ought not to be threatened due to the risk that people might be exposed to radioactive or other hazardous materials. Similarly, the public should be safe from the threat of injuries or deaths due to accidents during used nuclear fuel transportation or other operations associated with the management of used nuclear fuel.

In assessing the options against public health and safety, we considered many factors. We believe that any management system employed will result in direct or indirect risks to the health and safety of affected individuals or communities that must be fully acceptable according to current safety standards. The possibilities of unplanned events that could present unexpected risks or stresses must be considered, and appropriate contingency action provided. There should not be foreseeable outcomes of the approach that lead to greater risks to the public from the used nuclear fuel facility at any time in the future than is acceptable today.

The physical, chemical and radiological characteristics of used nuclear fuel, and their hazards, are well understood. Those hazards need to be managed to prevent unreasonable risk. Licensing requirements and compliance verification by the Canadian Nuclear Safety Commission will ensure that the effectiveness of any management approach will be monitored.

The public health and safety aspects of each approach were assessed under both the short (1 – 175 year) and long (greater than 175-year) time-frames. Risks were estimated under normal expected operating conditions and under "off-normal" scenarios in which members of the public might be inadvertently exposed to hazards associated with the various approaches.

Under normal operating conditions, risks associated with the following operations were considered: packing for shipment, transfer from old to new canisters, vehicle accidents, canister transport to dry storage and exposures during monitoring. Other risk scenarios considered included unanticipated deterioration of the natural and engineered barriers constructed to isolate the fuel, large-scale transportation accidents (e.g., the wreck of a train carrying used nuclear fuel), facility accidents, and unintended human intrusion.

Comparative Assessment

Table 8-3 presents our assessment of the relative benefits and risks and uncertainty for each of the four options studied.

Table 8-3 Public Health & Safety

	BENEFITS	RISKS & UNCERTAINTY
Option 1: Deep Geological Disposal	Radiological and non-radiological exposure to the public is expected to be well within current Canadian regulatory standards and norms with the performance and operation of the facility as designed. The public health and safety benefits, in comparison with the other options, are judged to be most pronounced in the very long term. The intrinsic geological features of the site, in combination with engineered features such as long-lived waste packages and material buffers are designed to isolate the used nuclear fuel from the accessible environment for the very long time periods that they remain hazardous. Not reliant on ongoing institutional control of the facility, it avoids risks that might otherwise be posed in the event of long-term societal instability. Deep underground placement reduces safety concerns both before and after closure because the materials would be difficult to access. Probability of unauthorized or inadvertent human intrusion into the closed repository is very low. Would allow for site selection solely on the basis of used nuclear fuel management and its public health and safety impacts. That is, the facility would be sited and designed to protect public health and safety. As well, the facility may be sited away from population centres and so fewer people would be potentially at risk. Although there does not currently exist a facility of this type in Canada or elsewhere, there has been a great deal of scientific and technical work completed on the design and operation of such a facility in both Canada and abroad. This work includes the study of the performance of natural analogues which have existed over the timeframes for which the facility would need to be effective.	There is some uncertainty regarding the performance of the system over the very long term because advance "proof" that such a system works is not scientifically possible. Detailed scientific studies, models and codes, and natural analogues, therefore, form the foundation of the assurances of performance. During normal and off-normal conditions in the near term, all potential exposures are expected during or just after placement of the fuel in the facility. Movement of radioactivity released from failed used fuel containers through the groundwater pathway is possible for hundreds of thousands of years into the future. However, predicted impact is well below applicable standards because of isolation provided by the host geological formation. Monitoring of system performance becomes more difficult once the used nuclear fuel is placed deep underground and as the site is backfilled and closed. In the unlikely event of a breach of containment sufficient to have an adverse environmental impact, the breach would be relatively more difficult to detect and address than in the storage options. Retrieval of the used fuel for corrective action is difficult and costly, involving similar risks to the public as used fuel placement. Transportation of the used nuclear fuel will be required and there is some risk to people along the transportation route because of conventional transport accidents. Robust containers are designed to ensure radiation containment in the face of a broad range of accident scenarios, covering both common and extreme events. Overall, radiation exposures for normal and off-normal transportation activities are considered very small. Risk of transport accidents depends on transportation distances and routes. Economic regions farther away from the sources of used fuel will potentially expose more members of the public to risk.

Table 8-3 (cont'd) Public Health & Safety

	BENEFITS	RISKS & UNCERTAINTY
Option 1: (cont'd) Deep Geological Disposal		Flexibility to address changing environmental conditions is low, however changing conditions are not expected to affect the performance of the system. Reversibility of decisions is difficult once the facility is closed. There is a lack of confidence by a substantial proportion of Canadians that enough is known to proceed with this option at this time, and that the waste can be transported safely. The probability of off-normal scenarios during the near term is very low. As well, with a negligible likelihood of human intrusion after the facility is closed, institutional controls would have to fail during the relatively short operational period for there to be even a risk of human intrusion and the resulting unacceptable risk to the public.
Option 2: Storage at Nuclear Reactor Sites	Radiological and non-radiological exposure to the public is expected to be well within current Canadian regulatory standards and norms with the performance and operation of the facility as designed. Movement of radioactivity is prevented through active management and institutional controls. The public health and safety benefits, in comparison with the other options, are judged to be most pronounced in the shorter term. In the short term, storage facilities are easy to monitor, making it easy to identify problems and take corrective action. Current capacity for effective management of facilities exists and has been demonstrated. The science and technology required are well in-hand. Existing processes have a record of ensuring protection of public health and safety and operating well within regulatory benchmarks in the near term. There is a reasonable expectation of the continuation of this performance over the near term.	In the long term, lacks the natural barriers afforded by placing the used nuclear fuel deep underground, and for this reason the safety of the facilities depends primarily on active management and maintaining institutional controls that prevent or restrict access. This may be increasingly difficult over the long term, because, for example, of the possibility that social instabilities might occur at some future time period; future societies may not be as safety conscious as we are today, safety operations may become lax over time, and/or the possibility of extreme natural or human induced events in the long term. Over the long term, the potential for events that might trigger exposure will increase. For example, there are risks that extreme natural events such as very high winds, rise in sea level, global warming or cooling, and earthquakes could damage the facilities, particularly given the location of some facilities in higher siesmic zones and adjacent to large bodies of water.

Table 8-3 (cont'd) Public Health & Safety

	BENEFITS	RISKS & UNCERTAINTY
Option 2: (cont'd) Storage at Nuclear Reactor Sites	Each of these sites already houses nuclear installations, so there is nuclear expertise on site and in the existing communities. Ability to monitor and demonstrate the ongoing performance is high. Flexibility to adapt to changing conditions or new information is high. With the option of shallow below-ground storage, some safety concerns are diminished. No transportation of used nuclear fuel is required off the nuclear plant site, as the used fuel would remain where it is generated; therefore there are no off-site transportation related risks.	If the integrity of institutions is compromised as it may be in the future, the value of monitoring and flexibility is lost, and in fact becomes a liability. Storage at seven sites, rather than one central site, introduces possible risk to a greater number of people. As well, these reactor sites were selected for their suitability for reactor operation, not for very long term safe storage of used nuclear fuel. The fact that several of these sites are located near larger population centres further increases the potential risk to the public. The used nuclear fuel will remain hazardous well beyond the decommissioning and ultimate abandonment of the nuclear reactor site. Although corrective action is expected to be easier, alternative options (contingency plans) in the event of unplanned circumstances are very limited. Repeated repackaging cycles cause an associated risk of radiation exposure well into the future (greater than 10,000 years). The probability of off-normal scenarios during the near term is very low However, if institutional controls cannot be maintained for thousands of years, human intrusion into the facility is likely, with the resulting radiation exposures and unacceptable risk to the public.

Table 8-3 (cont'd) Public Health & Safety

	BENEFITS	RISKS & UNCERTAINTY
Option 3: Centralized Storage	Radiological and non-radiological exposure to the public is expected to be well within Canadian regulatory standards and norms with the performance and operation of the facility as designed. Movement of radioactivity is prevented through active management and institutional controls. The public health and safety benefits, in comparison with the other options, are judged to be most pronounced in the shorter term. In the short term, storage facilities are easy to monitor, making it easy to identify problems and take corrective action. Current capacity for effective management of similar types of facilities exists and has been demonstrated. The science and technology required are well in-hand. Existing processes have a record of ensuring protection of public health and safety and operating well within regulatory benchmarks in the near term. There is a reasonable expectation of the continuation of this performance over the near term. Ability to monitor the performance is high. Flexibility to adapt to changing conditions or new information is high. With the option of shallow below-ground storage, some safety concerns are diminished. Would allow for site selection solely on the basis of used nuclear fuel management and its public health and safety impacts. That is, the facility could be sited and designed to protect public health and safety. As well, the facility may be sited away from high population centres and so fewer people would be potentially at risk. Siting choices extend to both economic regions on the Canadian Shield and to areas of sedimentary rock in other regions, offering greater opportunities to limit transportation distances.	In the long term, lacks the natural barriers afforded by placing the used nuclear fuel deep underground, and for this reason the safety of the facilities depends primarily on active management and maintaining institutional controls that prevent or restrict access. This may be increasingly difficult over the long term, because, for example, of the possibility that social instabilities might occur at some future time period; future societies may not be as safety conscious as we are today; safety operations may become lax over time; and/or the possibility of extreme natural or human induced events in the long term. Over the long term, the potential for events that might trigger exposure will increase. For example, there are risks that extreme natural events such as very high winds, rise in sea level, global warming or cooling, and earthquakes could damage the facility. These risks would be mitigated in part by careful selection of the centralized site, and by the fact that there is only one facility. These risks would also be reduced were the facility to be located shallow underground. If the integrity of institutions is compromised as it may be in the future, the value of monitoring and of flexibility is lost and, in fact, becomes a liability. Transportation of the used nuclear fuel will be required and there is some risk to people along the transportation route because of conventional transport accidents. Robust containers are designed to ensure radiation containment in the face of a broad range of accident scenarios, covering both common and extreme events. Overall, radiation exposures for normal and off-normal transportation activities are considered very small. Risk of accidents depends on transportation distances and routes. Economic regions farther away from the sources of used fuel will potentially expose more members of the public to risk. Repeated repackaging cycles cause an associated risk of radiation exposure well into the future (greater than 10,000 years).

Table 8-3 (cont'd) Public Health & Safety

	BENEFITS	RISKS & UNCERTAINTY
Option 3: (cont'd) Centralized Storage		The probability of off-normal scenarios during the near term is very low. However, if institutional control cannot be maintained for thousands of years, human intrusion into the facility is likely, with the resulting radiation exposures and unacceptable risk to the public.
Option 4: Adaptive Phased Management	Radiological and non-radiological exposure to the public is expected to be well within Canadian regulatory standards and norms if the facility is built to specification and managed as designed. It allows time to establish confidence in both transportation and the efficacy of the deep repository concept, before proceeding with them. Allows for an extended validation and optimization program, so that full advantage can be taken of early repository system operation to justify confidence in performance or permit necessary additional measures to be taken during the period when institutional integrity is more certain. It allows a period of high flexibility in which new learning might be easily incorporated. It allows confidence to be established through a stepwise process, the pace of which can be adapted to mirror public confidence. In the long term, when institutional integrity is most uncertain, it offers important public health and safety advantages of multiple engineered and geological barriers for used nuclear fuel isolation. Being located deep underground, the radioactive materials would be contained and isolated and difficult to access. In the deep repository, the used fuel is protected by both robust natural barriers provided by the geological formation (crystalline or sedimentary rock), as well as the engineered barriers in terms of container design, buffer materials, etc. The facility can be sited and designed to protect public health and safety by minimizing the likelihood that material released would come into contact with the public. Siting choices extend to economic regions on the Canadian Shield and suitable areas of sedimentary rock, offering greater opportunities to limit transportation distances.	Additional fuel handling associated with an optional step of shallow underground storage represents a small increased risk compared to Option 1. Transportation of the used nuclear fuel will be required and there is some risk to people along the transportation route because of conventional road accidents. Robust containers are designed to ensure radiation containment in the face of a broad range of accident scenarios, covering both common and extreme events. Overall, radiation exposures for normal and off-normal transportation activities are considered very small. Risk of conventional road accidents increases with transportation distances. Economic regions farther away from the sources of used fuel will potentially expose more members of the public to risk. The probability of off-normal scenarios during the near term is very low. As well, with a negligible likelihood of human intrusion after the facility is closed, institutional controls would have to fail during the operational period for there to be even a risk of human intrusion and the resulting unacceptable risk to the public. The period of operation is somewhat longer than for Option 1, so the risk is greater. The period of operation is much shorter than for Options 2 and 3, so the risk is much lower. Due to the extended implementation period, there is a risk that the societal will to complete the implementation process may diminish to the point of threatening the safe operation of the management system. Compared with Option 2 and Option 3, this risk is small. Compared with Option 1, this risk is greater, although the NWMO judges the risk to be small.

Summary Findings

For all four options, public health and safety performance is expected to be well within Canadian regulatory standards and norms in the near term provided that the facilities are built and operated as designed. In all cases, public health and safety would be protected through the use of multiple barriers to contain and isolate the used nuclear fuel from the environment. These natural and/or engineered barriers will be enhanced by institutions and oversight focused on ensuring that standards are met for both radiological and non-radiological exposures. Over the near term, accessibility and flexibility, in combination with strong institutional control, is judged to be the approach which best protects public health and safety. It allows for continuous learning and incremental improvements to be made.

Over the long term, a passive system that can effectively contain and isolate the material without requiring institutional control is judged to be a better approach to safety than one that continues to rely upon institutions.

Over the long term, Options 1 and 4, which are expected to achieve passive safety through a combination of engineered and natural geological barriers are preferable to storage approaches which rely to a large extent on institutional control to maintain safety. The combination of robust engineered barriers, together with the geological barriers associated with placement deep underground, is more likely to effectively contain and isolate the used fuel for the thousands of years over which the material remains hazardous.

Storage options such as those envisaged under Options 2 and 3 have a strong track record of effective management and ensuring public health and safety to date. There is every reason to expect continuation of positive operating performance over the near term. The significant downside risk associated with these storage options relates to their reliance on ongoing institutional controls and societal oversight, which may not be reliable in perpetuity. Without the benefit of the multiple barriers, including geological barriers, these options require ongoing active management and monitoring to ensure public health and safety.

When both the near term and the long term are considered, Option 4 is judged to offer the greatest benefits in terms of public health and safety. In the near term, the staged management of this approach allows for continuous learning that enables us to address many areas of uncertainty and establish further confidence in the deep repository concept before proceeding. Option 4 allows for a high degree of flexibility in implementation, offering time to learn and observe emerging science and to incorporate new developments that may emerge over the next few decades. Contingencies are available at each point in the process to ensure effective containment and isolation of the used nuclear fuel. The approach envisages an option for interim centralized storage below ground, as a step along the implementation path. And the approach allows for future generations to make the determination when the deep repository is most appropriately closed and sealed, as the last step in providing permanent safety and security. Over the long term, the combination of natural geological and engineered barriers would be designed to ensure that public health and safety are protected even in the absence of institutional controls.

In order to best protect the health and safety of individuals and the public at large, we understand that an optimal balance needs to be found between flexibility in the near term, which allows for new learning, and the implementation of an approach which isolates and contains the used fuel in a way which does not require active care by people over the very long term. Option 4 provides such a balance. Dialogue with Canadians has highlighted that an optimal balance also needs to be struck between moving cautiously, to allow for new learning and building of social confidence, and sustaining sufficient momentum to carry forward with the implementation of the approach to completion. Should the implementation period be too protracted, there is a risk that future generations will lose interest and/or otherwise abandon the approach mid-way through implementation with negative impacts on public health and safety as a result.

There is some risk associated with each of the approaches studied that momentum will be lost in the face of public opposition and/or loss of will. In recommending a stepwise imple-

mentation process, which involves potentially impacted communities of interest at each major point of decision-making, the NWMO believes that public acceptability will be greater with the Adaptive Phased Management approach than for Option 1. Public acceptance will expedite implementation of the deep repository by matching the pace and manner of implementation to the pace at which society is prepared to proceed. In laying out a process in which key decision points have been mapped, along with the means to ensure those involved in the decision (potentially impacted communities of interest) have the required capacity and information to make the necessary decisions, and putting contingencies in place should unforeseen events be encountered, implementation will proceed in as efficient a manner as social conditions allow. Through provision of the decision-making process, and contingencies for multiple decision-making outcomes, the continued safe management of used nuclear fuel would best be assured though to completion of implementation.

Analysis of Objective 3 – Worker Health and Safety

Our objective:
To ensure worker health and safety.
Construction, mining and other tasks associated with managing used nuclear fuel can be hazardous. The selected approach should not create undue or large risks to the workers who will be employed to implement it.

In assessing options for impacts on worker health and safety, we considered a number of factors. The management system and the technologies used, the design, the construction methods and the operational and monitoring procedures should be such that, in addition to complying with good engineering practices and all industrial safety regulations, workers involved with the used nuclear fuel facility should not be subject to risks or harmful exposures, chronic or accidental, greater than those acceptable to Canadian or international authorities at the time of construction. Workers engaged in future monitoring or maintenance activities should not be subject to risks greater than those acceptable today.

Risks were separately estimated for two time periods. They were estimated based on normal, expected operating conditions and under "off-normal" scenarios in which workers might be inadvertently exposed to hazards associated with the various approaches. Under normal operating conditions, worker risks associated with the following operations were considered: construction, transportation, fuel handling, and monitoring. The main "off-normal" risk scenarios considered included an extreme construction accident, accidental radiological exposures and extreme fuel handling accidents.

Comparative Assessment

Table 8-4 presents our assessment of the relative benefits and risks and uncertainty for each of the four options studied.

Table 8-4 Worker Health & Safety

	BENEFITS	RISKS & UNCERTAINTY
Option 1: Deep Geological Disposal	Radiological and non-radiological risks to workers during operations and transportation are expected to be well within Canadian regulatory standards and norms with the performance and operation of the facility as designed. Minimal radiation exposure to workers over the long term. Avoids radiation exposure to workers from ongoing perpetual repackaging and handling of the fuel. Once the facility is closed, no additional worker activities required.	In the short term, would require the relatively higher risk tasks of mining and earth moving. The size of the workforce required to support implementation of this option, and the number of workers potentially at risk, is about three times higher than for Options 2 and 3 in the near term. However, much of the work would be mechanized and a relatively small number of workers would be directly involved in hazardous operations. In the short term, the risks to workers arise mainly from construction and transportation requirements, and are non-radiological in nature. Even though radiological exposures may well occur, based on the adoption of safe operating practices and robust oversight, they are unlikely to cause serious health consequences. Would involve transportation of used fuel, with the potential risks of traffic accidents and other dangers to drivers. The level of risk to workers through traffic accidents will be affected by the specific routes taken and transportation distance and therefore the choice of economic region selected for the deep geological disposal facility.
Option 2: Storage at Nuclear Reactor Sites	Radiological and non-radiological risks to workers during operations are expected to be well within Canadian regulatory standards and norms with the performance and operation of the facility as designed. Does not require off site transportation, thus avoiding the risks to workers associated with transport-related accidents. Involves minimal construction risks.	Produces worker risks during the refurbishment of existing facilities and construction of new facilities repeatedly as the containers degrade and the fuel must be repackaged. The risks are greater than with Option 1 and Option 4 because significantly more handling and packaging would be required. Some risk of injury is associated with the requirement for ongoing repackaging and handling of used fuel in perpetuity. Construction risks extend into the long term, due to the fact that the facility will need to be rebuilt every 300 years. Institutions must continue to function well to ensure that the safe practices that protect workers (and others) do not decline. As long as institutions remain effective, unacceptable risks to workers due to radiation exposure are unlikely. Has all of the on-site worker risks associated with the centralized storage approach plus would require continuing operations involving more workers at multiple sites with differing conditions.

Table 8-4 (cont'd) Worker Health & Safety

	BENEFITS	RISKS & UNCERTAINTY
Option 3: Centralized Storage	Radiological and non-radiological risks to workers during operations and transportation are expected to be well within Canadian regulatory standards and norms with the performance and operation of the facility as designed. Construction related work risk is less than for Option 1 and Option 4. The consolidation of the used fuel at a single site allows for process optimization and oversight to ensure worker safety, compared with Option 2.	Produces worker risks during the construction of the facility and repeatedly as the containers degrade and the fuel must be repackaged. The overall risks are greater than with Option 1 and Option 4 because significantly more used fuel handling and packaging is required. Some risk of injury is associated with the requirement for ongoing repackaging and handling of used fuel in perpetuity. Construction risks extend into the long term, due to the fact that the facility will need to be rebuilt every 300 years. Institutions must continue to function well to ensure that the safe practices that protect workers (and others) do not decline. As long as institutions remain effective, unacceptable risks to workers due to radiation exposure are unlikely. Would involve transportation of used fuel, with the potential risks of traffic accidents and other dangers to drivers. The level of risk to workers through traffic accidents will be affected by the specific routes taken and transportation distance and therefore the choice of economic region selected for the centralized storage facility.

Table 8-4 (cont'd) Worker Health & Safety

	BENEFITS	RISKS & UNCERTAINTY
Option 4: Adaptive Phased Management	Radiological and non-radiological risks to workers during operations and transportation are expected to be well within Canadian regulatory standards and norms with the performance and operation of the facility as designed. Minimal radiation exposure to workers over the long term. Avoids radiation exposure to workers from ongoing perpetual repackaging and handling of the fuel. Once the facility is closed, no additional worker activities required. Phased implementation, with possibility of interim underground storage in rock caverns would involve slightly more handling of the fuel than in Option 1, but less than with Options 2 and 3.	The size of the workforce required to support implementation of this option is about three times higher than for Options 2 and 3, in the near term. Would involve transportation of used fuel, with the potential risks of traffic accidents and other dangers to drivers. The level of risk to workers though traffic accidents will be affected by the specific routes taken and transportation distance and therefore the choice of economic region selected for the central facility. Siting choices extend to both economic regions on the Canadian Shield and suitable areas with sedimentary rock, offering opportunities to limit transportation distances and associated worker risk as compared to Option 1. Low levels of worker risk would continue through to the closure of the facility and the longer period of institutional control and monitoring as compared to Option 1. As well the optional step of shallow underground storage would involve some additional risk associated with construction and fuel handling.

Summary Findings

In all four options, radiological and non-radiological risks to workers during operations and transportation are expected to be well within Canadian regulatory standards and norms provided that the activities are conducted as planned. Options 1 and 4 offer the lowest risk to workers because these approaches limit risks to workers to finite periods of time during which the centralized facilities are built, the sites investigated, and used fuel is moved and placed into the facilities. Worker risk would be slightly higher under Option 4, which involves an expanded implementation timeline for additional monitoring and phased decision-making, as well as potentially an additional interim storage step, compared with Option 1.

In contrast, Options 2 and 3 require ongoing risks to workers because storage operations would continue in perpetuity, with ongoing requirements for repackaging and handling of used fuel. It is expected that up to 100 repackaging cycles would be required over a 10,000-year period.

The consolidation of the used fuel at a single site associated with Option 3 incrementally reduces the worker risks associated with Option 2, which would require ongoing operation and fuel handling at seven different locations. This is because with consolidation, fewer workers are involved with Option 3 and process optimization and oversight to ensure worker safety would be easier to achieve at a single site rather than at multiple sites.

Analysis of Objective 4 – Community Well-Being

Our objective:
To ensure community well-being.
Implications for the well-being of all communities with a shared interest (including host community, communities in the surrounding region and on the transportation corridor, and those outside of the vicinity who feel affected) should be considered in the selection and implementation of the management system and related infrastructure. A broad range of implications must be considered, including those relating to economic activity, environmental disruption and social fabric and culture.

The assessments with respect to community well-being considered both the likely economic impacts of the approach, and the potential effects on social and cultural qualities of affected communities. On the economic side, consideration was given to potential effects on property values, jobs and businesses. Potential social and cultural impacts include raising fears and concerns of citizens and the risk of community polarization (e.g., contrasting beliefs between those who support and those who oppose locating a facility near their community). Some residents may see living near a radioactive waste management facility as placing a stigma on their community.

Comparative Assessment

Table 8-5 presents our assessment of the relative benefits and risks and uncertainty for each of the four options studied.

Table 8-5 Community Well-Being

	BENEFITS	RISKS & UNCERTAINTY
All approaches	All four management approaches provide significant economic benefits. No matter which management approach is ultimately used, and no matter what site location is preferred, economic benefits accrue to all Canadians, but the host province and region stand to capture the majority of employment, income and tax benefits. All of the management approaches provide substantial economic benefits in terms of the creation of thousands of jobs, billions of dollars in new income and new tax revenue to all three levels of government. Well executed implementation will enable these benefits to be aligned with the realization of social, cultural and economic aspirations and support the long-term stability of the affected communities. Economic impacts would extend to enhancements to community infrastructure associated with supporting the facility, such as construction of improved roads and generation of higher-paying jobs.	Despite the very positive economic benefits resulting from all four management approaches, there are a variety of social and economic costs that are attendant with projects of this magnitude, particularly when sited in rural regions of Canada. "Boom and bust" cycles linked to each of the management approaches involve thousands of workers and billions of dollars in expenditures with likely temporary effects on: housing and land values; demand for social and physical infrastructure services from influx of short term and temporary workers; and local and regional government tax revenues. The analysis of eleven illustrative economic regions shows that there are distinct differences among regions in relation to capacity to adapt to the positive and negative "shock(s)" that are linked to all four management approaches. The more rural and remote regions, including some Aboriginal communities, have lower adaptive capacity. Should a facility be sited in such a region, adequate support would need to be given to these communities to ensure they are able to effectively participate in decision-making and ensure a full slate of benefits accrues to them. As well, Aboriginal communities and those who have chosen to live in less populated areas may be concerned about the development commercializing their way of life, and cultural disruption in general.

Table 8-5 (cont'd) Community Well-Being

	BENEFITS	RISKS & UNCERTAINTY
Option 1: Deep Geological Disposal	Is expected to be implementable with no adverse consequences to the community, assuming a decision-making process that involves affected communities, and appropriate mitigation measures are taken. Economic benefits are provided in the near-term. Significant expenditures on transportation required to support this option generate thousands of jobs and income that extend beyond the host region. If done well, siting can be achieved with community participation. With no significant operations required in the long term, the facility would not lead to the same repeat cycles of boom and bust associated with Options 2 and 3. Results in the eventual permanent placement of the used nuclear fuel, which reduces the necessity for long-term institutional and operational continuity and financial surety. In the near term (less than 175 years), both Option 1 and Option 4 provide the greatest income, employment and tax benefits by up to a factor of two compared to Storage at Nuclear Reactor Sites, and by up to a factor of eight compared to Centralized Storage (above or below ground). Option 1 and Option 4 are roughly equivalent in economic value in each illustrative economic region.	Creating a new facility in a new location may create more adverse impacts on communities than leaving the waste where it is. Requires transportation away from existing reactors and would likely raise concerns of communities along the transportation routes, particularly if the safety of transportation had not yet been established to the satisfaction of those communities. Communities on transportation routes would need to have concerns addressed. Over the long term, the limited opportunity to demonstrate system performance (for instance by monitoring and access) may be a source of lingering concern among some in the community.

Table 8-5 (cont'd) Community Well-Being

	BENEFITS	RISKS & UNCERTAINTY
Option 2: Storage at Nuclear Reactor Sites	Is expected to be implementable with no adverse consequences to the community, assuming a decision-making process that involved affected communities, and appropriate mitigation measures are taken. Economic benefits to the community are spread out over thousands of years. In the long-term, only Option 2 and Option 3 generate any significant economic benefits from ongoing maintenance and cyclical facility rebuilding. Consequently economic, employment and income generating benefits continue for thousands of years. This option is the only approach that simultaneously develops facilities at all seven current reactor sites. Benefits are more widely distributed across six regions/seven sites, with the regions managing the largest volumes of used fuel capturing the greatest share of benefits. The most urbanized region is likely to gain the most economic benefit in absolute terms. As with centralized storage, the required science and technology are well in hand. Further, the opportunity to monitor the performance and the flexibility to adapt to changing conditions is facilitated. Is expected to be implementable with no adverse consequences to the community, assuming a decision-making process that involved affected communities, and appropriate mitigation measures are taken.	Boom and bust cycles associated with Option 2 continue through the ongoing operation of the facilities, repeated cyclically with the repackaging and facility rebuilding required every 100 years and 300 years respectively. Requires continuing administrative controls and operations, including the necessary funding, for the thousands of years the used nuclear fuel remains hazardous. These reactor sites were selected for their suitability for reactor operation, not for very long-term storage of used nuclear fuel and therefore may not be ideal for this purpose. The used nuclear fuel will remain hazardous and will need to be secured well beyond the almost certain shutdown and ultimate abandonment of the nuclear reactor sites. Multiple sites would need to be secured, some located next to important bodies of water. Changing the role of the reactor storage sites from temporary to long term would involve significant facility upgrades – there is potential to polarize the more immediate community because some people may feel betrayed by the change of status of the facility from interim to long-term waste management. As well, the proximity of a facility that is acknowledged to involve risks may be a target for citizen legal action.
Option 3: Centralized Storage	Economic benefits to the community are spread out over thousands of years. In the long-term, only Option 2 and Option 3 generate any significant benefits from ongoing maintenance and cyclical facility rebuilding. Consequently economic, employment and income generating benefits continue for thousands of years. The extent of benefits captured locally depends upon the nature of the economic region hosting the facility.	Boom and bust cycles associated with Option 3 continue through the ongoing operation of the facilities, repeated cyclically with the repackaging and facility rebuilding required every 100 years and 300 years respectively. Centralized storage shares with the at-reactor storage option the key disadvantage of requiring effective and continuing administrative controls and operations, including the required funding, for thousands of years.

Table 8-5 (cont'd) Community Well-Being

	BENEFITS	RISKS & UNCERTAINTY
Option 3: (cont'd) Centralized Storage	As with storage at nuclear reactor sites, the required science and technology are well in hand. Further, the opportunity to monitor the performance and the flexibility to adapt to changing conditions is facilitated. If done well, siting can be achieved with community participation.	Creating a new facility in a new location may create more adverse impacts on communities than leaving the waste where it is. Requires transportation away from existing reactors and would likely raise concerns of communities along the transportation routes, particularly if the safety of transportation had not yet been established to the satisfaction of those communities. Communities on transportation routes would need to have concerns addressed.
Option 4: Adaptive Phased Management	Is expected to be implementable with no adverse consequences to the community, assuming a decision-making process that involved affected communities, and appropriate mitigation measures are taken. Phased implementation allows for a more gradual implementation period, and more opportunity for community adjustment than is possible with Option 1. Since this approach includes the potential for implementation in either granitic rock or sedimentary rock, there is a greater range of potentially suitable economic regions for implementation than is possible with Option 1. This approach, therefore, offers greater opportunity to limit the scope of adverse social, human, physical and financial impacts on the host community. Is most amenable to responding to changes that may occur over the implementation period, and thereby maintaining public confidence. Over the decades of program development and implementation, the selected approach will encounter changes in society, technology, economics, and the environment. These changes will be further influenced by the evolving political and institutional landscape and more. This approach is staged to include periodic sequential decision points that give greater opportunity for stakeholders, and specifically the affected communities, to participate in the design, and evaluation of the program status for progressive decision-making.	Creating a new facility in a new location may necessarily create more adverse impacts on communities than leaving the waste where it is. These adverse impacts are expected to be substantially less than for Option 1 due to the greater flexibility in siting the facility which Option 4 provides for. Requires transportation away from existing reactors and would likely raise concerns of communities along the transportation routes, particularly if the safety of transportation had not yet been established to the satisfaction of those communities. Communities on transportation routes would need to have concerns addressed. However, it is expected that the ongoing process of citizen involvement which this approach suggests would help ensure that transportation safety is appropriately examined and confidence is increased before transport of the used fuel begins in earnest. Over the very long term, the limited opportunity to demonstrate system performance (for instance by monitoring and access) may be a source of lingering concern among some in the community. However, this is expected to be substantially less than for Option 1 because of the extended period of confirmation of performance which this option involves. Need for continuing administrative controls and operations, including the necessary funding, for a longer period than for Option 1, although it is judged reasonable to believe that institutions will continue to remain strong during this period.

Table 8-5 (cont'd) Community Well-Being

	BENEFITS	RISKS & UNCERTAINTY
Option 4: (cont'd) Adaptive Phased Management	Explicitly recognizes, and plans for, the breadth of communities which will be impacted over the course of eventual implementation of a deep repository. In the near term (less than 175 years), both Option 1 and Option 4 provide the greatest income, employment and tax benefits by up to a factor of two compared to Storage at Nuclear Reactor Sites, and by up to a factor of eight compared to Centralized Storage (above or below ground). Option 1 and Option 4 are roughly equivalent in economic value to each illustrative economic region. However, the benefits of Option 4 are stretched out over a longer time period (i.e. 30 years longer than Option 1). If done well, siting can be achieved with community participation. With no significant operations required in the long term, the facility would not lead to the same repeat cycles of boom and bust associated with Options 2 and 3. Results in the eventual permanent placement of the used nuclear fuel, which reduces the necessity for long-term institutional and operational continuity and financial surety.	Creating a new facility in a new location may create more adverse impacts on communities than leaving the waste where it is. Requires transportation away from existing reactors and would likely raise concerns of communities along the transportation routes, particularly if the safety of transportation had not yet been established to the satisfaction of those communities. Communities on transportation routes would need to have concerns addressed.

Summary Findings

All four approaches are expected to provide significant economic benefits to all Canadians, host province, region and community.

For any approach, implementation plans must be designed collaboratively with the receiving communities to facilitate the community's social, cultural and economic aspirations and avoid or minimize adverse impacts. Although not the focus of this analysis, it is understood that a complementary collaborative effort will need to be undertaken with communities which currently host interim storage facilities in order to ensure that the manner and pace of movement of waste from the community meets their needs.

Centralized approaches, Options 1, 3 and 4, allow the invitation of a willing host community as part of the site selection process, and the opportunity to work closely with the selected community to design implementation in a way that is supportive and responsive to the priorities of the community.

Option 4, in presenting a staged and adaptive approach, allows the implementation path to be responsive to the expectations of Canadian society today and continued influence of future generations on the subsequent decisions to be taken concerning design and evaluation of program progress. Option 4 recognizes that a range of communities will be impacted, and seeks to build confidence through a stepwise implementation path.

Analysis of Objective 5 – Security

Our objective:
To ensure security of facilities, materials and infrastructure.
The selected management approach needs to maintain the security of the nuclear materials and associated facilities. For example, over a very long time-frame, the hazardous materials involved ought to be secure from the threat of theft, despite possibilities of terrorism or war.

An approach must provide for the security of both nuclear materials and the facilities that store or use them. The loss of nuclear material would pose health and safety risks to Canadians and others. The loss of nuclear material could also trigger concerns in relation to international safeguards and non-proliferation obligations. In this context, security and safeguards are fundamental requirements that go beyond protecting the health and safety of Canadians.

To assess security, the vulnerability of each approach to various risk scenarios was considered. The risk scenarios included terrorism and potential "insider" threats focused on theft, diversion, sabotage, and "seize and hold" strategies. The adequacy of contingency plans and the robustness of the approach under scenarios involving societal breakdown and civil disobedience were also considered.

Comparative Assessment

Table 8-6 presents our assessment of the relative benefits and risks and uncertainty for each of the four options studied.

Table 8-6 Security

	BENEFITS	RISKS & UNCERTAINTY
Option 1: Deep Geological Disposal	Expected to perform well within the security requirements reflected in Canadian regulatory standards, if built and operated as designed. In the near term, the high radioactivity of used fuel provides a "self-protecting" barrier against intruders, in combination with the heavy and large containers used to store used nuclear fuel in the interim period. Facility design and monitoring provide additional layers of further security. Once the used fuel is placed underground and the facility is backfilled and closed, the fuel is difficult to access, reducing the scope for theft, hostile intervention and dispersion of nuclear material. The size and weight of the heavy, large structures used for storing and transporting used fuel provide significant barriers to sabotage or theft. Even before closure, the limited access to the fuel and the 500-1,000 metre distance to surface provide considerable protection against security threats. Security is not reliant on ongoing active institutional oversight, an important feature for the long term, over which societal stability and institutional controls cannot be assured. Avoids the ongoing requirement for repackaging and handling and transportation once all the used fuel is placed in the deep repository, thereby limiting risks of security breaches and making the fuel significantly more secure for the longer term. Could be sited in a location designed to limit security risk to the general population, for instance away from large population centres and with community involvement.	Repackaging of used fuel, for transportation and perhaps placement in a deep repository, is required. However, substantially less repackaging of used fuel is required compared with storage options. Requires the identification and development of a site with potentially contentious community involvement. Public opposition to siting and transportation before confidence has been achieved may result in disruption in implementation and added security risk. Transportation risk and cost expected to be higher under conditions of low public confidence. Transportation to a central site would require additional safety measures for the movement of the used nuclear fuel from the nuclear reactor sites to the storage facility. Total number of trip-kilometres required to transport all used nuclear fuel by road to a facility vary considerably, depending on the site. Vulnerability of the used nuclear fuel is assumed to increase with increases in number of trip-kilometres. Therefore, there is a greater security risk during transportation for sites located longer distances from the majority of used nuclear fuel (i.e., longer distances from southern Ontario). For this approach, our analysis suggests that selection of any of a broad range of economic regions would involve similar numbers of large population centres (defined as greater than 50,000 inhabitants) along transportation routes as would the other centralized approaches and thus have a similar degree of security risk for this measure in the near term.

Table 8-6 (cont'd) Security

	BENEFITS	RISKS & UNCERTAINTY
Option 2: Storage at Nuclear Reactor Sites	Expected to perform well within security requirements as reflected in Canadian regulatory standards if maintained and operated as designed. In the near term, accessibility of fuel is low, offering security protection. The high radioactivity of used fuel provides a "self-protecting" barrier against intruders. This barrier continues for the first several hundred years. Facility design and monitoring provide additional layers of security provision. Robust, heavy, large containers and structures used for storing used fuel provide significant barriers to sabotage or theft. In the near term, while nuclear plants continue operations, security is enhanced by security infrastructure already in place. Nuclear plants offer years of experience in protecting facilities from unauthorized entry/ access to fuel. With no requirements for off site transportation, this option avoids security risks associated with the transportation phase, and does not involve or require the cooperation of communities or the public outside of the host community.	After approximately 300 years, radiation levels decline such that the used fuel is no longer "self-protecting", making it more accessible to intruders. Managing the used fuel in surface facilities, at this point, requires significantly more physical protection resources than Options 1, 3 and 4 to ensure its long-term security. Security is heavily reliant on ongoing active management and institutional oversight and controls in perpetuity. Security risk could increase in the long term in the event of societal instability and resulting breakdown of institutional oversight. There is considerable uncertainty associated with the continuance of the societal infrastructure to ensure physical protection indefinitely. The level of the risk associated with a breakdown of institutional oversight, and complexity of managing it in the long term is compounded by the existence of seven sites, with several of the host economic regions including large population centres, as compared to a single central site. Requires ongoing repackaging of used fuel in perpetuity, providing repeated future opportunities for security risk. Strong physical protection would be required during the periodic repackaging operations required every 100 years and lasting approximately 30 years for each repackaging operation. As many as 100 repackaging cycles could be required over a 10,000-year period. Over the long term, the benefit from co-location at nuclear plants and the opportunity to benefit from shared oversight ceases once the nuclear plants are decommissioned. With the passage of time, it may be necessary to change current security standards and activities to account for changing world events. This may dramatically change future security requirements and the attendant costs.

Table 8-6 (cont'd) Security

	BENEFITS	RISKS & UNCERTAINTY
Option 3: Centralized Storage	Expected to perform well within security requirements as reflected in Canadian regulatory standards if built, maintained and operated as designed. In the near term accessibility of fuel is low, offering security protection. The high radioactivity of used fuel provides a "self-protecting" barrier against intruders. This barrier continues for the first several hundred years. Facility design and monitoring provide additional layers of further security provision. Robust, heavy, large containers used for storing used fuel provide significant barriers to sabotage or theft. The size and weight of the heavy, large structures used for transporting used fuel provide significant barriers to sabotage or theft. If central storage entails shallow underground storage, this offers an incremental security advantage over above ground facilities. Located at one central site, monitoring of the used fuel for the long term is facilitated, requiring fewer physical protection resources than would Option 2. Centralized storage, either above-ground or shallow below-ground, would allow for site selection on the basis of used nuclear fuel management and its safe and secure management, for instance away from large population centres and with community involvement.	After approximately 300 years, radiation levels decline such that the used fuel is no longer "self-protecting", making it more accessible to intruders. Managing the used fuel in surface facilities, at this point, requires significantly more physical protection resources than Options 1 and 4 to ensure the long-term security of the fuel. Security is heavily reliant on ongoing active management and institutional oversight and controls in perpetuity. Security risk would increase in the long term in the event of societal instability and resulting breakdown of institutional oversight. There is considerable uncertainty associated with the continuance of the societal infrastructure to ensure physical protection indefinitely. Requires ongoing repackaging of used fuel in perpetuity providing repeated future opportunities for security risk. Strong physical protection would be required during the periodic repackaging operations required every 100 years and lasting approximately 30 years for each repackaging operation. As many as 100 repackaging cycles could be required over a 10,000-year period. Requires the identification and development of a site with potentially contentious community involvement. Public opposition to siting and transportation before confidence has been achieved may result in disruption in implementation and added security risk. Transportation risk and cost expected to be higher under conditions of low public confidence. Transportation to a central site would require additional safety measures for the movement of the used nuclear fuel from the nuclear reactor sites to the central site.

Table 8-6 (cont'd) Security

	BENEFITS	RISKS & UNCERTAINTY
Option 3: (cont'd) Centralized Storage		Total number of trip-kilometres required to transport all used nuclear fuel by road to a facility varies considerably, depending on the site. Vulnerability of the used nuclear fuel assumed to increase in proportion to increases in number of trip-kilometres. Therefore, there is a greater security risk during transportation for sites located longer distances from the majority of used nuclear fuel (i.e. longer distances from southern Ontario). For this approach our analysis suggests that, selection of any of a broad range of economic regions would involve a similar number of large population centres (defined as greater than 50,000 inhabitants) along transportation routes as with the other centralized approaches and thus have a similar degree of security risk for this measure in the near term.
Option 4: Adaptive Phased Management	Expected to perform well within security requirements as reflected in Canadian regulatory standards if maintained and operated as designed. Accessibility of used fuel is low in both the near term and long term, offering protection from security breaches through hostile intrusion. In the near term, the high radioactivity of used fuel provides a "self-protecting" barrier against intruders, in combination with the heavy and large containers used to store used nuclear fuel in the interim period. Facility design and monitoring provide additional layers of security. The size and weight of the heavy, large containers used for transporting used fuel provide significant barriers to sabotage or theft. The optional phase of shallow underground storage prior to proceeding to the deep repository, offers enhanced barrier for physical protection during storage in the period leading up to final placement in the repository. A secure form of storage is ensured in the interim period should there be a delay in placement in the repository.	While offering more security than Storage at Nuclear Reactor Sites and Centralized Storage, the Adaptive Phased Management Approach is marginally less secure than Deep Geological Disposal in the Canadian Shield since it could involve additional repackaging of used fuel. As with Option 1 and Option 3, it would require additional safety requirements for the movement of the used nuclear fuel from the nuclear reactor sites to the storage facility. Total number of trip-kilometres required to transport all used nuclear fuel by road to a facility varies considerably, depending on the site. Vulnerability of the used nuclear fuel is assumed to increase in proportion to number of trip-kilometres. Therefore, there is a greater security risk during transportation for sites located longer distances from the majority of used nuclear fuel (i.e. longer distances from southern Ontario).

Table 8-6 (cont'd) Security

	BENEFITS	RISKS & UNCERTAINTY
Option 4: (cont'd) Adaptive Phased Management	Over time, declining radiation fields reduce the potential consequences of sabotage in the event of a security breach, but also reduce barriers to theft. For the long term, a combination of engineered and natural geological barriers deep underground provide enhanced security. Once the fuel is placed underground and the facility is backfilled and closed, the fuel is difficult to access, reducing the scope for theft, hostile intervention and dispersion of nuclear material. Even before closure, the limited access to the fuel and the 500-1,000 metres distance to surface provides considerable protection against security threats. Over the long term, security does not rely on ongoing active institutional oversight, an important feature for the long term, over which societal stability and institutional controls cannot be assured. Over the long term, avoids the ongoing requirement for repackaging and handling once all of the used fuel is placed in the deep repository, thereby limiting risks of security breaches and making the fuel significantly more secure for the longer term. Has the same high level of security in the long term as Option 1, as neither have repackaging events in the long term. The size and weight of the heavy, large containers used for transporting used fuel provide significant barriers to sabotage or theft. Could be sited in a location designed to limit security risk to the general population, for instance away from large population centres and with community involvement.	For this approach, our analysis suggests that selection of any of a broad range of economic regions would involve a number of large population centres (defined as greater than 50,000 inhabitants) along transportation routes. The flexibility in geologic media associated with this approach will provide more flexibility in siting which may allow transportation to be minimized. Requires the identification and development of a site with potentially contentious community involvement. Public opposition to siting and transportation before confidence has been achieved may result in disruption in implementation and added security risk. Transportation risk and cost expected to be higher under conditions of low public confidence. However, this approach provides for a longer period over which to establish and build confidence.

Summary Findings

All four options, if built and operated as designed, are expected to perform well within the security requirements of Canada's regulatory standards. Many aspects of security have been examined over the course of our analysis. Four particular aspects are briefly discussed below.

i) Fuel Accessibility

The less accessible the fuel, the stronger the contribution to ensuring the nonproliferation of weapons useable material. Access to the used fuel can be reduced by the actions of institutions, and the security mechanisms that they put in place and maintain, and through engineered and geological physical barriers that prevent access to the fuel.

Option 1 and Option 4, because they involve placing used nuclear fuel deep underground, and ultimately backfilling and sealing all routes to access the fuel, are inherently more secure than Option 2 and Option 3 over the long term. These two latter storage options keep and manage used nuclear fuel at or near the surface and rely upon security mechanisms in the form of robust containers and security fencing and personnel to prevent access. The storage of used fuel at or near the surface inherently poses additional security risk and demands additional security precautions. Security is heavily reliant on ongoing institutional management and controls, in perpetuity. Uncertainty over the availability of institutions and controls increases over time.

ii) Number of Repackaging Cycles

Repackaging of used nuclear fuel presents some risk of hostile attack for all four approaches. However, Option 1 and Option 4 do not require repackaging of used nuclear fuel once all used nuclear fuel is placed in the repository and are significantly more secure in the long term, compared with Option 2 and Option 3, which require as many as 100 repackaging cycles over a 10,000-year period.

While offering more security than Option 2 and Option 3, Option 4 is marginally less secure than Option 1 since it involves an additional repackaging event.

iii) Robustness of Physical Barriers

Of the four approaches, Options 1 and 4 offer the strongest physical protection of the used fuel and the management facilities against unintended security breaches through inadvertent intrusion or unauthorized intrusion. The combination of robust engineered barriers built into the design, the selection of the site, together with the geological barriers associated with placement of the fuel deep underground, is expected to enable secure isolation of the used fuel both in the near term and the long term. Protection against disruption or breaching of the barriers by intrusion is provided through these many barriers that isolate the used fuel, and is not reliant on ongoing effective institutional controls and active societal oversight over the very long term.

Of these two approaches, Option 4 offers additional advantages in that implementation allows for interim steps at each stage and contingency plans to ensure the security of the material should implementation not proceed as planned. Specifically, it allows for a centralized shallow underground storage facility in the period preceding the deep repository. The possibility of such intermediate steps would allow for timely centralization of the used fuel to a safe storage facility underground, while allowing for building confidence before emplacing the fuel in the final repository.

Option 4 has the same number and robustness of physical barriers as Option 1 following closure of the deep repository.

iv) Transportation Distance

Transportation of used nuclear fuel involves some inherent risk to security, although this risk is judged to be small. Option 2 requires no off-site transportation of used nuclear fuel, so there are no opportunities for attempted dispersion during transportation.

The options that require transportation to a central site, Option 1, Option 3 and Option 4, would require additional safety requirements for the movement of the used nuclear fuel from the nuclear reactor sites to the storage facility. For these three options, total number of trip-kilometres required to transport all used nuclear fuel by road to a facility is expected to vary considerably (by up to 15 times), depending on the site. Vulnerability of the used nuclear fuel is assumed to increase with the distance traveled.

Analysis of Objective 6 – Environmental Integrity

Our objective:
To ensure environmental integrity.
The selected management approach needs to ensure that environmental integrity is maintained over the long term. Concerns include the possibility of localized or widespread damage to the environment or alteration of environmental characteristics resulting from chronic or unexpected release of radioactive or non-radioactive contaminants. Concerns also include stresses and damage associated with new infrastructure (such as roads and facilities) and operations (e.g., transportation).

Assessing the degree of impact each approach would have on the natural environment required consideration of many factors, including the number and sensitivity of ecosystem elements that would potentially be affected, the likelihood of impact to each type of resource, and the significance of the potential consequences to affected resources. Many different types of valued and environmentally sensitive resources could be affected, including plants and animals, land, surface water, groundwater and the air (e.g., through air pollution created during the construction of a new facility). Also included in the assessment were various aesthetic impacts, such as noise, and visual changes to the natural scenery. As in the case of other objectives, it is necessary to consider not only the stresses that each approach would produce assuming that the approach performs as expected, it is also necessary to consider the possibility of risk scenarios which go beyond normal operating parameters. An important factor to be considered here is the impact of significant changes in environmental conditions associated with climate change and the impact these types of changes may have on the performance of the management system.

It is difficult to precisely forecast the environmental impacts of the various approaches. This is especially true in the cases of the geological repository and centralized storage approaches because the impacts of each approach depend greatly on where the new facilities would be located, something that is not yet known. The long time-frames involved complicate forecasts for all approaches.

Comparative Assessment

Table 8-7 presents our assessment of the relative benefits and risks and uncertainty for each of the four options studied.

Table 8-7 Environmental Integrity

	BENEFITS	RISKS & UNCERTAINTY
Option 1: Deep Geological Disposal	Under normal conditions, this approach is expected to be able to be constructed and operated without causing significant adverse effects on the environment in the near and long term. This is achieved by implementing standard mitigation measures and best management practices. This method is considered to deliver benefits over the very long term, since the used fuel is isolated from the environment. Provides significant advantages over surface-based facilities (Options 2 and 3) with respect to withstanding the effects of major environmental changes over the long term. The deep repository, isolated from surface water systems, provides a strong barrier against possible environmental events. Used fuel is placed deep underground. Once the facility is closed, it is not reliant on active management to ensure safety. With the multiple and robust barriers, the engineered facility together with the geological barrier of granitic rock, are designed to isolate the fuel from the environment, providing low likelihood of adverse environmental effects. The resilience of this management approach in providing a high level of protection of the environment is particularly critical in light of possible climatic changes and extreme natural events that may well be associated with the tens of thousands of years over which the used fuel must be managed. Some long-term environmental changes may be gradual, such as effects of climate change and rising surface water levels. Other effects may be episodic, such as earthquakes and seismic activities. Resilience of the facilities must also be considered for glaciation. Avoids the need for periodic repackaging of used fuel and associated risks to the environment. The site can be chosen to minimize environmental impact.	In the short term, the construction of the facility could produce adverse impacts on the environment. These impacts are expected to be localized and relatively short lived. Following closure of the repository, monitoring for potential environmental effects becomes more difficult than with surface based facilities. However, the likelihood of an adverse effect occurring even over the long term is low because of the physical and geological barriers built into this facility design. Used fuel retrieval or other corrective action is also difficult. Advance “proof” that such a system works is not scientifically possible because performance is required over thousands of years. Detailed scientific studies, models and codes and natural analogues, therefore, form the foundation of the assurances of performance. Requires transportation of the used fuel to the central facility over a 30-year period. The transportation routes would likely traverse multiple ecozones. With likelihood of transportation accidents low, transport is unlikely to carry with it large risks to the environment. In addition, risks associated with transportation would be lowest for sites that are located closest to the current reactor sites.

Table 8-7 (cont'd) Environmental Integrity

	BENEFITS	RISKS & UNCERTAINTY
Option 2: Storage at Nuclear Reactor Sites	Under normal conditions, this approach is expected to be able to be constructed and operated without causing significant adverse effects on the environment in the near and long term if implemented as designed and using standard mitigation measures and best management practices. Provides a robust management approach in the near term (first 175 years). Risk of occurrence of off-normal events is low in the near term. Avoids the construction of a deep repository and the potential environmental disruption associated with implementation. Also avoids involvement of a new potentially greenfield site. With facilities at or near surface, provides for ease of monitoring of facility performance. Anticipated problems are more readily identified and addressed. No transportation of used nuclear fuel would be required, as the used fuel would remain where it is generated. The science and technology required are well in-hand.	Protection of the environment for the long term is uncertain given that effective performance requires strong institutional control and oversight, and that is uncertain over the long term. Since the facilities are constructed at or near surface, they are unlikely to be able to withstand glacial events or major long-term environmental disruption from extreme weather events or other major climatic changes. With safety of the site reliant on ongoing active institutional control, social instability that jeopardizes refurbishment, monitoring and oversight, or leaves the site abandoned, would introduce significant environmental risk. These risks multiply in the long-term, with uncertainty over environmental patterns that may unfold over the tens of thousands of years for which the fuel requires isolation. Long-term risks are compounded, in light of the multiple (seven) sites at which facilities would exist. Adverse effects of off-normal scenarios may be most severe in those locations adjacent to large continuous bodies of water, as the impacts on the water resources could be far-ranging and could have international consequences.

Table 8-7 (cont'd) Environmental Integrity

	BENEFITS	RISKS & UNCERTAINTY
Option 3: Centralized Storage	Under normal conditions, this approach is expected to be able to be constructed and operated without causing significant adverse effects on the environment in the near and long term if implemented as designed and using standard mitigation measures and best management practices. Provides a robust management approach in the near term (first 175 years). Risk of occurrence of off-normal events is low in the near term. Avoids the construction of a deep repository and the environmental disruption associated with implementation. With facilities at or near surface, provides for ease of monitoring of facility performance. Unanticipated problems are more readily identified and addressed. Offers better and more predictable environmental performance than Option 2 both in near term and long term. One centralized facility reduces the range of environmental resources at risk. Siting of the new facility allows for it to be purposely located and built in such a way as to reduce environmental risks. The required science and technology are well in hand for the above ground storage design.	Protection of the environment for the long term is uncertain given that effective performance requires strong institutional control and oversight, and that is uncertain over the long term. The construction of the facility could produce adverse impacts on the environment. Since the facility is to be constructed at or near surface, it is less likely to be able to withstand glacial events or major long-term environmental disruption from extreme weather events or other major climatic changes without active institutional management. Below ground storage offers some advantages compared with surface facilities. With safety of the site reliant on ongoing active institutional control, social instability that jeopardizes refurbishment, monitoring and oversight, or leaves the site abandoned, would introduce substantial environmental risk. These risks multiply in the long term, with uncertainty over environmental patterns that may unfold over the tens of thousands of years for which the fuel requires isolation. Requires transportation of the used fuel to the central facility. The transportation routes would likely traverse multiple ecozones. With the likelihood of transportation accidents low, transport is unlikely to carry with it large risks to the environment. In addition, risks would be the lowest for sites that are located closest to the current location of the majority of the fuel.

Table 8-7 (cont'd) Environmental Integrity

	BENEFITS	RISKS & UNCERTAINTY
Option 4: Adaptive Phased Management	Under normal conditions, this approach is expected to be able to be constructed and operated without causing significant adverse effects on the environment in the near and long term if implemented as designed and using standard mitigation measures and best management practices. It allows a period of time of high flexibility in which new learning might be easily incorporated. It allows for decisions to be reversed, should this be required, and provides for a viable, safe and secure storage capability at each point in the process, even should there be delay before proceeding to the next stage of implementation. Over the long term, when most uncertain, not relying on ongoing institutional control of the facility, avoids risks that might otherwise be posed in the event of long-term societal instability. Being located deep underground, the radioactive materials would be contained and isolated from the environment. In the deep repository, the used fuel is protected by both robust natural barriers provided by the crystalline or sedimentary rock, as well as the engineered barriers in terms of container design, buffer materials, etc. Facility could be expressly sited and designed to minimize environmental impact. Extended implementation period allows more time to understand the environmental conditions through research at the underground characterization facility and used fuel placed in the optional shallow underground storage, before making the decision to move the fuel into the deep repository for long-term isolation. Over the decades of program development and implementation, the selected approach will encounter changes in society, technology, economics, and the environment. These changes are better accommodated by this adaptable approach.	In the short term, the construction of the facility could produce adverse impacts on the environment as the shallow storage in rock caverns is built, and later the deep repository is built at a depth of 500 to1,000 metres under ground. These impacts are expected to be localized and relatively short lived, compared with the storage options. The above ground facilities are less likely to withstand severe environmental events. However it is expected that such events are very unlikely during the period of above ground storage envisioned in this approach. These above ground facilities would require active institutional control, however social stability is expected to continue through the period of above ground storage envisioned by this approach. The step of shallow storage at a single purpose-built site would enhance robustness and surety of performance towards the end of this period. Following closure of the repository, at a time when society makes that decision, monitoring for potential environmental effects becomes more difficult than with surface based facilities. However, the likelihood of an adverse effect occurring even over the long term is low because of the physical and geological barriers built into this facility design. The extended period of technology development and testing is expected to increase the performance of the system and confidence in its performance. Requires transportation of the used fuel to the central facility. The transportation routes would likely traverse multiple ecozones. With the likelihood of transportation accidents low, transport is unlikely to carry with it large risks to the environment. Risks associated with transportation would be lowest for sites that are located closest to the current reactor sites. As well, the flexibility in geological media associated with this approach will provide more flexibility in siting which may allow transportation to be minimized.

Summary Findings

Under normal conditions, all four management approaches are expected to be able to be constructed and operated without causing significant adverse effects on the environment in the near and long terms if implemented as designed, using standard and proven mitigation measures and best management practices. For all options, a more detailed examination of environmental impacts will be required once potential sites have been identified.

The multiple barriers associated with Options 1 and 4, as discussed under "Public Health and Safety", also apply to environmental integrity. Site selection, engineered barriers and placement at depth in geologic media comprise robust management designs to protect environmental integrity. The performance of these barriers is not reliant on ongoing societal oversight to offer protection over the long term. A further benefit of Option 4 is the extended period over which the site and the facilities can be monitored, tested and refined, prior to final placement of the used fuel. This opportunity for active monitoring and study will allow us to learn, understand and adjust facility designs as may be appropriate over a staged implementation period.

Storage approaches, Options 2 and 3, offer the benefit of easy monitoring and access to the fuel to address any detected impacts. In the long term, however, these options introduce long-term risks. Monitoring and securing of the facilities is reliant on active institutional management and controls, over a time period in which we cannot be assured of ongoing social stability. Facilities sited at or near surface are also expected to be less resilient to long-term climatic changes and environmental conditions than facilities secured deep underground.

Analysis of Objective 7 – Economic Viability

Our objective:

To design and implement a management approach that ensures economic viability of the waste management system, while simultaneously contributing positively to the local economy.

Economic viability refers to the need to ensure that adequate economic resources are available to pay the costs of the selected approach, now and in the future. The cost must be reasonable. The selected approach ought to provide high confidence that funding shortfalls will not threaten the assured continuity of necessary operations.

Assessing the economic viability of the approaches required considering the likelihood that financial resources would be available to pay the costs, recognizing that these costs are uncertain and, especially in the case of the reactor site and centralized storage approaches would continue over a very long time.

Comparative Assessment

Table 8-8 presents our assessment of the relative benefits and risks and uncertainty for each of the four options studied.

Table 8-8 Economic Viability

	BENEFITS	RISKS & UNCERTAINTY
All approaches		Long-term management costs for the approaches (i.e., costs out to hundreds to thousands of years and beyond) are based on current technology costs and assumptions regarding frequency of events (e.g., repackaging). Such costs should be considered order-of-magnitude only – even assuming future generations choose to continue long-term storage using today's technology. It is not reasonable to assume that the financial markets of today will continue unchanged for the lifetime of the management approaches. Thus, elements related to interest rates, bond markets, financial institutions, and the ability to borrow are likely to change in the long term. However, it is reasonable to expect that financial markets will likely remain intact in the near term, including the time period to initially put the used nuclear fuel in place in a facility for any of the four approaches. During final design, siting, environmental assessment and licensing, modifications to the design or schedule could result in significant cost increases. For example, the licensing and approval process, add-ons, more restrictive standards and other possibilities unforeseeable to the designers may lead to costs in excess of original estimates and the allowable contingencies, although the contingencies which are provided for in the cost estimates are comparable or greater than those for comparable projects.
Option 1: Deep Geological Disposal	Higher initial costs and lower longer term costs provide greater financial surety. With respect to time dependence of estimate certainty and the provision of surety, this option has the most certain estimates, as the vast majority of costs would be incurred in the near term. It is also the easiest to develop surety for because the facility closes within 150 years. If one is only concerned about the ability to marshal the necessary financial resources to complete the management of used nuclear fuel, this method is best.	Although the burden of financial surety is placed mostly in the hands of the current generation, should new technologies arise or should other social and/or technology issues arise, then future generations may be burdened with our used nuclear fuel legacy to an even greater extent. Since this type of facility has not been previously constructed, there is potential for problems and delays, which would raise costs.

Table 8-8 (cont'd) Economic Viability

	BENEFITS	RISKS & UNCERTAINTY
Option 1: (cont'd) Deep Geological Disposal	This management approach places used fuel in a "final" state with relatively few financial requirements over the very long-term compared with the two storage options. This means that the burden of financial surety is placed mostly in the hands of the current generation. Provides higher confidence that funding shortfalls will not occur that would threaten the assured continuation of necessary operations compared with the two storage options.	There are additional significant uncertainties. There would be substantial costs incurred in finding and characterizing a central site. Transportation costs may be significant and could increase if there are major delays. Our analysis suggests that, the incremental transportation costs vary across the economic regions examined by up to $900 million (2002 dollars, not discounted). Incremental transportation costs are greater for economic regions located longer distances from the majority of the used nuclear fuel (i.e., southern Ontario). The potential incremental transportation costs are significant compared with the cost of the management approach in the near term.
Option 2: Storage at Nuclear Reactor Sites	There is more certainty over near-term costs because a modified version of the technology is known and currently used. No costs associated with off-site transportation.	Lower initial costs, and higher longer-term costs, create more uncertainty around financial surety. The cost estimates provided for storage approaches have a higher degree of uncertainty than those for Option 1 because they assume conditions far in the future. Although the current generation will set aside funds for the long-term management of the used fuel, this method imposes a liability on future generations for continued active management and appropriate oversight institutions and a burden to cover costs that are not anticipated and funded today. The need for major rebuilding operations and ongoing repackaging on a regular basis in perpetuity severely limits the current generation's ability to estimate costs and provide surety. Cost estimates are more uncertain the farther into the future they are projected. Uncertainty with respect to surety also increases.

Table 8-8 (cont'd) Economic Viability

	BENEFITS	RISKS & UNCERTAINTY
Option 3: Centralized Storage	There is more certainty over near-term costs because the technology is known and currently used.	Lower initial costs, and higher longer-term costs, create more uncertainty around financial surety. The cost estimates provided for storage approaches have a higher degree of uncertainty than those for Option 1 because they assume conditions far in the future. Although the current generation will set aside funds for the long-term management of the used fuel, this method imposes a liability on future generations for continued active management and appropriate oversight institutions and a burden to cover costs that are not anticipated and funded today. Although the approach might be less costly initially, there are significant uncertainties. There would be substantial costs incurred in finding and characterizing a site. Transport costs may be significant, and could increase if there are major delays. The need for major rebuilding operations and ongoing repackaging on a regular basis in perpetuity severely limits the current generation's ability to estimate costs and provide surety. Cost estimates are more uncertain the farther into the future they are projected.
Option 4: Adaptive Phased Management	Higher initial costs, and lower longer-term costs provide more financial surety than for Option 2 and Option 3. Adequate surety can be developed. Examples exist of select human organizations and their investments persisting for over 325 years. This approach provides for a long-term storage facility based on existing, passive technologies rooted in long-standing areas of human activity (mining, metallurgy). The approach balances the risks that the required financial resources will be available when needed with the benefits of new technology development and enhanced proof of concept for long-term isolation. It preserves opportunities for decision making to future generations for an extended period without compromising the responsibility of the current generation to provide for a long-term solution.	Spans a longer time period than Option 1, which increases risk of financial surety, but a much shorter period of time than Option 2 and Option 3 with, therefore, comparative greater expectation of financial surety. Since a deep repository type facility has not been previously constructed, there is potential for problems and delays, which would raise costs. The more measured approach to implementation associated with this approach may reduce this potential. There would be substantial costs incurred in finding and characterizing a central site. Transportation costs may be significant, and could increase if there are major delays. As with Option 1, transportation costs are expected to vary substantially with the site selected.

Summary Findings

All options require substantial funding to be provided by the owners of nuclear waste. In all cases, the *NFWA* would require contributions from each nuclear corporation against an approved funding formula and schedule, thus ensuring as much as possible that the generation that benefited from the nuclear power also sets aside the required amounts to fund the approach.

The options are differentiated by significant variation in cost (either total cost or present value). The options are differentiated by the timing of expenditures in both the near and long term.

The options are differentiated by the uncertainty associated with estimating the amount of funds required, and ability to protect these funds, to ensure availability for this purpose over the very long time period over which the approach requires expenditures.

Options 1 and 4 are judged to offer the most surety, requiring the majority of expenditures to be made in the near term (within the first 100 years). Over this period, we believe it is reasonable to be confident in the availability of strong institutions and, therefore, safekeeping of the funds that have been contributed for this purpose. Confidence is also higher since the period for which costs need to be estimated is shorter.

In contrast, Options 2 and 3 are judged to offer the least certainty both that estimates made now will be accurate for the long duration of implementation involved with these approaches and that funds set aside now can be protected for this purpose for the long period that they are to cover. This is because these approaches require used fuel repackaging and rebuilding of storage facilities every 100 to 300 years in perpetuity. Funding would need to be assured on an ongoing basis to support the refurbishment and maintenance that is essential to securing the safe storage of the used fuel. Looking out to the long term, over the thousands of years for which the fuel must be isolated from people and the environment, we face considerable uncertainty that introduces risk to financial surety. Over the long term we cannot predict the performance of financing instruments or the status of the financial and governmental institutions responsible for the safekeeping of the funds.

Analysis of Objective 8 – Adaptability

Our objective:
To ensure a capacity to adapt to changing knowledge and conditions over time.
The selected management approach should be robust in the face of new or unforeseen circumstances. The approach should provide flexibility to future generations to change decisions; not place burdens or obligations on future generations that will constrain them. The approach should be able to function satisfactorily in the case of unforeseen events.

There was much discussion on this objective by citizens during the dialogue following release of our second discussion document. Although there appeared to be broad agreement on the importance of this objective, some debate was raised concerning how best to characterize or define the objective. Should the adaptability of an approach be defined primarily on the basis of the flexibility in future decision-making that it provides? Should the adaptability of an approach be defined primarily on the basis of the robustness it provides in the face of changing environmental conditions?

We have proceeded in a way which understands that both of these are potentially important influences on the adaptability of a management approach even though the measures one might put in place to achieve flexibility might directly conflict with the measures one might put in place to achieve physical robustness. What is required to make an approach adaptable in the near term may not be the same as what is required to make an approach adaptable in the very long term. Given the long time-frames for which any management approach will need to effectively contain and isolate used nuclear fuel, the balancing of such tensions is integral to both understanding what adaptability means for this issue and assessing the approaches on it.

We have approached adaptation as a general strategy of systems for attaining or maintaining a goal in the face of changing environmental circumstances. "Adaptability" is defined as the set of characteristics of an option that are expected to make a management approach robust with respect to the widest range of possible social and environmental scenarios in the long term. To be "adaptable" is to be capable of responding well to changes in environmental and social conditions, over a wide range of such possible changes.

Assessing the adaptability of each approach required consideration of many factors, including whether there are opportunities to adapt to changing knowledge or circumstances during the period when the various stages of the project are being implemented. It also included consideration of the robustness of the operation of the option to contain and isolate the waste, and/or ease of taking corrective action to ensure continued containment and isolation, in response to a wide variety of expected challenges to system integrity over the very long term. These challenges might include extreme natural events, deficiencies in option performance as designed, and an availability of any institutional controls or systems that may be required.

Comparative Assessment

Table 8-9 presents our assessment of the relative benefits and risks and uncertainty for each of the four options studied.

Table 8-9 Adaptability

	BENEFITS	RISKS & UNCERTAINTY
Option 1: Deep Geological Disposal	Being able to offer an "immediate" solution in the near term is a benefit, since it does not handicap future generations in terms of cyclical or significant costs to manage. The need for adaptability in relation to financial surety is minimal. Higher initial costs and lower longer-term costs provide more financial surety. Results in the eventual permanent placement of the used nuclear fuel, which reduces or may eliminate the necessity for long-term institutional and operational continuity and financial surety. After placement and closure, provision of long-term resources and funding are not required. Is less susceptible to security breaches. This reduces the need for flexibility in relation to long-term monitoring and contingency planning. Is most robust in face of changing environmental conditions such as glaciation, climate change and societal instability. This approach removes the burden of making decisions about managing the waste. Over the long term, it is likely that institutions and governance will change. This approach minimizes the need for institutions and governance because actions are not required after the repository is closed. This assumes that predicted "normal" operating conditions prevail and that there is no need for interventions (i.e., used nuclear fuel retrieval or mitigation of adverse effects). However, analysis indicates that the cost of retrieval from a closed Deep Geological Disposal in the Canadian Shield facility will likely be less than the incremental cost to manage the two storage approaches over the long term.	There is some uncertainty over the performance of the system over the very long term because advance "proof" that such a system works is not scientifically possible since performance is required over thousands of years. Detailed scientific studies, models and codes, and the study of natural analogues therefore, form the foundation for the assurances of performance. Science, technology, and social values may change over time, which may make a change to the management approach desirable. Such change would be very difficult to accommodate once the repository is closed. Monitoring of system performance becomes more difficult as the used nuclear fuel is placed deep underground and as the site is backfilled and closed. As well, retrieval of the used fuel for corrective action becomes much more difficult, costly, and hazardous. Flexibility to address changing conditions is low, however changing conditions are not expected to affect the performance of the system. Reversibility of decisions is difficult once the facility is closed. Retrieval of the used fuel is not envisioned with this approach. Cost of retrieval is not included in the conceptual design cost estimates. Costs related to reversing adverse health or environmental effects are largely unknown. However, since it is more difficult to monitor environmental effects, after closure, it is reasonable to assume that it will take longer to discover adverse effects compared to the storage approaches that remain open for the very long term. As a result, there is greater risk of a higher potential remediation cost with this approach although the probability of adverse effects after closure is considered to be very low.

Table 8-9 (cont'd) Adaptability

	BENEFITS	RISKS & UNCERTAINTY
Option 2: Storage at Nuclear Reactor Sites	This approach provides greater ability to monitor performance and flexibility to adapt to changing conditions. Taking corrective actions when required is easier and less costly. The waste is easier to retrieve. No transportation of used nuclear fuel would be required, as the used fuel would remain next to where it is generated. The science and technology required are well in-hand.	In the longer term, a surface facility is less able and adaptable to withstand potential wide variations in environmental and social conditions. Requires ongoing active management and financial resources over the very long term with the associated institutional controls and governance. However, it is possible that new technologies may arise that are less costly and more effective in managing used nuclear fuel, thus lessening the risk and costs to future generations. Lack of contingency plan should there be a need to remove the waste from the site. Requires numerous periodic future interventions that will be influenced by future applicable governing laws, market forces/incentives, cultural/social values and norms, and the synthesis of continual learning. Although a benefit on one hand (e.g., one can leverage the best science of the day to repackage used nuclear fuel), it also poses some risk that the necessary support institutions and governance frameworks we now rely on will not be there in the very long term. This is compounded by the existence of seven individual sites. The adequacy of institutions and governance in the long term is a critical consideration. The cost or liability to future generations of ensuring the financial and institutional stability of overseeing agencies will be significant.

Table 8-9 (cont'd) Adaptability

	BENEFITS	RISKS & UNCERTAINTY
Option 3: Centralized Storage	This approach provides greater ability to monitor performance and flexibility to adapt to changing conditions. Taking corrective actions when required is easier and less costly. The waste is easier to retrieve. The science and technology required are well in-hand.	In the longer term, a surface or near surface facility is less able and adaptable to withstand potential wide variations in environmental and social conditions. Requires ongoing active management and financial resources over the very long term with the associated institutional controls and governance. However, it is possible that new technologies may arise that are less costly and more effective in managing used nuclear fuel, thus lessening the risk and costs to future generations. Lack of contingency plan should there be a need to remove the waste from the site. Requires numerous periodic future interventions that will be influenced by future applicable governing laws, market forces/incentives, cultural/social values and norms, and the synthesis of continual learning. Although a benefit on one hand (e.g., one can leverage the best science of the day to repackage used nuclear fuel), it also poses some risk that the necessary support institutions and governance frameworks we now rely on will not be there in the very long term. The adequacy of institutions and governance in the long term is a critical consideration. The cost or liability to future generations of ensuring the financial and institutional stability of overseeing agencies will be significant.

Table 8-9 (cont'd) Adaptability

	BENEFITS	RISKS & UNCERTAINTY
Option 4: Adaptive Phased Management	Offers twin benefits of developing a long term solution in a relatively short time frame, yet enables easy access and active monitoring capability in the meantime. The approach offers the benefit of an extended storage option that enables continued research and development and monitoring activities to "prove" the concept and design parameters to the satisfaction of multiple generations. If satisfied, future generations can decide to proceed with long-term isolation of the used nuclear fuel or implement an alternative approach at the time. This extended storage and monitoring period reduces the potential requirement for and the cost of retrieval from a "closed" long-term isolation facility. Allows for sequential decision making on whether, when and how fast used nuclear fuel is moved to final disposition. Provides a viable storage capability that can be adapted to facility progress and used fuel placement while providing flexibility for waste placement rates or potential retrieval. It is less dependent on institutions and governance in the long term because actions are not required after the fuel is placed in the repository other than long-term monitoring. A critical success factor in the decision-making process for selecting an appropriate used nuclear fuel management approach is providing opportunity for public stakeholders to influence the process. This approach sets in place an open and transparent process to continue over the long term in relation to monitoring and new knowledge about how best to deal with used nuclear fuel. It allows for both current and near current generations to participate before it is fully implemented.	As with Option 1, there is some uncertainty over the performance of the system, once the repository is closed, over the very long term because advance "proof" that such a system works is not scientifically possible since performance is required over thousands of years. However, the extended period of technology investigation, testing and confirmation, is expected to substantially reduce this uncertainty. As with Option 2 and Option 3, it requires on-going active management and financial resources with the associated institutional controls and governance. However, this is substantially less than for Option 2 and Option 3 and is expected to be limited to a period in which confidence in institutional integrity is reasonably high. Due to the extended implementation period, there is a risk that the societal will to complete the implementation process may diminish to the point of threatening the safe operation of the management system. Compared with Option 2 and Option 3, the risk is small. Compared with Option 1, this risk is greater, although NWMO judges this risk to be small. This is because the infrastructure and facilities for the geologic containment and isolation of the used fuel will be in place, operating and/or available for operation relatively early on, within the timeframe for which institutions are expected to be strong. This risk is, by design, constrained by the recommended implementation plan, and balanced by the potential to incorporate new learning which the flexibility of this approach, within the near term provides.

Summary Findings

Each of the four management approaches have some measure of adaptability, although the mechanisms they provide to achieve adaptability, and the degree and nature of adaptability over time, varies between the approaches.

In the near term, the storage options offer more accessibility to the waste, making it easier to monitor and access the waste to take corrective action if necessary, or to take advantage of new advances in waste management technologies. However, they also create long-term costs and institutional requirements that would burden future generations and would compete for resources with other valued objectives of the time. Should future generations not have the will or capacity (including knowledge and resources) to actively manage these facilities, the waste is vulnerable to the natural deterioration of the containment as well as a range of likely risk scenarios including climate change, human intrusion, and glaciation. Since the used fuel will be hazardous for hundreds of thousands of years, adaptability depends on the continued existence of institutions over this very long period, which is highly uncertain. Although in the short term these approaches are highly adaptable, taking into consideration both the near term and the longer term, they are judged to perform poorly on this objective.

The deep geological disposal concept takes the hazardous material out of the accessible environment making it less vulnerable to extreme events than the other approaches. Through the combination of natural and engineered barriers, the system is designed to isolate and contain the used fuel over the long periods for which it needs to be managed without requiring institutional care or intervention.

Over the long term, the system is designed to be robust in the face of a broad range of extreme events including severe climate change, human intrusion and glaciation. However, in so doing it makes it more difficult to monitor the used nuclear fuel and to detect problems and take corrective action in the unlikely event of a breach of containment. Note that over the very long term, there is some uncertainty over performance of the system because advance "proof" that such a system works is not scientifically possible since performance is required over thousands of years. It also makes it more difficult to take advantage of any advances in waste management technology that may become available in the future.

Over the very long term this approach is more robust in the face of extreme events, and is expected to perform better than the storage approaches. However, because it offers little opportunity for monitoring the performance of the system, for taking corrective action, or taking advantage of new technologies that may emerge during the period for which it is reasonable to believe that institutions and governance will remain strong, this approach is judged to be less adaptable than the Adaptive Phased Management approach.

Adaptive Phased Management offers a balance between the requirements for adaptability in the short term and in the long term. It offers the benefits of implementing an approach that in the long term does not require institutional control for effective performance, while providing for a period of easy access and active monitoring capability up to that point. It is less dependent on institutions and governance in the long term because actions are not required after the repository is closed other than long term monitoring. It offers the option of an extended storage period that enables continued research and development and monitoring activities to "prove" the concept and design parameters to the satisfaction of multiple generations. If satisfied, future generations can decide to proceed with long-term isolation of the used nuclear fuel or implement an alternative approach. It allows for both current and near term generations to participate in the selection and design of a long-term approach before it is fully implemented. It allows for sequential decision-making on whether, when and how fast used nuclear fuel is moved to final disposition, and it ensures there is a viable option available to reverse decisions made at each key decision point in the process. In this way it provides mechanisms to respond to changes in society, technology, economics, and the environment that will likely occur over the period of program implementation.

A Comment about Transportation

Throughout the course of our dialogues, many citizens expressed concern about the transportation of used nuclear fuel and questioned whether it can be accomplished safely. The NWMO acknowledges this concern and the need to demonstrate the safety of any transportation system to the satisfaction of citizens before beginning to transport used nuclear fuel to a centralized long-term management facility. We commissioned three background papers specifically to examine the state of knowledge and experience regarding the transportation of used nuclear fuel.[1] On the basis of these papers, and through further insight gleaned from discussions with nuclear waste management organizations and regulatory bodies in other countries, the NWMO believes that with sufficient effort, resources, preparation, oversight and continued vigilance, used nuclear fuel can be transported safely. This is for a number of reasons.

Robust containers. The design of the transport container for used nuclear fuel is the main safety feature in used fuel transport. The containers are designed to withstand expected accident conditions without breach of containment or without an increase in radiation level that could potentially endanger the general public and workers. Testing under accident conditions is done to ensure that a container meets rigorous requirements. Details of the tests and the acceptance criteria with regard to leakage and radiation fields are prescribed in regulations developed by the International Atomic Energy Agency (IAEA).

The severity of the acceptance tests, outlined in Table 8-10, particularly those for accident conditions, indicate the high safety standards to which used fuel packages are tested prior to being deemed transportation worthy. The regulations are under constant review to ensure that they are kept up to date with modern requirements and knowledge gained from any actual incidents or accidents – whether or not these accidents involved nuclear materials.

Used nuclear fuel containers are massive structures typically manufactured from forged steel. Because of the robustness of these containers, used nuclear fuel has been transported safely for over forty years internationally. The IAEA has also set standards for the physical protection of nuclear material and

[1] NWMO Background Paper: 6-6 - Wardrop Engineering. Status of Transportation Systems for High-level Radioactive Waste Management; 6-7 Amir Husain and Kwansik Choi. Status of Storage, Disposal and Transportation Containers for the Management of Used Nuclear Fuel; 6-8 – Gavin J. Carter. Review of the Fundamental Issues and Key Considerations related to the transportation of spent nuclear fuel.

Table 8-10 Test Requirements for Used Fuel Transportation Packages

CONDITIONS	TESTS
Normal transport conditions	• Water spray test: exposure to rainfall of approximately 5 cm/h for at least 1 hour is simulated • Free drop test, package is dropped a free distance of 0.3 m • Stacking test: a compressive load, equivalent to 5 times the mass of the package (container plus used fuel), is applied • Penetration test: a 6kg bar is dropped from a height of 1 m on top of the package
Accident transport conditions	• Free drop test: package is dropped a free distance of 9 m • Penetration test: package is dropped a free distance of 1 m onto a rigid vertical bar • Thermal test: package is exposed for 30 minutes to a hydrocarbon fuel/air fire with an average temperature of 800°C • Water immersion test: package is exposed to a 15 m (minimum) head of water for a duration of 8 hours (minimum).

Source: Background Paper 6-7, "Status of Storage, Disposal on Transportation Containers for the Management of Used Nuclear Fuel, Amir Husain and Kwansik Choi.

produced guidelines for member countries to plan for and respond to emergency situations.

Containers used within Canada must also be licensed by the Canadian Nuclear Safety Commission (CNSC) an independent agency of the Government of Canada which regulates the use of nuclear material. Canada has so far moved only a limited number of used nuclear fuel containers. However, three million tonnes of dangerous goods (including hazardous waste) in approximately 27 million shipments are successfully transported in Canada every year by road, rail and air. The CNSC works in conjunction with Transport Canada to ensure the safe transport of this material. The important role of the CNSC and Transport Canada in this area is more fully described in Chapter 10.

International experience. While used nuclear fuel has not been transported widely in Canada, government, regulators and commercial organizations around the world have extensive experience transporting radioactive and nuclear materials, and with regulating it for safety and security. Government and independent experts in many countries, most notably the United States, the European Union and Japan, as well as the IAEA, have also regularly examined and researched safety issues concerning radioactive material transport. A large body of technical data exists which can be drawn on by regulators, utilities, politicians and the public in preparing any future plans for the transportation of used fuel. This information has direct application and relevance because Canada, as a member of the IAEA, is obliged to meet the same level of international standards that have been the subject of this study and analysis.

Radioactive materials have been transported around the world for 40 years. In that time, there have been no accidents that resulted in the release of significant amounts of radioactivity. In the US, nearly 3000 shipments of commercial used fuel have been transported over 2.5 million km in the last 30 years. Approximately 4300 shipments (primarily by rail) are proposed within a 24-year period to the U.S. Yucca Mountain site beginning in 2010. The UK and France combined average 650 shipments of used fuel per year (primarily by rail), through countries much more densely populated than Canada. Sweden routinely moves used fuel by ship to a central storage facility. Used fuel and high level reprocessing waste has been transported by sea between Europe and Japan. The ships have covered 4.5 million kilometers transporting used fuel without an incident resulting in the release of radiation to an individual or the environment.

Studies have also been conducted to examine a range of "what if" scenarios and accident scenarios, including analyses of what would have happened if used nuclear fuel had been transported during some of the most severe hazardous material accidents. These studies have consistently shown that the levels of risk are very low whether used nuclear fuel is transported by land or sea.

In summary, the NWMO acknowledges the concerns of many citizens about the transportation of used nuclear fuel and the need to demonstrate the safety of any transportation system to the satisfaction of citizens before beginning to transport used nuclear fuel to a centralized long term management facility. The NWMO understands that decisions on risk and safety are societal ones. On the basis of the work which the NWMO has conducted during this study, including the commissioning of background papers, and the discussions it has had with nuclear waste management organizations in other countries, the NWMO believes that used nuclear fuel can be transported safely. Adequate effort, resources, preparation, oversight and continued vigilance are necessary requirements of any plan for transportation of used nuclear fuel and, therefore, must be critical elements of any implementation plan for a management approach.

Summary of our Assessment Findings

We reached our conclusions through an iterative process of several stages. Our analysis suggests:

- Taken individually, no one of the management approaches specified in the *NFWA* perfectly addresses all of the objectives which citizens said are important for any management approach for Canada to address, particularly when both the near term (the next 175 years) and the longer term is considered;

- Each of the three approaches specified for study in the *NFWA* has distinct advantages and limitations in light of this framework;

- A management approach which incorporates the most significant advantages of each approach, supported by a phased decision-making process designed to actively and collaboratively manage risk and uncertainties, is expected to perform better on our objectives than the other three approaches; and

- The process of implementation will be a test of the degree to which any of the approaches would ultimately address citizen objectives, values and ethical principles. Therefore, the requirements for an implementation plan form an essential part of our recommendation.

The storage options, Option 2 – Storage at Nuclear Reactor Sites and Option 3 – Centralized Storage, are expected to perform well over the near term (at least within the next 175 years). However, the existing reactor sites were not chosen for their technical suitability as permanent storage sites. Furthermore, the communities hosting the nuclear reactors have an expectation that the used nuclear fuel will eventually be moved.

The NWMO believes that the risks and uncertainties concerning the performance of the storage approaches over the very long term are substantial in the areas of public health and safety, environmental integrity, security, economic viability and fairness. A key contributing factor in expected performance is the extent to which the storage approaches rely on strong institutions and active management to ensure the safe and effective performance of the management system. The NWMO expects that these institutions and capacity for active management will be strong over the foreseeable future, but uncertain over the very long term. The NWMO believes that the type of responsible and prudent approach that Canadians have suggested is required dictates that we not rely on the existence of strong institutions and active management capacity over thousands and tens of thousands of years. On this basis, the NWMO does not suggest either of the storage options as a preferred approach for the long term.

Deep Geological Disposal in the Canadian Shield, Option 1, is judged to perform well against the objectives in the very long term because of the combination of engineered and natural barriers to isolate the used fuel. A key weakness, however, is its lack of adaptability, which is an important objective in the minds of citizens. Over the short term, the approach is judged to be less flexible in responding to changing knowledge or circumstances either concerning the performance of the system itself over time, or more broadly to innovations in waste management technologies. There is some uncertainty about how the system will perform over the very long term because we cannot obtain advance proof of the actual performance of the system over thousands of years. Also, this approach provides comparatively little opportunity for future generations to influence the way in which the used fuel is managed. Its lack of adaptability is a weakness that may ultimately affect the performance of the system over time on other objectives such as public health and safety and environmental integrity.

Adaptive Phased Management, Option 4, has been designed to build upon the advantages of each of the three approaches studied. It is designed to reduce uncertainties at each phase in the process and over time. Involvement of citizens in decision-making throughout all of the phases is important. The NWMO considers Option 4 to offer a preferred approach.

- This approach is designed to be **highly adaptive** in the near term, the period in which it is reasonable to believe there will be strong oversight institutions and active management capacity. It entrenches an explicit and planned process of social learning and action. Over this period, new learning and technological innovation is

easily incorporated into the management plan. Some social uncertainties, such as the role of nuclear generated electricity in Canada's energy mix, may be resolved in the near future. Some technical uncertainties, such as whether evolving technologies (i.e., transmutation) will become practicable, are also likely to be reduced. Some uncertainties over the performance of aspects of the deep geological system are also expected to be reduced with further research, testing and experimentation, particularly at the location where such a facility might be sited;

- This approach also clearly identifies the technology associated with a deep geological repository as the appropriate end point. It does not rely on human institutions and active management for its safe performance over the long term. The approach plans for and puts in place a safe and secure containment option for the used nuclear fuel at each point in the process. It provides real options and contingency plans should implementation through the phases not proceed as planned.

- This approach is designed to ensure that **public and worker health and safety** are maintained over the long term. Radiological and non-radiological exposures to the public and to workers are estimated to be very small. The optional step of shallow underground storage of used fuel at the central facility is expected to add a slight increase in radiation exposure to workers if more handling and repackaging of the used fuel is required, although the exposure would be well below current regulatory levels. The flexibility and adaptability of the approach allows for new and continuous learning to be incorporated. This is expected to improve the safety and performance of the management system through the reduction of uncertainty. It allows confidence to be established in the safety and performance of the technology before proceeding along each step in implementation.

- Similarly, site selection, engineered barriers and placement at depth in geologic media comprise a robust management design to **protect environmental integrity**. The extended period over which the site and the facilities can be monitored, tested and refined, prior to final placement of the used fuel are designed to strengthen the environmental performance of the system. The opportunity for active monitoring and study will allow us to learn, understand and adjust facility designs as may be appropriate over a staged implementation period.

- Over the long term, the approach will keep the waste **secure**, since it involves strong physical protection of the fuel against unintended security breaches by placing used nuclear fuel deep underground, and ultimately backfilling and sealing all routes to access the fuel.

- The approach is designed to be **fair** in the distribution of the risks, benefits and uncertainties within this generation and across generations. As a blend of a flexible centralized storage facility in the near term, coincident with an extended period of proof of concept activities, and final placement of used nuclear fuel in a deep repository, the management approach provides a balance between the major uncertainties associated with the performance of the individual technologies taken in isolation, both in the near term and over time.

- **Community well-being** is a key consideration in the approach in the sense that the staged and adaptive process will allow the implementation path to be responsive to the expectations of Canadian society today and continued influence of future generations on the subsequent decisions to be taken concerning design and evaluation of program progress.

- **Economic viability**, and in particular financial surety, is taken into account in requiring the majority of expenditures to be made in the near term (within the first 90 years). Over this period, it is reasonable to be confident in the availability of strong institutions and, therefore, safekeeping of the funds that have been contributed for this purpose.

Adaptive Phased Management provides the option for more robust and secure interim storage in shallow underground caverns located centrally at the site of the deep repository;

- The approach provides opportunity for future generations to influence the way in which the fuel is managed;
- The approach provides for research and collaborative decision-making in the determination of the manner and timing of movement through the phases;
- The approach suggests a process through which confidence in the technology and supporting systems can be developed before moving to the final phase; and
- The approach suggests a process for putting multiple options in place should these be required as contingencies throughout the implementation process.

Finally, our analysis suggests that some important issues are not fully addressed through the selection of the management approach itself. They will need to be considered through the collaborative decision-making process, which should accompany the implementation of any approach. These issues include the design of a fair siting process and the determination of safety thresholds that would need to be met before moving to the next phase of implementation.

Dialogue with Canadians has highlighted that an **optimal balance** needs to be found between flexibility in the near term, which allows for new learning, and the implementation of an approach which isolates and contains the used fuel in a way which does not require active care by people over the very long term. Option 4 provides such a balance. Canadians have also said that an optimal balance needs to be struck between moving cautiously, to allow for new learning and social confidence, and sustaining sufficient momentum to carry forward with implementation of the approach to completion. Should the implementation period be too protracted, there is a risk that future generations will lose interest and/or otherwise abandon the approach mid-way through implementation with negative impacts on public health and safety as a result.

As suggested earlier, the NWMO believes there is some risk associated with each of the approaches studied that momentum will be lost in the potential face of public opposition and/or loss of political will. A stepwise implementation process, involving potentially impacted communities of interest at each major point of decision-making, will result in greater public acceptability. This public acceptance should expedite the implementation of the deep repository by matching the pace and manner of implementation to that at which society is prepared to proceed. In laying out a process in which key decision points have been mapped along with the means to ensure those involved in the decision (potentially impacted communities of interest) have both the capacity and information to make the required decision, and putting contingencies in place should unforeseen events be encountered, implementation should proceed in as efficient a manner as social conditions allow. Through the nature of the decision-making process, and contingencies for multiple decision-making outcomes, the continued safe and secure management of used nuclear fuel is best assured through to completion of implementation.

In recommending Option 4, the NWMO considers the risk of a loss of momentum to be small overall, particularly over the period leading up to the completed construction of the deep repository which is expected to be within 90 years or less. The infrastructure and facilities for geological containment and isolation of the used fuel will be in place, operating and/or available for operation relatively early on, within the timeframe during which institutions are expected to be strong. The risk of a loss of momentum is, by design, constrained by the recommended implementation plan, and balanced by the potential to incorporate new learning, which the flexibility of this approach provides in the near term.

8.5 / The Preferred Approach and Possible Future Scenarios

This assessment has been conducted, and our recommendation is being made, based on what we know today, specifically the number of used nuclear fuel bundles which have been produced to date and which are planned to the end of the current lives of existing nuclear plants. Other decisions may be taken in the near future which could significantly change the conditions in which the management approach will be

called upon to operate.

Adaptive Phased Management may be sufficiently flexible and adaptable to respond to a range of future scenarios. A description of the scenarios considered, and the technical and cost implications of each are discussed in Appendix 10. These scenarios did not benefit from a comprehensive comparative assessment of any social and ethical factors.

Any decision which may impact the future of nuclear power in Canada may well be accompanied by changes in societal priorities and preferences concerning the manner in which used nuclear fuel should be managed. Since Adaptive Phased Management is by design marked by a sequence of steps and decisions, significant adjustments can be made at many points through the implementation process. Two brief examples follow for illustrative purposes.

Early Nuclear Phase Out

What if Canada decided to phase out nuclear power generation by 2012? First, there would be some practical implications. There would be less fuel to manage and transport to a central facility. Used fuel transportation could be completed more quickly, within a period of 20 years rather than 30 years. As well, the long term management facilities could be scaled back in size. From a technical perspective, with relatively minor adjustments to the design and scale of the central facilities, the Adaptive Phased Management approach could be adapted to meet the conditions in this scenario.

A phase out of nuclear power may be accompanied by a shift in societal priorities or other public policy. For example, in order to more quickly close out the nuclear fuel cycle there might be a desire to implement the deep repository more quickly. Should this scenario come to fruition within the first 30 years of implementation of the Adaptive Phased Management approach, flexibility exists to forego the optional step of shallow underground storage and proceed to implementation of the deep repository on an expedited timeframe. This is an example of how the flexibility which has been built in to the approach might be used to adapt to changing conditions. Under this scenario, it is expected that sufficient funds would be available under the proposed conservative funding formula to support an expedited timeframe for implementation, particularly if the shallow storage facility was not constructed or was constructed on a smaller scale.

Existing Reactor Refurbishment and Life Extension

What if each of the nuclear reactors in Canada operated longer than currently planned, to an average of 50 years? First, there would be a number of practical implications. There would be an increased volume of used nuclear fuel to manage and transport over a longer period of production. The used fuel transportation period and placement period would each be increased from 30 years to 40 years. As well, the size of the deep repository would need to be expanded. From a technical perspective, with relatively minor adjustments to the design and scale of the central facilities the Adaptive Phased Management approach could be adapted to meet the conditions in this scenario.

An extension of the life of existing plants may be accompanied by a shift in societal priorities or other public policy. For example, since operations will continue at each nuclear plant site for an extended period, there might be a desire to continue to keep used nuclear fuel at the existing reactor sites for the full extended duration of the plant operation, and then move directly to placement of the fuel in a deep repository. The flexibility built in to the approach could be used to respond effectively to these changing conditions by extending the period of reactor site storage and forgoing the step of centralized shallow storage. Cursory consideration of this scenario may suggest that in order to be robust against this scenario, the Adaptive Phased Management approach should be implemented at a site which is large enough to accommodate expansion and additional fuel should the need arise. Cursory consideration may also suggest that any discussions with communities expressing interest in hosting the centralized facilities include discussion of this scenario and the bounds of community interest in this light.

Part Five
Implementation

5

Chapter 9 / Foundation for Implementation

Over many years, much research has been directed to examining and understanding the technical management options presented by the different conceptual designs. Going forward, it will be essential that the NWMO demonstrate a continuing commitment to process. The process by which a management approach is implemented will be an important determinant of its overall effectiveness and the extent to which it is, and continues to be, responsive to societal needs and concerns.

The *Nuclear Fuel Waste Act* (*NFWA*) requires that our study address some specific aspects of implementation. In Chapters 9 through 16, we address each of these legislated requirements and expand our discussion to address additional considerations we believe to be integral to the overall implementation plan.

9.1 / Key Features of Implementation Plans

For any management approach selected, the decision-making and implementation processes will unfold over many years. As the NWMO proceeds with implementation, it will be important that implementation continue to be responsive to the values and objectives of Canadians. The manner of implementation will determine the effectiveness of any management approach, and the extent to which it reflects societal needs and concerns. Through implementation we will seek to build confidence.

In our dialogues with the general public, Aboriginal peoples and specialists alike, many people focused their comments on features they believe should be part of the implementation plan that accompanies the management approach selected. Indeed, as we reported in Part Three, much of the common ground uncovered in our study relates to principles and expectations for how decisions will be taken, how citizens will be involved, and how any management approach will be implemented and monitored over time. In the discussion on implementation that follows, we are guided by the considerable advice and sharing of views we benefited from over the course of the study.

As the NWMO assumes its role leading implementation of the management approach selected by government, we intend that our processes build upon the foundations established to date through the course of our study of management options.

Our intentions for the implementation plans are outlined below:

We will communicate a clear decision-making path that includes accountability. With our study we have begun what will be an ongoing process that unfolds through the decision-making and implementation processes. There will be a continuum of engagement activities appropriate to support decisions taken at each step. We must provide assurance that commitments made will in fact be met, and that contingency plans are known and available should they be required. Safety for people and the environment must remain primary considerations as implementation proceeds.

Aboriginal values and concerns are a priority. We will continue to pursue relationships with potentially affected Aboriginal peoples based on mutual trust, respect and integrity. We are committed to seeking an alignment between Aboriginal values and those reflected in our implementation plan. We will respect Aboriginal rights, treaties and land claims.

We will build on relationships that we have established. The three-year NWMO study provides a starting point for the much longer-term outreach and engagement that will be the centerpiece of implementation. Through a diverse engagement program, we have come to know many communities of interest and developed ongoing dialogues with them. Our engagement of the Canadian public and with Aboriginal peoples is just beginning. The dialogue we have begun will continue to grow in the years to come.

We will seek to continue real dialogue. From the inception of our study, we have endeavoured to engage Canadians in a dialogue that permits a rich conversation through which to shape each step of our work. Many participants expressed support for the process we initiated to formulate our recommendations. The dialogue must continue through the implementation phases. Although agreement between all participants may not always be forthcoming, effective dialogue facilitates a better understanding of different perspectives. Key is the creation of opportunities in which these important discussions may take place. This is an area in which process-related insights from Aboriginal Traditional Knowledge can be brought to bear to inform implementation.

We will focus our engagement on potentially affected communities of interest. We will encourage all parties with significant interest to participate so that we may understand their views and incorporate the broadest possible foundation of perspectives and knowledge into our implementation decisions. We want to understand concerns of citizens in regions and communities that are affected directly and indirectly. We also want such communities to become active players and problem solvers. The potentially affected communities of interest are broad, and will vary over time and across phases of implementation.

Our plans for engaging communities of interest will need to be developed iteratively and collaboratively with those most affected. Decision-making becomes increasingly more complex as more players demand an active role. Effective engagement is based on principles of openness, transparency, integrity and mutual respect, which imply a shared responsibility.

We will assign great importance to societal considerations in the site-selection process. We must continue to learn about, and adapt to, the requirements identified by communities of interest. In order to support effective participation, we must ensure that the citizens and communities potentially impacted by the selection of a site for the management facility are sufficiently resourced and informed to be equipped to participate in discussions and decision-making. Their participation must be based on an understanding of potential risks and the means to manage them. Communities of interest potentially affected by the facility must have opportunities for genuine involvement in implementation process.

We do not intend to site a facility without the support of the host community. We must seek to design and implement our activities to foster positive change over the long term. Should there be adverse impacts, we must recognize the contributions and costs borne by the community through appropriate mitigation measures designed in collaboration with them.

We will seek to ensure access to the intellectual capacity required to make decisions and to sustain operations. Monitoring of emerging research and technical developments internationally will be important. Skills and capacities of workers must be sustained to support the safe operation of the facilities over the period of time in which institutional control is required.

9.2 / Engaging Communities of Interest

Over the course of its study, the NWMO has attempted to involve a broad cross-section of communities of interest, because all citizens are potentially affected by any decision made regarding the long-term management of used nuclear fuel. As we move toward implementation, different perspectives will be identified by those who feel they will be differentially impacted. With implementation, our engagement must become more focused on the communities of interest potentially most affected at each phase of the process.

The determination of those most affected, and the nature of their involvement, must be the subject of dialogue in the months immediately following a decision by the Government.

In our dialogues, we were asked what we mean by "communities of interest". A "community of interest" is a group of people who share a common interest or purpose. The group may live in close proximity to each other, for instance, in a town – therefore, the town is a community of interest – or they may share a common concern or knowledge, and have come together to pursue specific interests. For example, Nuclear Waste Watch, an organization formed as a result of shared concerns about nuclear waste management and the NWMO study, is a community of interest. The Canadian Nuclear Society, an organization of engineering professionals working in the nuclear industry, is also a community of interest. An Aboriginal community represents yet another, as are communities that presently host Canada's nuclear reactors, and communities along a transportation route. Going forward, a willing host community that offers itself and is selected for

Table 9-1 Describing Affected Communities for the Four Management Approaches

MANAGEMENT APPROACH	COMMUNITIES OF INTEREST
Option 1: Deep Geological Disposal	Cities, towns, villages, municipalities and dispersed population in the vicinity of the site; the Aboriginal community within the affected traditional territory, transportation corridor communities, reactor site communities until all used nuclear fuel is re-located.
Option 2: Storage at Nuclear Reactor Sites	Reactor site cities, towns, villages, municipalities and implicated aboriginal people.
Option 3: Centralized Extended Storage	Cities, towns, villages, municipalities and dispersed population in the vicinity of the site; the Aboriginal community within the affected traditional territory, transportation corridor communities, reactor site communities until all used nuclear fuel is re-located.
Option 4: Adaptive Phased Management	Cities, towns, villages, municipalities and dispersed population in the vicinity of the site; the Aboriginal community within the affected traditional territory, transportation corridor communities, reactor site communities until all used nuclear fuel is re-located.
All management approaches	Professional organizations working in this area; academic institutions conducting research in related areas; research and/or implementing organizations in other countries involved in implementing a similar approach; civil society groups with an interest; regulatory bodies and government departments with an interest.

the long-term management facility will be a very important community of interest. The communities in the region that may be affected by the operation of the facility are similarly important.

Communities of interest include geographic communities, such as cities, towns, villages or municipalities. They also include governments, industries, and civil society. There are those in the international arena contributing to the development of our management approach (for example, by providing scientific or technical advice) or who may be influenced by what we do in Canada. They too are a community of interest. Communities of interest which are likely to be affected will vary over time as decisions about managing used nuclear fuel are made and implemented. Table 9-1 is a very preliminary reflection of the variety and breadth of communities of interest which may be impacted at one or more points in the implementation process.

A discussion of our engagement plans is continued in Chapter 13.

9.3 / "Consultation" with Aboriginal Peoples

On treaty lands, Aboriginal and treaty rights are defined and protected under s.35 of the *Constitution Act*, 1982. In addition, in 1987, the World Commission on Environment and Development (the Brundtland Commission) stated that tribal people must be given a decisive voice in the formulation of resource policy in their areas. Since then, a series of Supreme Court of Canada decisions has begun the process of formally clarifying the legal duty of consultation owed to Aboriginal peoples by the Crown.

Throughout our study, we have made best efforts to involve Aboriginal peoples in the dialogue. This activity is documented in full in Part Three of this report. We have heard from some that these discussions did not constitute "consultation" as they saw it. The nature of the specific obligation will be clarified as the Government makes its decision, and directly affected individuals and communities become more evident.

9.4 / The Site-Selection Process

Although site selection is not part of this study, many have asked that we elaborate on some of the major considerations and principles that might influence the site-selection process.

A Willing Host Community

The siting of the management facility will involve both technical and social dimensions that cannot be separated. Safety and security must be fundamental considerations. Technical and scientific factors associated with confirming the geology and suitability of the site are important, and regulatory processes will demand that a strong safety case be demonstrated. However, confidence in the technical aspects of a site alone is unlikely to be sufficient to provide the assurances that people seek in order to implement the project successfully. A dynamic process, implementation must unfold in an ethical way that continues to respect the social, cultural and economic aspirations of the affected community.

For this reason, the NWMO is committed to seeking an informed, willing community to host the long-term management facility.

Identification of a willing host community is central to building a foundation for collaboration and active involvement of the community in implementing the management approach. Implementation requires a host community that is well informed about the impacts, and is committed to working with the NWMO, shaping and directing key implementation decisions. Implementation presents a significant opportunity to build trust and cooperation, so that decisions taken support and make possible longer-term, sustained benefits for the community. It is against the backdrop of the community's own vision for its future that the NWMO would wish to proceed with implementation.

The NWMO does not intend to proceed with siting against the wishes of a local community. It is the potential host community that will be positioned to determine how to ascertain

whether it has the permission and trust of its residents in order for the NWMO to proceed.

It is up to the potential host community to determine how it will demonstrate its willingness to host the facility. It will be up to the potential host community to establish how it will invite its citizens to express their views.

In deciding whether or not "willingness" has been demonstrated at a level sufficient to proceed with siting in a potential host community, the NWMO will consider a number of factors.

For example, a "willing host community" must be one which:

- Has provided an open, inclusive and fair opportunity for engagement and dialogue with residents of the community, allowing their views to be heard and taken into account;
- Has considered the potential benefits and costs, as well as areas of risk and uncertainty, associated with hosting the long-term management facility;
- Has considered the full range of impacts on the community's social and cultural aspirations, as well as economic considerations. During our public engagement we heard concerns that a community might be drawn to accept the facility for purposes of economic development alone. The NWMO will want to ensure that the community's willingness is not driven exclusively by economic development reasons, without due consideration to social and cultural impacts implicit in becoming the host community;
- Has, in considering the implications of hosting the facility, been well informed by the best available knowledge about the project and has carefully considered the decision of hosting the facility. It has received sufficient resources from the NWMO with which to develop its capacity to undertake this investigation, including access to independent advisors;
- Has determined how it will demonstrate community willingness to host the facility, and has arrived at its interpretation of willingness using indicators/process/judgement of its own design; and
- Has demonstrated a willingness to work closely with the NWMO throughout the implementation process. The NWMO will want to work collaboratively with the community to identify measures and manage socio-economic effects that may arise in the course of implementing, monitoring and operating the facility, in a way that supports the community's long-term vision. Societal considerations will assume great significance in a site-selection process, and the NWMO must continue to learn about, and adapt to, the requirements identified by the host community.

These issues are discussed further in Chapter 14.

Collaborative Design of a Siting Process

The NWMO will play the lead role in coordinating the site-selection process. We will initiate our plans for siting-related activities immediately following a government decision on a management approach.

During our dialogues, we heard that the engagement process that the NWMO establishes as part of the siting process will be a particular area of interest and concern. To build and maintain trust, we were advised that the siting process must provide extensive opportunity for public input.

The NWMO is committed to developing and implementing a siting process collaboratively with affected communities of interest.

The siting process, and the engagement process to support it, must be the subject of a specific dialogue immediately following any government decision which involves the centralization of used nuclear fuel.

During the collaborative design of a siting process, the NWMO will seek to develop, confirm and communicate the:

- Objectives of the exercise;
- Principles that would apply;
- Major steps in the site-selection process, including the process that will be used to determine suitability and confirm acceptability, at each step along the way;
- Factors and criteria to be applied and how they would be used;
- Processes and mechanisms to integrate Aboriginal Traditional Knowledge;
- Information sharing that would be undertaken and studies required at each stage; and
- Processes and mechanisms to engage and support potential willing host communities, from the initial solicitation of expressions of interest, to the identification of a preferred site.

We received many comments on the complex issues to be addressed as the NWMO initiates a siting dialogue to identify an informed, willing host community. We will need to determine how decisions are considered and made, and who is involved in those decisions. Examples of some of the issues are outlined below:

- How can the NWMO develop a fair, ethical and effective siting process, which benefits from the input of potentially affected communities of interest?
- What information does the NWMO need to provide clearly and transparently at the outset, to support these initial discussions about a siting process? What preliminary information on site requirements and criteria should be tabled to initiate a dialogue?
- What level of input, agreement or assurance should be sought from different communities of interest as a preferred site is identified? How will conflicts be addressed?
- What process should the NWMO use to invite expressions of interest from potential host communities?
- How will the boundary of "host community" be defined, for purposes of a specific community demonstrating its willingness? (The notion of "host community" may be defined in terms of geographical or political boundaries, but not always.)
- What time and resources are required for potential host communities to build their capacities to make informed decisions: What information and capacity building are required to enable consideration by potential host communities, as part of the process of inviting informed consent by a willing host community? Are there specific types of preliminary feasibility studies and analyses that will be required? What social and technical data are required to understand the community-specific impacts? What financial resources and independent expertise is required to support the community's consideration?
- How can the NWMO best support an iterative process of learning and exploration? How can potential host communities help shape the nature of the investigations? What is the most effective way for the NWMO to share findings of research as it collects data and understands the character of potentially suitable sites?
- What is required in establishing clear authorities to negotiate and implement agreements with an informed willing host community?

- What types of agreements should the NWMO enter into with potentially interested host communities, to support further collaborative investigations?

- What are appropriate timelines for convening these different phases of the site selection process?

In our public dialogues, participants advised that the NWMO look to lessons learned from past siting exercises involving nuclear waste and other hazardous substances. We were encouraged to look at best practices from specific experiences within Canada and abroad as we elaborate a siting process.

Siting Principles and Other Factors

Participants in our dialogues also provided preliminary insights as to some of the principles that they believe should be fundamental in a collaboratively-designed siting process. We have considered these comments, in setting out the discussion that follows.

We believe that the ethical obligations outlined below should shape the way in which we proceed with the site-selection process, as we seek a willing community to host the long-term management approach:

- Respect for life in all its forms, including minimization of harm to human beings and other sentient creatures;

- Respect for future generations of human beings, other species, and the biosphere as a whole;

- Respect for peoples and cultures;

- Justice across groups, regions, and generations;

- Fairness to everyone affected and particularly to minorities and marginalized groups; and

- Sensitivity to the differences of values and interpretations that different individuals and groups bring to the dialogue.

In order for the site to be acceptable, it would need to address scientific and technical siting factors to ensure that any facility is likely to protect human beings, including future generations, other life-forms and the biosphere as a whole into the indefinite future. Any facility would be subjected to regulatory oversight to ensure that the site is acceptable from a safety perspective.

Based on these principles, the siting process will seek to:

- Be open, inclusive and fair to all parties, giving everyone with an interest in the matter an opportunity to have their views heard and taken into account;

- Ensure groups most likely to be affected by the facility, including the transportation required, are given full opportunity to have their views heard and taken into account, and are provided with the forms of assistance they require to present their case effectively;

- Include special attention to Aboriginal communities that may be affected. In particular, the NWMO will respect Aboriginal rights, treaties and land claims;

- Be free from conflict of interest, personal gain or bias among those making the decision and/or formulating recommendations;

- Be informed by a synthesis of the best knowledge – in particular natural science, social science, Aboriginal Traditional Knowledge, and ethics – relevant to making a decision and/or formulating a recommendation;

- Be in accord with the precautionary approach, which first seeks to avoid harm and risk of harm. If harm or risk of harm is unavoidable, place the burden of proving that the harm or risk is ethically justified on those making the decision to impose it;

- Ensure, in accordance with the doctrine of informed consent, that those who could be exposed to harm or risk of harm (or other losses or limitations) are fully consulted and are willing to accept what is proposed for them;

- Take into consideration, in so far as it is possible to do so, the costs, harms, risks, and benefits of the siting decision, including not just financial costs but also physical, biological, social, cultural, and ethical costs (harm to our values); and

- Ensure that those who benefited most from nuclear power (past, present and perhaps future) are bearing the potential costs and risks of managing used fuel and other nuclear materials.

We believe that the objective of fairness would best be achieved if the site-selection process is focused within the provinces that are directly involved in the nuclear fuel cycle.

We therefore intend to focus the site-selection process in Ontario, New Brunswick, Québec and Saskatchewan. We recognize that communities in other regions and provinces may come forward with interest in possibly hosting the centralized facility. Such expressions of interest will also be considered.

The NWMO will respect Aboriginal rights, treaties and land claims.

Those potentially affected by the development of the management facility must be involved in discussions and be provided in advance with information and resources that enables them to participate effectively. The implementation process must seek ways to assist citizens in the host community to manage the resulting change caused by the project so they can pursue their economic, social and cultural aspirations. Effects management measures will need to be used to avoid or reduce the severity of negative socio-economic impacts of hosting the facility while nourishing those that enhance desirable socio-economic and cultural characteristics.

We are particularly sensitive to the role of potentially affected Aboriginal peoples. We are committed to building a relationship based on mutual trust, respect, and integrity. We are committed to seeking an alignment between Aboriginal values and those reflected in our management strategy.

We have begun the process of exploring and learning how to bring holders of Aboriginal Traditional Knowledge into the discussion and integrate their insights into our work. We have learned that Aboriginal Traditional Knowledge is broad. Well known, is that it includes substantive knowledge about the land and ecology in any given location, stemming from long contact with the land. But it also includes process knowledge, about developing and maintaining effective and respectful relationships – between young and old, within a community, and between communities. Thus, it can teach us about effective decision-making and management processes.

We will continue to engage with the Aboriginal communities that may be affected by our work, to share our knowledge and to learn from them. We believe, as we have been told, that the best way forward will be found by bringing together Aboriginal Traditional Knowledge with "western" science in a partnership.

Safety will be central to all decision-making processes. Regulatory processes overseen by the Canadian Nuclear Safety Commission (CNSC) will lead the reviews of site locations. Environmental assessment and licensing procedures will demand that the safety case be clearly demonstrated. The CNSC, together with Transport Canada, will demand strong safety cases for any required transportation associated with implementation. For any management approach adopted, specific siting requirements will be defined once a decision has been taken on a specific approach, and the project specifications fully elaborated.

The scientific and technical siting factors will include:

For Option 1: Deep Geological Disposal in the Canadian Shield

- Location in the Canadian Shield;
- Absence of known potential economic resources at depth;
- Sufficient surface area for receipt facilities and associated infrastructure;
- Seismically stable region with low known or projected frequency of high magnitude earthquakes;
- Low frequency of major groundwater conducting fracture zones, features or faults at repository depth;
- Geotechnically suitable host rock formation at least 200 metres below surface with a preference for a suitable host rock formation between 500 and 1,000 metres below surface for the deep geological repository;
- Geochemically suitable (e.g., reducing) conditions in groundwater at repository depth;
- Evidence of rock mass homogeneity and stability at repository depth;
- Low hydraulic gradient and low permeability; and
- Diffusion controlled transport of dissolved minerals at repository depth.

For Option 2: Storage at Nuclear Reactor Sites

- Location of storage facilities at nuclear reactor sites.

For Option 3: Centralized Storage, Above or Below Ground

- Competent soil or similar material to support the storage facilities and associated infrastructure;
- Sufficient surface area for storage facilities and associated infrastructure; and
- Seismically stable region with low known or projected frequency of high magnitude earthquakes.

For Option 4: Adaptive Phased Management

- Location in suitable rock such as the crystalline rock of the Canadian Shield or in the Ordovician sedimentary rock basins;
- Absence of known potential economic resources at depth;
- Sufficient surface area for receipt facilities and associated infrastructure;
- Seismically stable region with low known or projected frequency and magnitude of earthquakes;
- Low frequency of major groundwater conducting fracture zones, features or faults at repository depth;
- Geotechnically suitable host rock formation below surface for the optional shallow rock cavern vaults;
- Geotechnically suitable host rock formation at least 200 metres below surface with a preference for a suitable host rock formation between 500 and 1,000 metres below surface for the underground characterization facility and the deep geological repository;
- Geochemically suitable (e.g., reducing) conditions in groundwater at repository depth;
- Evidence of rock mass homogeneity and stability at repository depth;
- Low hydraulic gradient and low permeability; and
- Diffusion controlled transport of dissolved minerals at repository depth.

9.5 / Managing Implementation

Immediately following a decision by the Government of Canada on the selection of a management approach, the NWMO will assume its mandate as the implementing agency, as required under the *Nuclear Fuel Waste Act* (*NFWA*). We must be prepared to move forward in a timely way to implement the Government's decision.

Implementation of any management approach will stretch out for many decades, as the project moves through phases of elaborating the management design, identifying candidate sites, building relationships with affected communities of interest, evaluating sites for adequacy, characterizing the site, undertaking environmental assessments and regulatory approvals, constructing, transporting and monitoring the used fuel. In support of these activities, we intend to develop the details of our multi-year strategic plans collaboratively with the many communities of interest affected by our project, inviting input on the way in which we design and tailor the many facets of our implementation processes as well as programs for citizen engagement. As part of the implementation process, we will clarify the roles and responsibilities of the NWMO and the waste owners respectively, including areas in which we will work together. For example, the NWMO and the waste owners will commit to working closely with reactor site communities which currently host the used fuel and which must be actively involved in implementation plans.

As we look ahead to the short-term horizon for the NWMO, our activities in the first three years will be focused on a number of fronts. The siting process discussed in the previous section will be one important area of focus for the NWMO. Some additional areas of activity for the NWMO are presented below:

Managing Community Impacts

We will be developing a five-year strategic plan and budget to support implementation of the management approach. We will be tabling this strategic plan with the Minister of Natural Resources Canada at the conclusion of our third year of implementation, and making it public at the same time.

In formulating our detailed strategic plans for implementation, we will work collaboratively with communities of interest, to develop our approach to dialogue, decision-making and attention to socio-economic impacts that will feature fundamentally in implementation.

- We will seek input from the potentially affected communities of interest concerning the way in which they wish to be engaged in the process. We want to initiate an open dialogue with affected interests, both to invite comment on our progress to date, and to help shape our future plans;

- We will seek direction and input from potentially affected communities for how we should analyze possible socio-economic effects of our implementation activities on a host community's way of life or on its social, cultural or economic aspirations, and consider how best to manage those effects;

- Working with potentially impacted communities, we will undertake research into social and ethical considerations and impacts that will be encountered through implementation and ultimately, during operation of the management facility. We will continue research on adaptive management as it relates to ongoing social and technical decision-making, including research to support the identification and management of possible community impacts, including impacts on traditional Aboriginal lands. (See Chapter 15 for a fuller discussion on Research and Intellectual Capacity); and

- We will support the development of capacity in potentially affected communities, so that they may increase their understanding of implementation issues, and initiate their own investigations, as required. (See Chapters 13 and 14 for more discussion.)

Furthering our Social, Technical and Scientific Research

We will continue our technical and scientific research activities in a number of areas:

- Research will include site-specific investigations into the technical performance of the management system;
- We will continue to undertake research on the characteristics and performance of geology which is potentially suited to implementation of the selected management approach. While much is already known about crystalline rock, further research is required to understand the suitability and technical requirements in the case of sedimentary rock, proposed to be included for study in the case of the recommended Option 4 (Adaptive Phased Management); and
- We will continue to monitor and engage in research being undertaken internationally to further the understanding of social, technical and ethical considerations.

Our research plans will be discussed and developed collaboratively with the communities of interest.

For a fuller discussion of research requirements, see Chapter 15.

Refinement of Financial Requirements

There is important work that the NWMO must continue relating to the financial provisions for the management approach. Building on work undertaken to date, we must develop and refine the cost estimates and funding formula to support the financing of the long-term management approach.

The *NFWA* sets out some specific requirements that we must address and report on, in each NWMO annual report issued following the government's selection of a management approach. We must provide:

- Details on the financial guarantees;
- An updated estimated total cost estimate of the management approach;
- The budget forecast for the next fiscal year;
- The proposed formula for the next fiscal year to calculate the amount required to finance the management of nuclear fuel waste; and
- The amount of the deposit required to be paid during the next fiscal year by each of the nuclear energy corporations and AECL.

The NWMO submits annual reports to the Minister of Natural Resources Canada. They are made public at the same time. When we report this information in our first NWMO annual report following the government's decision, the funding formula and the amounts of the deposits proposed by the NWMO will be subject to approval by the Minister of Natural Resources Canada. Once the level of deposits is approved by the Minister, each nuclear energy corporation and AECL will adjust their annual contributions to their respective trust funds accordingly.

The financial requirements are discussed in more detail in Chapter 11.

Oversight of Implementation

The NWMO will experience organizational change as it transitions from a phase of study to one of implementation. The organization will require different expertise and capabilities. In the transition to implementation, the NWMO will continue to be guided by the vision and values, and the objectives and ethical principles that have been instrumental in guiding our work thus far.

The NWMO Board of Directors will ensure that a strong governance structure is in place to oversee implementation of the government's decision in compliance with the *NFWA*. The Board will seek to ensure that the NWMO is equipped to assume its new and expanded responsibilities. In this regard, the Board will provide the organization with annual funding commensurate with its broadened scope of responsibility. The Board will ensure that the NWMO's policies, practices and internal controls are appropriate to lead and manage implementation in accordance with best practices.

As part of its overall review of the future

governance structure of the NWMO, the Board is currently reviewing its own membership and composition as appropriate for the evolving mandate of the NWMO. Similarly, the NWMO will review the terms of reference and membership of the Advisory Council to the NWMO. It will be important that the Council is appropriately constituted to bring a range of perspectives to its independent counsel to the NWMO on implementation issues.

For further discussion of the NWMO mandate and governance, see Chapter 10.

The *NFWA* sets out specific elements for implementation plans that are to be developed for each option in our study. In the chapters that follow, we address in turn, each of the elements required by the *NFWA*. We also address other elements that we believe are key to assuring procedural fairness, integrity and safety: governance and institutions (Chapter 10); financial surety (Chapter 11); and research and intellectual capacity (Chapter 15).

In many areas of implementation, our recommendations would be similar for all four management approaches. In other areas, we identify where implementation approaches differ, according to the option under review.

Our discussion of implementation activities and timetables in Chapter 16 presents possible schedules associated with each management approach. Detailed implementation plans will be developed through collaboration and dialogue, led by the NWMO, following the government's decision. Many individuals and communities of interest will have important roles to play in overseeing and participating in implementation. We look forward to advice and direction from a diversity of voices on how the process should be designed and what issues need to be explored.

Implementation plans will not be static. They will evolve. The unprecedented time horizon over which implementation will occur points to a requirement for continuous learning and a commitment to periodically assess progress and adapt to changing conditions.

Chapter 10 / Governance and Institutions

There is an extensive governance framework in place to oversee the long-term management of Canada's used nuclear fuel and to ensure this management continues to meet the needs of Canadians (as outlined in Figure 10-1).

The NWMO has committed to a collaborative process to guide implementation. At this early stage of development, we identify some of the participants who will be included in this process, and some key roles and responsibilities. The roles and responsibilities of other affected communities of interest will emerge through dialogue as part of the implementation process.

Following a decision on a management approach, implementation will be overseen by governmental and regulatory bodies. The NWMO will be required to comply with all applicable legislative and regulatory requirements. Chapter 10 summarizes some of the more significant governing legislation and highlights the key roles and responsibilities of the participants who will figure prominently.

For further discussion of the regulatory framework, see Appendix 5. Background papers available at www.nwmo.ca/institutions, present a more comprehensive listing of statutes and other laws of general application that may also be relevant.

Figure 1-3 Governance Framework for the Long-Term Management of Used Nuclear Fuel: Roles & Responsibilities

Government of Canada
Responsible for:
- Making the decision on the long-term management approach for used nuclear fuel.
- Developing policy, regulating, and overseeing producers and owners of waste to ensure that they comply with legal requirements and meet their funding and operational responsibilities.

Natural Resources Canada
Responsible for:
- Recommending a management approach to the Government of Canada from the options in the NWMO study.
- Administering the *Nuclear Fuel Waste Act*, and monitoring the NWMO and the nuclear fuel waste owners to ensure compliance with the *NFWA*, especially with respect to socio-economic effects.
- Approving the funding formula and annual deposits to the trust funds, ensuring trust funds are established, and required deposits are made by the nuclear fuel waste owners.
- Reviewing NWMO's reports and making public statements.
- Interacting with Aboriginal populations to meet government fiduciary responsibilities related to the *NFWA*.

Canadian Nuclear Safety Commission (CNSC)
Responsible for:
- Regulating the use of nuclear energy and nuclear materials to protect health, safety, security and the environment, and to respect related international obligations.
- Ensuring that Canada's international obligations are met, including safeguard agreements with the International Atomic Energy Agency (IAEA), and the *Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management*.
- Ensuring, prior to licensing, that environmental effects are carefully reviewed through environmental assessments, as required under the *Canadian Environmental Assessment Act*.
- Making determinations on licence applications brought forward by the NWMO for siting, constructing, operating, modifying and decommissioning the long-term management facilities.
- Undertaking ongoing compliance and enforcement of statutory requirements and current licence requirements and conditions, and taking enforcement actions on incidents of non-compliance.

Transport Canada
Responsible for:
- Establising and enforcing requirements to promote public safety during the transport of dangerous goods including radioactive material (in coordination with the CNSC).
- Approving Emergency Response Assistance Plans prior to transport.

Canadian Environmental Assessment Agency
Responsible for:
- Administering the *Canadian Environmental Assessment Act* with which the CNSC must comply before proceeding with each licence application from the NWMO.

Provincial Governments/Regulators
Responsible for:
- Shareholders/owner accountabilities for provincial nuclear power corporations.
- Enforcing provincial statutes that contribute to the regulatory framework that the NWMO must meet.

Major Nuclear Fuel Waste Owners
Responsible for:
- Establishing trust funds to finance the implementation of the long-term management approach selected by government.
- Establishing and maintaining a Nuclear Waste Management Organization.

Currently Canada's owners of used nuclear fuel are: Ontario Power Generation Inc. (owns approximately 90 percent of the used fuel), Hydro-Québec, NB Power Nuclear, and Atomic Energy of Canada Limited.

Figure 1-3 (cont'd) Governance Framework for the Long-Term Management of Used Nuclear Fuel: Roles & Responsibilities

Nuclear Waste Management Organization (NWMO)
Responsible for:
- Preparing the study of long-term management options.
- Consulting with the general public and Aboriginal Peoples.
- Implementing the management approach selected by Government, carrying out the associated managerial, financial and operational activities.
- Reporting regularly to the Minister of Natural Resources Canada and the public.

Advisory Council to the NWMO
Responsible for:
- Examining and providing written comments on the NWMO's study of management approaches and subsequent triennial reports submitted to the Minister of Natural Resources Canada.
- Providing ongoing guidance to the NWMO.

Host Communities
Responsible for:
- Contributing to the design of the implementation plan to ensure it will best meet the needs of the community.
- Participating in implementation of the plan to ensure community needs are met, and in particular, decisions which affect the pace and manner of moving through the phases of work.
- Participating in the design and implementation of measures to address socio-economic and cultural effects of NWMO activities.

Affected Aboriginal Peoples
Responsible for:
- Contributing to the design of the implementation plan to ensure the needs of those impacted will best be met.
- Participating in implementation of the plan to ensure the needs of those impacted are met, and in particular, decisions which affect the pace and manner of moving through the phases of work.
- Participating in the design and implementation of measures to address socio-economic and cultural effects of NWMO activities.

10.1 / The Government of Canada

The Government of Canada, in cooperation with the provinces and the owners and producers of nuclear fuel waste, has an important policy role to play in the long-term management of nuclear fuel waste. The federal government is responsible for developing policy and overseeing the producers and owners of nuclear fuel waste in order that they meet their operational and funding responsibilities in accordance with the approved long-term waste management plans. Government has put in place policies, legislation and regulations to provide direction and oversight for radioactive waste management.

In July 1996, the federal government announced its Policy Framework for Radioactive Waste. This Framework set out principles to govern the institutional and financial arrangements for radioactive waste management in Canada. It defines the roles of government and waste producers and owners:

- The federal government will ensure that radioactive waste disposal is carried out in a safe, environmentally sound, comprehensive, cost-effective and integrated manner;

- The federal government has the responsibility to develop policy, to regulate, and to oversee producers and owners to ensure that they comply with legal requirements and meet their funding and operational responsibilities in accordance with approved waste disposal plans; and

- The waste producers and owners are responsible, in accordance with the principle of "polluter pays," for the funding, organization, management and operation of disposal and other facilities required for their wastes. This recognizes that arrangements may be different for nuclear fuel waste, low-level radioactive waste and uranium mine and mill tailings.

The Canadian Parliament passed the *Nuclear Fuel Waste Act* (*NFWA*) in 2002. The *NFWA* assigns roles and responsibilities for the long-term management of nuclear fuel waste consistent with the government's Policy Framework for Radioactive Waste Management.

Under the *NFWA*, the federal government holds decision-making authority over the management approach selected for nuclear fuel waste. Its decision will be based on a comprehensive, integrated and economically sound approach for Canada. The *NFWA* is presented in full in Appendix 2.

Many agencies and departments of the federal government have related responsibilities. The key ones are identified in Figure 10-1.

10.2 / Natural Resources Canada

The federal Minister of Natural Resources Canada is responsible for administration of the *NFWA*. In administering this legislation, Natural Resources Canada has an important role in overseeing the long-term management of nuclear fuel waste.

Upon receipt of our study, Natural Resources Canada will initiate an inter-departmental review to invite comments from various departments, as well as the Canadian Nuclear Safety Commission. It is upon the recommendation of the Minister of Natural Resources Canada that the government will make its decision on the management approach from proposals put forward by the NWMO.

After the government decision, the Minister's oversight of the NWMO and the implementation process continues, under the various requirements of the *NFWA*. Provisions in the *NFWA* that make explicit the oversight of the Minister of Natural Resources Canada include the NWMO's reporting requirements to the Minister, and the Minister's review and approval authorities. Chapter 11 reviews the Minister's role in reviewing and approving financial provisions for the management approach.

10.3 / Canadian Nuclear Safety Commission

Any option chosen for the long-term management of used nuclear fuel will have to meet the regulatory requirements governing such facilities.

The Canadian Nuclear Safety Commission (CNSC) is the lead federal organization overseeing operations of the nuclear industry in Canada. The CNSC is an independent regulatory agency of the federal government, responsible for regulating the use of nuclear energy and nuclear materials to protect the health, safety, and security of Canadians, to protect the environment, and to ensure that Canada's commitments on the peaceful use of nuclear energy are respected.

The CNSC, operating within the mandate and authority of the *Nuclear Safety and Control Act*, regulates all activities relating to nuclear materials, equipment and processes within Canada. The requirements of the *NSCA*, as administered and applied by the CNSC, will oblige the NWMO to obtain licences for the site preparation, construction, operation, modification, decommissioning, and where applicable, abandonment of disposal/ storage facilities.

The CNSC's regulatory regime covers the entire nuclear substance lifecycle, from production, use, to final disposition of any nuclear substances. Of particular significance is the CNSC compliance program. Once a licence is issued, the licensed activities are monitored by the CNSC to ensure compliance with the regulatory requirements. Non-compliance is corrected using a set of graduated enforcement actions that range from verbal discussions and written notices to legal prosecution and revocation of licence.

The CNSC has established principles that it will take into account in making regulatory decisions concerning the long-term management of used nuclear fuel. The CNSC has issued a Draft Regulatory Guide, G-320, for public comment, which sets out typical ways to assess impacts that long-term waste management may have on the environment and on the health and safety of people in the long term. It is intended to assist licensees and applicants in assessing the long-term safety of storage and disposal of radioactive waste. Details are set out in Appendix 5.

In operating a nuclear waste repository, the NWMO will be required to demonstrate that it is in accord with regulations made under the *NSCA*. We will also be required to demonstrate compliance with the conditions of licence(s).

The CNSC regulates the safe transport of nuclear substances under the *NSCA* in coordination with Transport Canada, under the *Transportation of Dangerous Goods Act*. As part of this process, the CNSC: establishes package design requirements; reviews safety cases; ensures that the licensee provides the physical security that is required by the *NSCA*, by the regulations pursuant to the *NSCA*, and by licence conditions; and performs compliance inspections. For centralized options, we will be required to use a package design that will be certified by the CNSC, and obtain a licence to transport fuel waste materials to the centralized repository. Any shipment(s) of used fuel will require the NWMO (licensee, transporter) to file a transport security plan with the CNSC to ensure that the proposed security measures for any used fuel shipments are commensurate with any credible threat at the time of shipment(s).

In meeting its obligations under the *Canadian Environmental Assessment Act*, the CNSC is required to determine whether an environmental assessment must occur to assess the potential for significant environmental impacts. It is anticipated that the CNSC would require the NWMO to undertake an environmental assessment prior to deciding on licence applications for site preparation, construction, operation, modification, decommissioning or abandonment of a nuclear waste facility. The *Canadian Environmental Assessment Act* is the basis for the federal practice of environmental assessment to ensure that the environmental effects of projects overseen by the federal government are considered early in the project's planning stages. The Act is administered by the Canadian Environmental Assessment Agency. For further details concerning the relationship between the *Canadian Environmental Assessment Act* and the CNSC licensing process, see background paper 7-9. (**www.nwmo.ca/cnsc licensing**)

The CNSC, in applying the *NSCA* to determine the merits of any licence application within its purview, and thereby issue, renew,

suspend, amend, revoke or replace a licence, will make determinations on whether or not an applicant has also fulfilled the legislative and regulatory obligations of the *Nuclear Liability Act*, the *Canadian Environmental Protection Act*, the *Canada Transportation Act* and its regulations, and other acts and regulations it deems appropriate. The CNSC works with provincial, national and international agencies in harmonizing the regulation of radioactive waste management in Canada.

The CNSC usually issues licences for short periods of time. These licences must be renewed as part of the ongoing regulatory process. Licensing decisions are revisited with each renewal application. In considering each licence application, the CNSC takes into account the history of performance and compliance of the licensee, and the design and implementation of the licensee's programs in the areas of operations, quality assurance, radiation protection, environmental protection, non-radiological health and safety, emergency preparedness, nuclear security, safeguards and public information. This process continues until a licence to abandon is granted. Each application triggers a determination of the need for an environmental assessment under *CEAA*. The potential long-term impacts from the management of the used fuel need to be taken into account at each licence decision.

The CNSC may require that operators of nuclear facilities provide financial guarantees to ensure that operations will take place in a responsible and orderly manner. In the event that the waste owners are unable to pay and adequate financial guarantees are not in place, responsibility would rest with the federal and/or provincial governments, as managers of last resort.

The CNSC requires that all nuclear facilities have a decommissioning plan in place. The plan identifies the end-state of the facility and site, identifies the activities to achieve that end state, and includes an assessment of the potential environmental effects of the proposed decommissioning program. This decommissioning plan forms the basis for the financial guarantee, which is required to ensure that there will be funds available to implement the decommissioning plan and to prevent any financial burden on future generations. Future financial burden could arise from the need for institutional controls and the long-term care and maintenance of the wastes.

International Responsibilities

The CNSC is responsible for implementing Canada's international nuclear non-proliferation safeguards and security obligations in collaboration with Foreign Affairs Canada.

The cornerstone of the international nuclear non-proliferation regime is the *Treaty on the Non-Proliferation of Nuclear Weapons* (*NPT*). The *NPT* establishes commitments to prevent the spread of nuclear weapons, promote cooperation in the peaceful uses of nuclear energy, and achieve nuclear disarmament. Canada is an original signatory to the *NPT* and has centered its own nuclear non-proliferation policy on the treaty's provisions.

Canada has in place a comprehensive safeguards agreement with the International Atomic Energy Agency (IAEA) pursuant to the NPT. Safeguards require accurate accounting of nuclear material and inspection activities which include various technical measures to provide assurance to the IAEA that the sensitive material remains in place. The safeguards agreement gives the IAEA the right and obligation to monitor Canada's nuclear-related activities and to verify nuclear material inventories and flows in Canada. The CNSC is responsible for implementing the *Canada/IAEA Safeguards Agreement and Additional Protocol*. Through its regulatory process, the CNSC performs compliance and auditing activities to ensure that all relevant licensees have in place measures, policies and procedures to comply with these international commitments. Safeguards are intended to provide assurance to the international community that Canada is not using nuclear material for the production of nuclear weapons or other nuclear explosive devices. These are serious obligations and non-cooperation has significant repercussions.

The NWMO, operating under the jurisdiction of the CNSC, will also be required to manage itself in accord with the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. Under the *Convention*, Canada must demonstrate that it is meeting international commitments to manage radioactive waste and spent fuel safely.

10.4 / Transport Canada

Transport Canada promotes public safety during the transportation of dangerous goods. The department is responsible for regulating all dangerous goods that are transported in Canada, including Class 7 materials (radioactive materials). Responsibility for the regulation of transport of radioactive material is shared with the Canadian Nuclear Safety Commission. Transport Canada and the CNSC both have primarily adopted IAEA Regulations for the Safe Transport of Radioactive Material.

For Class 7 shipments Transport Canada is primarily responsible for:

- Establishing and enforcing any transportation requirements for carriers, vehicles or other conveyances except for the radiation protection program for the carriers;
- Establishing requirements and undertaking compliance inspections for transportation aspects such as training, classification, documentation, marking, labeling and placarding, emergency response planning and notification of releases and incident reporting;
- Setting the requirements of the Emergency Response Assistance Plan and reviewing and approving them; and
- Undertaking compliance inspections primarily to ensure that the Transport of Dangerous Goods Regulations are met.

Transport Canada enforces the requirement for detailed Emergency Response Assistance Plans to be in place prior to the transport of dangerous goods such as radioactive waste. Prior to transporting any nuclear fuel, the NWMO would be required to complete and receive an approval from Transport Canada of an Emergency Response Plan that met the requirements of the department, providing details on the contents, containers, transport routes and emergency response plans in place.

Transport Canada plays a key role in the response to emergencies and crises when they occur. In the event of an incident involving dangerous goods, the Canadian Transport Emergency Centre (CANUTEC), operated by Transport Canada, can assist emergency response personnel. Canadian emergency preparedness necessarily includes all levels of government, agencies and non-governmental organizations.

The CNSC is the prime agency of the federal government entrusted with regulating all activities related to the use of nuclear energy and nuclear substances. Its primary responsibilities related to the packaging and transport of nuclear substances are:

- The packaging aspects such as setting the package design requirements and reviewing the safety case;
- Establishing and enforcing the radiation protection program for the carriers;
- Investigating in the event of a dangerous occurrence;
- Issuing licences for shipments that require a licence to transport in accordance with the Packaging and Transport of Nuclear Substances Regulations;
- All aspects of physical security measures of nuclear substances and prescribed equipment against sabotage or theft for all modes and phases of transport; and
- Compliance inspections to ensure that the Transport of Dangerous Goods Regulations and the Packaging and Transport of Nuclear Substances Regulations requirements are met.

10.5 / Provincial Governments and Regulators

Some aspects of siting, construction and/or operation of a central used fuel management facility may be determined to be governed by provincial legislation. The legislative areas listed below may be relevant. In many cases provincial legislation adopts the procedures and requirements of federal Acts and regulations. In some instances, the provincial and federal governments have adopted harmonized procedures.

- Transportation: Most provinces and territories include nuclear substances in legislation and regulations addressing the transportation of dangerous goods within that province or territory;

- Emergency preparedness: Responsibilities for nuclear emergency preparedness fall to several levels of government. In particular, the CNSC has requirements in its Class 1 Nuclear Facilities Regulations and Regulatory Guide G-225. Provincial governments are responsible for protecting public health and safety, property and the environment within their borders. Provincial emergency preparedness legislation often requires that a plan be formulated to address off-site responses to emergencies at nuclear facilities (e.g., *Ontario Emergency Management Act*); and

- Environmental assessment and approvals: Provincial legislation requiring the assessment of potential environmental effects of an activity, plan or program may apply to some aspects of our work. For example, in Québec, the *BAPE – Bureau d'audiences publiques sur l'environnement* (public environmental hearing board) which mainly oversees the provincial environmental assessment process, has a responsibility to inform and consult the population about questions relating to the quality of the environment or certain projects which could significantly affect the environment and cause public concern.

In addition, legislation governing endangered species; environmental protection; heritage protection or preservation; water resources protection; occupational health and safety; and/or labour relations may be determined to be relevant. Municipalities, which derive their authority from provincial legislation, may have requirements that may also be relevant.

Appendix 5 provides more detail on the Canadian regulatory framework relevant to the management of used nuclear fuel.

10.6 / Major Nuclear Fuel Waste Owners

The *NFWA* assigns specific responsibilities to the major owners of nuclear fuel waste.

It requires that Canada's nuclear energy corporations establish a nuclear waste management organization – the NWMO. The nuclear energy corporations are the corporations that own used nuclear fuel resulting from production of electricity by means of a commercial nuclear reactor. These corporations, currently Ontario Power Generation Inc., NB Power Nuclear and Hydro-Québec, must remain members or shareholders of the organization.

This governance model is similar to those in Finland and Sweden, where the nuclear waste owners have the responsibility to establish and fund the implementing organization with responsibility for used nuclear fuel management.

Under the *NFWA*, the major owners of nuclear fuel waste – the nuclear corporations and Atomic Energy of Canada Limited (AECL) – will finance the long-term management approach selected by the government, including costs of designing and siting the approved approach, implementing and finally, decommissioning the facilities. The *NFWA* requires a specific guarantee in the form of trust funds held by a financial institution into which the nuclear energy corporations and AECL deposit money each year for the long-term management of used nuclear fuel. Money in the funds can only be withdrawn by the NWMO, and only after a construction or operating licence for a long-term management facility has been granted by the CNSC. To date, $770 million has been deposited into these trust funds. The financial obligations of the waste owners, assigned by the *NFWA*, are further elaborated in Chapter 11.

10.7 / Nuclear Waste Management Organization (NWMO)

The Organization's Mandate

The *NFWA* prescribes two phases of work for the NWMO:

- The first phase of the legislated mandate included conducting the study on management approaches and proposing a recommendation to the government. This work is now complete.

- After the Government of Canada specifies an approach for the long-term management of used fuel, we will then implement the approach. We will be responsible for managing and coordinating the full range of activities related to the long-term management of used nuclear fuel. Some of the near-term implementation activities of NWMO are profiled in Chapter 9.

The enduring nature of the NWMO will enable the insights and relationships developed in the course of our options study to be carried forward and built upon in succeeding years during implementation. The vision and values that have guided us will not change. We expect to be held accountable to our values and to delivering on our commitments. We will be an organization in which Canadians can have confidence and trust.

The NWMO will have to adapt over time as its mandate progresses. The size and composition of the organization will change as the skills and competencies required in subsequent work phases evolve.

Continuous learning must inform our decision-making. The extent and the way in which we monitor emerging knowledge about managing used fuel and, where appropriate integrate it, will be essential in building confidence in the integrity of our work. We will review our own work from the past three years, to consider those programs and practices which worked well, and areas in which we might seek to improve. The research and development, elaborated in Chapter 15, will be essential in informing our implementation decisions. We have an opportunity to draw on the best knowledge nationally and internationally through independent third-party guidance and peer reviews of our proposed research plans.

The NWMO is established as a not-for-profit corporation. We are directed and governed by requirements set out in the *NFWA*. As we become an implementing organization, we will also be guided by other federal, provincial and municipal laws and regulations, as well as international treaties to which Canada is a party.

Governance

Consistent with the governance structure set out in the *NFWA*, the nuclear energy corporations – Ontario Power Generation Inc., NB Power Nuclear, and Hydro-Québec – established the NWMO in 2002.

The Board of Directors, currently comprised of members from those three corporations, is responsible for oversight of the corporation and taking a leadership role in the development of the corporation's strategic direction. The Board is also responsible for approving annual budgetary provisions to support NWMO operations.

To formalize their obligations to establish the NWMO, the three founding member corporations clarified their roles and responsibilities in furthering those objectives. Members agreed on provisions for cost-sharing our annual operating budget to ensure that we have a secure and ongoing source of funds to carry out our activities and operations.

The Board of Directors appointed a President and CEO, who is accountable for the operation of the company. The President is responsible for the organization's planning, program design and direction of day-to-day operations.

The Board of Directors has directed the NWMO to make public the minutes of its meetings to provide transparency in its operations.

The NWMO will carry out the managerial, financial and operational activities to implement the long-term management of nuclear fuel waste under the governance of the Board. The Board will ensure that the organization is equipped to fulfill its ongoing role as envisaged by the *NFWA*. From the initial establishment of the NWMO, the Board has been mindful of adopting best practices, and has

endeavoured to establish the corporate foundation for the NWMO to transition into the next phase of its legislated mandate. As part of its planning for the second phase of the NWMO mandate, the Board will be addressing the underlying funding requirements and approving the NWMO's operating budgets. The Board will continue to oversee the effectiveness of the organization's governance practices and the integrity of its financial and administrative controls. The Board will propose amendments as appropriate to support the evolving roles and responsibilities of the NWMO.

As the organization prepares to assume its new implementation mandate, the NWMO has an opportunity to develop and adopt governance policies and practices that keep the organization consistent with leading governance practices, while recognizing the mandate of this special purpose corporation, which is funded by waste owners to fulfill their obligations under the *NFWA*, and under the oversight of the federal government.

The requisite skills and expertise of Board members will change over time as the organization's mission and operating environment evolve. After the government decision on a management approach, the organization will shift from a corporation undertaking a study, to an operational body. Related roles and functions associated with implementing and ultimately operating the management approach include, among other things: managing large financial provisions associated with the siting, construction and operation of facilities; stakeholder engagement and communications; broad-based technical and social research programs; implementation planning; and regulatory and governmental interface. This shift in the NWMO's responsibilities must be accompanied by a commensurate evolution in governance structures, including the membership, skills and qualifications of Board members, appropriate for the organization through different stages of its mandate.

During the NWMO's public engagement activities in the last three years, there have been many expressions of concern about the limitations of a Board composed entirely of nuclear waste owners. Expanding from an exclusively industry-based Board, to one which offers independent perspectives through unrelated (non-industry) directors, presents an opportunity for the NWMO to be responsive to public concerns, and to build trust and credibility with the Canadian public. The addition of independent directors would also be consistent with what has come to be accepted governance standards and best practices, where there is an overall drive to adopt and communicate high standards of governance to build the public trust.

In preparing for the NWMO's implementation mandate, the Board of Directors and the member organizations are currently reviewing the future governance of the NWMO, including the membership and composition of the Board of Directors.

Reporting

The NWMO has extensive reporting requirements to the Minister of Natural Resources Canada. These reporting requirements, outlined in detail in the *NFWA*, reflect the ongoing oversight role of the federal government that will remain in effect through subsequent phases of implementation and operation of the long-term used fuel management approach. Annual and triennial reporting requirements to the Minister, and to the Canadian public, provide important measures of ongoing accountability. The NWMO's reporting requirements are summarized in Figure 10-2.

Figure 10-2 NWMO Reporting Requirements

ANNUAL REPORTS	TRIENNIAL REPORTS
16. (1) The waste management organization shall, within three months after the end of each fiscal year of the organization, submit to the Minister a report of its activities for that fiscal year. 16. (2) Each annual report after the date of the decision of the Governor in Council under section 15 must include: (a) the form and amount of any financial guarantees that have been provided during that fiscal year by the nuclear energy corporations and Atomic Energy of Canada Limited under the *Nuclear Safety and Control Act* and relate to implementing the approach that the Governor in Council selects under section 15 or approves under subsection 20(5); (b) the updated estimated total cost of the management of nuclear fuel waste; (c) the budget forecast for the next fiscal year; (d) the proposed formula for the next fiscal year to calculate the amount required to finance the management of nuclear fuel waste and an explanation of the assumptions behind each term of the formula; and (e) the amount of the deposit required to be paid during the next fiscal year by each of the nuclear energy corporations and Atomic Energy of Canada Limited, and the rationale by which those respective amounts were arrived at. 17. (1) Each nuclear energy corporation and Atomic Energy of Canada Limited shall, either directly or through a third party, deposit to its trust fund maintained under subsection 9(1) its respective deposit specified in the annual report (a) if the Minister's approval under subsection 16(3) is not required, within 30 days after the annual report is submitted to the Minister under subsection 16(1); or (b) if the Minister's approval under subsection 16(3) is required, within 30 days after the date of that approval. 17. (2) Notwithstanding subsection (1), the Governor in Council may, on request by a nuclear energy corporation made before the expiration of the 30 day period referred to in that subsection, authorize the nuclear energy corporation to defer by one year all or part of its deposit required by that subsection, if the Governor in Council is of the opinion that the public interest requires that the money be used instead to repair the damage caused by an event that is not attributable to the corporation and is extraordinary, unforeseen and irresistible.	18. The annual report of the waste management organization for its third fiscal year after the fiscal year in which a decision is made by the Governor in Council under section 15, and for every third fiscal year after that, in this Act called the "triennial report", must include (a) a summary of its activities respecting the management of nuclear fuel waste during the last three fiscal years, including an analysis of any significant socio-economic effects of those activities on a community's way of life or on its social, cultural or economic aspirations; (b) its strategic plan for the next five fiscal years to implement the approach that the Governor in Council selects under section 15 or approves under subsection 20(5); (c) its budget forecast for the next five fiscal years to implement the strategic plan; (d) the results of its public consultations held during the last three fiscal years with respect to the matters set out in paragraphs (a) and (b); and (e) the comments of the Advisory Council on the matters referred to in paragraphs (a) to (d).

Figure 10-2 (cont'd) NWMO Reporting Requirements

OTHER REPORTING

22. (1) The waste management organization, every nuclear energy corporation and Atomic Energy of Canada Limited, as well as every financial institution that holds a trust fund, shall keep, at its place of business in Canada, records, books of account and other documents for at least six years after the end of the fiscal year to which they relate, in such form and containing such information as will enable the verification of the accuracy and completeness of the information that is required to be submitted or provided to the Minister under this Act.
(2) No person shall make false entry or fail to make an entry, in a record, book of account or other document required to be kept under subsection (1).

23. (1) The waste management organization shall provide the Minister, within three months after the end of each fiscal year of the organization, with financial statements audited at its own expense by an independent auditor.
(2) Every financial institution that holds a trust fund shall provide the Minister and the waste management organization, within three months after the end of each fiscal year of the trust fund, with financial statements relating to that trust fund, audited at its own expense by an independent auditor.

24. The waste management organization shall make available to the public

(a) the study, reports and financial statements that it is required to submit to the Minister under this Act, simultaneously with submitting them to the Minister; and

(b) financial statements provided to the waste management organization under subsection 23(2) as soon as practicable.

Advisory Council

The *NFWA* requires the governing body of the NWMO to appoint an Advisory Council. The *NFWA* assigned the Council specific responsibilities, and provides direction on the membership of the Advisory Council.

The *NFWA* requires that the Advisory Council provide its independent comments on our study and the management approaches. Early in 2005, the Council released its statement as to how it intended to discharge that legislated mandate. As required by the *NFWA*, the Council has prepared its independent comments, which are included with this study report.

The Advisory Council has an ongoing responsibility to examine and to provide written comments in the triennial reports that we must submit to the Minister of Natural Resources Canada. Specifically, the *NFWA* requires that the NWMO include in each of its triennial reports to the Minister, the Advisory Council comments on:

a) The NWMO's activities during the previous three years, including the NWMO's analysis of any significant socio-economic effects of the NWMO's activities on a community's way of life or on its social, cultural or economic aspirations;

b) The NWMO's strategic plan for the next five-year period;

c) The NWMO's budget forecast for the next five-year period; and

d) The results of the NWMO's public consultations held in the last three fiscal years with respect to items a) and b).

The Advisory Council's terms of reference for its next phase will be developed to reflect these obligations.

The NWMO Board of Directors appointed the Advisory Council in Fall 2002, consistent with the legislation. There are presently nine Advisory Council members, each appointed for four-year terms. Advisory Council members are profiled in Appendix 1.

Legislative direction concerning Council membership will continue to apply as we move into future phases of our mandate. Within the parameters of the *NFWA*, membership and the terms of reference will change as the project proceeds from a study on management options, to a concept chosen by government, and then, to a site-specific project in a known location and region.

Once an economic region is identified for implementing the approach selected by the government, the *NFWA* requires the Advisory Council to include representatives nominated by those local and regional governments and Aboriginal organizations.

In addition to meeting the requirements of the *NFWA*, the NWMO will be seeking the views of the Advisory Council on membership and composition for the next phase of the NWMO's mandate. The discussion will invite consideration of broadening Council representation and the range of expertise that will be desirable in light of the future role and expanded responsibilities of the NWMO.

10.8 / Host Communities

The NWMO anticipates an active role in implementation for potentially affected communities of interest. Communities likely to be most impacted will vary over time as we move through various stages of implementation.

The NWMO has suggested that the communities of interest which are potentially impacted by the implementation of the approach must be involved in the iterative determination of risk and safety assessment throughout the implementation process. This requires their involvement at a fundamental level of decision-making, the specifics of which will need to be made more concrete as implementation proceeds.

The NWMO has a legislated requirement under the *NFWA* to conduct public consultations as implementation proceeds. There are also regulatory processes that the NWMO must participate in which will require public consultation to support decision-making and approvals. We will ensure that all of these requirements are met. In addition, we intend to continue our engagement in a substantive way as we collaboratively design and implement the key processes and decision-making frameworks that will accompany siting and subsequent implementation steps.

A more detailed discussion of our proposal for engagement of communities of interest is provided in Chapters 9, 13 and 14.

Two communities of interest have been singled out for consideration in this chapter as key participants in any process going forward: the communities which currently host interim storage facilities and the community which would host the new central facility.

The NWMO has a responsibility to work with various communities of interest most affected by implementation to identify effective ways and means for them to participate in decision-making in the development and operation of the long-term waste management facility. Over the past decade, a number of innovative institutional arrangements have been developed to facilitate development of such community capacity. A number of examples are described in Chapter 14. Many of these involve formal agreements between the community or elements of the community and a project lead, like the NWMO.

10.9 / Affected Aboriginal Peoples

The Aboriginal community in Canada includes Indian, Inuit, and Métis people; status and non-status; on-reserve and off. In pursuit of their aspirations, they have created an array of organizations that range in focus and scale from the local community to the nation as a whole. The internal decision-making process is complex and varies significantly between the different Aboriginal groups.

National organizations have been created to address issues that fall under the mandate of the federal government or are otherwise national in scope. Similarly provincial, regional, or treaty organizations exist to address issues at the provincial, regional, or treaty level. In the case of First Nations who have land by treaty, the primary decision-making unit is the First Nation itself.

The NWMO is committed to respecting Aboriginal rights, treaties and land claims. Aboriginal and treaty rights are protected under s.35 of the *Constitution Act*, 1982. The nature of the specific obligations to consult will be clarified as the government makes its decision and directly affected individuals and communities become more evident. In addition to any legal obligation to consult, the NWMO will seek the active involvement of Aboriginal peoples that are potentially impacted by implementation.

The NWMO has suggested that all those most potentially affected by implementation must be involved in the iterative determination of risk and safety assessment throughout implementation. The NWMO recognizes that Aboriginal peoples may be affected by implementation decisions and will therefore need to play an important role in any collaborative process to determine risk and safety. Identification of specific roles and active involvement will be subject to discussion and agreement with Aboriginal peoples and communities who may be affected by implementation. In addition, certain roles fall from law and practice, the details of which will need to be resolved over time.

The NWMO is committed to engaging with potentially impacted Aboriginal peoples in a

way that will lead to a long-term, positive relationship – in a manner that is meaningful to both Aboriginal peoples and to the NWMO. It follows that our commitment is to build a way of working with the Aboriginal community that respects their various decision-making processes. We must provide an effective means for Aboriginal peoples to actively participate in decision-making.

This chapter has profiled the extensive system of governance and oversight provided through Canada's governmental bodies and regulatory agencies. It has also identified some of the responsibilities of various organizations and communities of interest that will have important roles to play in the implementation phase.

The chapters which follow address many of the specific elements that will comprise the implementation plan for the management approach selected by government.

A more detailed discussion of our proposal for community engagement is provided in Chapters 9 and 13.

Chapter 11 / Financial Aspects

11.1 / Funding Formula

The *Nuclear Fuel Waste Act* (*NFWA*) requires the NWMO to address the financial aspects of the long-term management of used nuclear fuel. (See Table 11-1.)

The annual amount required to finance the long-term management approach, selected by government for used nuclear fuel, has two components:

(i) the annual amount required to be contributed to the trust funds set up in accordance with section 9(1) of the *NFWA*, available to the NWMO to fund activities for which a construction or operating licence has been issued under the *Nuclear Safety Control Act*; and

(ii) the annual amount required to be provided to the NWMO to fund its activities prior to receipt of a construction licence.

The funding formula, covering both pre-construction licence and post-construction licence time frames is comprised of several elements. These include:

(i) the total cost of NWMO facilities, including design, siting, licensing, construction, operation, decommissioning and monitoring;

(ii) the total transportation costs for used fuel, from reactor sites to NWMO facilities;

(iii) volume of used fuel produced by each waste owner;

(iv) expected rate of return on *NFWA* trust funds;

(v) shared costs; each waste owner will pay a percentage of all shared costs based on the volume of used fuel they have produced, as well as factors based on individual owner usage of facilities; and

(vi) owner specific costs; these cover items of transportation that vary between the waste owners, and are dependent on location.

The following table sets out the specific sections of the *NFWA* addressing the Funding Formula.

Table 11-1 Funding Requirements

***Nuclear Fuel Waste Act* reference:**

13. (1) The study must set out, with respect to each proposed approach, a formula to calculate the annual amount required to finance the management of nuclear fuel waste.

The report must explain the assumptions behind each term of the formula. The formula must include the following terms:

(a) the estimated total cost of management of nuclear fuel waste, which must take into account natural or other events that have a reasonable probability of occurring;

(b) the estimated rate of return on the trust funds maintained under subsection 9(1);

(c) the life expectancy of the nuclear reactors of each nuclear energy corporation and of Atomic Energy of Canada Limited; and

(d) the estimated amounts to be received from owners of nuclear fuel waste, other than nuclear energy corporations and Atomic Energy of Canada Limited, in return for services of management of nuclear fuel waste.

(2) The study must set out, with respect to each proposed approach, the respective percentage of the estimated total cost of management of nuclear fuel waste that is to be paid by each nuclear energy corporation and Atomic Energy of Canada Limited, and an explanation of how those respective percentages were determined.

(3) The study must set out the form and amount of any financial guarantees for the management of nuclear fuel waste that have been provided by the nuclear energy corporations and Atomic Energy of Canada Limited under the *Nuclear Safety and Control Act*.

Total Cost

The total life cycle costs for used fuel management are different for each management approach, ranging from $2.3 to $6.2 billion present value in 2004 dollars. The used fuel owners are responsible for accumulating funds to cover the total life cycle costs. Total life cycle costs include items (i) through (iii) listed below. These costs are managed by the used fuel owners and the NWMO separately as follows:

- Of the total life cycle costs, the used fuel owners are responsible for managing approximately $900 million to $1.4 billion of costs depending on the management approach selected. This includes:

  (i) interim storage and retrieval costs at each reactor site.

- The portion of the total life cycle costs that the NWMO is responsible for managing (total NWMO costs), ranges from $0.9 to $4.8 billion in present value 2004 dollars, depending on the management approach chosen. These include:

  (ii) NWMO facility: siting, design, licencing, construction, operation,

decommissioning and monitoring. Costs incurred before a CNSC construction or operating licence is issued will be paid under terms of membership agreements or contractual agreements. Costs occurring after a construction or operating licence has been issued by the CNSC will be paid from the *NFWA* trusts; and

(iii) Used fuel transportation costs moving material from reactor sites to the NWMO facility. These will be paid from the *NFWA* trusts.

Those total NWMO costs are the basis upon which the funding formula is developed.

The estimated total life cycle costs, which include interim storage and retrieval, for management of nuclear fuel waste for Options 1, 2 and 3, those defined in the *NFWA*, are set out in the summary cost estimate reports commissioned by the Joint Waste Owners. (www.nwmo.ca/costreview) The NWMO has adopted these cost estimates which we believe represent thorough and reasonable cost estimates for the options based on the conceptual stage of design.

In the case of Option 4: Adaptive Phased Management, total life cycle cost estimates have been developed by Golder Associates Ltd., and Gartner Lee Limited, using consistent estimating assumptions (www.nwmo.ca/assessments).

We commissioned third-party reviews of the cost estimates. These reviews concluded that they have been prepared with an appropriate estimating methodology, including appropriate cost contingency allowances, and the cost estimates are suitable for our review and assessment of the magnitude of costs of alternative management options and development of a recommendation on a preferred approach.

Total costs, (full life cycle and NWMO) are presented in two formats, the first is termed '2002 constant dollars,' the second form is termed 'present value 2004.' The first format establishes a fixed point in time, in this case the year 2002, when costs for materials, labour and other requirements have established

Table 8-1 Total Life Cycle Cost Estimates for Management Approaches

MANAGEMENT APPROACH	Total Cost (2002B$) (out to 350 years)	Total Cost (2002B$) (out to 1,000 years)	Present Value (Jan 2004 B$)
Option 1: Deep Geological Disposal in the Canadian Shield	16.2	16.3	6.2*
Option 2: Storage at Nuclear Reactor Sites			
Current Technology	17.6		2.3
New Above Ground Technology	25.7	68.4	4.4
New Below Ground Technology	21.6		3.6
Option 3: Centralized Storage			
Casks/Vaults in Storage Buildings	15.7		3.1
Surface Modular Vaults	20.0	47.0	3.8*
Cask/Vaults in Shallow Trenches	18.7		3.6
Casks in Rock Caverns	17.1	40.6	3.4*
Option 4: Adaptive Phased Management			
With Shallow Underground Storage	24.4	24.4	6.1*
Without Shallow Underground Storage	22.6	22.6	5.1*

JWO cost estimates are based on 3.7 million fuel bundles and an average reactor life of 40 years. Golder estimates are based on 3.6 million fuel bundles.
Estimates for Options 1, 2 and 3 out to 350 years were prepared by consultants for the Joint Waste Owners (www.nwmo.ca/costsummaries).
Estimates for Options 1, 2 and 3 out to 1,000 years were prepared by Golder Associates Ltd. and Gartner Lee Ltd. (www.nwmo.ca/assessments).
Estimates for Option 4 were prepared by Golder Associates Ltd. and Gartner Lee Ltd. (www.nwmo.ca/assessments).
*Present value calculations performed by Golder Associates Ltd. and Gartner Lee Ltd., are for 1000 year total estimates.
All remaining present value figures were ta en from Joint Waste Owners cost estimates using 350 year total cost estimates.
o te 1000 year cost estimates were produced from an illustrative sample of all possible management approaches, for comparative purposes only.

benchmarks. These cost rates are then used throughout each year of activity of the management approach. The annual amounts are totaled and the result is an estimate of the total cost of the management approach if all prices remained constant at the year 2002 level.

The second format for costs is 'present value 2004.' For each year of implementation of a management approach, costs for labour, materials and other requirements are escalated at a forecasted rate of inflation. These inflation-adjusted costs are then discounted from the year of expenditure back through time, at a fixed rate, to the year 2004 to give the present value. The fixed rate, which includes an expected real rate of return, that is used to discount costs is the rate of annual earnings that could reasonably be expected to accrue to trust funds that are invested to cover the management approach costs (see Estimated Rate of Return later in this chapter for further details). The present value is then the total amount of money that needs to be set aside in 2004 to allow the funds to grow through the accumulation of investment earnings, taking into account inflation, so that the total cost of the management approach would be covered in the time frame required.

Table 11-2 presents total life cycle costs of used fuel and includes costs for interim storage, retrieval, facility design, construction, operation, decommissioning, monitoring, as well as fuel transportation, and is intended for purposes of comparing management approaches.

Table 11-3 below presents information on the

Table 11-3 Total NWMO Costs for Management Approaches, Excluding Interim Storage & Retrieval

MANAGEMENT APPROACH	Total Cost (2002B$) (out to 350 years)	Total Cost (2002B$) (out to 1,000 years)	Present Value (Jan 2004 B$)
Option 1: Deep Geological Disposal in the Canadian Shield	13.8	13.8	4.8
Option 2: Storage at Nuclear Reactor Sites			
Current Technology	15.6		0.9*
New Above Ground Technology	24.4	67.1	3.2
New Below Ground Technology	20.3		2.6*
Option 3: Centralized Storage			
Casks/Vaults in Storage Buildings	14.1		2.0*
Surface Modular Vaults	18.0	45.0	2.3
Cask/Vaults in Shallow Trenches	17.1		2.5*
Casks in Rock Caverns	15.5	39.0	2.1
Option 4: Adaptive Phased Management			
With Shallow Underground Storage	22.0	22.0	4.6*
Without Shallow Underground Storage	19.1	19.1	3.5*

"PV" denotes present value in billions of January 2004 Canadian dollars.
Data produced by Golder Associates Ltd. (GAL) and Gartner Lee Limited, (GLL). All values for Option 4 developed by GAL/GLL.
*PV values developed by GAL/GLL. All other PV values taken from JWO Cost Estimates, see References below.
JWO costs are for 3.7 million bundle scenarios, one operational cycle (approximately 350 years).
GAL/GLL costs are for 3.6 million bundle scenarios, three operational cycles (to year 1000).
GAL/GLL DGR calculations omit postulated $100K/annum monitoring costs beyond year 154 in order to be comparable to JWO numbers. Including additional monitoring costs to year 1000 would increase total cost by $86,400 K and present value by approximately $448K.
References:
(1) Joint Waste Owners (JWO 2004a. Costs of Alternative Approaches for the Long-Term Management of Canada's Nuclear Fuel Waste, Deep Geologic Disposal Approach. A Submission to the Nuclear Waste Management Office by Ontario Power Generation, Hydro-Quebec, New Brunswick Power, and Atomic Energy of Canada Limited.
(2) Joint Waste Owners (JWO), 2004b. Costs of Alternative Approaches for the Long-Term Management of Canada's Nuclear Fuel Waste, Reactor-Site Extended Storage Approach. A Submission to the Nuclear Waste Management Office by Ontario Power Generation, Hydro-Quebec, New Brunswick Power and Atomic Energy of Canada Limited.
(3) Joint Waste Owners (JWO), 2004c. Costs of Alternative Approaches for the Long-Term Management of Canada's Nuclear Fuel Waste, Centralized Extended Storage Approach. A Submission to the Nuclear Waste Management Office by Ontario Power Generation, Hydro-Quebec, New Brunswick Power, and Atomic Energy of Canada Limited.
4) Adaptive Phased Management Cost Estimate Summary Report, August 2005, produced by GAL/GLL for NWMO.
See www.nwmo.ca/assessments.

total costs that will be incurred for the long-term management of used fuel by NWMO over the life time of each management approach, and includes facility design, construction, operation, decommissioning, monitoring as well as fuel transportation. These costs, covering activities occurring before and after a construction or operating licence has been issued by the CNSC, are the basis of the funding formula.

The *NFWA* requires that we take into account natural or other events that have a reasonable probability of occurring. For example, as set forth in the Conceptual Design for Option 1: Deep Geological Disposal in the Canadian Shield, the design requires that testing, and on-going research and development work have as an objective designing and placing a containment canister that is capable of enduring glaciation, within the time-frame in which the used fuel would continue to be a hazard.

Ongoing research and development will include further study, modelling and analyses of the potential impacts of climate change (e.g., global warming and glaciation) and other natural events such as earthquakes, which have already been factored into the designs of the deep repository, the shallow underground storage facility and surface facility.

Estimated Rate of Return

The cost estimates referenced above are in billions of 2002 constant dollars and January 2004 present value billions of dollars. The present value calculation is based on a discount rate of 5.75 percent, which assumes a 3.25 percent real rate of return over a projected long-term average increase in the Ontario Consumer Price Index of 2.5 percent.

These data will be updated after the Government decides on a management approach, and will be reported in the first NWMO Annual Report required after this decision. Historical information available through Statistics Canada and the Bank of Canada show that the yields of Canada long bonds have exceeded CPI (Ontario) by approximately 4.8 percent over the past 25 years.

Reactor Life Expectancy

For purposes of the cost estimates it is assumed that the average life expectancy of the used fuel owner's nuclear reactors will be 40 years. See Appendix 10 for further discussion.

Fund Contributions from Other Used Fuel Owners

Current cost estimates do not include any allowances for an amount of used fuel to be received from owners other than Ontario Power Generation Inc., Hydro-Québec, NB Power Nuclear and Atomic Energy of Canada Limited.

Should new nuclear energy corporations enter the Canadian market, they would contribute to the NWMO, an amount per fuel bundle generated, based on the full cost of the program on a present value basis. This would include payment for their share of fixed costs already incurred in order to become a member of the Joint Waste Owner (JWO) group of companies (currently comprised of OPG, HQ, NBP and AECL).

Table 11-4 Current Projected Fuel Bundles and Percentages by Waste Owners

COMPANY	NO. OF BUNDLES	PERCENTAGE OF BUNDLES
Ontario Power Generation Inc.	1,746,410	88.21
NB Power Nuclear	103,436	5.22
Hydro-Québec	99,245	5.01
Atomic Energy of Canada Limited	30,682	1.55*
Total	**1,979,773**	**100.0**

*This figure does not include research reactor used fuel.

Percentage of Total Costs Allocated to Each Waste Owner

The percentage of the estimated cost that is to be paid by each nuclear energy corporation and AECL will be largely based on projections of used fuel to be generated by each waste owner. However, other considerations will need to be factored in, such as the usage of the long-term facilities by individual waste owners, transportation requirements and the timing of used fuel shipments by respective waste owners to the long-term management facility.

- For Option 1: Deep Geological Disposal, Option 3: Centralized Storage, or Option 4: Adaptive Phased Management
  > The overall objective is to share actual costs of long-term management based on the number of fuel bundles. That is, each waste owner would pay equal costs for each fuel bundle subject only to owner specific costs such as transportation. Transportation costs are the responsibility of the NWMO and will be paid from *NFWA* trust funds, however these costs vary between the used fuel owners and depend on the distance the fuel must travel to the future NWMO facilities.
- For Option 2: Storage at Nuclear Reactor Sites
  > Costs would be borne by the waste owner at each specific site. For shared facilities at a given location, costs would be shared based on each corporation's used fuel quantities at that location.

Current projected fuel bundles and percentages by each used fuel owner to year-end 2005 are shown in Table 11-4. The percentage ownership by waste owner will differ from these in the long term due to differences in end of life projections. In addition to CANDU fuel, AECL also has an amount of research reactor fuel. (See Appendix 4.)

11.2 / Financial Surety

Financial surety has the objective of determining what costs can reasonably be expected to occur over the life of a project, along with some contingency for unexpected events occurring, then designing a system that collects and protects enough funding to ensure that the entire cost of the project can be covered under a variety of social and economic circumstance and within the required time-frame. Financial surety can exist in many forms and generally includes utilizing a variety of financial instruments from secured assets and trust funds to government-supported guarantees.

Canada has a robust system of legal and regulatory oversight, covering all aspects of the nuclear industry. The standards that have been developed to provide financial surety for the long-term management of used nuclear fuel share many elements of design and implementation with other nations around the world.

In addition to the requirements of the *NFWA* there are legislative and regulatory structures in place that also address financial surety concerning obligations and expected costs of the present and future used fuel inventory, (see Appendix 5 for further detail on regulatory statutes). The following legislation and regulations direct the level of financial surety that is required within Canada:

- The *Nuclear Safety and Control Act*, 1997;
- Canadian Nuclear Safety Commission Regulatory Guide, G-206, "Financial Guarantees For the Decommissioning of Licensed Activities" 2000;
- Canadian Nuclear Safety Commission Regulatory Guide, G-219, "Decommissioning Planning For Licensed Activities," 2000;
- The *Nuclear Fuel Waste Act*, 2002; and
- The *Nuclear Liability Act*. A discussion of this Act is provided later in this chapter.

The following list covers both specific and general requirements that are addressed in legislation and regulations listed above, with many areas being impacted by more than one statute or regulation. Areas addressed include:

- Methods for collecting and managing funds that will meet the cost estimate forecasts in an equitable manner and within reasonable time-frames;
- Methods for adjusting the rate and size of funds that are collected should circumstances change over time;
- Reasonable determinations of cost estimates, derived financial obligations and forms of surety provided;
- Contingency programs that will allow all financial obligations to be met even when unexpected events significantly impact the markets of the used fuel owners;
- A reporting methodology to verify that appropriate financial practices are implemented and that on-going adjustments are made to both cost estimates and the financial guarantees to ensure they are reasonable; and
- Setting limits on liability and insurance requirements for various licensed operations.

Trust Funds

Canada has developed legislation that specifically addresses the future financial obligations for managing used nuclear fuel distinct from all other decommissioning costs. The *NFWA* administered by Natural Resources Canada, sets out requirements for the establishment of trust funds for this purpose.

Trust Fund Requirements

Table 11-5 provides the specific sections of the *NFWA* dealing with trust fund requirements.

Table 11-5 Trust Fund Requirements

***Nuclear Fuel Waste Act* (*NFWA*) reference:**
9. (1) Each nuclear energy corporation and Atomic Energy of Canada Limited shall maintain in Canada, either individually or jointly with one or more of the other nuclear energy corporations or Atomic Energy of Canada Limited, one trust fund with a financial institution incorporated or formed by or under an Act of Parliament or of the legislature of a province, except in the case of a nuclear energy corporation, a financial institution in relation to which the nuclear energy corporation beneficially owns, directly or indirectly, more than ten percent of the outstanding shares of any given class of shares.
9. (2) The financial institution that holds a trust fund referred to in this section shall maintain in Canada all documents relating to that trust fund.
10. (1) Each body mentioned in this subsection shall, either directly or through a third party, no later than 10 days after the day on which this Act comes into force, deposit to its trust fund maintained under subsection 9(1) the following respective amounts: (a) Ontario Power Generation Inc., $500,000,000; (b) Hydro-Québec, $20,000,000; (c) New Brunswick Power Corporation, $20,000,000; and (d) Atomic Energy of Canada Limited, $10,000,000.
10. (2) Each body mentioned in this subsection shall in each year, either directly or through a third party, no later than the anniversary of the day on which this Act comes into force, deposit to its trust fund maintained under subsection 9(1) the following respective amounts: (a) Ontario Power Generation Inc., $100,000,000; (b) Hydro-Québec, $4,000,000; (c) New Brunswick Power Corporation, $4,000,000; and (d) Atomic Energy of Canada Limited, $2,000,000.
10. (3) subsection (2) ceases to apply on the day on which the Minister approves the amount of the deposit under paragraph 16(3)(a).
10. (4) Interest accumulates on any portion of a deposit not paid by the day referred to in subsection (1) or (2), at the prime rate plus two percent, calculated daily from the day referred to in subsection (1) or (2), as the case may be, to the day before the day of the deposit.
10. (5) Each body mentioned in subsection (1) or (2) shall, either directly or through a third party, deposit to its trust fund maintained under subsection 9(1), no later than 30 days after the date of the decision of the Governor in Council under section 15, the applicable amount referred to in subsection (1) or (2) plus an amount, if any, equal to the interest.
17. (1) Each nuclear energy corporation and Atomic Energy of Canada Limited shall, either directly or through a third party, deposit to its trust fund maintained under subsection 9(1) its respective deposit specified in the annual report

(a) if the Minister's approval under subsection 16(3) is not required, within 30 days after the annual report is submitted to the Minister under subsection 16(1); or
(b) if the Minister's approval under subsection 16(3) is required, within 30 days after the date of that approval.

17. (2) Notwithstanding subsection (1), the Governor in Council may, on request by a nuclear energy corporation made before the expiration of the 30 day period referred to in that subsection, authorize the nuclear energy corporation to defer by one year all or part of its deposit required by that subsection, if the Governor in Council is of the opinion that the public interest requires that the money be used instead to repair the damage caused by an event that is not attributable to the corporation and is extraordinary, unforeseen and irresistible.

Once a decision has been made by the federal government on the appropriate management approach for all nuclear waste owners, then the funding formula will allocate liabilities to each nuclear waste owner for their portion of the estimated total cost of the management approach. The funding formula, as presented in the NWMO's Annual Report, following a government decision on an approach, will be subject to Ministerial approval.

In accord with the requirements of the *NFWA*, Ontario Power Generation Inc. (OPG), Hydro-Québec (HQ), NB Power Nuclear (NBP), and Atomic Energy of Canada Ltd. (AECL), each established individual trust funds that are held and managed by independent third parties. The trusts were established in 2002.

Initial deposits as specified by the legislation have been made by all four used fuel owners. Subsequent deposits as specified have been made by each used fuel owner. As of November 15, 2004, the four corporations collectively had contributed $770 million, to the *NFWA* trusts. As of November 15, 2005, a further $110 million will be contributed through the annual provision, bringing the total contribution to $880 million.

The *NFWA* specifies that contributions to the trusts are to continue at the present rate until the first Annual Report on funding requirements is provided by the NWMO to Natural Resources Canada, after a decision has been made on which management approach is to be implemented.

Contributions will be continually adjusted to reflect updated projections of overall costs of the management approach and the number of fuel bundles to be produced by each used fuel owner. Trust fund contributions to be made by each used fuel owner will be presented as part of each Annual Report following the decision by the federal government. Further discussion on trust fund holdings is presented later in this chapter under Financial Guarantees.

Safeguarding the Trust Funds

Individual waste owners are providing large sums of money to dedicated trust funds that will ensure the money is in place to implement the long-term management of used fuel. Experience in other countries has demonstrated the importance of safeguarding these large funds, so that they will be preserved for the intended purpose. In Canada, the *NFWA* built in explicit provisions to ensure that these trust funds are maintained securely and used only for the intended purpose. See *NFWA* section 11 in Appendix 2.

Through its reporting practices, both as explicitly required within the Act, and as a condition of attaining a CNSC licence to construct and operate a waste management facility, the NWMO will have an ongoing obligation to assess the accuracy of the cost estimate for the selected management approach, and the sufficiency of funding contributions to cover cash flow obligations for the life of the project.

We will make regular determinations on the sufficiency of funding, changes to the cost estimate, or other material matters that would impact the provided financial surety and will

provide this information to the CNSC, Natural Resources Canada and our Advisory Council.

As part of the ongoing federal oversight that will continue, the *NFWA* provides for ministerial review and approval of the funding formula and proposed deposits by each used fuel owner. The *NFWA* also specifies and limits who has authorization to withdraw from the trust funds, as is set out in Table 11-6 below.

Table 11-6 Authorized Withdrawals from *NFWA* Trusts

***Nuclear Fuel Waste Act* (*NFWA*) reference:**

11. (1) Only the waste management organization may withdraw moneys from a trust fund maintained under subsection 9(1).

11. (2) The waste management organization may make withdrawals only for the purpose of implementing the approach that the Governor in Council selects under section 15 or approves under subsection 20(5), including avoiding or minimizing significant socio-economic effects on a community's way of life or on its social, cultural or economic aspirations.

11. (3) The waste management organization may make the first withdrawal only for an activity in respect of which a construction or operating licence has, after the date of the decision of the Governor in Council under section 15, been issued under section 24 of the *Nuclear Safety and Control Act*.

11. (4) If the Minister is of the view that the waste management organization has with drawn moneys from a trust fund contrary to subsection (2) or (3), the Minister may require the Minister's prior approval in respect of any future withdrawal from a trust fund by the waste management organization.

Financial Guarantees

An important component of financial surety is financial guarantees. The Canadian Nuclear Safety Commission (CNSC) has required nuclear facility operators to provide evidence of financial guarantees as a condition of licensing their generation and storage facilities.

The CNSC, operating under the, *Nuclear Safety and Control Act* 1997 (*NSCA*), is the federal regulatory agency that oversees all licensing requirements for the site preparation, construction, operation, modification, decommissioning and abandonment of all Canadian nuclear facilities, including the licensing required for the management of used fuel facilities.

The *NSCA* provides that the CNSC is responsible for issuing, amending, revoking and regulating all licences in regard to all aspects of nuclear materials within Canada. Further, the *NSCA* provides that any licence, within the authority of the Commission, can contain any term and condition that the Commission deems appropriate in fulfilling its mandate.

Sections 24(5) and (6) of the *NSCA* specifically address issues of financial guarantees. Section 24(5) states:

A licence may contain any term or condition that the Commission considers necessary for the purposes of this Act, including a condition that the applicant provide a financial guarantee in a form that is acceptable to the Commission.

Financial guarantees are provided by each nuclear waste owner and AECL in accordance with CNSC Regulatory Guide G-206, Financial Guarantees for the Decommissioning of Licensed Activities (2000) and the Commission's Regulatory Guide G-219, Decommissioning Planning For Licensed Activities (2000).

The financial guarantees required under the *NSCA* have been provided by all waste owners. The waste owners are responsible for providing financial guarantees for all aspects of decommissioning, one component of which is used fuel management.

The *NFWA* trust funds are accepted by the CNSC as forming part of the financial guarantees that cover total liabilities held by the waste

owners, and are provided as part of the waste owner's licencing requirements for the operation of their generating and waste storage facilities.

In addition to the trusts that were created under the *NFWA*, the nuclear waste owners have established segregated funds and financial guarantees that address CNSC licencing requirements for their facilities. The segregated funds deal with both decommissioning obligations and used fuel management liabilities. To provide clarity on the scale of the resources that are being allocated for dealing with nuclear liabilities a summary of the segregated funds along with *NFWA* trusts is provided in Table 11-7.

Financial guarantees covering all elements of decommissioning including used fuel management provided by Ontario Power Generation (this includes costs related to used fuel produced by Bruce Power), Hydro-Québec, NB Power Nuclear and Atomic Energy of Canada Limited are as follows:

Table 11-7 Summary Information on Nuclear Funding Guarantees

WASTE OWNERS	FUNDING INSTRUMENT	VALUE ($million)
Ontario	Ontario Nuclear Funds Agreement, Segregated Funds (note 1)	5,296
	Provincial Guarantee (note 2)	1,510
	NFWA Trust (note 3)	807
Hydro-Québec	Provincial Guarantee: Decommissioning Fund (note 4)	205
	Provincial Guarantee: Used Fuel Fund (note 4)	320
	NFWA Trust (note 5)	28
New Brunswick Power	Decommissioning Fund (note 6)	76
	Used Fuel Fund (note 7)	105
	NFWA Trust (note 7)	28
Atomic Energy of Canada	Federal Government Guarantee	Fully covered
	NFWA Trust (note 8)	15

Note 1. Source is OPG "Annual Report To the Canadian Nuclear Safety Commission to provide status of Decommisssioning Plans and Financial Gurantee for all Class 1 facilities owned by OPG", January 2005.
Note 2. Under the Provincial Guarantee Agreement, the total guarantee available is $1.51billion.
Note 3. Source is "OPG Consolidated Statement of Income, Three Months Ended March 31, 2005".
Note 4. Value taken from "Financing the Management of Nuclear Fuel Waste in Support of the Nuclear Fuel Waste Act Report" submitted to NWMO July 22, 2005, by the used fuel owners.
Note 5. Information taken from "Financial Statement of Hydro Quebec Trust for Management of Nuclear Fuel Waste, December 31, 2004".
Note 6. Information taken from "New Brunswick Power Annual Report 2003/2004".
(http://www.nbpower.com/en/corporate/about/reports/reports.aspx)
Note 7. Values adjusted to reflect most recent submission by NB Power Nuclear to the CNSC (June 30, 2005)
Note 8. Value (rounded to nearest million), taken from "AECL Nuclear Fuel Waste Trust Fund Financial Statements December 31, 2004".
www.nwmo.ca/trustfunds

Ontario Power Generation Inc.

Effective July 31, 2003, OPG provided the CNSC with a Decommissioning Financial Guarantee that included a guarantee associated with used fuel arising from the operation of OPG-owned facilities, including the facility leased by Bruce Power.

- The value of the used fuel guarantee required changes over time based on new generation of used fuel;
- The guarantee covers a five-year period to year-end 2007 and is updated annually by means of an annual report provided to the CNSC;
- For year 2005, the value of the guarantee for used fuel management is approximately $4.5 billion stated in present value as of January 1, 2005 and $2.432 billion for the purpose of guaranteeing the funding of decommissioning and low- and intermediate-level waste management costs;
- The guarantee is satisfied by actual accumulation of funds within segregated funds under the Ontario Nuclear Funds Agreement (ONFA) between OPG and the Province of Ontario, the *NFWA* trust fund, and a Provincial Guarantee Agreement for the balance.
  - > The Provincial Guarantee Agreement provides an unconditional and irrevocable guarantee to cover the difference between monies set aside by OPG in segregated and *NFWA* trusts and the total financial guarantee required by the CNSC.
  - > The Provincial Guarantee Agreement covers approximately $1.51 billion in guarantee requirements, and will be reduced over time as funds are accumulated in trust funds.
- The Ontario Power Generation *NFWA* trust has $807 million as of March 31, 2005.

Hydro-Québec

Hydro-Québec has provided to the CNSC a financial guarantee of $525 million stated in present value as of January 1, 2013.

- The guarantee is in the form of an expressed commitment of the Province of Québec to Hydro-Québec, which provides a continuous guarantee of payment until December 31, 2013. The guarantee covers both decommissioning and used fuel; and
- The total guarantee is made up of $205 million for decommissioning and $320 million for used fuel, projected to be generated by the operation of Gentilly-2 until 2013.
- The Hydro-Québec *NFWA* trust has $28 million as of December 31, 2004.

NB Power Nuclear

NB Power Nuclear has provided a financial guarantee for the management of used fuel projected to be produced to the end of Point Lepreau Generating Station's current Power Reactor Operating licence (December 31, 2005).

- The financial guarantee is based on the present value of future costs to manage this fuel on an incremental fee for service basis;
- As of March 31, 2005 the present value of the long-term management costs was calculated at $96.8 million; a June 30, 2005 submission by NB Power Nuclear to the CNSC presents an updated estimate for the present value at $133.41 million. In light of the recent change in NB Power Nuclear's licence application, this value is being recalculated.

- At March 31, 2005 the used fuel fund contained $87 million and the *Nuclear Fuel Waste Act* fund contained $28 million.

Atomic Energy of Canada Limited

The AECL financial guarantee is in the form of an expressed commitment by the Government of Canada to the CNSC. No specific dollar values are quoted in the commitment letter.

- The AECL *NFWA* trust had $14.9 million as of December 31, 2004.

Annual Reporting

Section 16(2)(a) to (e) of the *NFWA* sets out all NWMO annual reporting requirements.

Each NWMO Annual Report to Natural Resources Canada will include:

(i) The form and amount of any financial guarantees that have been provided during the fiscal year by the nuclear energy corporations and Atomic Energy of Canada Limited;

(ii) The updated estimated total cost of the management of nuclear fuel waste;

(iii) The budget forecast for the next fiscal year;

(iv) The proposed formula for the next fiscal year to calculate the amount required to finance the management of nuclear fuel waste; and

(v) The amount of the deposit required to be paid during the next fiscal year by each of the nuclear energy corporations and Atomic Energy of Canada Limited.

Upon submission of the first Annual Report, following the government's selection of a management approach, the Minister has the opportunity to approve the funding formula and the deposits. A further opportunity arises with the submission of the first Annual Report after the issuance of a construction or operating licence.

If approval is withheld, a re-submission will be made as directed by section 16(4) of the *NFWA*. The timing for contributions to the trust fund is based on Annual Report submissions and Minister approval requirements. The Annual Report is due three months after the NWMO fiscal year-end, and contributions within 30 days after that. Ministerial approval is required to prolong that period.

Nuclear Liability

Liability and insurance provisions for damages to health, environment and property, arising out of the use of nuclear materials - are areas of risk addressed by the *Nuclear Liability Act*.

The federal *Nuclear Liability Act* establishes the legal regime for liability for third-party insurance and damage arising from nuclear accidents in Canada. The Act creates an obligation for nuclear operators to prevent injury to health, or damage to property, from nuclear material at the facility, and while it is being transported, until it enters another nuclear installation.

The CNSC determines which nuclear installations are covered under the *Nuclear Liability Act*, sets the basic insurance requirements for designated installations, and ensures that the operator of the nuclear facility maintains appropriate insurance coverage. Facilities for managing used nuclear fuel, as determined by the Canadian Nuclear Safety Commission (CNSC), are among the facilities covered under the Act.

Nuclear power plant operators designated under the *Nuclear Liability Act* by the Canadian Nuclear Safety Commission must maintain $75 million in mandatory insurance to cover third-party nuclear damages. The CNSC is authorized to license nuclear facility operators holding insurance below this maximum based on an assessment of the potential risks at a specific facility. Natural Resources Canada is presently leading a comprehensive review

of the provisions of the *Nuclear Liability Act*, to identify possible revisions required to modernize the Act and bring it into line with prevailing international practices and standards. See Appendix 5 for further discussion on this Act.

The NWMO expects that in its capacity as an operator of a used fuel management facility in the future, it will become subject to the federal *Nuclear Liability Act*. For purposes of costing the conceptual designs for each of the four management approaches, we made provision for liability insurance based on past experience with waste management facilities. The most recent Decision by the CNSC regarding insurance for waste management facilities was used as the basis for estimating insurance costs within the JWO cost estimates for options 1, 2 and 3. The NWMO will adjust costs related to liability insurance as amendments are made to the *Nuclear Liability Act*, and as decisions are taken by the CNSC concerning NWMO liability.

Chapter 12 / Services Provided to Other Owners of Nuclear Fuel Waste

Section 12(5) of the *Nuclear Fuel Waste Act* (*NFWA*) requires the NWMO to identify any services to be provided to other waste owners, beyond the nuclear energy corporations which are, Ontario Power Generation, Hydro-Québec and NB Power Nuclear, specifically, those referred to in section 7 of the Act. For the *NFWA* see Appendix 2.

Services to AECL

Section 7(a) of the *NFWA* relates to the NWMO's requirement to offer its services to Atomic Energy of Canada Ltd. There are two time periods within which the NWMO will provide services to AECL, each period governed by distinct agreements. With respect to implementation in the pre-construction licensing period, costs to be covered by AECL will be set out in an NWMO commercial contractual agreement specifying obligations and costs.

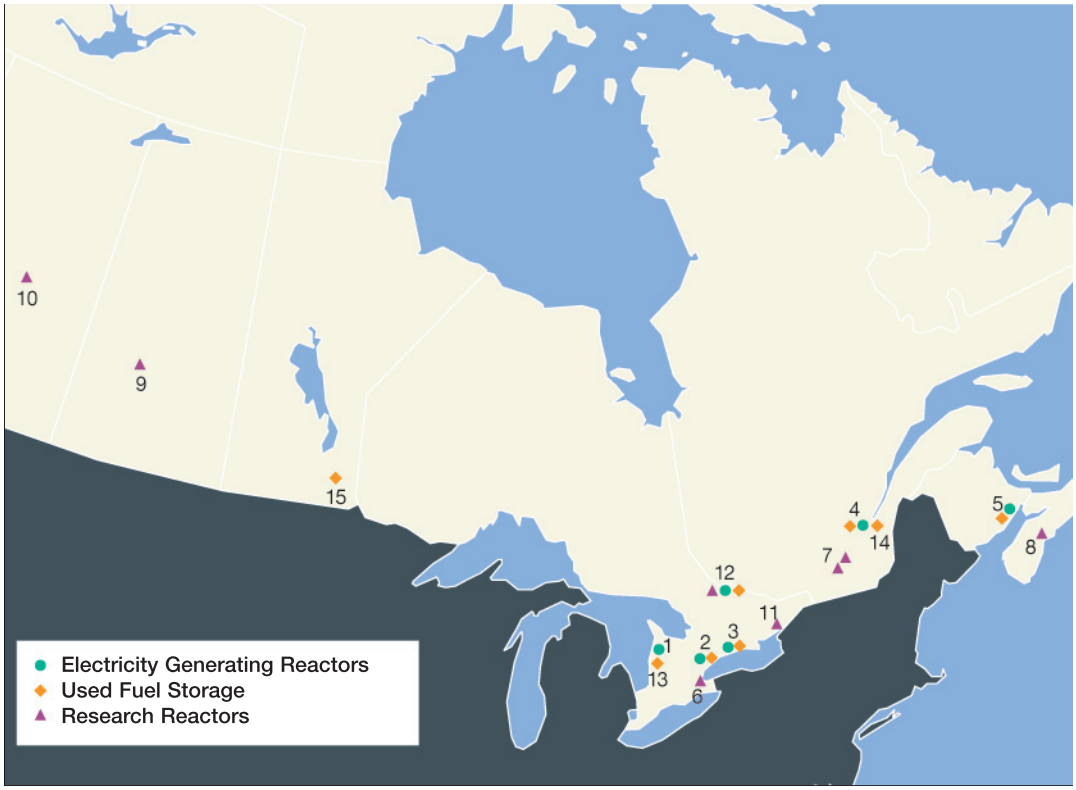
The second time period when the NWMO will offer AECL services will be after a construction licence has been issued. Again, a contractual agreement between AECL and the NWMO will then set out post-licence costs to be paid from AECL's *NFWA* trust fund. AECL will use our services, and pay for them from an allocated proportion of costs as set out in a funding formula approved by the Minister The services to be offered by the NWMO would be consistent with those offered to all other members.

Services to Others

Section 7(b) of the *NFWA* refers to two distinct groups. The first are the existing research reactors at various academic institutions across Canada. The second group would be made up of new market entrants.

Research reactors are located throughout

Figure 12-1 Nuclear Reactor Sites and Used Fuel Storage Facilities in Canada



Canada providing nuclear analysis and radionuclide production, as shown in Figure 12-1. Research reactors differ from commercial power reactors in size, power output and used fuel production. The nuclear fuel in a research reactor is typically 1 kg or less, and the reactor may operate for 20 years or longer before the fuel becomes waste requiring long-term management. The result being that the cumulative waste produced by existing research facilities is a very small portion of the entire used fuel inventory in Canada.

Tables 12-1 and 12-2 provide summary information on the location and nature of Canada's research reactors and their requirements for used fuel management services.

Table 12-1 Research and Isotope Producing Reactors in Canada

RESEARCH REACTOR	REACTORS	LOCATION (see map)
McMaster University (Pool-type research reactor)	5 MWt	Hamilton, ON (6)
École Polytechnique (SLOWPOKE-2)	0.02 MWt	Montréal, QC (7)
École Polytechnique (Subcritical Assembly)	0 MWt	Montréal, QC (7)
Dalhousie University (SLOWPOKE-2)	0.02 MWt	Halifax, NS (8)
Saskatchewan Research Council (SLOWPOKE-2)	0.02 MWt	Saskatoon, SK (9)
University of Alberta (SLOWPOKE-2)	0.02 MWt	Edmonton, AB (10)
Royal Military College of Canada (SLOWPOKE-2)	0.02 MWt	Kingston, ON (11)
AECL (Maple 1)	10 MWt	Chalk River, ON (12)
AECL (Maple 2)	10 MWt	Chalk River, ON (12)
AECL (NRU)	135 MWt	Chalk River, ON (12)
AECL (ZED-2)	0.0002 MWt	Chalk River, ON (12)

Table 12-2 Canadian Research Reactor Functions and Used Fuel Management Agreements

FACILITY OPERATOR	PURPOSE OF RESEARCH	TYPE OF NUCLEAR FUEL	FORECAST WASTE MASS	WASTE MANAGEMENT AGREEMENT
University of Alberta	Neutron activation analysis and radionuclide production	93% HEU U235	<1kg	Material to return to US supplier
Royal Military College	Neutron activation analysis and neutron radiography	19.89% LEU U235	1.15kg	Material to return to US supplier
Saskatchewan Research Council (SRC)	Neutron activation analysis of environmental samples	93% HEU U235	<1kg	Material to return to US supplier
Dalhousie University	Perform fundamental and applied studies in nuclear analytical chemistry	93% HEU U235	<1kg	Material to return to US supplier
McMaster University	Dedicated production facility manufacturing I-125 for use in nuclear medicine	(93%) HEU, (19.89%) LEU	135.6kg	Material to return to US supplier
École Polytechnique (SLOWPOKE-2)	Neutron activation analysis and radionuclide production	19.89% LEU U235	1.15kg	Material to return to US supplier
AECL (all research)	Historic & on-going research	multiple fuels	12% by mass of AECL CANDU fuel inventory	Material to be managed under *NFWA*, by NWMO

Note: Highly Enriched Uranium (HEU); Low Enriched Uranium (LEU); uranium-235 (U235).

The four management approaches under study by the NWMO have not identified services to be offered to waste owners other than NWMO Members (Ontario Power Generation Inc., NB Power Nuclear, Hydro-Québec) and AECL. Research reactors within Canada presently disposition used nuclear fuel in one of two ways. Under existing agreements, waste material is returned to the point of origin, under conditions licensed by the CNSC and Transport Canada. This means that the used fuel is returned to the institution or organization that originally provided the nuclear fuel for the research reactor. The NWMO would not provide services in this instance because the requirement for service falls under an alternative existing Agreement. In other cases, material is transferred back to AECL, to be temporarily stored at their Chalk River Laboratory and at some later date is to be returned to the original supplier in the United States.

In the event that there are new market entrants in the future, for research or commercial operations, the services and fees negotiated by the NWMO would be determined, at that time, by the nature of the waste owner's fuel, the volume of material to be managed and an allocation of costs in accord with existing member costs.

Chapter 13 / Continuing the Collaborative Process of Dialogue and Engagement

In a democratic society citizens have a right to know about and participate in discussions and decisions that affect their quality of life. Furthermore, citizens bring special insight and expertise which usually results in making better decisions. The NWMO's search for effective engagement, while based on the farsighted requirements of the *Nuclear Fuel Waste Act* (*NFWA*), reflects our belief that the challenge of managing used fuel over the long term demands engagement, genuine dialogue and deliberation.

A critical component of implementation, phasing and adaptation of any management approach is the continuing and evolving active engagement of both specialists and citizens. Engagement will enhance the NWMO's ability to progress effectively through each phase.

This is for a number of reasons. First, knowledge, experience, values and societal priorities may well change over the period of implementation. These kinds of changes will drive both the need to refine the approach and its implementation as well as uncover opportunities for doing so. It will be important to establish mechanisms to identify the need for change and examine the nature and consequences of any modifications to the approach which may be required.

Secondly, it is only as we move through implementation that it will be possible to fully understand those likely to be affected and identify which voices will need to be heard at each point in the process. It will be necessary to identify the "communities of interest" which are likely to be most affected at each phase of implementation, their capacity for engagement in the implementation process and any support they will require. Only through successful engagement and collaborative decision-making in the early stages of implementation will trust and confidence begin to be built in the process itself. The ability of the engagement process to identify, and effectively address, the difficult issues which will emerge over the course of implementation will be a key measure of success.

The *Nuclear Fuel Waste Act* (*NFWA*) requires that the NWMO set out a program for public consultation as part of an implementation plan for each approach. Although the specific details of a program for engaging communities of interest will need to be developed iteratively and collaboratively with those most affected, we provide the foundation for the program in this chapter.

13.1 / Setting the Context for Effective Engagement

The NWMO has heard from its dialogue with Canadians, and agrees, that in order for engagement to be effective, it will need to be based on the ethical principles identified through the study process. Implementation of these ethical principles would require that any engagement program:

- Be informed by the best knowledge – in particular from the natural and social sciences, Aboriginal Traditional Knowledge, and ethics – relevant to making a decision and/or formulating a recommendation;
- Ensure that those who most directly could be exposed to harm or risk of harm (or other losses or limitations) are involved in discussions and provided in advance with information and resources that enable them to participate effectively; and
- Take into consideration, in so far as it is possible to do so, the cost, harms, risks, and benefits of decisions which are taken, including not just financial costs but also physical, biological, social, cultural, and ethical costs (harm to our values).

Recognizing that all Canadians might have an interest in the matter of the long-term management of used nuclear fuel, the NWMO involved a broad cross-section of communities of interest in the course of its study. As we move to implement the decision of the Government of Canada, engagement will become more focused on the communities of

interest which are potentially most affected at each phase of the implementation process. The determination of who those communities are and the nature of their involvement, will be the subject of dialogue in the period immediately following a decision.

In addition to the ethical principles, any engagement program will be built on the following understandings:

1. Judgments about acceptable risk and safety at each point in the process need to be made collaboratively with those most potentially affected.

The views of Canadian society in judging benefits or risks and assessing the social implications of various approaches have been important in developing a socially acceptable recommendation. Canadians expect that the best scientific and technical knowledge will be brought to bear in identifying and understanding the source and nature of risk and the ways in which safety can be assured. However, the decision as to whether safety has been assured to a sufficient degree to warrant implementation is a societal one, and will be affected by social notions of what constitutes risk, safety and thresholds to be met. This requires sustained engagement with people and communities.

In implementing any management approach selected by the Government of Canada, managing risk in a socially responsive way will require the involvement of those potentially affected at each point in the process in judgments about what constitutes acceptable risk and safety. Those communities of interest will be diverse, including specialists, citizen groups, individual citizens and waste producers. Mechanisms will need to be developed to involve them effectively in developing the assessment criteria for the phases of the project and evaluating progress against these criteria.

2. Detailed implementation plans need to be developed in an iterative and collaborative manner with those most potentially affected.

A commitment to continuous learning and adaptation to evolving conditions implies that implementation plans will not be static. They will need to evolve as the implementation process becomes more focused and localised. We anticipate that many communities of interest will have important roles to play at various points in the process, including the design of the process and the issues to be explored. Methods for engagement and timetables for implementation must be discussed and defined as part of the necessary collaboration and dialogue.

3. Addressing the needs and concerns of affected site communities is a key goal of engagement.

Once a willing host community has been identified, its vision of its social, cultural and economic aspirations will need to be recognized and supported as a key goal of the engagement program. The concerns of other communities of interest, such as those in surrounding regions must also be taken into account through any engagement program.

4. Transparency and openness in decision-making will be facilitated through the design and implementation of the engagement program.

In order to demonstrate the continued appropriateness of the engagement program as it evolves and the decisions which emerge from it, the engagement program will need to be operated in an open and transparent manner. Furthermore, although we expect the engagement process to become increasingly more focused on the communities of interest most directly affected, it is expected that others will continue to remain interested and engaged through the program.

5. Continuous learning and adaptation are also important goals of the engagement program.
The NWMO believes that continuous learning and adaptability are integral to successful implementation plans. A used nuclear fuel management program that will evolve over a long period of time will have many opportunities for improvements to increase performance, enhance effectiveness, improve understanding and confidence, and address societal concerns. To realize these benefits, there needs to be both a vibrant and robust research and development effort, and an engagement program which includes specific activities to consider new learning and incorporate it in decision making.

6. The engagement program should preserve and sustain a sense of urgency and momentum throughout implementation.
While taking the time to engage potentially affected communities of interest effectively, it will also be important to encourage implementation to proceed through the phases in as expeditious manner as full engagement will allow. It will be important to incorporate resiliency in the engagement process to allow for adjustments in course in the face of unplanned obstacles or problems which may arise.

7. The conditions for educational outreach and the development of an informed citizenry as well as a culture of vigilance should be enhanced through the engagement process.
There is an appetite for more knowledge and understanding about used nuclear fuel, the requirements for its management, and the activities of the NWMO among citizens across Canada. In virtually every dialogue held, the NWMO was told that we must take the task of education as a priority, increasing understanding within this generation of citizens and putting in place mechanisms to transfer knowledge to future generations. There must be a readily accessible opportunity for all citizens to access information, pose questions, have these questions answered, and develop confidence that the process which has been put in place will maximize safety and security and reflect the values and priorities of Canadians. As well, the efforts we make today to build an informed citizenry must contribute to a more informed citizenry in generations to come.

8. A special responsibility is owed to potentially affected Aboriginal peoples.
An engagement program must recognize the special obligation of government to Aboriginal peoples to consult on matters which may affect them, as laid out in legislation. Aboriginal and treaty rights are protected under s.35 of the *Constitution Act, 1982*. Since then, a series of Supreme Court of Canada decisions has begun the process of formally clarifying the legal duty of consultation by government owed to Aboriginal peoples. This process continues. Throughout our study, and as outlined in Chapter 3 and in more detail in Appendix 11, we have made best efforts to involve Aboriginal peoples in the dialogue. We have heard from Aboriginal peoples that these discussions did not constitute formal "consultation" as they saw it. The nature of the specific obligation will be clarified as affected individuals and communities become more evident.

9. 'Consultation' required by regulatory processes will be one among many components of the engagement program.
Over the course of implementation a number of regulatory decisions and approvals will be sought, each with specific requirements for public consultation. Two examples are approval under the *Canadian Environmental Assessment Act* (*CEAA*) of an environmental assessment for a preferred site and Canadian Nuclear Safety Commission (CNSC) approval and issuance of site preparation and construction licenses for a shallow rock storage cavern, an underground characterization facility and a deep geological repository. There may be additional requirements under provincial legislation, as outlined in more detail in Appendix 5. There are also regulatory requirements related to public information during all stages of implementation. The engagement program must ensure that the specific requirements of each of these processes are fully satisfied.

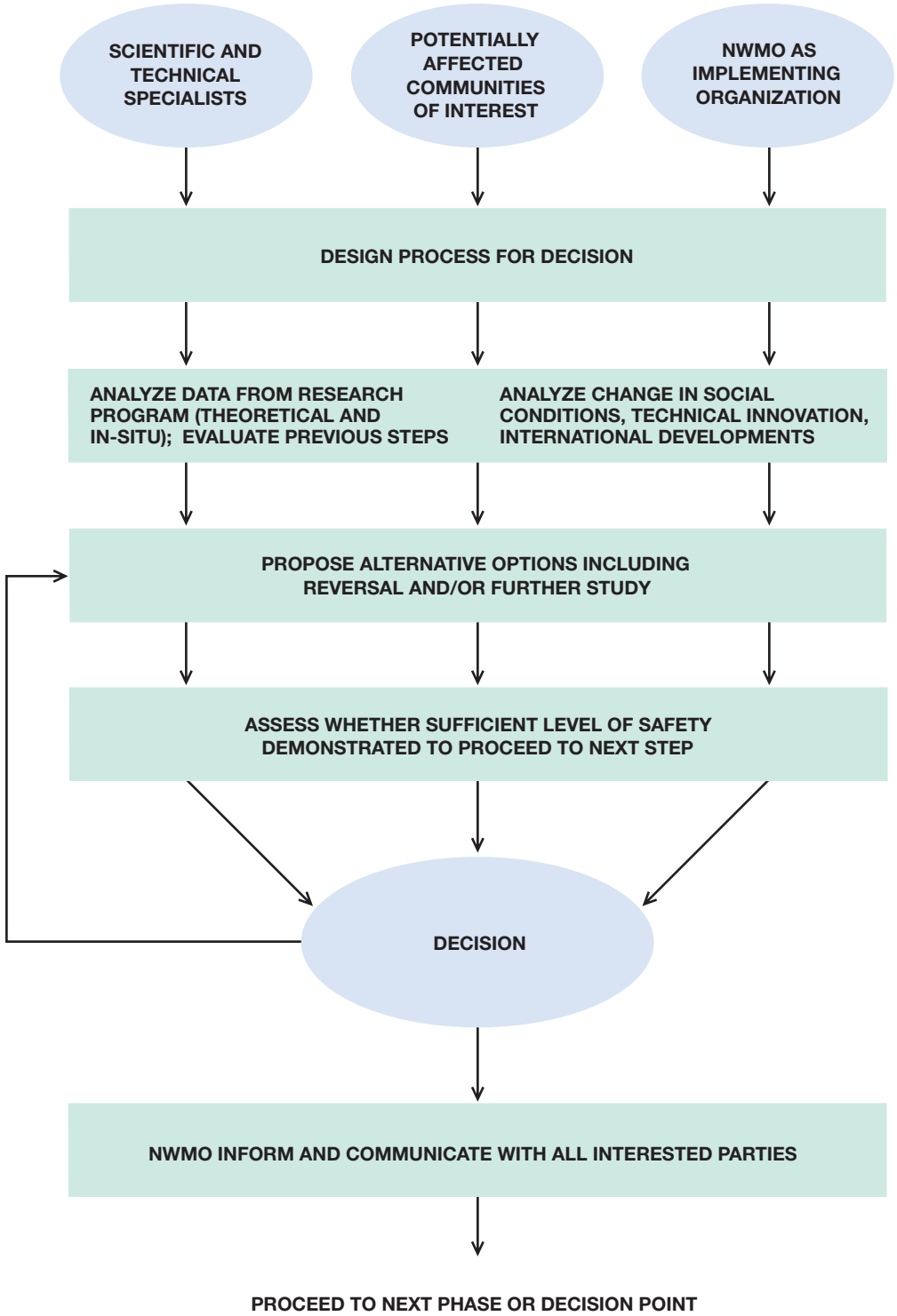
13.2 / Engagement as an Input to Decision-Making

The flow chart which follows (Figure 13-1) illustrates, at a conceptual level, the nature of the engagement which is being proposed for each of the decisions to be taken, regardless of the chosen management approach.

Implementation of the Adaptive Phased Management approach would involve decision points which would be the subject of public engagement. These decisions vary in complexity and some would likely involve a more elaborated series of decisions. The decision points for the Adaptive Phased Management approach include:

- Collaboratively develop a siting process and engagement program with people and communities from areas potentially affected, including Aboriginal peoples;
- Initiate the siting process to select a preferred site (including feasibility studies and site characterization) from candidate sites, including expressions of willingness from communities to engage in the site investigation process;
- Select a site;
- With public engagement and safety analyses, assess the project against the requirements of an environmental assessment, including shallow rock cavern storage, the underground characterization facility and deep geological repository;
- Decide whether or not to construct a central shallow underground storage facility;
- Decide when to begin transportation of used fuel from the reactor sites to the central site;
- Decide when to construct the deep geological repository and ancillary facilities;
- Decide when to begin to place waste in the shallow underground storage facility and/or deep repository;
- Decide the nature of active monitoring of the facility before closure of the facility;
- Decide when to close the deep repository; and
- Decide the nature and period of extended monitoring following closure of the repository.

Figure 13-1 Illustrative Dialogue & Engagement Process for Each Decision Point



Note: Loosely adapted from "One Step at a Time, the Staged Development of Geologic Repositories for High-Level Radioactive Waste", National Research Council of the National Academies, the National Academies Press, 2003.

By means of further illustration, Table 13-1 identifies the nature and breadth of contribution from the engagement program for each of the key implementation decisions of the Adaptive Phased Management approach.

Table 13-1 Engagement as an Input to Decision-Making

NO.	DECISION POINT	INPUTS
1	Identify candidate areas	• **From NWMO study:** Technical and societal siting principles identified through NWMO study process • **Research:** Advancement of Canadian and international research on characteristics and performance of appropriate geology • **Dialogue:** Results of dialogue with potentially affected communities, and other interested communities of interest, to determine an appropriate siting process and criteria • **Site-specific research:** Surface-based site characterization data • **'Acceptance/Confidence' achieved:** Expression of interest from potential communities for further feasibility studies and analyses.
2	Select preferred site	• **Dialogue:** Agreement from potential communities, and other directly affected communities of interest, for further feasibility studies and analyses • **Site-specific research:** Surface & subsurface site characterization data at potential sites; feasibility studies, including transportation studies; preliminary safety analyses to support technical feasibility and acceptability of sites; preliminary transportation analyses; preliminary engineering designs & cost estimates • **Application** of site evaluation & selection process – assessment against siting process and criteria developed collaboratively earlier • **'Acceptance/Confidence' achieved:** Agreement from preferred site community, and other communities of interest most directly impacted, to proceed with further studies, analyses, environmental assessment and licensing process.
3	Decide whether or not to construct central shallow underground storage facility	• **Site-specific research:** Detailed surface and subsurface site characterization data at the preferred site; further safety analyses, engineering design and cost estimating work; preliminary safety assessment report • **'Acceptance/Confidence' achieved:** Agreement from host community, and other directly affected communities of interest, to construct underground storage facility • **Meet regulatory conditions:** Environmental assessment approval; site preparation licence from CNSC • **Change in social conditions:** Strong indication from reactor site communities of a need to move waste off site; unforeseen developments that increase the desirability of centralizing the fuel for reasons of enhanced security • **Innovation in technologies:** Unforeseen developments in technological innovation.
4	Decide when to begin transportation of used fuel from the reactor sites to the central site	• **Dialogue:** NWMO to establish timelines through engagement with reactor site communities and the individual utilities. • **'Acceptance/Confidence' achieved:** That sufficient level of safety demonstrated to proceed with transportation, among directly impacted communities of interest • **Meet regulatory conditions:** The extent to which NWMO has finalized transportation plans to the satisfaction of regulatory and governmental authorities and the communities affected.

Table 13-1 (cont'd) Engagement as an Input to Decision-Making

NO.	DECISION POINT	INPUTS
5	Decide when to construct the deep geological repository	• **International experience:** Successful operation of deep geological repositories in other countries (e.g., Finland, Sweden, USA) • **Site-specific research:** Confirmation of site suitability for a deep geological repository – successful operation of underground characterization facility and tests of containment and isolation systems and technology demonstration; final safety analyses; final engineering designs and cost estimates; final safety case to support deep repository • **'Acceptance/Confidence' achieved:** Confirmation from host community, and other directly affected communities of interest, that safety has been sufficiently demonstrated and agreement to construct deep geological repository.
6	Decide when to close the deep repository	• **Operational performance and experience:** Successful operation of deep geological repository; in-situ monitoring data, engineering analyses and safety analyses confirm performance of repository • **Dialogue:** With host community, and other directly impacted communities of interest, concerning timing and manner of closure of the deep geological repository • **Change in social conditions:** Developments that might lead society to conclude that easy access to the used fuel is no longer a priority, for example: > review of latest international research findings suggest partitioning and transmutation or other used fuel treatment methods do not present a preferred waste management option; > Canada's activity in nuclear fuel cycle – level of nuclear operations and type of technology adopted – do not support economics or feasibility of using reprocessed fuel; and > Demand/supply for Canada's natural uranium reserves – natural sources of uranium appear to be sufficient to support Canada's nuclear operations, without reliance on reprocessed fuel > Unforeseen developments that increase the desirability of closing the repository or keeping it open • **Innovation in technologies:** Expected developments in technological innovation do not materialize • **'Acceptance/Confidence' achieved:** Confirmation from host community, and other directly impacted communities of interest, that passive safety performance of the repository, and/or the ability to retrieve the waste once the repository has been closed, and/or the effectiveness of remote monitoring to monitor the performance of the system once closed, has been sufficiently demonstrated to warrant closing of the repository.

13.3 / Incorporating Evolving Best Practices

How to achieve effective engagement in important public policy issues, and in nuclear waste management decision-making in particular, is a topic of much academic research and innovative experimentation. Over the course of its study, the NWMO in conjunction with a variety of independent contractors, tried a number of innovative approaches to engaging specialists and citizens. We benefited from academic research, including exploration of community based initiatives. There have also been advances in designing initiatives to broaden involvement in performance assessment, involving specialists and citizens in dialogue around a single table. This research and experience is the foundation upon which we will develop the tools and capacity to implement the range of engagement initiatives which implementation of the approach will require.

Internationally, there is also research and experimentation in engagement to draw upon. Specifically, advancements, successes and challenges experienced in Finland, Sweden, Japan, the United Kingdom, France, Germany and the United States will be monitored. As well, the work of the OECD's Forum for Stakeholder Confidence, and initiatives by the International Atomic Energy Agency, continue to provide important opportunities to share and learn from experiences of others.

These best practices will be documented and updated and made available to interested citizens and communities throughout the implementation process.

The NWMO has used a wide variety of means to disseminate information through its website, e-dialogues, national and local advertising, public information and discussion sessions, and media interviews and to create genuine opportunity for dialogue. However, we recognize that during implementation specific educational initiatives should be undertaken. As new tools and approaches are developed both in Canada and internationally, they will need to be reviewed, assessed and if appropriate adopted over the course of the implementation process.

13.4 / Comparing the Management Approaches

In our mission statement, we highlighted the importance of striving for social acceptability in the selection of any management approach. The way in which an approach is implemented, and specifically the process of engagement, is an important means to accomplish this goal.

How then do we see an engagement strategy differing among the four approaches studied? We recommend that no matter which management approach is ultimately selected by the Government, the essence of the engagement program outlined in this chapter should be applied.

However, we believe that the likelihood of successfully implementing this type of engagement is much higher with the preferred approach of Adaptive Phased Management than with the other approaches. This is because:

- The implementation of the non-preferred approaches is less amenable to being broken up into incremental pieces for the purposes of engagement;
- The non-preferred approaches are less able to address outcomes of engagement different from those planned and anticipated; and,
- There are few or no contingencies designed into the non-preferred approaches to accommodate major disruptions in implementation introduced through formal or informal engagement.

The type of comprehensive engagement outlined in this chapter is most anticipated and taken into account, by the Adaptive Phased Management process.

CHAPTER 14 / Addressing Social, Economic and Cultural Effects

Section 12(6)(c) of the *Nuclear Fuel Waste Act* (*NFWA*) requires the NWMO to specify the means that will be used "to avoid or minimize significant socio-economic effects on a community's way of life or on its social, cultural or economic aspirations."

The socio-economic dimension is key to the success of our strategy for managing used nuclear fuel. There are a growing number of experiences that offer innovative ways of bringing affected individuals, organizations, and communities into decision-making processes and addressing socio-economic and cultural effects in a way that ensures communities themselves remain in control of their own future. The result is an alignment between a given project and citizen values and priorities.

For communities and the NWMO, the way ahead must be marked by trust and integrity, not acrimony. Seen in this light, the effective management of socio-economic effects will pave the way for this project to provide real opportunity – an opportunity that brings an overall positive contribution – to people, their community, and the environment.

14.1 / The Context

NWMO's overall strategy for managing socio-economic effects consists of three key components:

1. **Seeking a willing community to host any long-term waste management facility;**
2. **Building with that community a strategy for long-term community sustainability; and**
3. **Working collaboratively and openly with all those potentially affected by implementation in a fair and equitable manner.**

Many considerations will come into play as we consider the definition of "host community". Community is not readily defined along geographic or political boundaries. A community may reflect shared perceptions and attitudes, and shared socio-economic foundations. It may be defined in part by behaviour patterns which individuals or groups of individuals hold in common, through their daily social interactions, the use of local facilities, participation in local organizations, and by involvement in activities that satisfy the population's economic and social needs. Arriving at an appropriate definition of "host community", and understanding its characteristics, values, goals and concerns, will be an important starting point for assessing and managing potential socio-economic and cultural effects.

Much of the discussion in this chapter focuses on the management of potential impacts in the communities closest to the central site – the willing host, recognizing that this is where effects are likely to be greatest and actions required, most significant. However, we recognize that there may be other areas potentially affected or implicated through the implementation process. We will ensure that all potentially affected are positioned to be active participants in decisions taken in implementing Adaptive Phased Management. All potentially affected parties must be afforded fair and equitable treatment, in engagement with the NWMO, in assessing

potential significant socio-economic effects, and in managing those effects.

This includes paying particular attention to Aboriginal communities that may be affected. Implementation must respect Aboriginal rights, treaties and land claims, and be sensitive to the social, cultural and economic aspirations of those communities. We are committed to building a relationship based on mutual trust, respect and integrity, and seeking an alignment between Aboriginal values and those reflected in our management strategy.

Communities in which the used nuclear fuel is currently stored will also figure prominently in implementation, regardless of which management approach is selected. Our recommended approach, Adaptive Phased Management, involves continued storage of used nuclear fuel at existing interim storage facilities until such time as a new facility is available to receive the used fuel – whether a centralized shallow underground storage facility, and/or a deep geological repository in an appropriate geological formation. Continued secure storage of the used nuclear fuel at the existing reactor sites is an integral and essential component of Adaptive Phased Management.

The purposes of socio-economic and cultural effects management are to:

- ensure that people affected and their communities have the capacity to cope with change;
- ensure that good relationships are fostered between the proponent, a community and others involved in or affected by a project's development; and
- help to ensure that over the long term of any project, its consequences are contributing positively to a community's goals and aspirations.

Table 14-1 Categories of Measures to Address Impacts

Enhancement	refers to actions or measures undertaken with the objective to maximize the potential impacts deemed to be beneficial.
Mitigation	refers to actions or measures undertaken with the objective to avoid, or reduce the severity of adverse impacts.
Compensation	refers to actions or measures undertaken with the objective to redress or offset the unavoidable or residual adverse impacts of the management approaches. These measures can be impact-related, aiming to offset impacts to a level equivalent to pre-project conditions. Compensation measures may also be equity-related, intended to improve the community's share of benefits over costs. Equity-related compensation is often referred to as an incentive.
Monitoring and Contingency Measures	can take the form of policies or programs designed to ensure a timely and appropriate response to potential problems and unanticipated adverse impacts. These contingency measures may involve the application of mitigation, enhancement or compensatory measures.
Community Liaison Measures	are policies, programs or administrative procedures aimed at establishing and maintaining cooperative, non-adversarial relationships between the project proponent, project workers, the local community, and various levels of government in order to build commitment to the project and the effects management process, and to address some of the more intangible social impacts related to public risk perception.

Source: www.nwmo.ca/assessments

Historically, in the field of environmental assessment, measures taken to minimize or avoid adverse effects are generally referred to as "mitigation." Under the *Canadian Environmental Assessment Act*, "mitigation" refers to measures that serve to prevent, eliminate, reduce or control adverse environmental effects of a project, including restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means. In the field of socio-economic impact assessment, the concept of "mitigation" is broadened somewhat and is generally referred to as "socio-economic effects management". It includes not only measures to prevent, eliminate, reduce or control adverse environmental effects; and replace, restore or compensate for damages; but also measures to enhance positive effects and the implementation of practices and procedures for developing and maintaining trust or positive relationships with those affected. "Socio-economic effects management" involves the coordinated application of enhancement, mitigation, compensation, monitoring and contingency measures, and community liaison measures, as depicted in Table 14-1.

Through our discussions with Canadians and drawing from recent developments in Canada and abroad, we have found that a significant evolution in understanding continues to take place regarding how to best address social, economic and cultural implications of development. These insights are particularly important to apply to the development and operation of a facility to manage used nuclear fuel, given its unprecedented nature and time horizon.

At the very heart of this evolution is recognition that short-term solutions are rarely effective, and that mitigation of adverse effects, on its own, is also not adequate. Initiatives must be designed to seek positive contributions to the community that will continue over the long term. Further, the issue is not simply one of jobs, income, or tax revenues. More fundamentally, it is an issue of people's future and the degree of confidence that this future will unfold in a manner consistent with closely held values and priorities. This touches the heart of a community's culture. If synchronicity between a proposed project and people's values is not evident, the project may be seen as a threat to the fabric of community life, and be vehemently opposed.

We believe that such an alignment is possible. The key to success lies in how the citizenry are directly involved in the decisions that affect their current and future way of life. With involvement, trust can emerge; without it, trust is unlikely.

The NWMO is committed to a collaborative process of decision-making that includes:

- Working closely with communities to tailor programs for citizen involvement in the decisions that affect the community's way of life. Fairness requires that the NWMO provide for the participation of interested citizens in key decisions taken on managing socio-economic effects, through full and deliberate engagement during the different stages of decision-making and implementation; and

- Develop, with the host community, a community-oriented strategy for long-term sustainability. This requires working together to design measures appropriate to nourish the positive socio-economic and cultural effects, while avoiding or minimizing any negative effects.

We propose to involve people starting with the collaborative design and implementation of the process of engagement itself and extending through to collaborative design and implementation of measures to address socio-economic and cultural effects of NWMO activities. Collaboration is essential not only in the phase of inquiry and investigation, but also in decision-making throughout the life of the project.

Over the past number of years, effects assessment has evolved steadily to include a broader perspective. Table 14-2 describes a "sustainable livelihoods framework" that offers one way to approach potential community impacts in an integrated and comprehensive way, by considering the main factors that affect people's livelihoods. This framework invites consideration of the many aspects that are often included in the kind of sustainable development context that the NWMO has adopted.

In the context of siting, designing, constructing and maintaining a facility for the management of used nuclear fuel, it will be important to look at individual community characteristics to:

- Identify possible ways to support people and communities in building their livelihood assets;
- Identify ways to encourage responsive support from institutions and organizations; and
- Identify avenues that people and communities might choose to harness change for social and economic enhancement.

Having established an understanding of the ways in which a community may be impacted, it will then be possible to design and implement measures for assessing the capacity of the community to respond and the specific measures needed to manage effects, both in terms of enhancing positive effects and minimizing negative effects.

Table 14-2 The Sustainable Livelihoods Framework

The Sustainable Livelihoods Framework provides insight into the different dimensions of well-being, in terms of social, human, physical, financial and natural dimensions:

- **Social Capital**, consisting of networks and connectedness that increase people's trust and ability to work together;
- **Human Capital**, consisting of skills, knowledge, ability to work, and good health;
- **Physical Capital**, consisting of infrastructure and producer goods;
- **Financial Capital**, consisting of available stocks and inflows of money; and
- **Natural Capital**, consisting of natural resource stocks and intangible public goods – atmosphere, biodiversity; and divisible assets, such as trees, water and land.

The breadth of considerations covered by this framework is illustrative of the range of effects to be considered in implementation. In practice, the nature of the community effects and appropriate means of addressing those effects must be considered in the context of a specific site. Regions will differ significantly in their social, human, physical, financial and natural capitals.

People living in a community have a greater or lesser adaptive capacity based on the relative strength of the sustainable livelihood assets present in that location. The "adaptive capacity" of the residents or community to adjust to change, take advantage of opportunities presented by change, and/or cope with the consequences of change, will differ significantly depending upon the site selected for implementation. The measures required to manage those impacts will therefore differ according to the specific regions selected for implementation.

Investment in the community in terms of social, financial, physical and human capital may be required to ensure that it is equipped to participate in negotiations and decision-making, as well as participate in the benefits that emerge from increased employment activities. To ensure a fair process, early measures are required to build the capacity of people within such communities to effectively participate in discussions, dialogue and any required negotiations.

Note: Drawn from "Assessment of Benefits, Risks and Costs of Management Approaches for Used Nuclear Fuel by Economic Region", Golder Associates Ltd. and Gartner Lee Ltd., February 2005.

14.2 / What are Potential Socio-Economic Effects?

Socio-economic effects (or changes to the socio-economic conditions) are determined by many factors including:

- Existing or baseline conditions in an area such as the stability or the size of the local population;
- Key project or program factors that may create effects including estimated workforce requirements, infrastructure needs, and approach to decision-making;
- Changes to traffic patterns and economic flows within a region;
- The nature of the changes, including whether they are direct or indirect, of great or small magnitude, short or long duration, their significance and reversibility; and
- The community's own goals and aspirations and the degree that those affected have the opportunity and ability to participate in, and have some measure of control over, the outcome of decisions that will affect their lives and livelihood.

The socio-economic effects may vary according to the stage or phase of a project. For example, those produced during a site selection process may be completely different from those occurring during the operation of a specific facility. Identification and determination of socio-economic effects require dialogue with the people in the communities that may be affected.

Socio-economic effects ripple out across a community and region. There are direct effects from a project, such as the employment and wages earned. This in turn, creates indirect effects, such as the impact on goods and services purchased by that worker. In addition, there are tertiary effects. For example, if the work environment leads to the acceptance of a safety culture or an attitude towards co-workers that extends to the community, these are called tertiary effects. In this case, they would be educational in nature, and might lead to fundamental cultural changes. Tertiary effects are often much longer term in nature than direct and indirect effects, and for a project such as the long-term management of used nuclear fuel, they can be very significant indeed.

It is also important to think about socio-economic effects beyond the marketplace. These include effects on faith and cultural oriented activities, the wide range of volunteer activities, recreational activities, housework, and subsistence activities. These are activities that are essential to the fabric of community life. Yet, they often play little or no role in standard market-oriented economic analyses. However, in small communities, particularly Aboriginal communities, these aspects of traditional life carry great importance. The internal cultural and social structure of Aboriginal communities may be vulnerable to pressures that arise from development activities.

Social, economic and cultural effects may also be felt in areas far removed from the physical location of the new project or facility.

For example, the transportation of used nuclear fuel, away from existing reactor site communities to the chosen central host community could have implications for many communities of interest. Communities currently hosting used nuclear fuel may be impacted by decisions taken with respect to the timing and manner in which the used fuel is transported from their communities. The development of transportation plans concerning mode of transport, routes, security and safety measures, emergency preparedness may have implications for the reactor site communities currently hosting the used fuel, communities along the transportation route, and the central host community selected for the long-term management facility. All will have an interest in assuming active roles in engaging with the NWMO regarding the assessment of potential risks and community impacts, and in ensuring that potential effects are recognized and managed appropriately by the NWMO.

The linked issues of fairness and justice lie at the centre of many socio-economic concerns. If the distribution of costs, benefits, risks and responsibilities is perceived as fair and just, a sense of integrity emerges. Individuals, organizations

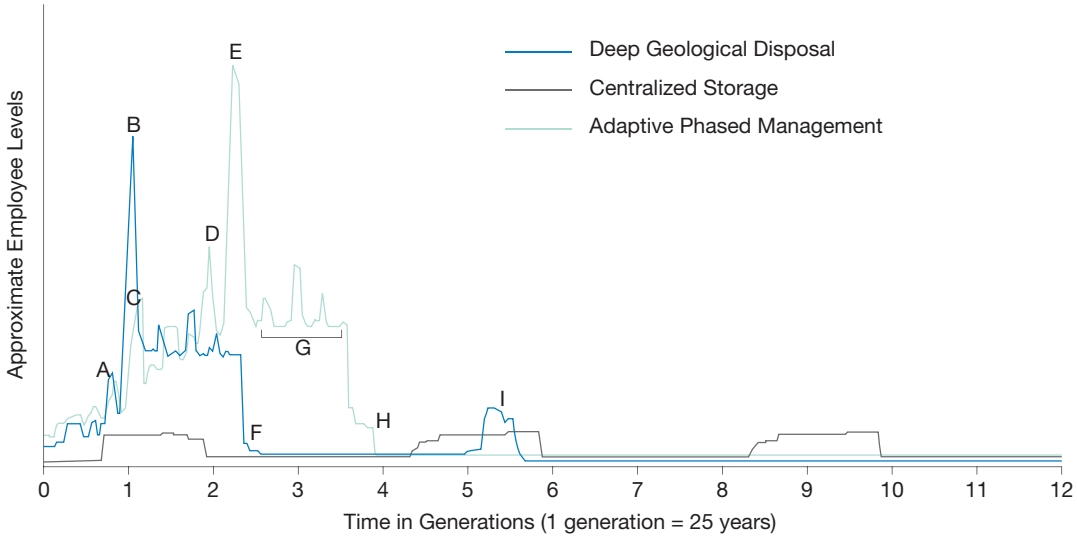
and communities can open to many possibilities in the belief that their place will be respected. However, if a sense of unfairness arises, rather than a sense of integrity, it is bitterness, contempt, and even helplessness that come to dominate. Under these conditions, people lose any confidence that they can control their own future. It is for this reason that fairness and justice figure prominently in both the assessment process and the ongoing implementation strategy.

14.3 / The Particular Issue of Long-Term Community Sustainability

Long-term management of used nuclear fuel is without precedent in terms of the time-horizon over which socio-economic and environmental effects may be felt. The nature of the activity means that there will be rises and falls in the number of workers on site with a particularly dramatic peak occurring during any construction phase. In addition, the time over which these variations will be experienced on site varies significantly across the four options.

Figure 14-1 provides a conceptual schematic of the relative employment trends (NWMO plus contracted) for three of the four options: Deep Geological Disposal in the Canadian Shield (Option 1), Centralized Extended Storage (Option 3), and Adaptive Phased

Figure 14-1 Conceptual Schematic of the Relative Employment Trends for Each Option



A) Siting

B) Construction of deep repository

C) Construction of shallow rock caverns and underground research laboratory

D) Transport and emplacement of used fuel in shallow caverns, simultaneous R&D with the underground research laboratory

E) Construction of deep repository and packaging plant

F) Extended monitoring

G) Transfer of used fuel from shallow underground storage to repackaging plant, repackage, transfer to deep repository

H) Extended monitoring

I) Decommissioning

Note: The Reactor-site storage option is complex because it depends on how many workers will be shifted from continuing operations of the power producers.

Management (Option 4). Estimates for Storage at Nuclear Reactor Sites (Option 2) are not included because many of those involved would be drawn from existing operations of the power producers and just how this would be done is not known. It is not possible to specify exact numbers because of the many factors involved but it is possible to provide order-of-magnitude trends. For example, the highest peak shown (for Option 4) may reach to about 1,500 and the "average" level for Option 4 from generations one to four would be in the order of 500 people. The portion of these working on site will vary significantly depending on the phase of work.

Figure 14-1 serves to illustrate approximate variations of worker activity over time. Centralized Extended Storage involves a smaller work force that repeats every several generations in line with requirements for repackaging. Option 1: Deep Geological Disposal involves a single high peak during construction followed by a level of activity several times that of the Option 3: Centralized Storage lasting about a generation. Following closure, this level drops down to a low level.

For its part, Option 4: Adaptive Phased Management climbs to a peak during the time when construction of the deep underground facility overlaps with operation of the shallow-underground facility. However, what is notable in the case of Option 4, is that even though there are peaks that must be carefully managed, Option 4 builds gradually and extends over about four generations before dropping down to closure and monitoring conditions. This longer duration activity provides a greater window of opportunity for investment in social, human, physical, financial, and environmental capitals. In turn, with involvement in decision-making, there is heightened opportunity for management of socio-economic and cultural effects to be driven by community values and concerns.

Building a strategy to achieve this result in collaboration with any host community is an important task ahead for the NWMO. Direct, indirect, and tertiary effects will all have to be carefully considered over the full project life cycle.

Implementation presents the significant opportunity to understand the longer-term vision held by the community so that decisions taken in the implementation process may support and make possible longer-term, sustained benefits for the community. It is the willing host community that must lead the development of a strategy to manage the changes introduced by hosting the facility in a way that will support and sustain the achievement of the community's social, cultural and economic aspirations. While the NWMO has an important role to play in providing the resources and support necessary to address community impacts, it is only the community itself that can appreciate its vision, its values and aspirations for the future, all of which must drive decisions taken in implementation.

The NWMO will consider the range of anticipated costs, harms, risks, and benefits of the siting decision. We must consider not only financial costs, but also physical, biological, social, cultural, and ethical costs (harm to our values). Implementation provides an opportunity to avoid and mitigate negative socio-economic impacts. The implementation process must recognize the contributions and costs borne by the community through appropriately designed measures, developed with the community.

Ultimately, quality of life, as perceived by the residents, will be a measure of whether or not we have recognized and appropriately addressed the effects of this project on their community, and made possible sustained long-term enhancements. If implemented well, we will have designed and implemented our activities to foster positive change over the long term.

In particular, mechanisms will have be to considered that deal directly with the transition from high to low levels of activity. One possibility is to create a mechanism to ensure that resources for the use of the community are set aside during the high level of activities for drawing on during the low. This kind of thinking was behind development of such funds as the Alberta Heritage Fund, the Alaska Permanent Fund, and the Norwegian Petroleum Fund, amongst others. These kinds of financial mechanisms need to be reviewed to ascertain strengths and weaknesses and whether or not some form of such an approach might be useful in this case.

In sum, the various elements touched on above need to be brought together in a community-oriented strategy for sustainability that provides a blueprint for addressing socio-

economic and cultural effects throughout the project life cycle. In building such a blueprint, suggestions may arise for modification to the level or duration of some of the technical aspects of the project to align the overall result with community priorities.

14.4 / Actions to Address Socio-Economic and Cultural Effects

We will work collaboratively to develop a siting process and engagement program with people and communities from areas potentially affected, including Aboriginal peoples. It is through a collaborative process that we would seek to identify any potentialy disruptive impacts of the long-term management approach on communities, and together develop appropriate contingency plans and effects management measures.

In the discussion below, we describe some traditional and some more innovative approaches to socio-economic and cultural effects management. We then discuss actions and measures to address potential socio-economic and cultural effects that may arise during different times of implementation of a long-term management approach for Canada's used nuclear fuel.

Traditional Approaches to Socio-Economic and Cultural Effects Management

The initiatives below are illustrative of the types of activities that have traditionally been considered and/or utilized in other exercises, and might be considered as the NWMO and communities address potential impacts. These illustrative measures are summarized in Table 14-3, and discussed more broadly in the background papers available at www.nwmo.ca/assessments.

Establishing and Maintaining Trust

It is important that implementation plans are responsive to the types of measures required for the affected community/ies to develop and maintain trust in the overall decision-making process. In this regard, it is important that NWMO seek to develop the capacity of the community, so that it is empowered and equipped to participate in the decision-making process, allowing community members to have influence over conditions that matter to people affected by the implementation and operation of the facility.

There may be a role for community agreements that can assist in establishing cooperative and positive working relationships between the NWMO and the community. Specific procedures for dispute resolution might be established to support decision-making processes during implementation.

Provision for active community involvement in project oversight and in the monitoring of socio-economic and environmental effects may be an important component of implementation. Opportunities for community oversight will be key to developing and maintaining trust during project implementation and operation. Community oversight measures are aimed at increasing community access to information, and providing more direct involvement in facility siting and routing, decision-making, design, and operations above and beyond regulatory controls. Developing and maintaining local advisory capacity will be important. Monitoring of socio-economic and environmental effects will play an important role in providing important information to enhance project implementation at the broadest level, but also in enabling the community to actively monitor, provide input and contribute to decision-making processes affecting their socio-economic status.

Decisions will involve many participants including citizens, and particularly Aboriginal peoples, from the affected communities. By developing important baseline understandings, and monitoring changes over time, the community will remain positioned to assume active roles throughout implementation. Through monitoring, the community may assist in identifying unintended effects and the appropriate contingency measures that may be required to mitigate adverse impact.

Table 14-3 Illustrative Measures for Addressing Socio-Economic and Cultural Effects

Establishing and Maintaining Trust	• Community Agreements • Alternative Dispute Resolution • Socio-Economic and Environmental Effects Monitoring • Community Oversight • Involvement of the Public and Aboriginal Peoples
Managing Community Change	• Impact Assistance Grants • Community Capacity Building • Property Value Protection • Community Infrastructure Development • Direct Financial Compensation and In-kind Replacement • Closure Planning
Enhancing Benefits	• Preferential Hiring • Employment and Training Support • Economic Development and Business Enhancement • Occupational Training • Employment Support Services • Off-Site Fabrication of Components • Co-Use and Acquired Property Management • Corporate Donations
Avoiding and Minimizing Adverse Effects	• Optimizing Facility Design • Commuting Programs for Workers • Provision of Temporary Accommodation • Managing Nuisance Effects • Improved Roadways and Access Routes

Source: www.nwmo.ca/assessments

Managing Community Change

A number of opportunities exist in the implementation process to assist affected communities in managing the change brought about by the project. Measures can be used to enhance community competence and adaptability to the changes brought about. A competent community may harness and enhance its resources, particularly those indigenous to the community. A competent community is skilled in problem solving and provides resources that aid the well-being of community members. Characteristics of a competent community include collaboration for integration of services and decision-making, which is facilitated by knowledge of other agencies and services, and participation by citizens in the functioning of organizations.

Community infrastructure development may be required in cases where there are insufficient levels of service to support the facility's construction and operation. Early community involvement in implementation and impact assistance grants can assist in minimizing adverse impacts on residents in terms of pressures placed on their community infrastructure as a result of the long-term waste management facility. Opportunities exist to help offset demonstrated or expected burdens imposed by the facility on the host community through compensation agreements, and through initiatives designed to protect property values. The provision of planning and technical assistance may build the capacity of a community to participate in implementation decision-making and ongoing monitoring of effects, so that the community may retain control over its future growth and development. The development of facility closure plans would also be important in minimizing the social and economic disruption for employees and the community as activity declines.

Enhancing Benefits

Community well-being can be supported by measures that seek to enhance the benefits available to the community as a result of the project implementation and operation. This can be achieved by measures designed to enhance the community's share of benefits from the project. Preferential hiring practices might be considered, to help ensure that local residents have the opportunity to fully participate in the project and share in the economic benefits. Employment, training and support programs may be considered, to enhance opportunities for local residents to participate in the project. A number of opportunities exist to enhance economic development and business activity, to provide local firms preference in the provision of goods and services required by the project, through such measures as preferential hiring; employment and training support; economic development and business activity enhancement; employment support services; and corporate donations.

Avoiding and Minimizing Adverse Effects

Where adverse effects are anticipated, measures can be taken to avoid or minimize the negative socio-economic impacts. Initiatives may seek to ensure the compatibility of the project within its socio-economic setting and manage the influx of population into a community. In general, this can be achieved through the implementation of best practices for facility siting and routing; facility design optimization and continual improvement; measures to facilitate local commuting and long-distance commuting; provision of temporary accommodation; nuisance effects management; access modifications and restrictions.

Exploring Innovative Ways of Addressing Socio-Economic and Cultural Effects

Over the past several decades, a range of innovative administrative arrangements have emerged to address socio-economic and cultural effects and simultaneously, to create a solid means for ensuring that affected interests are included in key project decision-making processes. Many of these innovations also provide surety to parties that responsibilities will be discharged in a way that is satisfactory to all concerned. An important task for the NWMO will be to review the experience of others within Canada and abroad, and to make that information available to interests throughout this process. This then will provide a strong basis for collaboratively designing the kind of administrative arrangements that will work best in the particular circumstances that are faced in this project.

Table 14-4 presents examples of how active community involvement and shared decision-making have been provided in other projects, with the necessary supporting resources and infrastructure.

Table 14-4 Innovations in Addressing Socio-Economic Effects

Innovative arrangements in Canada's North. Over the past several decades, and perhaps sparked by the innovative mid-1970s work of the Berger Commission on the Mackenzie Valley pipeline, Canada's north has seen a range of innovative instruments struck to address Aboriginal and northern concerns related to a range of resource developments. Co-management agreements, socio-economic agreements, impact and benefit agreements are some of the labels that have emerged. Mining, pipeline development, gas and oil developments, hydroelectric power developments have all played a part. Some of these arrangements have worked well, but some have not. In the Yukon, a new *Yukon Environmental and Socio-Economic Assessment Act* is setting a whole new standard for assessment. This body of knowledge needs to be carefully reviewed and the lessons learned brought to bear in a way that works for effective long-term management of used nuclear fuel.

The Stillwater Good Neighbourhood Agreement. In May 2000, a historic agreement was signed between the Stillwater Mining Company (SMC) of Montana and three not-for-profit organizations – the Northern Plains Resource Council (NPRC), Stillwater Protective Association (SPA), and Cottonwood Resource Council (CRC). All three of these organizations play a role in ensuring that quality of life in the region is maintained and improved. The agreement sets out to: (1) minimize the adverse impacts caused by company operations on the local communities, economies, and environment; (2) establish and maintain a mechanism of open lines of communication between the parties to ensure that concerns held by affected residents are addressed; (3) ensure that the community has the opportunity to participate in company decisions that may affect the local communities, economies, or environment (the nature of that participation varies depending on the issue); (4) bind the company and successors, partners, subsidiaries and affiliates for the life of mining operations; and (5) minimize future litigation by utilizing the processes and mechanisms established by the Agreement to resolve disputes.

The Antamina Mine's approach to community development and environmental protection. With an initial capital investment of $2.3 billion, Peru's Antamina Mine, which began production in 2001, is the largest "greenfield" mine development in history. Some 10,000 people were employed during the construction phase and 1,400 people are now permanently employed. Components of their innovative approach to community development and environmental protection include:
(1) an explicit tripartite perspective involving the company, government, and society; (2) a comprehensive safety program based on building a culture of awareness through standards, training, inspections, audits, and continuous learning; (3) the adoption of internationally accepted principles of social responsibility based on (i) the need to obtain a "social licence" (defined as the consent or acceptance by the principal affected interests) to be able to operate in harmony with the local communities in the project's area of influence; (ii) triple bottom line reporting that includes economic and financial balance, environmental, safety, and health balance, and a social responsibility balance; and (iii) an extensive program of public engagement based on consultation and dialogue; (4) the use of collaborative community-company committees to address a range of environmental concerns and to serve in a monitoring and dispute resolution function; (5) participation by the company in a number or regional environmental working groups involving other companies, non-governmental organizations and local government; and (6) a number of special programs related to agriculture, education, and health.

Measures to Address Potential Socio-Economic and Cultural Effects by Project Activity

In addition to positive economic benefits resulting under any one of the four management approaches, there are a variety of social and economic costs that are attendant with projects of this magnitude. Further to the earlier discussion of potential socio-economic and cultural effects, and with consideration of the traditional and innovative approaches to effects management, Table 14-5 outlines some common socio-economic and cultural effects that may arise during different times of implementation for the four management approaches, and a discussion of possible means and measures to address them. They are offered as examples of changes that may occur, not predictions of what is likely to occur.

It is important to note that while current used fuel owners (Ontario Power Generation, Hydro-Quebec, NB Power Nuclear and AECL) will continue to have the legal ownership and management responsibility of the used fuel while it remains in interim storage at nuclear reactor sites, it is essential that there be close collaboration between the nuclear corporations, the NWMO and the current host communities so that implementation decisions taken with respect to the long-term management approach seek to avoid or minimize disruptive impacts on the current host communities.

It is through a collaborative process that we would seek to identify any potentially disruptive effects of the long-term management approach on reactor site communities, and together develop appropriate contingency plans and effects management measures. Formal mechanisms of public engagement and dialogue must continue. The NWMO must ensure that resources are provided for capacity-building within reactor site communities, to enable the current host communities to be active participants in decisions taken in moving the used fuel to the new facility. Current reactor site communities will continue to be important participants throughout implementation and until all used nuclear fuel is removed from those sites. In the event that a reactor site community were to be selected as the willing host for the new centralized long-term management approach based on any of the four options, it must be treated as a "new host community", afforded full consideration of costs, benefits and risks associated with its long-term contributions in hosting the management facility throughout all phases of implementation.

Table 14-5 Measures to Address Potential Socio-Economic Effects by Project Activity

Project Activity with order-of-magnitude estimates of time duration and employees on site	Potential Socio-Economic Effects and Measures Required
Transition to Decision	This period exists between the filing of the NWMO Study Report (November 2005) and the taking of a decision by the government. • Community debate may arise about the implications of the chosen management strategy and/or the acceptability of hosting a facility over the long term. This debate can be potentially divisive within a community, or serve to bring a community together in a strengthening way. • Effectively designed processes can lead to enhanced confidence building and capacity to participate through, for example, (1) continued development of community familiarity with issues through ongoing dialogue; (2) continued development of language capacity for Aboriginal peoples; (3) development of technical knowledge; (4) for the NWMO, a growth in capacity to include others in the dialogue, in particular Aboriginal peoples and Aboriginal Traditional Knowledge in deliberations. Local Advisory Capacity. Guidance on identifying and managing potential socio-economic effects could be sought from interests that may potentially be affected as well as from experts in the field. This input is essential in providing socio-economic-related insight to us concerning the area hosting the facility, benefiting from Aboriginal Traditional Knowledge, and serving as an ongoing focus of socio-economic and cultural-related work as implementation proceeds. Benefiting from International Experience. Opportunities might be sought to ensure an ongoing flow of information, research, insights and experiences from other countries that are studying and implementing long-term management approaches for used nuclear fuel. The insights available from other jurisdictions will be of interest not only to us, but also to the local area identified to host the Canadian facility. Generic Socio-economic Research. A comprehensive review of potential socio-economic effects and concrete experiences elsewhere, including successful implementation, might be conducted. This type of review might consider mechanisms that have been developed to address long-term community sustainability such as those mentioned in the previous section, as well as those mechanisms intended to ensure effective communication with communities of interest as the project proceeds. A review of the particular socio-economic needs, concerns, and issues (and ways of addressing them) of various special community groups including reactor-site communities and transportation route communities might be undertaken. In addition, consideration of approaches to dispute management might be useful, in light of the overarching importance of seeking fairness and justice in the implementation strategy.

Table 14-5 (cont'd) Measures to Address Potential Socio-Economic Effects by Project Activity

Project Activity with order-of-magnitude estimates of time duration and employees on site	Potential Socio-Economic Effects and Measures Required
Transition to Decision (cont'd)	Aboriginal-Specific Research, Development, and Training. Capacity-building might be advanced through research, development and training to support the active engagement of Aboriginal peoples affected by the implementation of the management approach for used fuel. Implementation might explore the nature of Aboriginal Traditional Knowledge and its applications for both process- and substantive-related issues of concern related to long-term management of used nuclear fuel. Consideration could be given as to how best to build innovative approaches for effective dialogue within the Aboriginal community and between the Aboriginal and non-Aboriginal elements of Canadian society using the long-term management of used nuclear fuel as a focus. There may be interest in reviewing ways of maintaining desirable aspects of a traditional life style and traditional economy while also participating in a wage economy.
Siting Process	In generic terms, this activity will begin in the "Transition to Decision" phase above. However, with the government decision, activity will begin to gather momentum and, over time, will become increasingly specific in terms of geographic location. • There may be community debate or other potential effects about the acceptability of entering into a feasibility study or site selection process. Depending on the nature of this discussion, the outcome can range from a strengthening of community cohesiveness to a significant rupture of cohesion. • Effectively designed processes can lead to enhanced confidence building and capacity to participate through (1) continued development of community familiarity with issues through ongoing dialogue; (2) continued development of language capacity for Aboriginal peoples; (3) development of social, cultural, economic, environmental, and technical knowledge; (4) for the NWMO, a growth in capacity to include others in the dialogue, in particular Aboriginal peoples and Aboriginal Traditional Knowledge in deliberations. • Community Resources for Capacity-Building: The NWMO has a responsibility to work with the various communities to negotiate effective ways and means for communities to assume and discharge any responsibilities that arise related to the long-term management of used nuclear fuel. Any implementation plan would be developed collaboratively with communities.
Site Characterization and Design; Environmental Assessment Process **Total time approximately 10 to 20 years**	From this point onwards, a specific site has been chosen while the final transportation corridors may still be under discussion. • Once the site(s) has been chosen, a significant responsibility would accrue to the host community in terms of its capacity to engage as a host. • Enhanced confidence building and capacity to participate could be provided through (1) continued development of community familiarity with issues through ongoing dialogue; (2) continued development of language capacity for Aboriginal peoples; (3) development of social, cultural, economic, environmental, and technical knowledge; (4) for the NWMO, a growth in capacity to include others in the dialogue, in particular Aboriginal peoples and Aboriginal Traditional Knowledge in deliberations.

Table 14-5 (cont'd) Measures to Address Potential Socio-Economic Effects by Project Activity

Project Activity with order-of-magnitude estimates of time duration and employees on site	Potential Socio-Economic Effects and Measures Required
Site Characterization and Design; Environmental Assessment Process (cont'd) **Estimated workers on site variable. Generally, about 25, could peak for short duration several times that amount**	• Communities may require assistance in coping with the economic and social change introduced by the project. Assistance would be essential to enable communities to effectively participate in the planning process and realize employment and income opportunities. • The long process of designing, building and operating a used nuclear fuel management facility can serve as a bridge to the kind of future that is sought by a community, but only if the community is resourced and equipped to assume a lead role in the collaborative assessment of impacts and the collective decision-making required, while supported by the NWMO. Communities affected by any future facility must have opportunities for genuine involvement, which enables them to become active players and problem solvers. Their participation must be based on an understanding of potential risks and the means to manage them. • The community must define the processes and resources required to support its informed and engaged consideration of implementation issues. The community must assume a leadership role in providing the opportunities for citizens to receive information, share knowledge, ask questions and discuss the issue. We expect that the community will have many demands relating to: opportunities to shape the nature of issues investigated at the site; active roles for the community in monitoring the site investigation; transparency in the sharing of findings of research and site assessments; opportunities for critical independent reviews; and input into decisions taken. The NWMO must ensure that communities are informed and sufficiently resourced to be equipped to participate in discussions and decision-making, as well as the monitoring and reporting of community conditions, including any changes that result from our activities.
Construction **Total time: up to several decades** **Estimated workers on site will range from about 600 to 800 for Option 1: Deep Geological Disposal and Option 4: Adaptive Phased Management** **Fewer workers will be required for Option 2: Storage at Nuclear Reactor Sites and Option 3: Centralized Storage** **Numbers may peak at higher levels for durations of a few years**	All four management approaches would provide economic benefits in terms of the creation of new jobs, new income and new tax revenue to governments. Well executed implementation would enable these benefits to be aligned with the realization of social, cultural and economic aspirations and support the long-term stability of the affected communities. • Implementation plans designed with the host community could seek to enhance the benefits to be captured from project construction and operation. • Such discussions might address hiring practices, to ensure some employment opportunities for local residents; employment and training support, allowing local residents, including Aboriginal peoples, to develop the necessary skill bases. • Local businesses might be assisted to recognize and capture new economic development opportunities, in ways that might be sustained following the completion of the capital-intensive phases of the project.

Table 14-5 (cont'd) Measures to Address Potential Socio-Economic Effects by Project Activity

Project Activity with order-of-magnitude estimates of time duration and employees on site	Potential Socio-Economic Effects and Measures Required
Construction (cont'd)	All four management approaches would generate some negative consequences, which could range from worker population growth and decline, community disruption or nuisance effects. The construction phase will be marked by a significant influx of workers and a heightened level of activity. As a result, significant socio-economic effects can occur and their careful management is crucial. For Option 1(Deep Geological Disposal) and Option 4 (Adaptive Phased Management), there will be fluctuations in activity levels above a relatively high base level. Particular attention will have to be paid to these peaks. Each of the following examples can lead to a significant contribution in the evolution of the community, or difficulties, depending upon how they are managed. • The influx of non-local workers may disrupt community cultural, social, and health conditions; Aboriginal communities may be particularly at risk. There may be a requirement for additional social services during and after peak project development, to help address stress on families and local businesses as they cope with possible job and economic declines. Other social stresses on families may arise, such as increased crime. • The influx of higher wage-earning workers into the community may affect local wage profile. • The demand for skilled trades or wage levels may result in movement of local workers from one industry to another. • The flow of dollars into the local economy may cause a rise in the level of economic activity during the construction period followed by a difficult drop if not carefully planned and orchestrated. • Infrastructure development can lead to improvements of local infrastructure: transportation, communication, education, health, recreation; however, demand for such infrastructure may push local community to build facilities which may be difficult to support in the absence of the construction activity that led to their creation in the first place. • An increase in demand for supplies and services may over-tax community infrastructure if not properly prepared for: water, sewer, waste disposal, utilities, emergency response, community and regional administrative services, recreation facilities, etc. All management approaches have the potential for significant increased demand for infrastructure services, such as roads, recreation facilities, water and sewage management, schools, social services and healthcare, to accommodate the large influx of workers during periods of construction and fuel placement. Following the project completion, out-migration from the community may place stress on local businesses and the community may experience a loss in tax base which makes it difficult to sustain the expanded infrastructure. • Vehicular traffic may be problematic for community if not carefully managed: noise, dust, traffic and visual impacts. • There may be an escalation in property values as economic activity and employment builds up to service the construction and operation phases of implementation. Housing and land values may then decline significantly upon the project completion.

Table 14-5 (cont'd) Measures to Address Potential Socio-Economic Effects by Project Activity

Project Activity with order-of-magnitude estimates of time duration and employees on site	Potential Socio-Economic Effects and Measures Required
Construction (cont'd)	• There may be changes in community character, such as the loss of a rural town atmosphere, and changes in rural/remote wilderness. There are a number of actions that can be taken to avoid or minimize negative effects on the community, to lead to better community relationships and a higher level of acceptance of the project in the community. A number of short-term initiatives are available to support the large influx of workers and vehicles required, such as measures to facilitate commuting, provision of temporary accommodation, actions to limit residents' exposure to nuisance effects, and development of access routes to limit traffic disturbances. For example: • There may be a need for property value protection measures. • With any management approach, there must be a plan developed that identifies the potential socio-economic consequences of eventual decommissioning and closure of the facility, and the ways and means for addressing any associated negative effects. These and other social issues would need to be addressed early on in the project planning stage. Communities must be well equipped to cope and adapt to the social and economic changes that are associated with such large projects. It is necessary to plan early as to how the host community can participate in the positive impacts made possible by the project, as well as how they will manage the inevitable economic swings caused by the project cycles. There are many measures that might be developed collaboratively with the host community, to recognize the community contributions and help to offset any negative circumstances precipitated by the development and operation of the facilities. Examples of measures that might be collaboratively developed, to provide for meaningful input of the public and Aboriginal peoples include: • community agreements; • formal roles for the community in oversight of the project; • active roles for the public in the monitoring of environmental and socio-economic effects; and • active community roles in the information exchange, discussions and decision-making around siting and transportation issues. The application of such measures will be very specific to individual communities. The NWMO will need to build, with the community, comprehensive public engagement processes that are responsible, responsive and effective means for providing community input. To be effective, and to establish and maintain trust of the local citizens, measures must be developed in close consultation with the community early in the project.

Table 14-5 (cont'd) Measures to Address Potential Socio-Economic Effects by Project Activity

Project Activity with order-of-magnitude estimates of time duration and employees on site	Potential Socio-Economic Effects and Measures Required
Operation: fuel transportation and emplacement, ongoing research and development **Total time: about 30 years** **Estimated workers on site: about a hundred**	In theory, during this phase, socio-economic effects should stabilize for approximately 30 years. Operations-related activities can introduce changes to the socio-economic characteristics of an area such as: • Workforce/labour changes, as construction-related workforce and labour are replaced with stable operating workforce for fuel placement activities. • Changes to local/regional spending for payroll, materials, services. • Infrastructure maintenance, including access routes maintenance. • Off-site service requirements, including water, sewer, waste disposal, utilities, emergency response, administrative, etc. • Physical attributes (noise, dust, traffic, visual effects, etc.) With its stability, there is significant opportunity in this phase to contribute to the evolution of community culture in a way that is consistent with community values and priorities.
Operation: post fuel placement **Duration of this phase is indefinite** **Estimated workers on site about 30 for security, monitoring and reporting**	The high level of activities has gone to be replaced by low level of continuous monitoring, regardless of the management option chosen. • Socio-economic and cultural effects will be at a consistent, but low, level.
Closure and Postclosure with Monitoring **Duration of this phase is indefinite** **During closure, the number of people on site would rise to about several dozen. Later, a few workers would be required for monitoring as long as it was maintained.**	For Centralized Extended Storage (Option 3) and Storage at Nuclear Reactor Sites (Option 2), this phase will never arise. For Deep Geological Disposal (Option 1) and for Adaptive Phased Management (Option 4), if and when a decision is made to permanently close the facility, a relatively short period of construction would bring workers onto the site, followed by a low level of activity for as long as monitoring is maintained. • A short initial period of decommissioning activity will be followed by reduced activity levels.

The NWMO has an ongoing legislative obligation under the *Nuclear Fuel Waste Act* to analyze any significant socio-economic effects of activities on a community's way of life or its social, cultural or economic aspirations. The discussion in this chapter has considered the range of possible impacts that may arise, and has offered some illustrative examples of how those effects might be managed. A more definitive and detailed discussion of these issues will be possible following: the decision by the government on a management approach; the selection of a central site for implementation; and articulation of a transportation plan. The NWMO will work with potentially affected communities to discuss how potential impacts and risks might be assessed, tracked, and addressed through measures designed collaboratively by the NWMO and the affected communities.

For any management approach selected, the decision-making and implementation processes will involve at least many decades. As we proceed, it will be important that a management approach be implemented in a way that continues to be responsive to the values and objectives of citizens affected by the implementation and operation of the facility. The unprecedented nature of the time horizon brings with it a need for continuous learning, and a commitment of the NWMO working with communities to define and periodically assess indicators of progress as a means of adapting to evolving conditions. During this period, there will be an opportunity to adjust the pathway as may be appropriate with the benefit of new information, continuous learning, monitoring of research and technological developments and discussion of timelines most appropriate for communities affected by the transition to long-term management.

Chapter 15 / Research and Intellectual Capacity

Although the *NFWA* does not require that the NWMO include research as part of the implementation plans, we address the issue in light of the significance that research and intellectual capacity have for the continuous learning and adaptability that are integral to implementation plans.

15.1 / The Important Role of Research

Regardless of the approach taken, activities to manage used nuclear reactor fuel would continue for a very long time. Any management program would be expected to apply the best practices available at that time. There is confidence in present best practices for safely handling used nuclear fuel and that such fuel can be properly managed into the future. However, a program that would evolve over a long period of time would have many opportunities for improvements to increase performance, enhance effectiveness, improve understanding, and address arising societal concerns. To realize these benefits, there needs to be a vibrant and robust research and development effort during management program development and execution, a period that would last many generations.

While the role for research and issues of intellectual capacity were not explicitly required as part of our study under the *NFWA*, we believe that there are many important reasons to pursue such a research and development program. Consequently, NWMO is responsible for ensuring that the research program is funded. The program's scope and content would be guided by:

The intrinsic need to embody the principles of continuous learning – The program for the management of used nuclear fuel would evolve over generations. Continuous learning would not just allow, but demand research and development to help assure focus on areas that warrant attention. Continuous learning also sets a standard for everyone associated with the program that excellence and integrity are the expected hallmarks. Program requirements are set not at minimally acceptable performance and regulatory compliance, but at meeting societal expectations to continually improve upon best practices and adapt to unfolding advances in related fields as the program progresses.

Increased understanding and capabilities that would surely come from research and development can measurably improve performance, reduce uncertainties and address residual concerns. Over time, it is easy to imagine, for example, major advances in geological understanding and predictions, together with improved man-made materials, engineered barrier system designs to isolate the waste, facility and transportation designs, and instrumentation to measure and confirm performance. Similarly, Canadian values and priorities may change, and the ability to adapt to changes would be necessary to maintain citizen confidence.

Preparation for facility siting, design, licensing, development, and operations – The long term management program would evolve through a number of important stages: developing a concept, identifying candidate sites, building relationships with affected communities and organizations, evaluating candidates for adequacy, finalizing designs, obtaining necessary licenses, building the necessary facilities and infrastructure, operating the system, eventually preparing for closure or steady state maintenance, and confirming post operational performance. These stages would occur over many decades. There would be many opportunities to improve system design, minimize costs, enhance schedules, reduce uncertainties, and assure regulatory and societal requirements.

Assurance of adequate human capacity to manage the program throughout its existence – The extended time-frame of any management program would present the challenge of sustaining an expert workforce to manage and operate the program. A healthy, properly sized, and focused research and development program would assure the continual refreshment of the qualified, trained staff required for effective program management. Exciting and cutting edge work attracts the best while assuring integration of program operations with advances in scientific and technological capabilities.

Enhanced scientific understanding to improve confidence in predictions, reduce uncertainties, and to evaluate potential program improvements – It is to be expected that research and development conducted over the course of the management program could be applied to markedly improve understanding and narrow the remaining uncertainties about anticipated performance over long periods of time. Program managers would be able to use this improved understanding to modify program elements where warranted, to improve expected performance and reduce unnecessary program schedule delays and costs. Of course, it is always possible that improved understanding may open up new questions about system performance, which would call for new avenues of research and development to address the new information.

The ability to confirm performance during and after program operations – Thorough confirmation of performance during development and initial operations and after the operational stage is complete are important steps. These confirmations serve to increase confidence in performance, meet regulatory compliance standards, identify any anomalies, and provide further assurance to the public and stakeholders that the implementers and regulators take their long term stewardship responsibilities seriously. Research and development programs would enhance capabilities to confirm performance through continual improvements, for example, in instrumentation, data acquisition techniques and methods, analytical and

modeling capabilities, and computer simulations. Such improvements would be particularly valuable in a staged program.

The obligation to citizens to clearly demonstrate an ongoing capability to manage the enterprise and to respond to their concerns and desires – The management program for spent nuclear fuel is challenging both because of its long duration and because of the intense and widely varying views of the public and effected stakeholders. Citizens and their representatives want to be confident that responsible organizations would maintain the necessary capabilities to oversee and manage program development and implementation. A vibrant and well directed research and development program would help assure the staffing of a cadre of trained and experienced personnel focused on solving anticipated and emerging issues associated with the program throughout its duration.

The ability to enact mid-course corrections in response to new information or societal decisions – Because the management program would last for generations, it is possible, if not probable, that new scientific and technical information and capabilities, and perhaps changes in societal perspectives and desires, would lead to proposals for beneficial changes in program plans and implementation. In this regard, the research and development program would serve two important purposes. It would create the new information and capabilities that could serve as the rationale for subsequent decision making. It would also maintain the expertise and resource base to implement desirable changes.

There are many areas where new information and capabilities may lead to improvements in program implementation or modification of program goals. Some include the continuing development of advanced nuclear power plants, new fuel cycle processes and facilities; potential international or regional institutional changes to allow for multinational ownership or control of sensitive facilities; changes in international policies and treaties; and new developments in partitioning and transmutation of used nuclear fuel and in deep borehole management techniques.

The ability to adapt new capabilities developed external to the program that show the promise of improving program success – Over time, there would be marked changes in many areas of scientific, technical, and social science germane to the management program. One would expect significant advances in geosciences and biosciences and the development of new materials, improvements in computer codes and the modeling of natural and engineered systems, better instrumentation capabilities, new social science insights, and much more. Many of these advances would occur largely outside the program itself, but offer major potential benefits if adapted into the program. The research and development program would allow for identification and adaptation of such advances into the program as warranted.

The ethical obligation to undertake research on social impacts – The extended time-frame of any management program means that the period of potential social impacts itself is very long, longer than virtually any other program undertaken. For this reason, there is an ethical obligation to monitor impacts. It is important to have ongoing research on the ethical adequacy and social impact of the facility in order to be able to fully identify these impacts and appropriate responses.

15.2 / Research Requirements Common to all Management Approaches

Social and Technical Research Requirements

In the sections that follow, we provide examples of some of the areas of research that would be appropriate under any of the four management approaches.

As part of the implementation process, we would identify specific areas requiring study through ongoing engagement. Beyond the required technical expertise, additional research and development should be conducted on a range of non-technical issues of importance, including socio-economics, stakeholder involvement, and public attitudes. It would be important to involve external parties in identifying research of relevance and interest. Research funding should most often be competitively determined and the work carefully peer reviewed. Some topics that may require research include:

- Applying Aboriginal Traditional Knowledge – applies to both process issues (starting immediately) and substantive issues (when the site or sites are identified for more detailed assessment);
- Dispute management over the long term;
- Adaptive management as it relates to ongoing social and technical decision-making;
- How to monitor and assess community well-being;
- How to work with a community to ensure that cultural integrity is maintained in a way that works for the community;
- How to smooth out the economic boom and bust cycle in the adjacent region/community; what mechanisms can be created to address this in concrete terms; and
- Canada produces power using CANDU reactors which use different fuels than the more predominant Light Water Reactors used elsewhere in the world. Since the wastes residing within the used fuel represent the "source term" of radioactivity, it is important to have an indigenous program to identify issues of particular importance to Canada and assure that these are carefully addressed.

The scope of our program should be determined in conjunction with early bilateral and international program contacts to build upon the existing data and capabilities in other countries and international organizations. Formal working relations should be established as appropriate with waste management programs in other countries on problems of mutual interest. International collaboration has been a hallmark of radioactive waste management programs. Much of the work can be done collaboratively and information sharing and personnel exchanges can benefit all parties.

International exchanges of research findings make it possible for countries to allocate resources efficiently, sharing information on a wide range of technical considerations.

Human Resource Capacity

To ensure the safe management of used nuclear fuel, we must have access to a sufficient and sustainable number of trained and skilled personnel throughout the development and implementation of a radioactive waste management approach.

It can take a generation to build up appropriate expertise related to long-term used fuel management, but it can be lost very quickly. It would be important for us to canvass Canadian experience and capabilities and initiate a program to preserve knowledge already gained, and to organize a program with existing expertise, focused on issues of particular relevance to the programmatic choice coming out of the NWMO's November 2005 recommendations and subsequent government decisions.

The program should encourage the broad involvement of the Canadian academic community, with an emphasis on involving the next generation of leaders in research

and development, graduate students, doctoral graduates, and young faculty.

We will require expertise and capabilities in a range of fields, including, but not limited to: socio-economics; ethics, finance, public engagement, Aboriginal Traditional Knowledge, siting and waste management technology. We must ensure that there is an adequate number of qualified personnel with ethical and socio-economic expertise to evaluate and conduct socio-economic impact assessments, manage community agreement negotiations and identify key ethical issues that may impact future generations. There must also be specialists qualified to manage the financial aspects associated with such a project. Furthermore, we would require trained personnel to develop and implement a comprehensive public engagement plan particularly during the initial siting phase, post government decision on the selected way forward for Canada. These specialists would also be required to ensure that the public's concerns are taken into account throughout the implementation process.

Depending on the management approach selected, many scientific disciplines would be required for implementation, among them earth sciences such as geology, hydrology, geochemistry, seismology, geomechanics and biosciences, as well as climatology, materials development and performance, and corrosion. Implementation may require program capabilities that merge earth sciences with engineering. A combination of experiments, analysis, modeling, simulation and computation are required for system design and even more so for performance assessments that would be the basis of licensing. Careful and sustained programs would have to be nurtured to develop this interdisciplinary need.

Areas of required technical capabilities and expertise include, but are not limited to: project management; risk, cost and benefit analysis; logistical studies; technology evaluations; institutional requirement analysis; code verification and validation; information research; quality assurance; environmental impact assessment; ecological sciences; and transportation equipment design, safety analysis and engineering design.

Expertise unique to used nuclear fuel management include: fuel waste characterization; waste-form behaviour; radiation shielding; radiological safety assessment; occupational radiation exposure management; material sciences and waste package design; and decontamination methods development and management. Many of these disciplines are specialized, so these skills may not be transferred over from other industries.

It is anticipated that the NWMO would not need to have this range of expertise fully covered with its in-house staff complement. Opportunities exist to contract for external support in many of these areas.

Monitoring of Research Internationally

Chapter 6 addressed the significant expenditures which have been made in Canada studying the long-term management of used nuclear fuel. In addition to commissioning its own research, the NWMO would benefit from monitoring findings of research activities under way in Canada and in other countries.

Over 30 countries have radioactive waste management programs and several (United States, Finland and Sweden) are close to implementing repositories for used nuclear fuel or high level radioactive waste (HLW). The level of funding for research and development activities varies from country to country. The Swedish (SKB) annual used fuel research and development budget is approximately $10 million while the United States (DOE) annual budget at Yucca Mountain is over $500 million ($US).

There are large international research programs such as the European Commission Sixth Framework Programme 2002 – 2006, with a radioactive waste management budget of 90 million Euros over the five-year period. Research areas under this program cover improvements of fundamental knowledge, development and testing of geological repository technologies, study of natural analogues and new and improved tools to model the performance and safety of geological repositories. There is also further work addressing partitioning and transmutation technology as well as concepts to produce less waste. France is particularly active in advancing the research and development program for partitioning and

transmutation of used nuclear fuel wastes.

International research activities also include initiatives such as the Nuclear Energy Agency's Forum for Stakeholder Confidence, which enables a sharing of international experiences in planning and implementing engagement programs for long-term management approaches. The CARL project, an international social science research project, is investigating the effects of stakeholder involvement on decision-making in radioactive waste management.

The NWMO should keep a "watching brief" on a number of approaches and technical (and non-technical) developments in Canada and in other countries which, if successful, might lead to eventual improvement or modification of the Canadian program.

These may include, but are not limited to:

- Other waste management technologies such as reprocessing, partitioning and transmutation;
- Deep borehole disposal;
- International/regional initiatives regarding the fuel cycle, including used fuel storage and further disposition;
- Reprocessing and associated waste management;
- Engineered materials and barrier development;
- New instrumentation, particularly for performance confirmation;
- Modeling, simulation, and analytical techniques to evaluate long-term performance;
- Developments regarding evolving models for citizen engagement in decision-making; and
- Developments regarding social impact assessments.

15.3 / Research Specific to Individual Management Approaches

Canadians have said that regardless of the management approach eventually chosen by the federal government, there must be adequate resources dedicated to an ongoing research program associated with the long-term management of Canada's nuclear fuel waste. These resources should be allocated to keep Canadians abreast of new developments in radioactive waste management, both within Canada and internationally, to ensure that new knowledge and new developments can be incorporated into the solution for Canada's used nuclear fuel.

In the sections that follow, we provide examples of some areas of research that would be appropriate under different management approaches.

Option 1: Deep Geological Disposal in the Canadian Shield

Deep Geological Disposal involves transportation of the used fuel from each of the nuclear facilities currently in Manitoba, Ontario, Québec and New Brunswick to a central deep geological repository for permanent isolation of used nuclear fuel in Canada. Following a federal government decision to proceed with Deep Geological Disposal, it is expected that it would take about 30 years to site a geological repository and obtain an operating licence. This initial 30-year period would involve key decisions including selection of used fuel container and sealing system design, selection of host rock formation and selection of the preferred site for a geological repository and the transportation system to the central facility.

Research and development activities for Option 1 would be required to identify, characterize, engineer, analyze, study, demonstrate and select the appropriate repository technology and final site during the siting and design and construction phase. This research and development would include development of site screening criteria and the site selection process, technical and social site characterization, biosphere and geosphere evaluation, computer model development, repository engineering and safety assessment activities to support feasi-

bility studies in potential host communities, and the selection of a final engineering design and preferred site to support the safety and environmental impact assessment documents and related licensing activities. It would include further study, modelling and analyses of the potential impacts of climate change (e.g., global warming and glaciation) and other natural events such as earthquakes, which have already been factored into the design of the deep repository and surface facilities. It would also include development of used fuel monitoring activities at repository depth, demonstration of used fuel container placement and retrieval technology at underground research facilities, vault sealing system development, security development work and further development of transportation technology, logistics and implementation schedule.

The research and development program follows the step-wise implementation of the deep repository concept with specific information designed to support the decision-making process. Examples of key decisions during the staged approach to implementation of Option 1 which would be supported by the research and development program include:

- Selection of design alternative (e.g., in-floor, in-room or long horizontal borehole placement of used fuel containers);
- Identification of the site selection process and site screening criteria;
- Selection of candidate sites for the repository from preliminary feasibility studies;
- Selection of the preferred host rock and depth for a repository;
- Selection of the preferred site for the repository;
- Decision to proceed with development of the underground characterization facility at the preferred site;
- Selection of the optimal transportation technology, route and logistics (timing);
- Identification of the repository monitoring system during used fuel container placement operations;
- Identification of the repository monitoring system after used fuel container placement operations;
- Identification of design improvements for the approach during implementation and re-licensing of the facility;
- Review of design from a safeguards perspective;
- Identification of the time period for extended monitoring of the repository (after container placement operations are complete); and
- Decision to decommission and close the facility.

The social and technical research and development program during the Siting and Design and Construction phase for Deep Geological Disposal would be between $10 million and $20 million per year. It is expected that the Canadian research and development program would continue its international collaboration and joint research and development program activities with other waste management organizations such as Posiva, SKB, and Nagra and seek opportunities to collaborate with other waste management organizations, as appropriate.

Option 2: Storage at Nuclear Reactor Sites

Storage at Nuclear Reactor Sites involves perpetual storage of used nuclear fuel at each of the nuclear facilities currently in Manitoba, Ontario, Québec and New Brunswick. Following a federal government decision to proceed with Storage at Nuclear Reactor Sites, it is expected that it would take three years to review the storage design alternatives and up to an additional seven years to obtain operating licences for the facilities, depending on the choice of storage technologies. This initial 10-year period is crucial for the identification, analysis and selection of the preferred storage

alternative at each reactor site in Canada.

During the Siting and Design and Construction phase, research and development would be required to site, characterize, engineer, analyze, study and select the appropriate storage technology for each site. Used fuel storage technology has been developed in several countries and these technologies would be further reviewed to assess their feasibility in Canada. This research and development would support the safety assessment and environmental impact assessment documents and related licensing activities. It would include further study, modelling and analyses of the potential impacts of climate change (e.g., global warming) and other natural events such as earthquakes (which have already been factored into the design of the storage facilities). It would also include development of used fuel monitoring activities, long-term used fuel integrity studies and security development work.

The research and development program follows the step-wise implementation of the Storage at Nuclear Reactor Sites concept with specific information designed to support the decision-making process. Examples of key decisions during the staged approach to implementation of Storage at Nuclear Reactor Sites that would be supported by the research program include:

- Selection of reactor site storage design alternatives (e.g., existing or new technology);
- Identification of the optimum monitoring system period for used fuel examinations;
- Identification of design improvements for reactor site storage during implementation and re-licensing of the facilities; and
- Review of design from a safeguards perspective social and technical.

The research program during the Siting and Design and Construction phase for Storage at Nuclear Reactor Sites would be several million dollars for each site in Canada.

Option 3: Centralized Extended Storage

Centralized Storage, either above or below ground, involves transportation of the used fuel from each of the nuclear facilities currently in Manitoba, Ontario, Québec and New Brunswick to a central facility in Canada for perpetual storage of used nuclear fuel. Following a federal government decision to proceed with Centralized Storage, it is expected that it would take about 15 years to site a central facility and obtain an operating licence. This initial 15-year period would involve key decisions with respect to selection of used fuel storage design, location and transportation system to the central facility.

As with the Storage at Nuclear Reactor Sites, research and development would be required to identify, characterize, engineer, analyze, study and select the appropriate storage technology and final site during the Siting and Design and Construction phase. This research would address the engineering and safety assessment activities conducted to support the feasibility studies in potential host communities, development of site screening criteria and the site selection process, technical and social site characterization, selection of a final design and central site to support the safety and environmental impact assessment documents and related licensing activities. It would include further study, modelling and analyses of the potential impacts of climate change (e.g., global warming) and other natural events such as earthquakes (which have already been factored into the design of the storage facilities). It would also include development of used fuel monitoring activities, long-term used fuel integrity studies, security development work and further development of transportation technology, logistics and implementation schedule.

The research program follows the step-wise implementation of the Centralized Storage concept with specific information designed to support the decision-making process. Examples of key decisions during the staged approach for implementation of Centralized Storage which would be supported by the research program include:

- Selection of centralized storage design alternative (e.g., above or below ground);
- Identification of the site selection process and site screening criteria;
- Selection of candidate sites for centralized storage from preliminary feasibility studies;
- Selection of the preferred host rock, depth (if below ground) and site for centralized storage;
- Selection of the optimal transportation technology, route and logistics (timing);
- Identification of the optimum monitoring system period for used fuel examinations;
- Identification of design improvements for centralized storage during implementation and re-licensing of the facility; and
- Review of design from a safeguards perspective.

The social and technical research and development program during the Siting and Design and Construction phase for centralized storage would be about $5 million per year.

Option 4: Adaptive Phased Management

Option 4: Adaptive Phased Management involves transportation of the used fuel from each of the nuclear facilities currently in Manitoba, Ontario, Québec and New Brunswick to a central facility for an optional interim storage period, followed by used fuel placement in a deep geological repository for long-term isolation. Following a federal government decision to proceed with Adaptive Phased Management, it is expected that it would take about 30 years to site a central facility in suitable geomedia such as the Canadian Shield or in the Ordovician sedimentary rock basins and obtain an operating licence. This initial 30-year period would involve key decisions with respect to selection of used fuel container and sealing system design, selection of host rock formation and selection of the final site for a geological repository and transportation system to the central facility.

The research to date on sedimentary rock provides several independent geoscientific arguments suggesting that Ordovician shales and limestones might provide a highly suitable environment to host a deep geological repository for used nuclear fuel. However, more research and development work on sedimentary rock needs to be completed to determine the suitability of these rock formations.

The siting period would also continue the necessary research and development of the technology for used fuel storage, transportation and isolation. For example, containers and handling systems for extended storage of used nuclear fuel in shallow underground rock caverns may need a design update. Transportation systems for used fuel would need further development, testing and demonstration. And the mode of transportation: road, mostly rail or mostly water, may need further optimization to meet the needs of potential host communities for the central facility.

Research and development activities for a deep geological repository would be required to identify, characterize, engineer, analyze, study, demonstrate and select the appropriate isolation technology and final site during the siting phase. This research and development would address development of site screening criteria and the site selection process, technical and social site characterization, biosphere and geosphere evaluation, computer model development, repository engineering and safety assessment activities conducted to support the feasibility studies in potential host communities, and the selection of a final engineering design and preferred site to support the safety and environmental impact assessment documents and related licensing activities. It would include further study, modelling and analyses of the potential impacts of climate change (e.g., global warming and glaciation) and other natural events such as earthquakes, which have already been factored into the design of the deep repository, the optional shallow underground storage facility and surface facilities. It would also include development of used fuel monitoring activities at repository depth, demonstration of used fuel container placement and retrieval

technology at international underground research laboratories, vault sealing system development, security development work and further development of transportation technology, logistics and implementation schedule.

Initially, the research and development would take place at surface laboratories and at international underground research laboratories at generic sites such as the Äspö Hard Rock Laboratory in Sweden. (Canada currently is participating in international research projects at Äspö). Later, the research and development would take place at the underground characterization facility at the preferred site in Canada.

The research and development program follows the step-wise implementation of the Adaptive Phased Management approach with specific information designed to support the decision-making process. Examples of key technical decisions for long-term isolation of used fuel which would be supported by the research and development program include:

- Identification of potentially suitable rock formations at candidate sites for a deep geological repository (e.g., crystalline rock, sedimentary rock);
- Identification of the site selection process and site screening criteria;
- Selection of candidate sites for a deep geological repository from preliminary feasibility studies;
- Selection of the preferred host rock and depth for the deep geological repository;
- Selection of the preferred site for the underground characterization facility and the deep geological repository;
- Selection of a long-term isolation design alternative (e.g., in-floor, in-room or long horizontal borehole placement of used fuel containers);
- Selection of the optimal transportation technology, route and logistics (timing);
- Identification of the repository monitoring system during used fuel container placement operations;
- Identification of the repository monitoring system after used fuel container placement operations;
- Identification of design improvements for a deep geological repository;
- Review of design from a safeguards perspective;
- Identification of the time period for extended monitoring of the deep geological repository (after container placement operations are complete) and any impacts on the integrity of the used fuel containers within the placement rooms; and
- Support for a decision to decommission and close the facility.

The cost estimates for the social and technical research and development program for Adaptive Phased Management provide between $10 million and $20 million per year during Phase 1 and about $30 million per year at the underground characterization facility during Phase 2. It is expected that the Canadian research and development program would continue its international collaboration and joint research program activities with other waste management organizations such as Posiva, SKB and Nagra and seek opportunities to collaborate with other waste management organizations, as appropriate.

Continuous learning through research and development and monitoring of emerging knowledge will be paramount to informed decision-making in implementing a long-term management approach for used nuclear fuel.

Each phase of implementation will require consideration of choices and decisions, with each step informed by the latest understanding of science, engineering, social sciences and the natural sciences. Research will be important in guiding decisions on technology for used fuel management, the detailed site investigations and in monitoring developments internationally in areas that may have relevance in confirming or proposing adjustments to the implementation path.

The NWMO believes that ongoing research and development should be a component of our annual business plans. Our research and development program should be reflected in the five-year strategic plans that are submitted to the Minister of Natural Resources Canada in the triennial reports. We should report regularly to the public on its key areas of investigation and how findings have impacted on decisions along the way.

The extent to which the NWMO monitors, considers and reflects emerging knowledge into its plans for managing used nuclear fuel would be essential to building confidence of the public.

We could be assisted by independent third party guidance on matters of such public interest, to confirm the areas of proposed research and our application of key research findings drawn nationally and internationally.

Chapter 16 / Description of Activities and Timetables

As required by the *Nuclear Fuel Waste Act* (*NFWA*), a description of activities and possible timetables are presented in this chapter.

It is important to note that the timetables are put forward as possible and typical implementation schedules only. They provide an indication of a representative schedule for implementation of each approach under study. They illustrate the time required to proceed through the various stages of siting, regulatory approvals and construction. Implementation schedules were based in part on siting experiences in other countries such as Finland and Sweden. The timelines form the basis of the cost estimates prepared for each management approach. They have not been optimized nor do they necessarily reflect the most appropriate schedules when technical and social considerations are taken into account. The actual timelines would need to be defined following a decision on a management approach by the federal government.

It is important to note that the regulatory regime would require licences to be obtained throughout various stages in the lifecycle of a waste management facility including site preparation, construction, operation, modification and decommissioning. Safeguarding used nuclear fuel is part of Canada's international obligations to the International Atomic Energy Agency under Canada's Safeguard's Agreement. Technical specifications and procedures for nuclear materials safeguards have been explicitly included in the conceptual designs for the waste management facilities and transportation systems. Safeguard measures include the use of seals, surveillance and nuclear material accountancy throughout all phases of implementation. As well, development of emergency response plans would need to be included and these would have to be submitted and approved. Canadian standards and regulations will continue to evolve taking into account requirements for international safeguards.

16.1 / Option 1: Deep Geological Disposal in the Canadian Shield

This section presents an estimated timetable for the implementation activities anticipated to site, design, construct, operate, monitor, decommission and close a deep geological repository for the placement of used fuel. The schedule and assumptions are based on the conceptual design and cost estimating reports prepared by consultants for the Joint Waste Owners. (See conceptual design reports at www.nwmo.ca/conceptualdesigns).

The deep geological repository program is often divided into two distinct periods: the preclosure period and the postclosure period. The preclosure period, which could last about 150 years, includes all activities from siting through to decommissioning and closure of all facilities related to the repository. After the

Figure 16-1 Overall Work Schedule for Deep Geological Disposal in the Canadian Shield

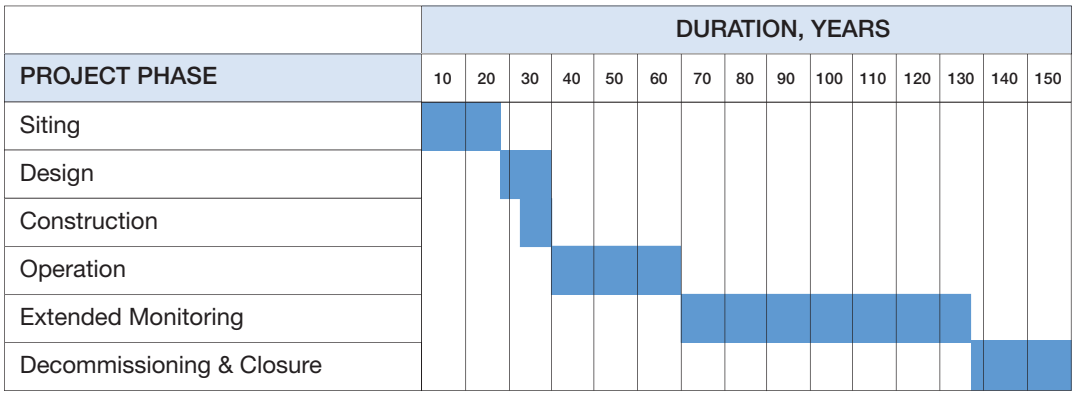
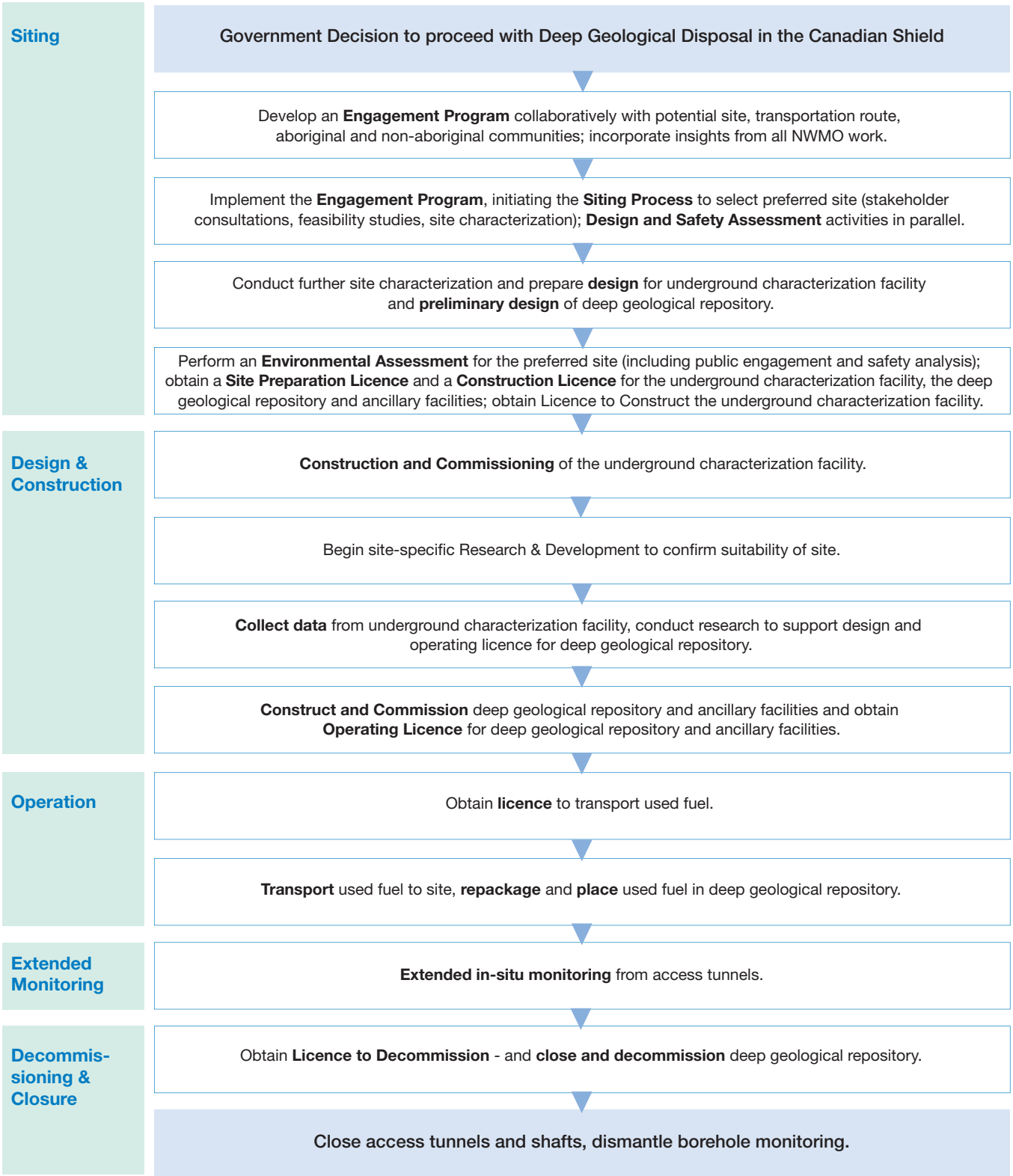


Figure 16-2 Activity Flowchart for Deep Geological Disposal in the Canadian Shield



extended monitoring period, it is assumed that the deep repository would be backfilled, sealed and the site closed, and that regulatory approval would be sought and obtained to "abandon" the site. The overall work schedule and activity flowcharts for Deep Geological Disposal in the Canadian Shield are presented in Figures 16-1 and 16-2, and described in detail below.

Siting Phase

The siting phase covers the time period in which a suitable location for a central deep geological repository in the Canadian Shield is being sought. It begins after a formal decision is made to start the process of finding a suitable site and would end when regulatory approval is received to construct the facility at the preferred site (estimated to be about 15 to 20 years).

During the siting phase, the current owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transported from the reactor sites to the central facility for long-term management.

The siting phase would involve developing a siting process that would include both public consultation and technical assessments on the basis of site characteristics. The acceptability of a site would be determined on the outcome of this siting process. The major components of the siting process would include initial public engagement, discussions and hearings, development and application of site screening criteria, an environmental assessment and the preparation of licence applications. Each of these major components necessarily includes both public involvement/participation and technical assessment and analysis.

The outcome of these public engagement activities would be coupled with the initial site characterization and screening to select a preferred site. Site characterization activities during the siting phase would involve an iterative process of investigation beginning with non-invasive surface-based feasibility studies at perhaps three candidate areas followed by more detailed surface and underground characterization via borehole drilling at select candidate sites and the final preferred site. These activities would provide an understanding of site-specific geosphere and biosphere conditions necessary to assess and communicate possible site suitability to host a deep geological repository.

During the siting phase, a preliminary conceptual deep geological repository design would be prepared for each site being evaluated. Design work would be completed for the surface and underground facilities primarily to establish the access, utility and infrastructure requirements. The design would include technical specifications for safeguarding the nuclear materials at the facility and during transportation. These requirements would be assessed during initial site screening to ensure that they could be met at potentially suitable site locations in the areas selected for detailed evaluation. Details of the environmental and deep geological repository monitoring program and the plan to incorporate this program into subsequent site evaluation activities would be developed. Following the selection of a preferred site, a preliminary deep geological repository design specific for the site would be completed prior to entering into the environmental assessment process and the licensing process.

Once an application for site preparation is made, or intent to apply is given, an environmental assessment would be required. The NWMO would be required to demonstrate, during the environmental assessment process, that there would be no significant adverse impact on the environment resulting from the construction, operation, decommissioning and closure of the deep geological repository (and during the postclosure period). The environmental assessment will require preparation of environmental assessment guidelines, site evaluations, a comprehensive survey to measure and record the current background conditions at the proposed site, a preliminary safety assessment, and environmental assessment technical studies and report.

The end point of the siting phase would be the receipt of a site preparation licence and a construction licence, the latter giving regulatory approval to begin construction of the deep geological repository facility on the preferred site. It is anticipated that the construction licence would be a staged licence, where the first stage is the construction of the

underground characterization facility. Further construction activities would depend on acceptable results obtained from the site evaluation provided through operation of the underground characterization facility.

Design and Construction Phase

The construction phase (about 10 to 15 years) begins with the receipt of regulatory approval to begin construction and ends when commissioning of the facilities is completed prior to receiving the first formal shipment of used fuel for placement. It involves constructing the infrastructure and surface facilities needed to receive used fuel, the underground access ways and service areas, and a portion of the underground rooms for used fuel.

It is anticipated that the construction licence may be provided as a staged licence, initially providing approval for the construction of the underground characterization facility, and identifying specific requirements to be met prior to the start of full-scale construction of the facilities. A period of underground data gathering and evaluation in the underground characterization facility would be used to improve the definition of the geotechnical parameters and confirm suitability of the site, provide the basis for the detailed design of the deep geological repository, and validate licensing assumptions.

When the licence requirements have been met and the approval of the regulator obtained, construction of the full-scale deep geological repository facility and its ancillary facilities can begin. Provision is made in the design for concurrent excavation during the operations phase to provide further rooms in the repository at the required time.

Operation and Extended Monitoring Phase

The operation and monitoring phase (about 100 years) begins with regulatory approval to receive shipments of used fuel for placement under a licence to operate and ends with approval to begin decommissioning activities. This phase includes a 30-year period during which used fuel is placed into the deep geological repository rooms followed by a period of extended monitoring which is assumed to last up to 70 years. This phase ends when approval is given to initiate decommissioning of the deep geological repository facilities.

The application for an operating licence would include a final safety analysis report, consistent with the actual design built and in support of the conclusions of the environmental assessment report submitted. Also, the results of the commissioning program would be required prior to granting approval to operate. The licence would specify requirements, particularly in regard to health and safety and monitoring and the onus would be on the licensee to prove compliance. The licence may need to be renewed periodically as specified by the regulator.

The operation phase would involve receiving used fuel transported to the deep geological repository facility, sealing it in corrosion resistant used fuel containers, placing and sealing the used fuel containers in repository rooms, and constructing and preparing additional repository rooms. After the last used fuel container has been placed in the deep geological repository there would be an extended period of monitoring and assessing the conditions in the vicinity of the deep geological repository. The extended monitoring program makes use of the shafts and underground access tunnels while they are still available prior to deep geological repository sealing in the decommissioning phase. Extended monitoring activities would include environmental monitoring, monitoring used fuel container performance and monitoring rock mass behaviour. The monitoring data would be used to confirm the long-term safety assessment of the sealed deep geological repository and provide the basis for decommissioning and closure of the facility.

Decommissioning Phase

The decommissioning phase is the period (about 10 years) in the life cycle of the deep geological repository during which the surface facilities are decontaminated, dismantled and removed. The beginning of this phase is marked by regulatory approval of a licence to decommission. The underground facilities are decontaminated (if necessary) and dismantled, with tunnels and shafts backfilled and sealed. At the end of the decommissioning stage the site would be in a state suitable to allow public use of the surface. However, public access to certain areas would likely be restricted by maintenance of fencing securing ongoing monitoring activities.

Closure Phase

Closure activities (about 15 years) include dismantling the borehole monitoring instruments and sealing of the characterization and monitoring boreholes that are surface based and which may compromise the integrity of the deep geological repository system over the long term. The remaining surface facilities serving these ongoing monitoring activities would be removed together with all security measures, thereby fulfilling the objective to return the site to green field conditions. Final removal of all institutional control of the facility would require regulatory approval and the issuance of a licence to abandon the facility.

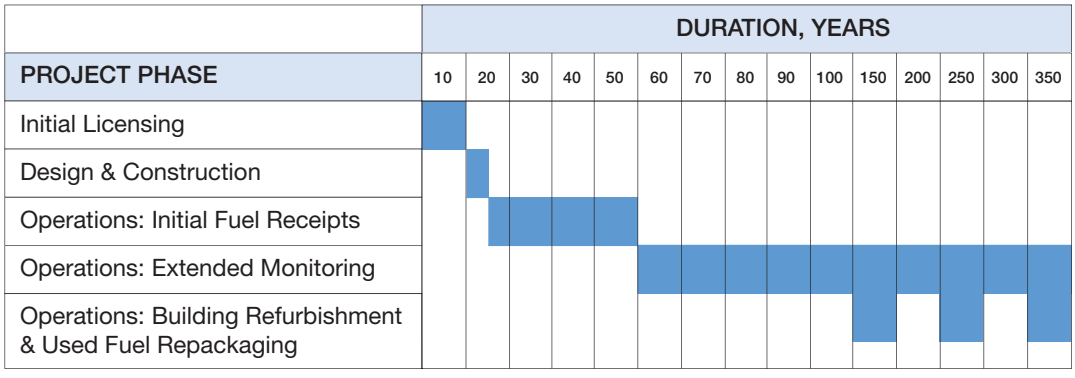
16.2 / Option 2: Storage at Nuclear Reactor Sites

This section presents an estimated timetable and a general description of the implementation activities anticipated for the long-term storage of used fuel at the reactor sites. (Currently, used fuel is being managed in interim storage facilities at the reactor sites). There are a variety of viable technical alternatives that could be followed at each of the sites requiring different maintenance considerations. Furthermore, different technical methods are currently used at the various sites; each could form the basis for a long-term storage plan.

This section does not attempt to provide a comparison of the technical alternatives, but rather identifies the phases of activity that would be required regardless of the method, or methods, selected. Figures 16-3 and 16-4 present the overall work schedule and activity flowchart for Storage at Nuclear Reactor Sites. Note that the estimated number of years per phase is not as clear cut as it may be for the other options that have central long-term management of used fuel at a single site because of the number of reactor sites and the different expected duration of phases for each reactor site.

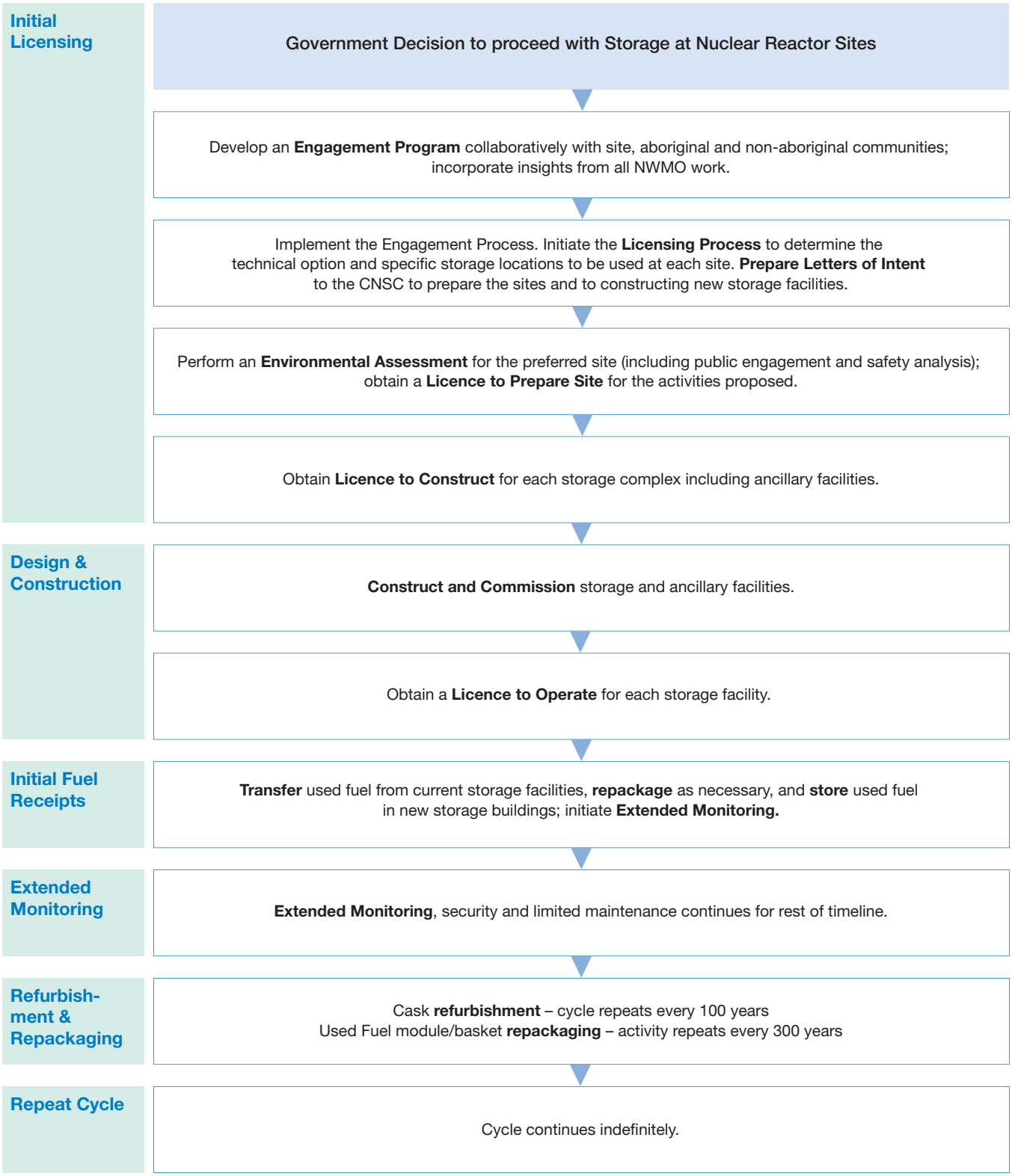
The typical schedule and the following description of activities are based on information in the conceptual design and cost estimating reports prepared by consultants for the Joint Waste Owners. (See conceptual design reports at www.nwmo.ca/conceptualdesigns).

Figure 16-3 Overall Work Schedule for Storage at Nuclear Reactor Sites



Note: Extended Monitoring and Building Refurbishment/Used Fuel Repackaging activities continue in perpetuity, based on a 300-year cycle.

Figure 16-4 Activity Flowchart for Storage at Nuclear Reactor Sites



The illustrative schedule of activities has been developed for the first 300-year cycle, although the time period for active management of used fuel at the reactor sites would continue indefinitely.

The estimated schedule for the first cycle assumes that new storage structures and possibly new dry storage technology would be implemented. New storage designs would need to be developed for each site including technical specifications for safeguarding the nuclear materials at the facilities. Emergency response plans may also need to be revised for each site. Due to the varying size of the facilities and the different fuel inventories at the sites, initial fuel receipt may continue at some reactor sites while construction is still occurring at others or extended monitoring may have begun at other reactor sites.

Initial Licensing Phase

This initial phase begins after a government decision is made to continue to manage the used fuel at the reactor sites and ends about 10-years later when all approvals have been received to construct the necessary storage structures and implement the selected long-term storage technology at the reactor sites.

This phase begins with an extensive NWMO review process of the alternatives to determine whether to continue using the existing interim dry storage facilities for long-term storage or to implement new dry storage technologies at some, or all, of the sites. Following this review, siting and conceptual design studies would be carried out at each reactor site, taking about one year to complete. When complete, letters of intent would be sent to the regulator to prepare sites and to construct new long-term storage facilities. This would initiate the provincial and federal environmental assessment process and an application for a licence to prepare the site and construct the facility.

During the environmental assessment process, the NWMO will be required to demonstrate that there would be no significant adverse impact on the environment resulting from the construction, operation and maintenance of the long-term reactor site storage facility. The environmental assessment will require the preparation of environmental assessment guidelines, site evaluations, preliminary safety assessment, preliminary decommissioning plan and environmental assessment technical studies and report. All of this would be done consistent with a public engagement plan approved by the regulator.

During the initial licensing phase, the owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transferred to the long-term storage facilities at the reactor sites.

Construction Phase

The construction phase is estimated to take about two to five years. It begins with regulatory approval to begin construction and ends when the facilities are commissioned and ready to receive used fuel from existing interim storage. It involves clearing of land, surface and/or underground excavation, construction of processing buildings, ancillary facilities, and construction of at least the first stage of the storage building. Provision is made in the design for construction and expansion during the initial fuel receipt phase to provide further storage capacity as required concurrent with interim storage.

Once commissioned, an application for a new or modified operating licence would be prepared to allow for the new buildings and structures to receive, process and store the used fuel. The application for an operating licence would include a preliminary decommissioning plan and a final safety analysis report, consistent with the actual design built and the anticipated activities. The final safety analysis results must also be consistent with the conclusions of the environmental assessment report.

Operations: Initial Fuel Receipt Phase

The initial fuel receipt phase begins with regulatory approval to receive transfers of used fuel for storage under an operating licence and ends with receipt of the last fuel transfer. The fuel transfer period is about 35 years. This phase may begin prior to completed construction of the entire storage complex, and additional storage capacity may be added in a staged manner as required. The length of this phase varies with the size of the used fuel inventory at each site.

There is a significant amount of activity during this phase. Depending on the technical alternative selected, the used fuel storage containers would require conversion in a processing building into a format appropriate for the long-term storage approach selected. The licence will specify requirements, particularly in regard to health and safety and monitoring and the onus would be on the licensee to prove compliance. Two particularly important requirements are environmental protection policies and procedures, i.e. an environmental management system, and effluent and environmental monitoring programs. The licence may need to be renewed periodically as specified by the regulator.

Operations: Extended Monitoring Phase

This phase commences at the end of initial fuel receipts and continues indefinitely throughout the reconstruction, refurbishment and repackaging phases described in the following subsection. This is a time of routine monitoring of the facility and the environment, as well as continued surveillance and security provision. The operating licence is expected to contain a combination of requirements related to monitoring, reporting, security and facility preparedness to respond to unacceptable monitoring results. Two particularly important requirements are environmental protection policies and procedures, i.e., an environmental management system, and effluent and environmental monitoring programs. This phase continues for as long as the long-term management facility is in existence.

Operations: Reconstruction, Refurbishment and Repackaging

Given that the used fuel storage facilities and principal containment structures have a finite life span, it would be necessary to move the used fuel from an ageing storage complex to new facilities, in addition to refurbishing and repackaging the storage casks and modules. Depending on the technical alternative chosen, this may be achieved by the staged building of additional storage capacity on the site, permitting the transfer of fuel containers from one storage location to another. Once the fuel has been transferred and the old storage units emptied, redundant storage structures and buildings would be demolished and new ones constructed.

There are two used fuel repackaging events that require consideration. One event, based on a 100-year service life of the storage casks, requires the removal of modules or baskets containing fuel from existing storage casks, and repackaging in fresh storage casks. The other repackaging event, occurring every 300 years based on the assumed service life of modules, module canisters and baskets requires the removal and transfer of fuel bundles to fresh modules, module canisters and baskets as required. The used fuel repackaging facility would perform functions relevant to the specific alternative chosen. It is assumed that the repackaging facility would comprise a shielded cell complex, housed within a large building, configured to perform the activities required for repackaging the used fuel.

The specific refurbishment requirements and the schedule and timing for the different technical alternatives are described in the conceptual design reports, available at www.nwmo.ca/conceptualdesigns.

16.3 / Option 3: Centralized Storage

This section presents an estimated timetable and a general description of the implementation activities anticipated to site, design, construct, operate, monitor and maintain a Centralized Storage facility for the long-term storage of used fuel. The Joint Waste Owners commissioned conceptual designs for four technical alternatives that could be followed in implementing the centralized storage concept, including above and below ground options, each with differing maintenance considerations; however the general schedule and phases are consistent for all alternatives.

Figures 16-5 and 16-6 present the overall work schedule and activity flowchart for Centralized Storage. This is based on the conceptual design and cost estimating reports prepared by consultants for the Joint Waste Owners. (See conceptual design reports at www.nwmo.ca/conceptualdesigns). The illustrative schedule of activities has been developed for the first 300-year cycle, although the time period for active management of used fuel at the reactor sites would continue indefinitely.

Siting Phase

The siting phase covers the time period in which a suitable location for a centralized storage facility is being sought. It begins after a formal decision is made to start the process of finding a suitable site and would end when regulatory approval is received to site and construct the facility at the preferred site (assumed to be about 15 years).

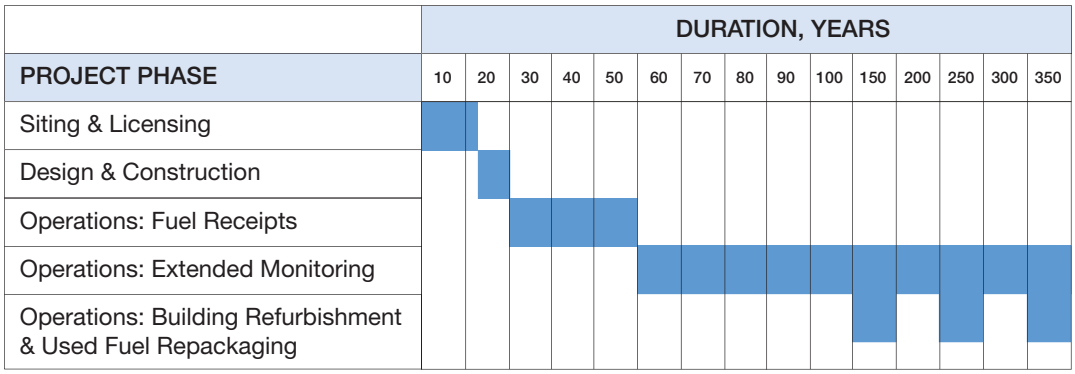
During the siting phase, the owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transported from the reactor sites to the central facility for long-term management.

The siting phase would involve developing a siting process that would include both thorough stakeholder consultations and technical assessments on the basis of site characteristics. The acceptability of a site would be determined on the outcome of this siting process. Key components of the siting process include initial public consultations and hearings, development and application of site screening criteria, an environmental assessment and the preparation of licence applications. Each of these major components necessarily includes both public involvement/participation and technical assessment and analysis.

The outcome of these public engagement activities would be coupled with the initial site characterization and screening to gain consensus toward selecting a preferred site. The approach would involve initial technical feasibility studies, followed by surface based characterization work, including subsurface exploration by borehole drilling carried out at perhaps two candidate sites in potential host communities prior to selecting a preferred site.

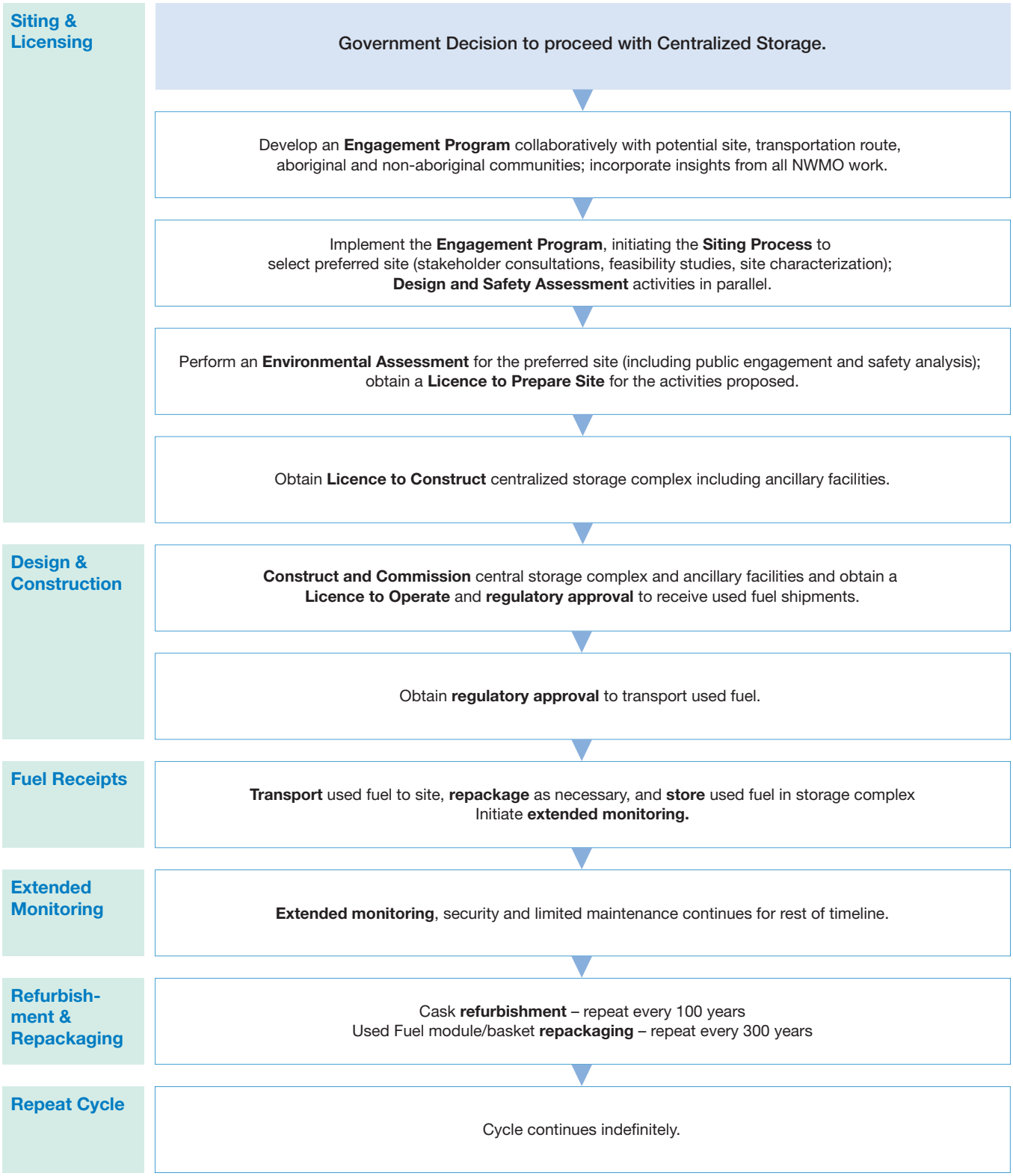
During the siting phase, a preliminary

Figure 16-5 Overall Work Schedule for Centralized Storage



Note: Extended Monitoring and Building Refurbishment/Used Fuel Repackaging activities continue in perpetuity, based on a 300-year cycle.

Figure 16-6 Activity Flowchart for Centralized Storage



conceptual design for centralized storage would be prepared for each site being evaluated. The design would include technical specifications for safeguarding the nuclear materials at the facility and during transportation. Following the selection of a preferred site, a comprehensive survey to measure and record the current background conditions at the proposed site would be conducted and a preliminary centralized storage design specific for the site would be completed prior to conducting the environmental assessment and preparing the application for a licence to prepare the site and construct the facility.

Once application for site preparation is made, or intent to apply is given, an environmental assessment will be required. The NWMO would be required to demonstrate during the environmental assessment process that there would be no significant adverse impact on the environment resulting from the construction, operation and maintenance of the centralized storage facility. The environmental assessment will require the preparation of environmental assessment guidelines, site evaluations, preliminary safety assessment, preliminary decommissioning plan and environmental assessment technical studies and report. All of this would be done consistent with a public engagement plan approved by the regulator.

Design and Construction Phase

The construction phase (about five years) begins with the receipt of a licence to begin construction and ends when the commissioning of the facilities is completed, prior to receiving the first formal shipment of used fuel for storage. It involves clearing of land, surface and/or underground excavation, construction of a processing building and ancillary facilities, and construction of at least the first stage of the storage complex. Provision is made in the design for concurrent construction and expansion during the fuel receipt phase to construct further storage capacity at the required time.

The application for a licence to operate is prepared during this phase. It will include a preliminary decommissioning plan and a final safety analysis report consistent with the actual design built and in support of the conclusions of the environmental assessment report submitted.

Operations: Fuel Receipt Phase

The fuel receipt phase (about 30 years) begins with regulatory approval to receive shipments of used fuel for storage under a licence to operate and ends with receipt of the last shipment. Following this would be an indefinite period of monitoring.

This phase of operations would involve receiving used fuel transported to the central site and sent to the storage complex. Fuel would arrive in existing storage casks, or be conveyed in transportation casks containing modules or baskets. Depending on the technical alternative selected, some fuel storage containers would require conversion in a processing building into a format appropriate for long term storage. During this phase, additional storage capacity would be constructed, expanding the storage complex in a staged manner.

Fuel receipt would be carried out entirely under an operating licence with specific requirements, particularly in regard to health and safety and monitoring. The onus would be on the licensee to prove compliance to these requirements. The licence may require periodic renewal as specified by the regulator.

Operations: Extended Monitoring Phase

This phase commences at the end of initial fuel receipts and continues indefinitely throughout the reconstruction, refurbishment and repackaging phases described in the following subsection. This is a time of routine monitoring of the facility and the environment, as well as continued surveillance and security provision. The operating licence is expected to contain a combination of requirements related to monitoring, reporting, security and facility preparedness to respond to unacceptable monitoring results. This phase continues for as long as the long-term management facility is in existence.

Operations: Reconstruction, Refurbishment and Repackaging

Given that the storage facilities and principal containment structures have a finite life span, it would be necessary to move the used fuel from an ageing storage complex to new facilities in addition to refurbishing and repackaging the storage casks and modules. Depending on the technical alternative chosen, this may be

achieved by the staged building of additional storage capacity on the site, permitting the transfer of fuel containers from one storage location to another. Once the fuel has been transferred and the old storage unit emptied, the redundant building would be demolished and a new one constructed. This process is estimated to require 30 years.

There are two repackaging events that require consideration. One event, based on a 100 year service life of the storage casks (applicable to the alternatives Casks and Vaults in Storage Buildings, Casks and Vaults in Shallow Trenches, and Casks in Rock Caverns), requires the removal of modules (or in the case of Casks in Rock Caverns removal of baskets containing fuel from existing storage casks), and repackaging them in fresh storage casks. The other repackaging event, occurring every 300 years – based on the assumed service life of modules, module canisters and baskets – requires the removal and transfer of fuel bundles to fresh modules, module canisters and baskets as required. The used fuel repackaging facility would perform functions relevant to the specific alternative under consideration. It is assumed that the repackaging facility would comprise a shielded cell complex, housed within a large building, configured to perform the activities required for repackaging the used fuel.

The shielded cell complex is capable of allowing the opening of the storage casks, withdrawal of the modules and withdrawal of fuel bundles from the modules. The fuel bundles are transferred to 'fresh' modules, which would then be loaded into a new storage cask or a new welded canister. Alternatively, the shielded cell complex permits the opening of seal welded baskets and the withdrawal of the fuel bundles within. The fuel bundles are inserted into 'fresh baskets', and the basket assembly seal welded. The repackaging event for each alternative is assumed to require about 30 years. The specific refurbishment requirements and the schedule and timing for the different technical alternatives are described in the conceptual design reports at www.nwmo.ca/conceptualdesigns.

16.4 / Option 4: Adaptive Phased Management

The Adaptive Phased Management approach could be implemented in three major phases. In Phase 1, the used fuel continues to be stored and managed by the individual waste owners at the reactor sites until the necessary siting, approvals, and construction of a central long-term management facility have taken place. An engagement program would be collaboratively developed as a vehicle for various public inputs during implementation, and an oversight and reporting program would be instituted.

Phase 1 includes the option to construct shallow underground caverns for storage of used fuel at the central site while awaiting development of the deep repository. Also during the first phase, an underground characterization facility (UCF) would be constructed and site-specific research and development would be performed.

Phase 2 includes the option to transport used fuel from the reactor sites to the central location for interim shallow underground storage, demonstration of long-term isolation technology in the underground characterization facility and design and construction of the deep repository.

In Phase 3, the used fuel would be retrieved from storage, packaged into long-lived containers and placed in the deep repository. Extended monitoring would then occur until a decision is made to decommission the underground characterization facility and surface handling facilities and close the deep repository. This would be followed by a period of postclosure monitoring for as long as future societies decide is necessary.

Each of the three major phases of Adaptive Phased Management has key activities and decision points. While we do not know the precise duration of these activities or the outcome of future decisions, we can provide an indication of a representative schedule for implementation based on the conceptual design work and analyses of the three options for used fuel management described previously as well as international experience. Some of the key decisions which could affect implementation activities and the schedule include:

- The selection of a preferred site for central, long-term management of used nuclear fuel.
- A decision about whether or not to construct an interim shallow underground storage facility at the central site and transport used fuel to the central facility while awaiting development of the deep geological repository.
- A decision about when to construct the deep geological repository and ancillary facilities.
- A decision about when to close the deep geological repository and decommission the surface facilities.

Figures 16-7 and 16-8 present the overall work schedule and activity flowchart for Adaptive Phased Management.

Figure 16-7 Overall Work Schedule for Adaptive Phased Management

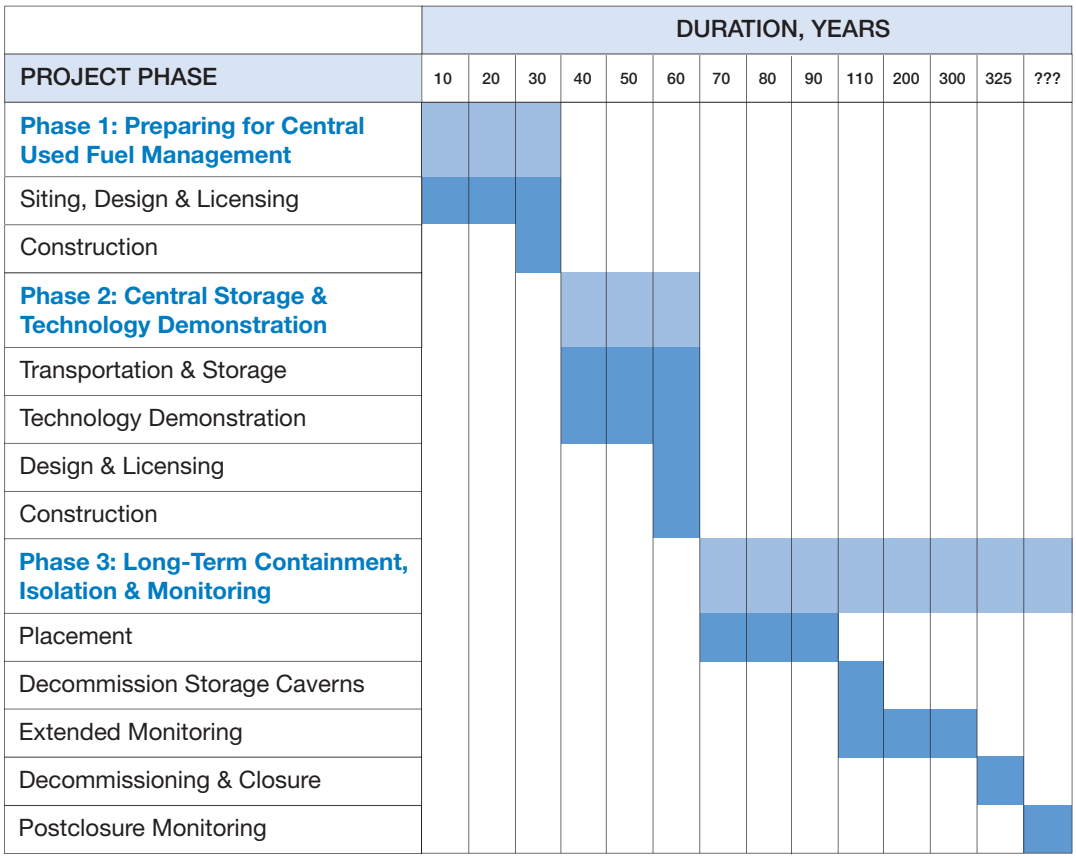


Figure 1-2 Activity Flowchart for Adaptive Phased Management

We have conservatively assumed for conceptual design, cost estimating and planning purposes that a decision has been made in Phase 1 to build the optional shallow underground caverns for centralized storage and that used fuel is transported from the reactor sites to the central facility beginning in Phase 2. Possible drivers which may affect the decision of whether or not to construct an interim shallow underground storage facility include:

- A strong indication from some or all of the reactor site communities of a need to move used fuel off site, perhaps as a result of reactor decommissioning activities;
- Unforeseen developments that increase the desirability of centralizing used fuel for reasons of enhanced security; and
- Unforeseen developments in new technological innovation.

Phase 1: Preparing for Central Used Fuel Management

Siting, Design and Licensing

In Phase 1, a suitable location for a shallow underground storage facility, an underground characterization facility and a deep geological repository would be sought, and licences obtained. The siting portion of Phase 1 would begin immediately after a formal decision is made to follow an Adaptive Phased Management approach, and it would end when a licence is received to construct a shallow underground storage facility and an underground characterization facility (estimated to be about 20 years).

During the siting phase, the owners of used fuel would continue to be responsible for its interim management at the reactor sites. The NWMO would assume management responsibility of the used fuel when it is transported from the reactor sites to the central facility for long-term management.

It is expected to take about 10 years to complete the feasibility studies and select a preferred site, followed by five more years to complete detailed site characterization and prepare safety reports, design reports and associated documentation required for licensing.

It is likely that the construction licence application for the deep geological repository would be submitted later in Phase 2 after confirming the suitability of the site and completing the safety analyses based on the final design of the facility.

The first activities in Phase 1 would be developing an engagement program and instituting an oversight and reporting program. The engagement program and siting process would be developed in collaboration with people and communities potentially affected including Aboriginal peoples. Based on input from this engagement program, a process would be developed and immediately implemented to determine site acceptability. The major components of the siting process would include public engagement and technical assessments. Other key activities in this phase include initial public consultations and hearings, development and application of site screening criteria, an environmental assessment, and the preparation of licence applications. Each of these components necessarily includes both public involvement/participation and technical assessment and analysis.

A preliminary conceptual shallow storage facility, an underground characterization facility, and a deep repository design would be prepared for the sites being considered. Design work would be completed sufficiently to establish access, utility, and infrastructure requirements as part of initial site screening of areas selected for detailed evaluation. The design would include technical specifications for safeguarding the nuclear materials at the facility for all phases of implementation and during transportation. Following the selection of a preferred site, a shallow underground storage design specific for the site and a preliminary design for the underground characterization facility and deep geological repository would be completed prior to conducting the environmental assessment and licensing processes.

The environmental assessment and application for a site preparation licence would need to consider the impacts from all facilities intended for the site, even if they would not be built for decades to come. The NWMO would be required to demonstrate during the environmental assessment process that there would be

no significant adverse impact on the environment resulting from the construction, operation, decommissioning and closure of all facilities intended for the site.

The environmental assessment will require the preparation of environmental assessment guidelines, site evaluations, a comprehensive survey to measure and record the current background conditions at the proposed site, a preliminary safety assessment, and environmental assessment technical studies and reports. All of this would be done in concert with a public engagement plan approved by the regulator. A period of five years has been allocated to complete the environmental assessment and licensing process. Although there may be additional environmental assessments required in subsequent phases, we expect that they would be based on this major environmental assessment completed in Phase 1.

Construction

Assuming a decision has been made to build the shallow underground caverns for centralized storage, this facility and associated infrastructure plus the underground characterization facility would be built during Phase 1 construction (estimated to be about 10 years). This period begins with regulatory approval to begin construction and ends when commissioning of the facilities is completed; that is when shallow storage may receive used fuel and site-specific research and development may be performed at the underground characterization facility. If a decision has been made not to build the shallow underground caverns for centralized storage, then only the underground characterization facility and associates surface facilities and infrastructure would be constructed at the central site.

The underground storage areas of the central facility would be built as a series of shallow rock caverns excavated at a nominal depth of 50 metres below surface and accessible by ramp. The shallow underground caverns would be designed and constructed so that they would not compromise the integrity or safety of the natural geosphere barrier associated with the deep geological repository. As for the underground characterization facility, the underground access ways and service areas, and the underground rooms for used fuel would be constructed at a nominal depth of between 500 and 1,000 metres below surface and accessible by shaft. It is anticipated that the underground characterization facility may require modification or expansion during the operation phase depending on research findings.

Phase 2: Central Storage and Technology Demonstration

Transportation and Storage

Adaptive Phased Management includes the option to store used fuel in a shallow underground storage facility at the central site, while awaiting development of the deep repository. If this option is selected, then used fuel would begin to be transported from the reactor sites to the central site and placed in shallow underground caverns. If a decision has been made not to build the shallow underground caverns for centralized storage, then used fuel would remain at the reactor sites and be transported to the central facility during Phase 3. The decision about used fuel transportation would be influenced by the engagement program.

Used fuel transportation can only begin when the central facility has been granted an operating licence to receive, handle, and store used fuel shipments. As well, regulatory approval will be required for the transportation routes and methods, the emergency response plans, and the packages and transport containers that are designed and licensed for this purpose. It is estimated that transportation would continue for approximately 30 years.

The mode of transportation (road, rail or water) and the routes that would be utilized would depend on the location of the central facility, technical requirements and outcomes from the engagement process developed in Phase 1.

Technology Demonstration

Along with continued characterization of the site, further demonstration of the technology to contain and isolate used fuel in a deep geological repository would continue at the underground characterization facility. The NWMO has conservatively assumed a period of 20 years of research and demonstration at the underground characterization facility would be required to confirm the suitability of the site, to gain sufficient confidence in understanding the long-term issues and to prove the safety of isolating used fuel in a deep geological repository. Once a decision is made to proceed with developing the deep repository, site-specific research, long-term tests and technology demonstration at the underground characterization facility would continue in parallel with design and licensing activities for the deep repository.

Design and Licensing

It is estimated that a decision could be made to place fuel in a deep repository at or about Year 50. As with decisions on siting and transportation, this decision is subject to the engagement and oversight programs developed in Phase 1. A decision to place fuel in a deep repository would mark the beginning of another phase in which the design would be finalized and regulatory approvals would be sought for an operating licence for the deep repository and ancillary facilities. This period is expected to last about 10 years.

The final deep repository design would be based on underground data gathering and evaluation in the underground characterization facility which would be used to confirm the suitability of the site, provide the basis for the detailed design of the deep repository, and provide validation of assumptions made in the final safety analysis report. The repository design, which was initially prepared in Phase 1, may be updated depending on technical conditions and regulatory expectations at that time. With the licence requirements met and approval of the regulator obtained, this phase would end and construction of the deep repository and its ancillary facilities would begin.

Construction

The deep repository placement rooms would be constructed for the purpose of receiving used fuel. This activity formally begins with the decision to construct, and ends when the repository rooms and surface facilities have been commissioned to receive, process and store used fuel. Initial construction is expected to last about 10 years, although provisions are expected for concurrent excavation during Phase 3, providing additional rooms for used fuel at the required time.

An application for an operating licence would be made in parallel with construction activities, including a final safety analysis report. Also, the results of the commissioning program would be required prior to granting approval to operate.

Phase 3: Long-Term Containment, Isolation and Monitoring

Placement

Placement (estimated to be about 30 years) begins with regulatory approval under an operating licence for the deep repository and ends when the last fuel bundle has been placed and an extended monitoring program is initiated. Used fuel is assumed to be transferred from storage to the surface facilities for packaging into long-lived containers and then placed in a network of horizontal tunnels and rooms excavated in stable rock at a nominal depth of 500 to 1,000 metres below surface. The durable used fuel containers would be made of corrosion-resistant material and placed within the rooms or in boreholes drilled into the floor of the rooms. Used fuel containers are assumed to be placed in the deep repository over a 30-year operating period.

The operating licence will specify requirements, particularly in regard to health and safety and monitoring, and the onus would be on the licensee to prove compliance. Finally, the licensee may be required to report on the status of the facility and compliance with the licence and the used fuel management program in compliance with engagement programs and the oversight regime. The licence may require periodic renewal by the regulator.

Decommission Storage Caverns

After the used fuel has been removed from the optional shallow underground storage caverns, the underground facility would be kept open and available for used fuel storage, if required. After about 20 years, the shallow underground caverns are assumed to be decommissioned and closed.

Extended Monitoring

Extended monitoring begins after the used fuel is placed in the deep repository and ends when a decision is made to backfill and seal the deep repository, and approval is given to close and decommission the facilities. The extended monitoring program would take place in-situ at repository depth, making use of the shafts and underground access tunnels.

Extended monitoring activities would include environmental monitoring, monitoring used fuel container performance, and monitoring rock mass behaviour. The monitoring data would be used to confirm the long-term safety of the repository and provide the basis for decommissioning and closure of the facility. The time period for extended monitoring has been conservatively assumed to be about 210 years. After closure of the deep repository, postclosure monitoring of the facility would take place from the surface if necessary.

Decommissioning and Closure

Decommissioning activities include decommissioning of the underground characterization facility and any remaining long-term experiments or demonstrations of technology, plus decommissioning of the surface handling facilities. Decommissioning the repository begins when a decision is made to dismantle and remove underground equipment such as in-situ monitoring devices, backfill and seal the access tunnels and shafts, and the regulatory approval is granted to do so. This would be one of the last decisions that would need to be supported by the engagement program. Possible benefits of closing the repository, or leaving it open, would need to be determined at that time. During decommissioning the surface facilities would be decontaminated, dismantled and removed. It is estimated that final decommissioning activities would require about 25 years to complete. At the end of the decommissioning stage the site would be in a state suitable to allow public use of the surface. However, access may still be denied by maintenance of fencing to secure ongoing postclosure monitoring activities.

Postclosure Monitoring

After the closure of the deep repository and the decommissioning of all facilities at the central site, postclosure monitoring could take place at the surface. This would continue indefinitely until a decision was taken to end all activities associated with the deep repository.

Flexibility in Schedule for Implementation

Adaptive Phased Management allows flexibility in the pace and manner of implementation through phased decision making. In Figure 16-7 we have illustrated one possible implementation schedule which we believe is conservative and allows for genuine choice. In our illustrative timeline, the used fuel is fully transported from the reactor sites, and placed in the deep repository within 90 years, followed by an extended period of monitoring. However, other implementation schedules are possible, including an accelerated schedule. Implementation of Adaptive Phased Management could proceed faster or slower than the illustrative schedule outlined in this chapter and will depend on future decisions which cannot be known at this point in time.

We can predict with greatest accuracy the timelines for Phase 1. We have the benefit of Canadian experiences with other siting and environmental assessment processes. In addition, we are guided by the siting and regulatory experiences related to radioactive waste management facilities in Finland and Sweden. Our illustrative timeline for Phase 1, of 30 years, covers a period in which the following activities would take place:

- Continued research and development;
- Siting feasibility studies;
- Selection of a preferred site;
- Completion of detailed site characterization;
- Development and certification of transportation containers;
- Preparation of safety reports, facility design reports and associated documentation to support the environmental assessment, licensing and approvals process;
- A 10-year period of construction of the underground characterization facility and the optional shallow underground storage facility; and
- Citizen engagement associated with the activities noted above.

Based on our observations of other similar processes, we believe that 30 years is a reasonable timeline for Phase 1. However, should a decision be taken not to construct the optional shallow underground storage facility at the central site, then it is possible that construction of the underground characterization facility could be completed in five years, potentially shortening Phase 1 to 25 years.

In our illustrative timeline, Phase 2 activities would take place during years 30 through 60 in the implementation period. The activities taking in place in this period would include:

- Transport of used fuel from the reactor sites to the central site, where the used fuel is placed in the shallow underground storage facility;
- Research and testing at the underground characterization facility, to demonstrate and confirm the suitability of the site and the repository technology;
- Completion of the final design and safety analyses, to support the application for an operating licence for the deep repository;
- Construction of the deep repository; and
- Citizen engagement in the activities above.

It is possible that there may be a shorter period of demonstration of the long-term isolation technology in the underground characterization facility, enabling Phase 2 to proceed in 10 years, for example. This may be the case if the optional shallow underground storage facility is not constructed, and there are no unforeseen developments at the planned repository site. Used fuel would remain stored at reactor sites. Final repository design, licensing and construction activities would occur in parallel with site characterization and technology demonstration, resulting in all Phase 2 activities completed in 10 years, rather than the 30 year period reflected in our illustrative timeline.

During Phase 3 of our illustrative timeline, used fuel is transferred from the shallow underground storage facility to the deep repository over a period of 30 years. Under an accelerated schedule of implementation, without the optional shallow underground storage facility, used fuel would be moved from reactor sites to the central facility, repackaged into long-lived containers and placed in the deep repository. In both instances, a period of 30 years is required for the process of placing the used fuel bundles in the deep repository.

An accelerated implementation schedule may therefore enable all used fuel to be placed in the deep repository by year 65, rather than year 90, as depicted in our illustrative timeline.

An important component of Adaptive Phased Management, is the provision for ongoing monitoring after the used fuel is placed in the deep repository, to assess the performance of the repository system, and to allow for retrieval of the used fuel, if required. Even under an accelerated implementation schedule, we believe that a period of extended monitoring is an important provision. Decisions on the duration of this monitoring, the timing of closure of the facility and postclosure monitoring would be taken by a future generation.

Appendices

A

Appendix 1 / NWMO Profile

The Nuclear Waste Management Organization (NWMO) was established by Canada's nuclear electricity generators following passage of the *Nuclear Fuel Waste Act* in 2002 (See Appendix 2: *Nuclear Fuel Waste Act*). The legislation provides a framework for the Government of Canada to make a decision on the long-term management of used nuclear fuel. It requires the NWMO to investigate and develop an approach and present its recommendations to the government by November 2005.

The NWMO Board of Directors is currently composed of representatives of the major owners of used nuclear fuel: Ontario Power Generation Inc., Hydro-Québec and NB Power Nuclear. (www.nwmo.ca/directors)

The founding Chair was Richard Dicerni who retired from OPG in 2005. Stuart Groom served as a director until his retirement from NB Power in 2003. And René Pageau represented Hydro-Québec until he left the utility in 2004.

Current board members are:

- **Ken Nash (chair),** Vice President, Nuclear Waste Management – OPG.
  A mechanical engineering graduate from Salford University in the United Kingdom, Mr. Nash joined OPG's predecessor company, Ontario Hydro, in 1981 after working for British Nuclear Fuels Plc. on nuclear fuel design and nuclear waste management.

- **Laurie Comeau,** Manager, Personnel Safety and Environment, Point Lepreau Nuclear Generating Station – NB Power Nuclear.
  Mr Comeau's 24 year career in the nuclear industry has been focused on radiation safety, conventional safety, environmental monitoring, dosimetry, emergency preparedness, fire prevention and waste management.

- **Fred Long,** Vice President, Financial Planning – OPG.
  Mr. Long joined Ontario Hydro in 1976 after earning his Ph.D. in physics from McMaster University. He has held numerous positions in financial planning, financial policy and strategy, and operational audit.

- **Adèle Malo,** Vice President, Law and General Counsel; Vice President, Sustainable Development – OPG.
  Called to the Bar in 1989, Adèle Malo has practiced law with major corporations and law firms in Canada. She holds a Bachelor of Laws from the University of Windsor and a Master of Laws from the University of Cambridge.

- **Michel Rhéaume,** Licensing Manager, Gentilly-2 Refurbishment Project – Hydro-Québec.
  Mr. Rhéaume is a physics graduate of the Université du Québec à Trois-Riviéres. He began his career at Hydro-Québec in 1975 and has been a manager in: Health Physics, Emergency Preparedness, Environment, Nuclear Safety and Licensing and Nuclear Waste Management.

The NWMO has an arms-length Advisory Council composed of individuals knowledgeable in nuclear waste management issues and experienced in working with citizens and communities on a range of public policy issues. (www.nwmo.ca/advisorycouncil)

The Advisory Council has a legislative mandate to provide written comments on the NWMO study to the Minister of Natural Resources Canada. Its report is presented at the back of this study report. Throughout the study period, the Advisory Council has provided ongoing advice and guidance to the NWMO Board of Directors and its President.

Advisory Council members are:

- **Hon. David Crombie – Chairman**
  The Honourable David Crombie is the President and CEO of the Canadian Urban Institute and Chair of Ontario Place. He is a past mayor of the City of Toronto and a Privy Councillor. Mr. Crombie was the first Chancellor of Ryerson University and is the recipient of honorary doctorates of law from the University of Toronto and the University of Waterloo. Mr. Crombie is an Officer of the Order of Canada.

- **David Cameron**
  David R. Cameron is a Professor of Political Science at the University of Toronto and a Fellow of the Royal Society of Canada. He has held a number of senior government positions in both the federal and Ontario civil services. He continues to advise on a wide range of governmental issues.

- **Helen Cooper**
  Helen Cooper has devoted most of her professional career to strategic planning and development for broader public sector and not-for-profit organizations. She has practised as a mediator and adjudicator in dispute resolution and has taught courses in urban planning at both Queen's University and the University of Waterloo. She is a former mayor of Kingston, Ontario and a former president of the Association of Municipalities of Ontario.

- **Gordon Cressy**
  Gordon Cressy is the President of the Canadian Tire Foundation for Families. A past President of the United Way of Greater Toronto, he has held Vice-President positions at both the University of Toronto and Ryerson University. Mr. Cressy has a lengthy record of community involvement.

- **Frederick Gilbert**
  Frederick Franklin Gilbert is the President of Lakehead University in Thunder Bay, Ontario. He has had an extensive teaching, research and administrative career in the United States and Canada and has held several environmental and wildlife management public service appointments and positions. His research interests included resource management and the sustainable use of the natural environment.

- **Eva Ligeti**
  Eva Ligeti is the Executive Director of the Clean Air Partnership, a non-profit organization with a mandate to make Toronto more environmentally sustainable and a world leader in clean air. A lawyer, she served as Ontario's first Environmental Commissioner from 1994 to 1999.

- **Derek Lister**
  Derek Lister is the Chairman of the Chemical Engineering Department at the University of New Brunswick in Fredericton, where he also holds the Research Chair in Nuclear Engineering. His main research interests are in the areas of chemistry and corrosion associated with nuclear systems.

- **Donald Obonsawin**
  Donald Obonsawin is the President and CEO of Jonview Canada Inc. He has been Deputy Minister of seven Ontario government ministries over a 15-year period. He has also held senior positions with the federal departments of Indian Affairs and Northern Development and Health and Welfare Canada.

- **Daniel Rozon**
  Daniel Rozon is a retired Professor of Engineering Physics at l'École Polytechnique de Montréal. A fellow of the Canadian Nuclear Society, he is a specialist in reactor physics, with research interests in nuclear fuel management optimization. He was the director of the Nuclear Engineering Institute (l'Institut de génie nucléaire) for more than 15 years.

A Roundtable on Ethics, composed of experts in the field of ethics from a variety of disciplines, provided advice and feedback to the NWMO throughout its study. (**www.nwmo.ca/ethicsroundtable**) The Roundtable helped ensure the systematic integration of ethical considerations in the development and application of the framework used to assess the management options. Members are:

- **Andrew Brook**
  Andrew Brook is Professor of Philosophy and Director of the Institute of Cognitive Science at Carleton University. He is a graduate of the Universities of Alberta and Oxford and is a Past President of the Canadian Philosophical Association. Dr. Brook's research interests include: interdisciplinary cognitive research; Kant; consciousness; psychological and psychoanalytic explanation; environmental ethics; and ethics of nuclear waste management.

- **Wesley Cragg**
  Wesley Cragg is the George R. Gardiner Professor of Business Ethics, and Director of the Business Ethics Program at the Schulich School of Business at York University. He is also Chair and President of Transparency International, Canada. Dr. Cragg's areas of expertise include: business ethics, professional ethics; ethics and work; law and ethics; moral, social, political and legal theory.

- **George Erasmus**
  George Erasmus has made a lifelong contribution to the welfare and community of Canada's Aboriginal peoples. He has served as the president of the Indian Brotherhood of Northwest Territories/Dene Nation, and was twice elected as the National Chief of the Assembly of First Nations. Mr. Erasmus was co-chair of the groundbreaking 1996 Royal Commission on Aboriginal Peoples. He is President and Chairman of the Aboriginal Healing Foundation and is also currently Chief Negotiator for the Dehcho First Nations, in their land and governance process with the Federal Government.

- **David MacDonald**
  Ordained as a minister of the United Church of Canada, David MacDonald's long service to Canada has included: election to the House of Commons for the riding of Egmont, PEI for six terms beginning in 1965; Cabinet Minister; Fellow in Residence of the Institute for Research on Public Policy; President of the Futures Secretariat; Canadian Emergency co-ordinator/African Famine; and, United Church advisor on residential schools reconciliation and agreement.

- **Arthur Schafer**
  Arthur Schafer is the Director of the Centre for Professional and Applied Ethics at the University of Manitoba. He is also a Full Professor in the Department of Philosophy and an Ethics Consultant at the Health Sciences Centre in Winnipeg. A former Head of the Section of Bio-Medical Ethics in the Faculty of Medicine at the University of Manitoba, he is a recipient of many awards and honours. Professor Schafer has published widely in the fields of moral, social and political philosophy.

- **Margaret A. Somerville**
  Margaret Somerville is Samuel Gale Professor in the Faculty of Law, Professor in the Faculty of Medicine, and the Founding Director of the Centre for Medicine, Ethics and Law at McGill University. Widely published, a frequent participant in national and international conferences and consultations and all forms of media, she has been active in the worldwide development of bioethics and most recently was named the first recipient of the UNESCO Avicenna Prize for Ethics in Science. Dr. Somerville's areas of expertise include: bioethics; health law and ethics; medical law; torts; and criminal law.

The NWMO has also benefited from the informal and ongoing advice of a panel whose members have international experience in matters of resource development and Aboriginal concerns, environment and nuclear energy. Members are:

- **Justice Thomas Berger**
  From 1974 to 1977 Thomas Berger served as the Commissioner of the Mackenzie Valley Pipeline Inquiry, recommending a ten year moratorium on building a pipeline so that native land claims could be settled. He represented Vancouver – Burrard as a Member of Parliament in 1962-63 and was later an MLA and leader of the British Columbia New Democratic Party. Mr Berger served as a Justice of the Supreme Court of British Columbia from 1973 to 1983. He now practices law in Vancouver.

- **Dr. Hans Blix**
  Hans Blix was Director General of the International Atomic Energy Agency from 1981 to 1997 and was a member of Sweden's delegation to the United Nations from 1961 to 1981. In 2000 he was appointed Executive Director of the United Nations Monitoring, Verification, and Inspection Commission, supervising international inspections for weapons of mass destruction in Iraq until the inspections were suspended in 2003. A Swedish citizen, Dr. Blix has written several books on subjects associated with international and constitutional law.

- **Dr. Gustav Speth**
  James Gustav Speth is Dean of the School of Forestry and Environmental Studies at Yale University. He founded and was president of the World Resources Institute, co-founded the Natural Resources Defense Council, served as advisor on environmental issues for U.S. Presidents Carter and Clinton, and was Chief Executive Officer of the United Nations Development Program. In 2002, for his role in bringing the global warming issue to wide public attention, Dr. Speth was awarded the international environmental Blue Planet Prize.

Elizabeth Dowdeswell is President and CEO of the NWMO.

NWMO staff are:
Kathryn Shaver – Executive Director and Corporate Secretary
Gillian Adshead
Ginni Cheema
Jo-Ann Facella
Morrie Herman
Anthony Hodge
Elena Kapila
Michael Krizanc
Paul Lovie
John Neate (2003-04)
Pat Patton
Donna Pawlowski
Sean Russell

Appendix 2 / *Nuclear Fuel Waste Act*

NUCLEAR FUEL WASTE ACT [1]

Summary

This enactment implements a key component of the Government of Canada's 1996 *Policy Framework for Radioactive Waste* – that the federal government, through effective oversight, would ensure that the long-term management of radioactive waste is carried out in a comprehensive, integrated and economically sound manner. The key elements of the enactment include

(a) requiring the major owners of nuclear fuel waste to establish a waste management organization (referred to in this Summary as the "WMO") to carry out the managerial, financial and operational activities to implement the long-term management of nuclear fuel waste;

(b) requiring the major owners of nuclear fuel waste to establish trust funds and to make annual payments into those trust funds to finance the long-term management of nuclear fuel waste; and

(c) authorizing the Governor in Council to make a decision on the choice of approach for long-term management of nuclear fuel waste for Canada to be implemented by the WMO.

The enactment also requires that the WMO carry out public consultations, that the WMO's study and reports (which are submitted to the Minister) be made public, that the WMO establish an Advisory Council, whose comments on the WMO's study and reports are made public, and that the Minister make public statements on all of the WMO's reports.

Table of Provisions

SHORT TITLE
1. Short title

INTERPRETATION
2. Definitions

PURPOSE OF ACT
3. Comprehensive, integrated and economically sound approach

APPLICATION OF ACT
4. Binding on Her Majesty
5. Application to nuclear energy corporations and AECL

WASTE MANAGEMENT ORGANIZATION
6. Incorporation and purpose
7. Duty toward other owners of nuclear fuel waste
8. Advisory Council

FINANCING
9. Trust funds
10. Initial deposit to trust funds
11. Withdrawals from trust funds

STUDY BY WASTE MANAGEMENT ORGANIZATION
12. Study within three years
13. Financial aspects
14. Minister may consult public
15. Decision of Governor in Council

REPORTS BY WASTE MANAGEMENT ORGANIZATION
16. Obligation to submit annual reports
17. Obligation to deposit
18. Triennial report
19. Minister's statement
19.1 Tabling of reports in Parliament

CHANGE IN APPROACH
20. New approach – technical difficulty

WITHDRAWAL BY BENEFICIARY
21. Withdrawals from trust funds

RECORDS, BOOKS AND FINANCIAL STATEMENTS
22. Records and books to be kept
23. WMO financial statements

DOCUMENTS TO BE MADE PUBLIC
24. Documents to be made public

INSPECTION OF RECORDS AND BOOKS
25. Auditors
26. Duty to assist auditor

OFFENCES AND PUNISHMENT
27. Failure to deposit amounts
28. Failure to submit study
29. Offence by employee or agent
30. Due diligence
31. Time limit for prosecution

COMING INTO FORCE
32. Coming into force

[1] Canada Gazette, Part III, Volume 25, No. 2, Chapter 23. Ottawa, Friday, August 2, 2002, Statutes of Canada 2002.

NUCLEAR FUEL WASTE ACT	
49-50-51 Elizabeth II Chapter 23	
	An Act respecting the long-term management of nuclear fuel waste [Assented to 13th June, 2002] Her Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:
Short title	SHORT TITLE **1.** This Act may be cited as the *Nuclear Fuel Waste Act*.
Definitions	INTERPRETATION **2.** The following definitions apply in this Act.
"economic region"	"economic region" means an economic region described by Statistics Canada in its *Guide to the Labour Force Survey*, published on January 31, 2000.
"management"	"management", in relation to nuclear fuel waste, means long-term management by means of storage or disposal, including handling, treatment, conditioning or transport for the purpose of storage or disposal.
"Minister"	"Minister" means the Minister of Natural Resources or such member of the Queen's Privy Council for Canada as the Governor in Council may designate as the Minister for the purposes of this Act.
"nuclear energy corporation"	"nuclear energy corporation" means (a) Ontario Power Generation Inc., Hydro-Québec, New Brunswick Power Corporation, and any other body that owns nuclear fuel waste resulting from the production of electricity by means of a commercial nuclear reactor; (b) any successor or assignee of a corporation mentioned in paragraph (a); and (c) any assignee of Atomic Energy of Canada Limited, being the company incorporated or acquired pursuant to subsection 10(2) of the *Atomic Energy Control Act*, chapter A-19 of the Revised Statutes of Canada, 1970.
"nuclear fuel waste"	"nuclear fuel waste" means irradiated fuel bundles removed from a commercial or research nuclear fission reactor.
"prime rate"	"prime rate" means, for any day, the rate of interest charged by banks to their most credit-worthy borrowers for short-term business loans, as determined and published by the Bank of Canada for the month in which the day falls.
"waste management organization"	"waste management organization" means the corporation established under section 6, regardless of the actual name of that corporation.
Comprehensive, integrated and economically sound approach	PURPOSE OF ACT **3.** The purpose of this Act is to provide a framework to enable the Governor in Council to make, from the proposals of the waste management organization, a decision on the management of nuclear fuel waste that is based on a comprehensive, integrated and economically sound approach for Canada.
Binding on Her Majesty	APPLICATION OF ACT **4.** This Act is binding on Her Majesty in right of Canada or a province.
Application to nuclear energy corporations and AECL	**5.** This Act applies to a nuclear energy corporation and to Atomic Energy of Canada Limited only if it is the owner of nuclear fuel waste.

NUCLEAR FUEL WASTE ACT	
49-50-51 Elizabeth II Chapter 23 (cont'd)	
	WASTE MANAGEMENT ORGANIZATION
Incorporation and purpose	**6.** (1) The nuclear energy corporations shall establish a corporation, in this Act referred to as the waste management organization, whose purpose under this Act is to do the following on a non-profit basis: (a) propose to the Government of Canada approaches for the management of nuclear fuel waste; and (b) implement the approach that is selected under section 15 or is approved under subsection 20(5).
Participation in waste management organization	(2) Once the waste management organization has been established, every nuclear energy corporation shall become and remain a member or shareholder of it.
Not an agent of Her Majesty	(3) For all purposes the waste management organization is not an agent of Her Majesty in right of Canada.
Duty toward other owners of nuclear fuel waste	**7.** The waste management organization shall offer, without discrimination and at a fee that is reasonable in relation to its costs of managing the nuclear fuel waste of its members or shareholders, to (a) Atomic Energy of Canada Limited, and (b) all owners of nuclear fuel waste produced in Canada that are neither members nor shareholders of the waste management organization its nuclear fuel waste management services that are set out in the approach that the Governor in Council selects under section 15 or approves under subsection 20(5).
Advisory Council	**8.** (1) The waste management organization shall create an Advisory Council, which shall (a) examine the study referred to in subsection 12(1) and the triennial reports referred to in section 18 that are to be submitted to the Minister; and (b) give written comments on that study and those reports to the waste management organization.
Representation on Advisory Council	(2) The members of the Advisory Council shall be appointed by the governing body of the waste management organization. The governing body shall make all reasonable efforts to ensure that the Advisory Council's membership (a) reflects a broad range of scientific and technical disciplines related to the management of nuclear fuel waste; (b) reflects expertise, in matters of nuclear energy, (i) in public affairs, and (ii) as needed, in other social sciences; (b.1) reflects expertise in traditional aboriginal knowledge; and (c) includes representatives nominated by local and regional governments and aboriginal organizations that are affected because their economic region is specified for the approach that the Governor in Council selects under section 15 or approves under subsection 20(5).
	FINANCING
Trust funds	**9.** (1) Each nuclear energy corporation and Atomic Energy of Canada Limited shall maintain in Canada, either individually or jointly with one or more of the other nuclear energy corporations or Atomic Energy of Canada Limited, one trust fund with a financial institution incorporated or formed by or under an Act of Parliament or of the legislature of a province, except, in the case of a nuclear energy corporation, a financial institution in relation to which the nuclear energy corporation beneficially owns, directly or indirectly, more than ten per cent of the outstanding shares of any given class of shares.

NUCLEAR FUEL WASTE ACT

49-50-51 Elizabeth II Chapter 23 (cont'd)

Documents relating to trust funds	(2) The financial institution that holds a trust fund referred to in this section shall maintain in Canada all documents relating to that trust fund.
Initial deposit to trust funds	**10.** (1) Each body mentioned in this subsection shall, either directly or through a third party, no later than 10 days after the day on which this Act comes into force, deposit to its trust fund maintained under subsection 9(1) the following respective amounts: (a) Ontario Power Generation Inc., $500,000,000; (b) Hydro-Québec, $20,000,000; (c) New Brunswick Power Corporation, $20,000,000; and (d) Atomic Energy of Canada Limited, $10,000,000.
Subsequent deposits to trust funds	(2) Each body mentioned in this subsection shall in each year, either directly or through a third party, no later than the anniversary of the day on which this Act comes into force, deposit to its trust fund maintained under subsection 9(1) the following respective amounts: (a) Ontario Power Generation Inc., $100,000,000; (b) Hydro-Québec, $4,000,000; (c) New Brunswick Power Corporation, $4,000,000; and (d) Atomic Energy of Canada Limited, $2,000,000.
When obligation ceases to apply	(3) Subsection (2) ceases to apply on the day on which the Minister approves the amount of the deposit under paragraph 16(3)(a).
Calculation of interest	(4) Interest accumulates on any portion of a deposit not paid by the day referred to in subsection (1) or (2), at the prime rate plus two per cent, calculated daily from the day referred to in subsection (1) or (2), as the case may be, to the day before the day of the deposit.
Latest date for deposit	(5) Each body mentioned in subsection (1) or (2) shall, either directly or through a third party, deposit to its trust fund maintained under subsection 9(1), no later than 30 days after the date of the decision of the Governor in Council under section 15, the applicable amount referred to in subsection (1) or (2) plus an amount, if any, equal to the interest.
Withdrawals from trust funds	**11.** (1) Only the waste management organization may withdraw moneys from a trust fund maintained under subsection 9(1).
Condition for withdrawals	(2) The waste management organization may make withdrawals only for the purpose of implementing the approach that the Governor in Council selects under section 15 or approves under subsection 20(5), including avoiding or minimizing significant socio-economic effects on a community's way of life or on its social, cultural or economic aspirations.
First withdrawal	(3) The waste management organization may make the first withdrawal only for an activity in respect of which a construction or operating licence has, after the date of the decision of the Governor in Council under section 15, been issued under section 24 of the *Nuclear Safety and Control Act*.
Ministerial approval	(4) If the Minister is of the view that the waste management organization has withdrawn moneys from a trust fund contrary to subsection (2) or (3), the Minister may require the Minister's prior approval in respect of any future withdrawal from a trust fund by the waste management organization.

NUCLEAR FUEL WASTE ACT	
49-50-51 Elizabeth II Chapter 23 (cont'd)	
	STUDY BY WASTE MANAGEMENT ORGANIZATION
Study within three years	**12.** (1) Within three years after the coming into force of this Act, the waste management organization shall submit to the Minister a study setting out (a) its proposed approaches for the management of nuclear fuel waste, along with the comments of the Advisory Council on those approaches; and (b) its recommendation as to which of its proposed approaches should be adopted.
Methods to manage nuclear fuel waste	(2) Each of the following methods must be the sole basis of at least one approach: (a) deep geological disposal in the Canadian Shield, based on the concept described by Atomic Energy of Canada Limited in the *Environmental Impact Statement on the Concept for Disposal of Canada's Nuclear Fuel Waste* and taking into account the views of the environmental assessment panel set out in the *Report of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel* dated February 1998; (b) storage at nuclear reactor sites; and (c) centralized storage, either above or below ground.
Technical description, region	(3) The study must include a detailed technical description of each proposed approach and must specify an economic region for its implementation.
Comparison of risks, etc.	(4) Each proposed approach must include a comparison of the benefits, risks and costs of that approach with those of the other approaches, taking into account the economic region in which that approach would be implemented, as well as ethical, social and economic considerations associated with that approach.
Services to certain owners of waste	(5) Each proposed approach must include a description of the nuclear fuel waste management services to be offered by the waste management organization under section 7.
Implementation plan	(6) Each proposed approach must include an implementation plan setting out, as a minimum, (a) a description of activities; (b) a timetable for carrying out the approach; (c) the means that the waste management organization plans to use to avoid or minimize significant socio-economic effects on a community's way of life or on its social, cultural or economic aspirations; and (d) a program for public consultation.
Consultation	(7) The waste management organization shall consult the general public, and in particular aboriginal peoples, on each of the proposed approaches. The study must include a summary of the comments received by the waste management organization as a result of those consultations.
Financial aspects	**13.** (1) The study must set out, with respect to each proposed approach, a formula to calculate the annual amount required to finance the management of nuclear fuel waste. The report must explain the assumptions behind each term of the formula. The formula must include the following terms: (a) the estimated total cost of management of nuclear fuel waste, which must take into account natural or other events that have a reasonable probability of occurring; (b) the estimated rate of return on the trust funds maintained under subsection 9(1); (c) the life expectancy of the nuclear reactors of each nuclear energy corporation and of Atomic Energy of Canada Limited; and (d) the estimated amounts to be received from owners of nuclear fuel waste, other than nuclear energy corporations and Atomic Energy of Canada Limited, in return for services of management of nuclear fuel waste.

NUCLEAR FUEL WASTE ACT

49-50-51 Elizabeth II Chapter 23 (cont'd)

Respective percentages	(2) The study must set out, with respect to each proposed approach, the respective percentage of the estimated total cost of management of nuclear fuel waste that is to be paid by each nuclear energy corporation and Atomic Energy of Canada Limited, and an explanation of how those respective percentages were determined.
Financial guarantees	(3) The study must set out the form and amount of any financial guarantees for the management of nuclear fuel waste that have been provided by the nuclear energy corporations and Atomic Energy of Canada Limited under the *Nuclear Safety and Control Act*.
Minister may consult public	**14.** (1) The Minister may engage in such consultations with the general public on the approaches set out in the study as the Minister considers necessary.
Revision of study	(2) If the Minister is of the opinion that the study fails in a significant way to meet the requirements of sections 12 and 13, the Minister shall direct the waste management organization to revise the relevant portions of it and submit the revised study to the Minister within the period that the Minister specifies.
Decision of Governor in Council	**15.** The Governor in Council, on the recommendation of the Minister, shall select one of the approaches for the management of nuclear fuel waste from among those set out in the study, and the decision of the Governor in Council shall be published in the *Canada Gazette*.
	REPORTS BY WASTE MANAGEMENT ORGANIZATION
Obligation to submit annual reports	**16.** (1) The waste management organization shall, within three months after the end of each fiscal year of the organization, submit to the Minister a report of its activities for that fiscal year.
Contents of annual report after section 15 decision	(2) Each annual report after the date of the decision of the Governor in Council under section 15 must include (a) the form and amount of any financial guarantees that have been provided during that fiscal year by the nuclear energy corporations and Atomic Energy of Canada Limited under the *Nuclear Safety and Control Act* and relate to implementing the approach that the Governor in Council selects under section 15 or approves under subsection 20(5); (b) the updated estimated total cost of the management of nuclear fuel waste; (c) the budget forecast for the next fiscal year; (d) the proposed formula for the next fiscal year to calculate the amount required to finance the management of nuclear fuel waste and an explanation of the assumptions behind each term of the formula; and (e) the amount of the deposit required to be paid during the next fiscal year by each of the nuclear energy corporations and Atomic Energy of Canada Limited, and the rationale by which those respective amounts were arrived at.
Minister's approval of formula and deposits	(3) The formula referred to in paragraph (2)(d) and the amount of each deposit referred to in paragraph (2)(e) are subject to the approval of the Minister when proposed in (a) the first annual report after the date of a decision of the Governor in Council under section 15 or subsection 20(5); and (b) the first annual report after the issuance, under section 24 of the *Nuclear Safety and Control Act*, of a construction or operating licence for an activity to implement the approach that the Governor in Council selects under section 15 or approves under subsection 20(5).
Grounds for refusing to approve	(4) If the Minister (a) is not satisfied that the formula referred to in paragraph (2)(d) will provide sufficient funds to implement the approach that the Governor in Council selects under section 15 or approves under subsection 20(5), or

NUCLEAR FUEL WASTE ACT	
49-50-51 Elizabeth II Chapter 23 (cont'd)	
	(b) is not satisfied that the amount of each deposit referred to in paragraph (2)(e) is consistent with the formula referred to in paragraph (2)(d), the Minister shall refuse to give the approval referred to in subsection (3) and shall direct the waste management organization to revise the relevant portions of the annual report and submit the revised annual report to the Minister within 30 days.
Obligation to deposit	**17.** (1) Each nuclear energy corporation and Atomic Energy of Canada Limited shall, either directly or through a third party, deposit to its trust fund maintained under subsection 9(1) its respective deposit specified in the annual report (a) if the Minister's approval under subsection 16(3) is not required, within 30 days after the annual report is submitted to the Minister under subsection 16(1); or (b) if the Minister's approval under subsection 16(3) is required, within 30 days after the date of that approval.
Extension of time	(2) Notwithstanding subsection (1), the Governor in Council may, on request by a nuclear energy corporation made before the expiration of the 30 day period referred to in that subsection, authorize the nuclear energy corporation to defer by one year all or part of its deposit required by that subsection, if the Governor in Council is of the opinion that the public interest requires that that money be used instead to repair the damage caused by an event that is not attributable to the corporation and is extraordinary, unforeseen and irresistible.
Triennial report	**18.** The annual report of the waste management organization for its third fiscal year after the fiscal year in which a decision is made by the Governor in Council under section 15, and for every third fiscal year after that, in this Act called the "triennial report", must include (a) a summary of its activities respecting the management of nuclear fuel waste during the last three fiscal years, including an analysis of any significant socio-economic effects of those activities on a community's way of life or on its social, cultural or economic aspirations; (b) its strategic plan for the next five fiscal years to implement the approach that the Governor in Council selects under section 15 or approves under subsection 20(5); (c) its budget forecast for the next five fiscal years to implement the strategic plan; (d) the results of its public consultations held during the last three fiscal years with respect to the matters set out in paragraphs (a) and (b); and (e) the comments of the Advisory Council on the matters referred to in paragraphs (a) to (d).
Minister's statement	**19.** The Minister shall, within 90 days after receiving a report, issue a public statement regarding the report.
Tabling of reports in Parliament	**19.1** The Minister shall cause a copy of each report to be laid before each House of Parliament within the first fifteen sitting days of that House after the Minister has received the report.
New approach – technical difficulty	CHANGE IN APPROACH **20.** (1) If the waste management organization is unable, for technical reasons beyond its control, to implement the approach that was selected by the Governor in Council under section 15, the waste management organization shall so report in its triennial report and shall, in that report, propose a new approach.
New approach – technical innovation	(2) If a new technological method is developed that has been the subject of a scientific and technical review by experts from international governmental organizations that deal with nuclear matters and has received their support, the waste management organization may propose, in its triennial report, a new approach for the management of nuclear fuel waste that is based on that new method.

NUCLEAR FUEL WASTE ACT

49-50-51 Elizabeth II Chapter 23 (cont'd)

Application of other provisions	(3) Subsections 12(3) to (7) and sections 13 and 14 apply, with such modifications as the circumstances require, in respect of an approach proposed under subsection (1) or (2). The approach must be accompanied by the comments of the Advisory Council on that approach.
Submission to Governor in Council	(4) If the Minister is satisfied that the new approach referred to in subsection (1) or (2) is technically and economically feasible in Canada, the Minister shall submit the new approach to the Governor in Council.
Decision of Governor in Council	(5) The Governor in Council may, on the recommendation of the Minister, approve an approach proposed under subsection (1) or (2), in which case the decision of the Governor in Council shall be published in the *Canada Gazette*.
Withdrawals from trust funds	WITHDRAWAL BY BENEFICIARY **21.** Notwithstanding subsection 11(1), the Governor in Council may, on the recommendation of the Minister, authorize a beneficiary of a trust fund to withdraw all or part of the balance in the trust fund if (a) the Governor in Council has approved an approach under subsection 20(5) and the total balance in the trust funds exceeds the estimated total cost of implementing that approach; or (b) the waste management organization has completed the implementation of an approach that the Governor in Council selected under section 15 or approved under subsection 20(5).
Records and books to be kept	RECORDS, BOOKS AND FINANCIAL STATEMENTS **22.** (1) The waste management organization, every nuclear energy corporation and Atomic Energy of Canada Limited, as well as every financial institution that holds a trust fund, shall keep, at its place of business in Canada, records, books of account and other documents for at least six years after the end of the fiscal year to which they relate, in such form and containing such information as will enable the verification of the accuracy and completeness of the information that is required to be submitted or provided to the Minister under this Act.
False entries, omissions	(2) No person shall make a false entry, or fail to make an entry, in a record, book of account or other document required to be kept under subsection (1).
WMO financial statements	**23.** (1) The waste management organization shall provide the Minister, within three months after the end of each fiscal year of the organization, with financial statements audited at its own expense by an independent auditor.
Trust fund financial statements	(2) Every financial institution that holds a trust fund shall provide the Minister and the waste management organization, within three months after the end of each fiscal year of the trust fund, with financial statements relating to that trust fund, audited at its own expense by an independent auditor.
Documents to be made public	DOCUMENTS TO BE MADE PUBLIC **24.** The waste management organization shall make available to the public (a) the study, reports and financial statements that it is required to submit to the Minister under this Act, simultaneously with submitting them to the Minister; and (b) financial statements provided to the waste management organization under subsection 23(2), as soon as practicable.

NUCLEAR FUEL WASTE ACT	
49-50-51 Elizabeth II Chapter 23 (cont'd)	
	INSPECTION OF RECORDS AND BOOKS
Auditors	**25.** (1) The Minister may designate as an auditor for the purposes of this Act any person that the Minister considers to be qualified.
Powers of auditors	(2) For the purpose of ensuring compliance with this Act, an auditor may, during normal business hours, (a) enter any premises of a body referred to in subsection 22(1), after having given reasonable advance notice to the person in charge of the premises; and (b) inspect, make copies of, and take extracts from, any records, books of account and other documents that the auditor believes on reasonable grounds are required by subsection 22(1) to be kept.
Designation to be produced	(3) An auditor shall, if so requested either before or after entering any premises under this section, produce to the person in charge of the premises evidence of the auditor's designation by the Minister.
Duty to assist auditor	**26.** (1) Every person shall give all reasonable assistance to an auditor.
Prohibitions	(2) No person shall obstruct or hinder an auditor, or make a false or misleading statement, either orally or in writing, or provide false or misleading information, to an auditor.
	OFFENCES AND PUNISHMENT
Failure to deposit amounts	**27.** (1) If a nuclear energy corporation or Atomic Energy of Canada Limited fails to comply with subsection 10(5) or section 17, it is guilty of an offence and liable on summary conviction to a fine not exceeding $300,000 for each day on which the offence is committed or is continued.
Court order	(2) If a body is convicted under subsection (1), the court may, in addition to any punishment imposed under that subsection, order the body to deposit to its trust fund, on or before the date fixed by the court, the amount that it failed to deposit as required, plus interest on that amount at the prime rate plus two per cent calculated from the day on which the amount was required to have been deposited.
Failure to comply with court order	(3) If a body fails to comply with an order made under subsection (2), it is guilty of an offence punishable on summary conviction and liable to a fine equal to twenty per cent of the aggregate amount set out in that order.
Failure to submit study	**28.** (1) If the waste management organization fails to submit the study of its proposed approaches within the period set out in subsection 12(1), it is guilty of an offence and liable on summary conviction to a fine not exceeding $300,000 for each day on which the offence is committed or is continued.
Failure to submit revised study, annual report	(2) If the waste management organization fails to comply with a direction of the Minister made under subsection 14(2), or fails to submit the report of its activities within the period set out in subsection 16(1), it is guilty of an offence and liable on summary conviction to a fine not exceeding $100,000 for each day on which the offence is committed or is continued.
Failure to submit revised annual report	(3) If the waste management organization fails to comply with a direction of the Minister made under subsection 16(4), it is guilty of an offence and liable on summary conviction to a fine not exceeding $50,000 for each day on which the offence is committed or is continued.

NUCLEAR FUEL WASTE ACT	
49-50-51 Elizabeth II Chapter 23 (cont'd)	
Withdrawals, making documents public	(4) If the waste management organization withdraws moneys from a trust fund without the Minister's approval where that approval is required under subsection 11(4), or fails to comply with section 24, it is guilty of an offence and liable on summary conviction to a fine not exceeding $100,000.
Auditors	(5) Every person who contravenes section 26 is guilty of an offence and liable on summary conviction to a fine not exceeding $100,000.
Other offences	(6) Every person who contravenes any other provision of this Act is guilty of an offence and liable on summary conviction to a fine not exceeding $50,000.
Offence by employee or agent	**29.** In a prosecution for an offence under this Act, it is sufficient proof of the offence to establish that it was committed by an employee or agent of the accused, whether or not the employee or agent is identified or has been prosecuted for the offence.
Due diligence	**30.** No person shall be found guilty of an offence under this Act if it is established that the person exercised all due diligence to comply with this Act or to prevent the commission of the offence.
Time limit for prosecution	**31.** Proceedings in respect of an offence under this Act may be instituted within but not later than two years after the time when the subject matter of the proceedings arose or the Minister became aware of the subject matter of the proceedings.
Coming into force	COMING INTO FORCE ***32.** This Act comes into force on a day to be fixed by order of the Governor in Council. *[Note: Act in force November 15, 2002, see SI/2002-139.]

Appendix 3 / Nature of the Hazard

In order to understand the nature of the inherent hazard posed by used nuclear fuel which will need to be addressed by any management approach, the NWMO sought insight from a variety of specialists as well as interested citizens. A diversity of views has been expressed over the course of the NWMO's study, a diversity which tends to mirror that expressed internationally when this issue is discussed. In the pages which follow, the NWMO outlines its understanding of the nature of the hazard as the underpinning for its recommendation on a management approach. The discussion begins with an overview of some key facts, the interpretation of these facts by a multi-disciplinary group convened by the NWMO for this purpose, and concludes with a statement by the NWMO. The NWMO encourages learning and debate to continue to further develop understanding of the nature of the hazard posed by used nuclear fuel.

Some Key Facts

1. Canadian Used Nuclear Fuel – Characteristics

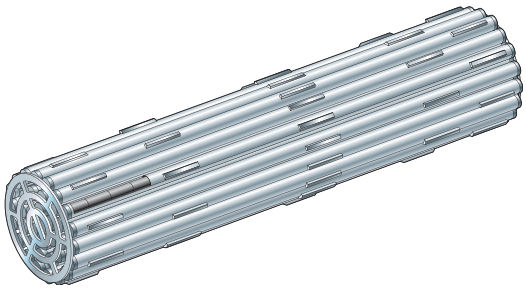
Most of the used nuclear fuel in Canada consists of used fuel which is generated at commercial nuclear power reactors in Ontario, Québec and New Brunswick. These 'CANDU' (Canadian Deuterium Uranium) reactors produce used fuel that is specific to this technology. There are also very small quantities of used fuel from research and isotope-producing reactors in Canada (*Asking the Right Questions?*, NWMO 2003). In many respects, these other nuclear fuel types are similar to CANDU fuel and are commonly used at other research facilities around the world. In the very near future, other fuel types may be introduced in Canada. For example, some Canadian nuclear utilities have proposed slight modifications to the composition of nuclear fuel through proposals to use slightly enriched uranium.

In a nuclear-powered electricity generating station, heat is produced by fission. Fission occurs within a fuel bundle when a neutron is absorbed by certain heavy elements (such as uranium-235 or plutonium-239). The characteristics and radionuclide content of used CANDU fuel for long-term management has been described in several reports such as AECL (1994) and Tait et al. (2000).

In the CANDU system used in Canada, each fuel bundle contains about 19 kg of natural uranium in the form of high-density uranium dioxide ceramic pellets. These pellets are sealed inside zirconium alloy tubes, about 0.5m long, arranged in a circular array 10 cm in diameter (see Figure A3-1). Energy is created in the nuclear reactor through the splitting of uranium atoms (fission) in a controlled chain reaction and the heat this process generates. This heat is removed by passing heavy water over the many bundles in the reactor. The heavy water then passes through boilers which transfer the heat to ordinary water, creating steam. The steam drives a turbine generator, producing electricity.

When an atom is split and neutrons are released, one neutron goes on to split another atom, and so on, keeping the nuclear reaction going. As this process continues, the concentration of fission products and actinides produced as a result of the nuclear reaction increases. The nuclear reaction begins to be impeded. At this stage, after about 12 to 18 months, the fuel is removed from the reactor both because of this build-up of fission products and actinides and the depletion of the fissionable material.

Figure A3-1 CANDU Fuel Bundle



Before entering the nuclear reactor, CANDU fuel (unirradiated or fresh fuel) consists primarily of ceramic uranium dioxide pellets. These pellets are composed of natural uranium which is approximately 99.28 percent uranium-238 and 0.72 percent uranium-235 (NWMO 2003). After leaving the nuclear reactor CANDU fuel (irradiated or used fuel) consists of approximately 98.58 percent uranium-238, 0.23 percent uranium-235, 0.27 percent plutonium-239 and very small amounts of hundreds of other radioactive fission products and actinides (see Table A3-1).

When the used fuel is removed from the reactor, it is highly radioactive. The radioactivity decreases substantially with time due primarily to the decay of short-lived radionuclides. The radioactivity of used fuel (Bq/kg U) decreases to about one percent of its initial value after one year, decreases to about 0.1 percent after 10 years and decreases to about 0.01 percent after 100 years (AECL 1994). After approximately one million years, the radioactivity in used fuel approaches that of natural uranium (AECL 1994; NWMO 2003; McMurry et al. 2003).

The fact that the total radioactivity of used fuel becomes comparable to the total radioactivity associated with a natural uranium ore deposit after a million years is considered by some people to be a useful benchmark. The total radioactivity of a used CANDU fuel bundle as a function of time out of reactor is illustrated in Figure A3-2.

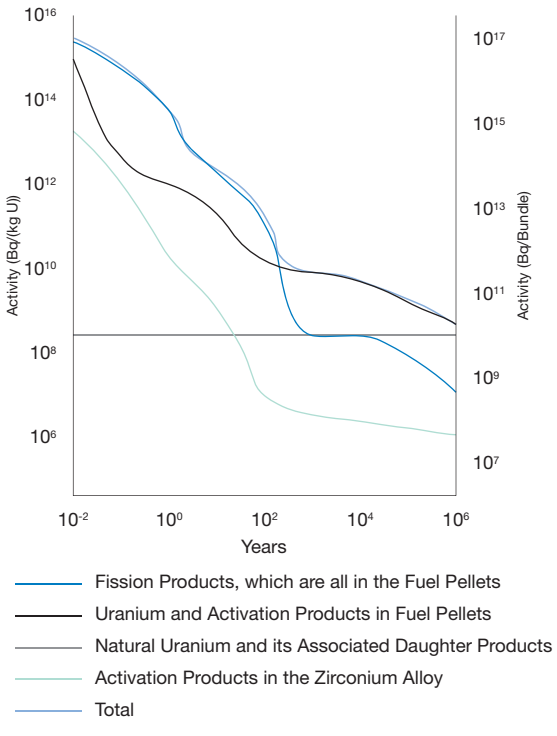
Radiotoxicity must also be considered. Note that the radiotoxicity of used fuel also becomes comparable to that of natural uranium ore on a one million year time frame.

Much of the emitted radiation is absorbed as heat by the fuel and surrounding materials. When a bundle is removed from the reactor, the heat output is about 37,000 watts (AECL 1994). The heat output drops to 73 watts after one year, five watts after 10 years and one watt after 100 years. After about 200,000 years, the decay heat from used fuel begins to approach that of natural uranium (McMurry et al. 2003).

Table A3-1 Composition of Fresh and Used CANDU Natural Uranium

COMPONENT	COMPOSITION OF UNIRRADIATED OR FRESH FUEL, %	COMPOSITION OF IRRADIATED OR USED FUEL, %
Uranium-235	0.72	0.23
Uranium-236	0	0.07
Uranium-238	99.28	98.58
Plutonium-239	0	0.25
Plutonium-240	0	0.10
Plutonium-241	0	0.02
Plutonium-241	0	0.01
Fission products	-	0.74

Figure A3-2 Total Activity of Used CANDU Fuel as a Function of Time Out of Reactor



2. Canadian Radiation Protection Regulations and Licences

The typical sources of radiation exposure are illustrated in Figure A3-3. They include radon gas from the earth's crust, radioactivity in the air, food and water, cosmic radiation and medical exposures such as dental x-rays.

The Canadian Nuclear Safety Commission (CNSC) public dose limit is the critical benchmark for public radiological safety analyses. The CNSC, which is responsible for regulating the use of nuclear materials, has set an annual radiation dose limit for members of the public of 1 mSv in one calendar year from the combined exposure to all activities which may result in radiation exposure, excluding natural background radiation and medical treatments (Radiation Protection Regulations under the *Nuclear Safety and Control Act*). For comparison, the average annual background radiation dose to members of the public in Canada from natural sources is approximately 1.7 mSv (R. Grasty et al. 2004). The total average annual background radiation dose to members of the public from natural and man made (anthropogenic) sources combined is approximately 3 mSv (Sutherland 2003).

The CNSC dose limit for nuclear energy workers has been set at the higher limit of 100 mSv in 5 years with an average of 20 mSv per year and an annual maximum exposure of 50 mSv.

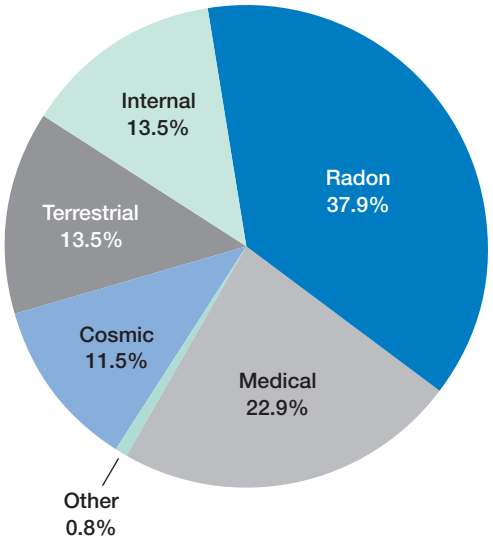
The CNSC's *Nuclear Substances and Radiation Devices Regulations* for uranium-238 requires a licence for possessing more than 1 x 10^7 Bq of uranium-238 in a non-dispersible form, which is equivalent to approximately one kg of uranium.

Measuring Radiation – Some Definitions

Bq or Becquerel
Standard international unit of radioactivity in a material reflecting the rate of decay of one atom per second.

Sv or Sievert
Standard international unit that indicates the biological damage caused by radiation. The biological damage depends on the type and energy of the radiation.

Figure A3-3 Sources of Background Radiation Exposure in Canada



Reference: Tammemagi, Hans and David Jackson, "Unlocking the Atom: the Canadian Book on Nuclear Technology". Hamilton: McMaster University Press, 2002.

3. Main Hazards

3.1 Radiotoxicity and Chemical Toxicity of Used Nuclear Fuel

Used nuclear fuel is a potential source of both external radiation and internal exposure to humans and the natural environment. The health effects from exposure to radiation have been studied over the years and documented in numerous publications such as BEIR (1990), ICRP (1991) and UNSCEAR (2000), which form the foundation for the development of international standards and regulatory regime. This work was summarized for the NWMO by Sutherland (2003). There is, however, some on-going debate on the potential biological effects of radiation on humans and non-human biota, and the health risks and dose models associated with low doses (e.g., see ECRR 2003). In particular, there is on-going debate on whether there are potential benefits from low doses of radiation (hormesis), whether the linear-no-threshold hypothesis for calculating risk is overly conservative, and whether or not regulations set to protect humans are sufficient to protect non-human biota.

The linear-no-threshold hypothesis is a conservative set of assumptions on which the

Table A3-2 Canadian Drinking Water Guidelines – Maximum Acceptable Concentration (Ref. Health Canada, April 2004)

RADIONUCLIDE	HALF LIFE (years)	INGESTION DOSE CONVERSION FACTOR (Sv/Bq)	MAXIMUM ACCEPTABLE CONCENTRATION (Bq/L)
Uranium-235	704,000,000	3.8×10^{-8}	4[a]
Uranium-238	4,470,000,000	3.6×10^{-8}	4[a]
Plutonium-239	24,100	5.6×10^{-7}	0.2
Radium-226	1,600	2.2×10^{-7}	0.6
Cesium-137	30.2	1.3×10^{-8}	10
Carbon-14	5,730	5.6×10^{-10}	200
Iodine-129	16,000,000	1.1×10^{-7}	1

[a] Note, the MAC for uranium based on chemical toxicity is 0.02 mg/L or about 0.5 Bq/L.

International Atomic Energy Agency's (IAEA) safety standards, the International Committee for Radiological Protection's (ICRP) recommendations, and CNSC regulatory oversight are based. The assumption is made that there are health risks associated with any exposure to radiation, even though it has not been proven that low doses are harmful (Sutherland 2003). This assumption may lead to an over-estimate of harm. However, it is considered the most defensible assumption on which to base safety standards by these international and Canadian authorities.

As part of the continuing debate, a report recently released by the U.S. National Academies' National Research Council supports the linear no-threshold (LNT) model of radiation health effects (BEIR June 2005). Also released in 2005 was the largest epidemiological study of low-dose radiation risk ever conducted. Carried out by the International Agency for Research on Cancer, the "International Collaborative Study" (IARC 2005) also appears to support existing radiation protection standards that assume even low doses (nuclear worker level doses, 19 mSv on average used in the study) can be harmful.

The hazard associated with used nuclear fuel from ingestion (for instance as dissolved in water) or inhalation (from dispersion in the air) depends on the exposure pathway, the dose associated with each radionuclide and the time the used nuclear fuel has been out of the reactor. A common index of radiotoxicity is based on the dose or risk calculated from ingestion (Mehta et al. 1991; OECD 2004). Similarly, drinking water guidelines are usually based on the water ingestion pathway (2 L/day), dose conversion factors for individual radionuclides and a dose limit set at 10 percent of the public dose limit (0.1 mSv in a calendar year).

Health Canada Guidelines for Canadian Drinking Water Quality were published in April 2004. The Health Canada maximum acceptable concentration (MAC) for selected radionuclides which are important in used nuclear fuel is listed in Table A3-2. The principal chemical in used fuel is uranium and the MAC for uranium is limited by its chemical toxicity value of 0.02 mg/L which corresponds to a radionuclide concentration of about 0.5 Bq/L.

The radiotoxicity analysis for used CANDU fuel suggests that this material is a potential internal exposure health risk for more than one million years (Mehta et al. 1991; AECL 1994). Similar analysis for used pressurized water reactor (PWR) fuel with enriched uranium-235 suggests that the radiotoxicity of used fuel becomes equal to the equivalent uranium ore after about 130,000 years (IAEA 2004). Other analysis suggests the time period is between 500,000 and one million years (OECD 2004).

3.2 External Radiation from Used Nuclear Fuel

The external radiation field from a CANDU bundle depends on time out of reactor and exposure distance from the fuel, which is typically measured from 0.3 to one metre from the source (Sutherland 2003). External radiation fields for various fuel ages are listed in Table A3-3 (Sutherland 2003). Exposure time to reach the public radiation dose limit of 1 mSv in a calendar year is also provided.

The analysis in Table A3-3 indicates that at 50 years, the external radiation dose from unshielded used nuclear fuel would present a significant health risk. At a dose rate of 1,150 mSv/h, unshielded nuclear fuel would give a potentially fatal dose of 5 Sv after about four hours of exposure. While the external radiation from used fuel declines rapidly with the passage of time, it could still be considered significant from a public dose perspective far into the future since exposure to million-year old fuel (or unirradiated fuel for that matter) could potentially reach the public dose limit of 1 mSv/a after about 110 hours.

4. Longevity

Based on the above discussion, one could conclude that used nuclear fuel poses a hazard which needs to be managed for one million years or more.

Discussion – Results of an NWMO Workshop

A workshop involving 16 specialists knowledgeable on various technical, environmental, health, social and ethical aspects of used nuclear fuel addressed the question "What is the nature of the hazard from used nuclear fuel?." After considering the information described above, workshop participants prepared a statement which is included here, and reproduced in the box following, as an additional component of the NWMO's description of the nature of the hazard.

Table A3-3 External Radiation from Used CANDU Fuel as a Function of Time

AGE OF USED CANDU FUEL (years)	UNSHIELDED EXTERNAL RADIATION FIELD AT 0.3 m (mSv/h)	EXPOSURE TIME TO REACH PUBLIC DOSE LIMIT OF 1 mSv/a
50	1,150	3 seconds
100	360	10 seconds
200	37	97 seconds
500	0.82	1.2 hours
1,000,000	0.009	110 hours

Figures shown for an average burn-up of 7,800 MW days per tonne of uranium.

A Participants' Statement on Characterizing the Hazard of Used Nuclear Fuel

A workshop addressing the question "what is the nature of the hazard from used nuclear fuel" was held in Toronto on February 10, 2005. The workshop involved 16 experts and other persons knowledgeable on various technical, environmental, health, social and ethical aspects of used nuclear fuel. This statement is the result of that workshop.

The Context

Note: This short section is written to reflect the wide-ranging discussion during the first session of the workshop in the morning, in so far as it provides context for the statement.Topics raised included:

Participants had differing views on the role of nuclear power in Canada.

Management solutions need to take account of possible changes in technology over time.

Prior informed consent is important to apply, including for Aboriginal communities.

There are three lines of inquiry when it comes to understanding the hazard. These are:

- *What is the inherent hazard of used nuclear fuel?*
- *How dangerous is it to human health and the environment?*
- *How can NWMO recommendations best protect human health and the environment from the hazards of used nuclear fuel?*

Inherent Hazard

Hazard can be considered generally as a source of danger or a possibility of being harmed. The inherent hazards of used nuclear fuel are primarily its radiotoxicity and its chemical toxicity.

Used nuclear fuel is inherently hazardous to human health and the environment. Maximum hazard exists in the short term, and while it does diminish over time, for practical purposes some hazard remains for an indefinite time.

The concept of indefinite time is in keeping with the premises of traditional knowledge and the need to ensure the health of all living beings. It reflects a recognition that there is scientific uncertainty.

There is a view among workshop participants that the containment and isolation of used nuclear fuel cannot be guaranteed for an indefinite period.

Pathways

The radiological hazard inherent in used nuclear fuel can negatively impact the health of humans, other organisms and ecosystems if it enters into the environment. It can then have impacts through external exposure to the body, or through internal exposure by lesions, ingestion or inhalation. The chemical hazard inherent in used nuclear fuel can impact humans, other organisms and ecosystems through dispersal and uptake into living organisms. Radiotoxicity and chemical toxicity depend on dose received.
The main potential pathways for internal exposure are through groundwater flow and subsequent entry into the food chain. A potential pathway for both external and internal exposure is through airborne transport of material.

Control and Protection

Used nuclear fuel needs to be contained and isolated as a response to the hazard it poses.

There remain different scientific interpretations of the health impact of low doses and dose rates of ionizing radiation. While experts differ over what may constitute a safe level of radiation exposure, it is consistent with international practice to act, in a conservative manner, as if there are health risks from any exposure to radiation.

Some experts say it may be useful to study the characteristics of natural uranium deposits to ensure long-term protection of life from the hazards of used nuclear fuel.

There is an established international system for radiation protection to regulate radiation exposure resulting from human activity. This has been used for several decades to protect workers and the public.

Participants suggest that NWMO make reference to the International Atomic EnergyAgency documentation of this system based on recommendations of the International Commission on Radiological Protection (ICRP) and scientific reviews carried out by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

Participants suggest NWMO make reference to a table on external radiation from used nuclear fuel as a function of time. They further suggest that NWMO prepare some form of simple graphic information on potential health hazard from used nuclear fuel.

Some participants suggest that the NWMO make reference to recommendations of the European Committee on Radiation Risk (ECRR 2003) related to the health effects of ionizing radiation exposure at low doses for radiation protection purpose.

Some participants suggest that the NWMO make reference to the draft 2005Recommendations of the International Commission on Radiological Protection (ICRP).

Security

Security is required for used nuclear fuel because of the possibility that saboteurs could try to defeat the security measures of facilities and use the material to cause harm to people and the environment. Security concerns also relate to the diversion of used nuclear fuel toward the making of weapons.

Regulation, Standards and Oversight

Any approach for long-term management of used nuclear fuel will need to provide confidence that its implementation will meet or exceed regulatory requirements established by Canadian authorities, including the Canadian Nuclear Safety Commission, and it should be consistent with internationally recognized approaches. Canadian regulations generally follow international practices but Canadian law takes precedence.

Participants agree that the NWMO should include a short statement on the ethical and social framework which it has applied to its work, and on the perspectives of Aboriginal peoples.

Uncertainty

Much is known about the hazard associated with used nuclear fuel and its implications for long-term management approaches. However, given the long time periods involved, there are limitations to our knowledge and uncertainties associated with the environmental and human activity aspects of management approaches. A precautionary approach is appropriate.

The preceding statement, and an accompanying report, emerged from discussion among the following individuals:

List of Participants

Anar S. Baweja
Environmental Impact Specialist, Environmental Radiation Hazards Division – Radiation Protection Bureau, Healthy Environments and Consumer Safety Branch (HECS)

Andrew Brook
Professor of Philosophy, Director, Institute of Cognitive Science, Member, Canadian Psychoanalytic Society, Member of NWMO's Roundtable on Ethics

Jerry M. Cuttler
Cuttler & Associates

Mary Lou Harley
Member, Nuclear Issues Writing Group for Justice, Global and Ecumenical Relations Unit, United Church of Canada

Tom Isaacs
Director, Office of Policy, Planning and Special Studies, Lawrence Livermore National Laboratory

Robert Lojk
Director Waste and Geoscience Division, Canadian Nuclear Safety Commission

Dave Martin
Greenpeace

Dan Meneley
Engineer Emeritus and former Chief Engineer, AECL

Reza Moridi
Chief Scientist, Radiation Safety Institute of Canada

Allan Morin
Elder

Fergal Nolan
President and Chief Executive Officer, Radiation Safety Institute of Canada

John A. Read
Director General, Transport Dangerous Goods (TDG)

John Rowat
Department of Nuclear Safety and Security, International Atomic Energy Agency

David W. Whillans
Senior Scientist, Science and Technology, Health Physics Department, Radiation Protection Division, Ontario Power Generation – Nuclear

Winston Wuttunee
Elder

Facilitators

George Greene
President, Stratos Inc.

Mary Jane Middelkoop (rapporteur)
Stratos Inc.

NWMO's Conclusion

Consistent with international standards and the regulatory regime governing management of used nuclear fuel in Canada, for the purposes of its study the NWMO has taken the position that used nuclear fuel will need to be contained and isolated from people and the environment essentially indefinitely.

The NWMO encourages learning and debate to continue to further develop understanding of the inherent nature of the hazard posed by used nuclear fuel. We recognize that international standards and domestic requirements may evolve with new learning. Any implementation plan for the long term management of used nuclear fuel will need to monitor evolution in understanding and/or requirements and be sufficiently adaptable to incorporate and respond to them. Any implementation plan will also need to include a substantial and continuing effort to increase the understanding of citizens on this issue.

References

AECL. 1994. Environmental impact statement on the concept for disposal of Canada's nuclear fuel waste. Atomic Energy of Canada Limited Report, AECL-10711, COG-93-1. Chalk River, Ontario.

BEIR. 1990. Health effects of exposure to low levels of ionizing radiation. Committee on the Biological Effects of Ionizing Radiation. National Research Council, National Academy Press. Washington, DC.

BEIR, 2005. Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2 (2005). Board on Radiation Effects Research, The National Academies Press. Washington, DC.

ECRR. 2003. Recommendations of the European committee on radiation risk. The health effects of ionising radiation exposure at low doses for radiation protection purposes. Regulators' Edition.

Gierszewski, P., J. Avis, N. Calder, A. D'Andrea, F. Garisto, C. Kitson, T. Melnyk, K. Wei and L. Wojciechowski. 2004. Third case study – Postclosure safety assessment. Ontario Power Generation, Nuclear Waste Management Division Report 06819-REP-01200-10109-R00. Toronto, Ontario.

Government of Canada. 2000. Radiation protection regulations. Canada Gazette Part II, Vol. 134, No. 13, SOR/DORS/2000 203. 31 May 2000. Ottawa, Ontario.

Grasty, R., J.R. LaMarre. 2004. The annual effective dose from natural sources of ionising radiation in Canada. Radiation Protection Dosimetry 108(3), p.215-226.

IAEA. 2004. Implications of partitioning and transmutation in radioactive waste management. International Atomic Energy Agency Technical Report Series No. 435. Vienna, Austria.

IARC. 2005. Risk of cancer after low doses of ionising radiation – retrospective cohort study in 15 countries. British Medical Journal.

ICRP. 1991. 1990 recommendations of the International Commission on Radiological Protection. Annals of the ICRP 21(1 – 3). ICRP Publication 60. Pergamon Press, Oxford.

McMurry, J., D.A. Dixon, J.D. Garroni, B.M. Ikeda, S. Stroes-Gascoyne, P. Baumgartner and T.W. Melnyk. 2003. Evolution of a Canadian deep geologic repository: Base scenario. Prepared by Atomic Energy of Canada Limited. Ontario Power Generation, Nuclear Waste Management Division Report 06819-REP-01200-10092-R00. Toronto, Canada.

Mehta, K., G.R. Sherman and S.G. King. 1991. Potential health hazards of nuclear fuel waste and uranium ore. Atomic Energy of Canada Limited Report AECL 8407. Chalk River, Ontario.

NWMO. 2003. *Asking the Right Questions? The Future Management of Canada's Used Nuclear Fuel.*
(See www.nwmo.ca/askingtherightquestions)

NWMO. 2004. *Understanding the Choices. The Future Management of Canada's Used Nuclear Fuel.*
(See www.nwmo.ca/understandingthechoices)

OECD. 2004. The handling of timescales in assessing post-closure safety. Lessons learnt from the April 2002 Workshop in Paris, France. Organization for Economic Co-operation and Development, Nuclear Energy Agency Report NEA No. 4435, ISBN 92-64-02161-2. Paris, France.

Sutherland, J.K. 2003. Health aspects of high-level radioactive waste. Background Paper 3-2 prepared by Edutech Enterprises for the Nuclear Waste Management Organization.
(See www.nwmo.ca/backgroundpapers)

Tait, J.C., H. Roman and C.A. Morrison. 2000. Characteristics and radionuclide inventories of used fuel from OPG generating stations. Ontario Power Generation, Nuclear Waste Management Division Report 06819-REP-01200-10029-R00. Toronto, Ontario.

UNSCEAR. 2000. United Nations Scientific Committee on the Effects of Atomic Radiation. Sources and Effects of Ionizing Radiation. UNSCEAR 2000 Report to the General Assembly. United Nations. New York.

Appendix 4 / Status of Used Nuclear Fuel in Canada

In Canada, producers and owners of used nuclear fuel are responsible for its interim management. After seven to ten years in water-filled storage bays, used fuel bundles are transferred to dry storage facilities at the reactor sites.

The uranium mass of a CANDU fuel bundle is approximately 19.2 kilograms. As of December 31, 2004, Canada had 35,888 tonnes of uranium in its used nuclear fuel.

Electricity Generating Stations

Bruce Power operates six of eight reactors at the Bruce nuclear generating stations in Kincardine, Ontario. The company reported on March 21, 2005 that it had reached a tentative agreement with a negotiator appointed by the Province of Ontario for the potential restart of two additional units, one of which was shut down in October 1995, and the other in October 1997. Current operating licences for both Bruce A and Bruce B expire on March 31, 2009.

Ontario Power Generation Inc. (OPG) operates the Pickering nuclear generating stations in Pickering, Ontario. All four reactors at the Pickering B plant are in service. Estimated operating lives for these reactors range from 2013 to 2016. The current Pickering B operating licence expires on June 30, 2008.

Unit 4 at Pickering A was returned to service in September 2003. It had been shut down along with the other three Pickering A units in 1997. Unit 1 is planned to be returned to service in 2005. The pressure tubes at Pickering A were replaced between 1984 and 1993. As a result, OPG expects the operating life estimate for Units 1 and 4 to be extended to 2023. In August 2005, OPG announced that it would not refurbish Units 2 and 3 due to unexpected wear in the steam generators. The current operating licence for Pickering A expires on June 30, 2010.

Table A4-1 Storage of Used Nuclear Fuel as of December 31, 2004

Storage Location	Licensee	Bundles in Reactor(s)	Bundles in Wet Storage	Bundles in Dry Storage	Total Fuel Bundles
Bruce A	Bruce Power[1]	12,480	361,271		373,751
Bruce B	Bruce Power[1]	24,575	369,344	29,184	423,103
Pickering	OPG	36,744	382,332	135,927	555,003
Darlington	OPG	24,960	256,068		281,028
Douglas Point	AECL[2]			22,256	22,256
Chalk River	AECL[3]			4,853	4,853
Gentilly 1	AECL[4]			3,213	3,213
Gentilly 2	HQ	4,560	33,814	60,000	98,374
Pt. Lepreau	NBP	4,560	39,482	63,180	107,222
Whiteshell	AECL[5]			360	360
Total		**107,879**	**1,442,311**	**318,973**	**1,869,163**

1 OPG manages used fuel produced by Bruce Power which leases the Bruce reactors from OPG.
2 The Douglas Point Nuclear Generating Station in Kincardine, Ontario was shut down in 1986.
3 Chalk River Laboratories (CRL), near Deep River, Ontario is a nuclear research facility with test reactors, fuel inspection and other facilities. Most of the used fuel bundles in the CRL dry storage area are from the Nuclear Power Demonstration (NPD) reactor which was de-fueled in 1987. A quantity of non-standard fuel waste is also stored at the CRL.
4 Gentilly 1, at Becancour, Québec was shut down in 1977.
5 The dry storage facility at Whiteshell, Manitoba houses research reactor fuel rods and some used fuel bundles from the shutdown Douglas Point reactor.

OPG also operates four reactors at the Darlington nuclear generating station in Clarington, Ontario. The estimated operating life of these units ranges from 2018 to 2019. The current operating licence for Darlington expires on February 29, 2008.

Hydro-Québec operates one reactor at the Gentilly-2 nuclear generating station in Bécancour, Québec. The power plant is designed to operate until 2013. No decision has been taken on a company proposal to refurbish the plant, extending its life to 2035. The operating licence for Gentilly-2 expires on December 31, 2006.

NB Power Nuclear operates one reactor at the Point Lepreau nuclear generating station in Lepreau, New Brunswick. Its current operating licence expires on December 31, 2005. In July 2005, the Province of New Brunswick announced that it would proceed with the refurbishment of the Point Lepreau reactor beginning in 2008 and ending in 2009. The planned refurbishment of Point Lepreau could extend its service life for another 25 to 30 years beyond the refurbishment completion date.

The current inventory of used nuclear fuel in wet and dry storage at the nuclear reactor sites as of December 31, 2004 is listed in Table A4-1.

Projections of used fuel inventory in Canada can be made based on operational experience. When all of Canada's 22 CANDU reactors are operating, they generate about 16,000 MW and produce about 100,000 used fuel bundles per year, or about 6.25 bundles per MW year. The actual production of used fuel will depend on a number of factors such as reactor operational experience, decisions on refurbishment and life extension (e.g., Point Lepreau, Gentilly, Bruce A, Pickering A) and whether or not new reactors are constructed. Therefore, projections of used fuel inventory change as new information becomes available.

An estimate of the projected inventory of used fuel for each of the owners is given in Table A4-2. The original estimate was prepared in 2001 by the Joint Waste Owners for NWMO conceptual design and cost estimating purposes. The 2001 projected inventory assumed that the Pickering, Bruce and Darlington reactors in Ontario would operate 40 years, the Point Lepreau reactor in New Brunswick would operate 25 years, and the Gentilly reactor in Québec would operate 30 years. The total projected used fuel inventory was 3,557,451 bundles, which has been rounded up to 3.6 million bundles for conceptual design and cost estimating purposes.

In 2004, the Joint Waste Owners revised their projections based on a common 40-year average nuclear reactor life. This 2004 estimate is 3,665,094 fuel bundles or a rounded value of 3.7 million fuel bundles. The change in the reference scenario from about 3.6 million to 3.7 million fuel bundles (< 3%) would not have a significant impact on the conceptual designs for long-term management facilities. The larger value is more conservative from a design and cost perspective, but not materially different than the original estimate since the reference

Table A4-2 Projected Total Inventory of Used Nuclear Fuel

	Projected Total Used Fuel Inventory (number of bundles)	
Used Fuel Owner	**2001 Estimate**	**2004 Estimate**
Ontario Power Generation Inc.	3,274,431	3,274,412
Hydro-Québec	132,838	180,000
NB Power Nuclear	119,500	180,000
Atomic Energy of Canada Limited	30,682	30,682
Total	**3,557,451**	**3,665,094**
Total (rounded)	**3,600,000**	**3,700,000**

designs were prepared using the projected number of used fuel bundles rounded up to the nearest 100,000 bundles.

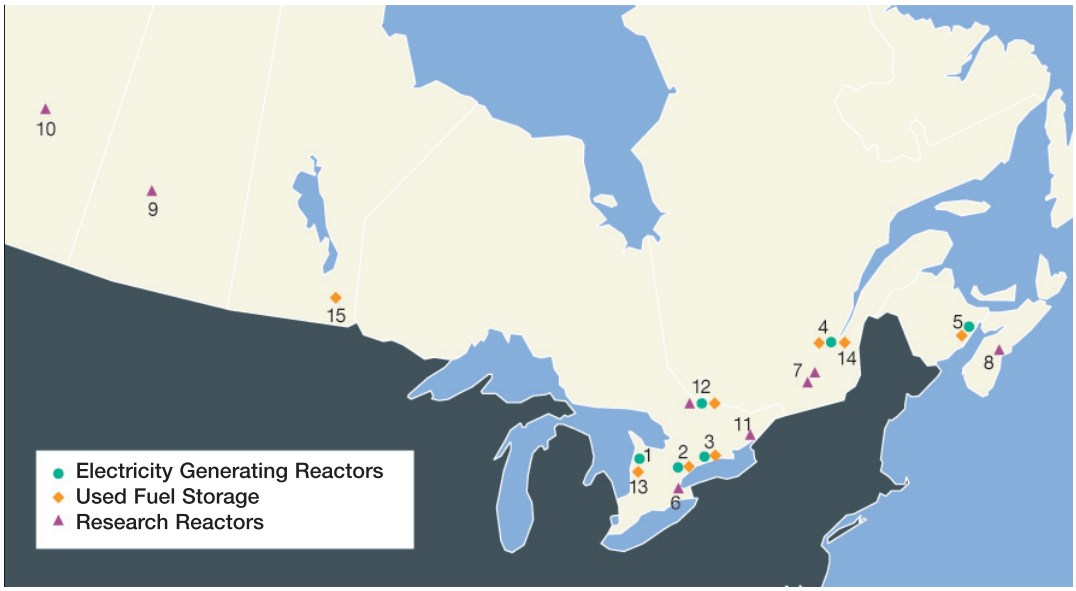
There continues to be uncertainty regarding the number of used fuel bundles that will eventually be produced in Canada. To address that uncertainty, the Joint Waste Owners have also prepared used fuel estimates for an average station life of 30 years (3.0 million bundles) and an average station life of 50 years (4.4 million bundles).

Research Reactors

Canada has a number of research and isotope-producing reactors. These include five SLOWPOKE reactors located at: École Polytechnique in Montréal, Dalhousie University in Halifax, Royal Military College in Kingston, the Saskatchewan Research Council in Saskatoon, and the University of Alberta in Edmonton. SLOWPOKE reactors, which use U-235 enriched fuel, can operate on one fuel charge for 20 to 40 years. The total mass of U-235 fuel in a SLOWPOKE reactor core is about one kilogram. Used fuel from some of these research reactors has been shipped to the AECL site at Chalk River, Ontario.

AECL has operated research reactors to support nuclear R&D and/or produce

Figure A4-1 Nuclear Reactor Sites in Canada



1. Bruce Nuclear Generating Station – Kincardine, ON
2. Pickering Nuclear Generating Station – Pickering, ON
3. Darlington Nuclear Generating Station – Clarington, ON
4. Gentilly 2 Nuclear Generating Station – Bécancour, PQ
5. Point Lepreau Nuclear Generating Station – Lepreau, NB
6. McMaster University – Hamilton, ON
7. École Polytechnique – Montréal, PQ
8. Dalhousie University – Halifax, NS
9. Saskatchewan Research Council – Saskatoon, SK
10. University of Alberta – Edmonton, AB
11. Royal Military College – Kingston, ON
12. AECL CRL – Chalk River, ON
13. AECL Douglas Point – Kincardine, ON
14. AECL Gentilly 1 – Bécancour PQ
15. AECL Whiteshell Labs – Pinawa, MB

medical isotopes since 1945. At Chalk River Laboratories (CRL), AECL operates the NRU, MAPLE 1 and MAPLE 2 production reactors, and a low-power ZED-2. The NRX reactor is shut down. Non-operating low-power reactors at CRL include PTR and ZEEP. AECL operated two reactors, WR-1 and SLOWPOKE Demonstrator (SDR) at its Whiteshell site in Manitoba. Both are shut down.

Used fuel from Canada's SLOWPOKE and AECL reactors is divided into about 70 different types, each with its own characteristics. AECL has long-term management strategies applicable to all used fuel arising from these research reactors.

McMaster University in Hamilton operates a pool-type reactor. Used fuel from this reactor is returned to its manufacturer in the United States.

The amount of used nuclear fuel from a research reactor, such as the SLOWPOKE, is typically about a kilogram or less, which is a very small amount compared to the approximately 19.2 kilograms of uranium in a single CANDU fuel bundle. Nevertheless, research reactor fuel is an important component of Canada's used fuel inventory and it will be incorporated into the long-term management approach.

Appendix 5 / Regulatory Framework

The legal and administrative arrangements governing nuclear energy have evolved considerably since the industry's inception immediately after World War II. The Government of Canada has legislative authority over the development and control of nuclear energy in Canada. The industry is regulated both through laws of general application and through specially focused regulations, policies and licence provisions. Consultation and cooperation among provincial, national and international agencies is essential to promote harmonized regulation and consistent national and international standards and achieve conformity with the measures of control and international obligations to which Canada has agreed concerning radioactive waste.

Federal Legislation

Canada has in place a comprehensive network of laws, regulations and policies that provide the legal basis for mitigation, preparedness and prudent risk management of nuclear installations and radioactive substances.

Nuclear Fuel Waste Act

The aim of the *Nuclear Fuel Waste Act* (*NFWA*) is to provide the necessary framework for choosing and then implementing a long-term management approach for nuclear fuel waste in Canada that is comprehensive, integrated and economically sound. It has five major sections addressing: the creation and function of the waste management organization; financing; the study produced by the waste management organization; reports, approvals and inspections; and offences and punishment. (See Appendix 2 for the *NFWA*.)

The *NFWA* requires the establishment of the NWMO to propose to the Government of Canada approaches, including its preference, for the long-term management of nuclear fuel waste and to implement the approved approach. The NWMO is to present its study to the Minister of Natural Resources Canada within three years of the act coming into force. The Minister may seek public comment on the study, or request the NWMO to undertake further work, before

providing a recommendation to the government.

Once the government decides on the approach for long-term management of used nuclear fuel the NWMO is required to implement that approach. Changes with respect to reporting and financing take effect.

Nuclear Safety and Control Act

The Canadian Nuclear Safety Commission (CNSC) is the regulatory body established by the federal government to license nuclear facilities and to regulate the use of nuclear energy and materials to protect health, safety, security and the environment and to respect Canada's international commitments on the peaceful use of nuclear energy. The CNSC operates and enforces regulations under the *Nuclear Safety and Control Act* (*NSCA*). The CNSC is the nuclear energy and materials "watchdog" in Canada. The Commission is responsible for regulating nuclear power plants, nuclear research facilities and many uses of nuclear materials, including the use of radioisotopes for the treatment of cancer, and the operation of uranium mines and refineries.

The CNSC mandate involves:

- Regulating the development, production and use of nuclear energy in Canada;
- Regulating the production, possession and use of nuclear substances, prescribed equipment and prescribed information;
- Implementing measures respecting international control of the use of nuclear energy and substances, including measures respecting the non-proliferation of nuclear weapons; and
- Disseminating scientific, technical and regulatory information concerning the activities of the CNSC.

Requirements of Licensees

All current nuclear facilities – including provisions for nuclear waste management – must be licensed by the CNSC. The CNSC requires licence applicants to conduct detailed analyses of the anticipated effects on the environment, and on human health, safety and security of the proposed licensed activity. It also requires applicants to conduct a public information program that provides this information to persons living in the vicinity of the site in a clear and understandable manner.

As part of the review process, the CNSC evaluates the detailed submissions of the applicant, including the public information program. In addition, and to facilitate openness and transparency, the CNSC makes decisions on the licensing of major nuclear facilities through a public hearing process. The CNSC notifies and encourages individuals and organizations to attend public hearings, and to make submissions orally or in writing. Advance notice of the hearings is published in newspapers and notice of hearings and meetings is posted on the CNSC website (www.nuclearsafety.gc.ca). A detailed record of proceedings, including the reasons for decisions of the Commission, is made available to the public shortly after the proceedings. The CNSC also administers the *Nuclear Liability Act*, including designating nuclear installations and prescribing basic insurance to be carried by the operators.

To transport used nuclear fuel, a proponent (the consignor) must obtain a licence that contains, in addition to the information required by the Packaging and Transport of Nuclear Substances Regulations of the *Nuclear Safety and Control Act*, a detailed transportation security plan. The information required for the plan includes, but is not limited to:

- A threat assessment;
- Proposed security measures; and
- Arrangements for a response force.

Before a licence is issued, the security plan submitted with the licence application is reviewed by CNSC staff to ensure compliance with the regulations and a "best-practices" approach to the security arrangements.

CNSC Regulatory Documents

As the federal regulator, the CNSC executes licensing decisions made by the Commission or its designates and continually monitors licensees to ensure they comply with safety requirements that protect workers, the public, and the environment and uphold Canada's

international commitments on the peaceful use of nuclear energy. The requirements are set out through the *NSCA*, its associated regulations, licences and directives provided by the CNSC. The CNSC also offers instruction, assistance and information on these requirements in the form of regulatory documents, such as policies, standards, guides and notices. Compliance is verified through inspections and reports.

CNSC Regulatory Policy P-290, Managing Radioactive Waste

Regulatory policies are documents that describe the philosophy, principles or fundamental factors which underlie the CNSC's approach to its regulatory mission. They provide direction to CNSC staff and information to stakeholders.

Regulatory Policy P-290 "Managing Radioactive Wastes" describes the philosophy that underlies the CNSC's approach to regulating the management of radioactive waste and the principles that are taken into account when making a regulatory decision concerning radioactive waste management. It is intended to promote the implementation of measures to manage radioactive waste so as to protect the health and safety of persons and the environment, provide for the maintenance of national security, and achieve conformity with measures of control and international obligations to which Canada has agreed; and to promote consistent national and international standards and practices for the management and control of radioactive waste.

When making regulatory decisions concerning the management of radioactive waste, the CNSC will consider the extent to which the owners of the waste have addressed the following principles:

- The generation of radioactive waste is minimized to the extent practicable by the implementation of design measures, operating procedures and decommissioning practices;
- The management of radioactive waste is commensurate with its radiological, chemical and biological hazard to the health and safety of persons and the environment and to national security;
- The assessment of future impacts of radioactive waste on the health and safety of persons and the environment encompasses the period of time when the maximum impact is predicted to occur;
- The predicted impacts on the health and safety of persons and the environment from the management of radioactive waste are no greater than the impacts that are permissible in Canada at the time of the regulatory decision;
- The measures needed to prevent unreasonable risk to present and to future generations from the hazards of radioactive waste are developed, funded and implemented as soon as reasonably practicable; and
- The transborder effects on the health and safety of persons and the environment that could result from the management of radio-active waste in Canada are not greater than the effects experienced in Canada.

CNSC Draft Regulatory Guide G-320, Assessing the Long-term Safety of Radioactive Waste Management

Regulatory guides are documents that indicate acceptable ways of meeting CNSC requirements as expressed in the Act, Regulations, regulatory standards or other legally-enforceable instrument. They provide guidance to licensees and other stakeholders.

The purpose of Draft Regulatory Guide G-320 "Assessing the Long-term Safety of Radioactive Waste Management" is to assist licensees and applicants assess the long-term safety of storage and disposal of radioactive wastes. Long-term safety assessments are used to give reasonable assurance that proposed plans for the long term management of radioactive waste are consistent with CNSC requirements for protecting the health and safety of humans and protecting the environment.

Draft Regulatory Guide G-320 sets out typical ways to assess the impacts that radioactive waste storage and disposal methods have on the environment and on the health and safety of people in the long term. It provides guidance on such matters as:

- Assessment methodologies, structure and approach;
- Level of detail of assessments;
- Confidence to be placed in assessment results;
- Applying radiological and non-radiological criteria;
- Defining critical groups for impact assessments;
- Selecting time frames for impact assessments;
- Setting post-decommissioning objectives;
- Long term care and maintenance considerations, and
- Use of institutional controls.

The approaches described are possible methods of providing reasonable assurance of long-term safety. They are not equally applicable to every assessment; licence applicants are expected to propose and justify their application of the guidance provided.

Compliance Verification

Confirmation of compliance with licences is managed within the CNSC's formal compliance verification program which includes promotion, verification and enforcement.

A compliance promotion program informs the regulated community of the rationale behind the regulatory regime and disseminates information about regulatory requirements and standards.

To verify compliance, the CNSC regularly evaluates the licensee's operations and activities, ensures that administrative controls are in place, reviews, verifies and evaluates information provided and evaluates any remedial action to ensure that incidents are avoided in the future. Routine inspections, evaluations and audits are supplemented by analysis of safety-significant events.

The CNSC uses a graduated approach to enforcement, commensurate with the risk or regulatory significance of the violation.

Canadian Environmental Assessment Act

Canadian laws of general application that are relevant to aspects of the management of used nuclear fuel include the *Canadian Environmental Assessment Act*. An environmental assessment is required prior to the initial issuance of licences by the CNSC that authorize activities involving nuclear substances. Since all of the aspects involved in managing nuclear waste, including interim and long-term storage and disposal and any transportation between, must be authorized through issuance of a CNSC licence, each of these aspects must be considered in the environmental assessment of the project. Certain projects, as defined by the Comprehensive Studies List Regulations, are required to be subject to a comprehensive study. The environmental assessment must be conducted "as soon as practicable in the planning stages and before irrevocable decisions are made."

Nuclear Liability Act

A fundamental component of sound risk management is to anticipate and prepare for potential damages to persons and property associated with major hazards. This is the essence of the precautionary approach. Canada's *Nuclear Liability Act* establishes a compensation and civil liability regime in the event of a nuclear accident with third-party consequences.

The Canadian Nuclear Safety Commission is the federal agency that is responsible for regulating and licensing nuclear activities in Canada. It determines which nuclear installations are covered under the *Nuclear Liability Act*, it sets the basic insurance requirements for designated installations, and it ensures that the operator maintains the appropriate insurance coverage through its licensing process. Nuclear facilities designated to be nuclear installations under the Act include nuclear power generating plants, research reactors, nuclear material processing plants, as well as facilities for managing used nuclear fuel as determined by the Canadian Nuclear Safety Commission.

The fundamental principles of the *Nuclear Liability Act* are as follows:

- Nuclear operators are absolutely and exclusively liable for nuclear damage

resulting from the nuclear installation they operate;

- Nuclear operators must maintain mandatory financial security against the third-party nuclear damage that may result from the operation of their installations; and,

- There is a financial limit on the operator's liability as well as a limit on the time period over which a third party may make a nuclear damage claim.

Operators of all nuclear power plants designated under the *Nuclear Liability Act* by the Canadian Nuclear Safety Commission must maintain $75 million in mandatory insurance to cover third-party nuclear damages. The liability limit of smaller nuclear installations covered under the legislation is set to reflect their specific situations and risks.

Under the existing Act, the only acceptable financial cover for the operator's financial responsibility is private insurance through an approved insurer. Only one insurer, the Nuclear Insurance Association of Canada, has been approved by the Government of Canada to provide such insurance. The Nuclear Insurance Association of Canada is a pool of domestic and international insurers that have agreed to come together to provide the necessary insurance coverage for third-party nuclear damage under the Act. The pool provides the basic insurance specified by the Canadian Nuclear Safety Commission. In the event that the basic insurance is less than the full $75 million mandatory coverage under the *Nuclear Liability Act* (i.e. in the case of small facilities), the Government of Canada reinsures the difference between the basic insurance and the $75 million operator limit. The Government of Canada also reinsures certain risks that the insurance pool does not cover. The *Nuclear Liability Act* establishes a regime for handling claims in the event of a nuclear incident with third-party impacts.

The monetary limitation on liability for damages arising from accidents occurring at nuclear installations has been a source of some controversy for many years. Natural Resources Canada is presently leading a comprehensive review of the provisions of the *Nuclear Liability Act*, to identify possible revisions required to modernize the Act and bring it into line with prevailing international practices and standards.

Table A5-1 lists the key federal legislation that provides the overarching legal and administrative framework governing used nuclear fuel in Canada.

International Treaties and Conventions

Canada also participates actively in the conventions and standards development led by the United Nations' International Atomic Energy Agency (IAEA). The IAEA serves as the global focal point for nuclear cooperation, assisting member countries in planning for and using nuclear science and technology for various peaceful purposes.

Among other roles, the IAEA develops nuclear safety standards and, based on these standards, promotes the achievement and maintenance of high levels of safety in applying nuclear energy, as well as in protecting human health and the environment against ionizing radiation.

The IAEA also verifies, through its inspection system, that member countries comply with their commitments under the *Treaty on the Non-Proliferation of Nuclear Weapons* (*NPT*), to use nuclear material and facilities for peaceful purposes only. The verification approaches and measures utilized by the IAEA to verify that nuclear material is not diverted from peaceful uses to nuclear weapons or other nuclear explosive devices are commonly referred to as 'safeguards'.

While the *NPT* is the parent treaty for safeguards, important practical arrangements are contained in a hierarchy of other agreements. The safeguards commitments made by Canada under the *NPT* are detailed in:

- INFCIRC/164, Agreement between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the *Treaty on the Non-Proliferation of Nuclear Weapons* and

- INFCIRC/164/Add.1, the Protocol Additional to the Agreement between Canada and the IAEA for the Application of Safeguards in Connection with the *Treaty on the Non-Proliferation of Nuclear Weapons*.

In addition, facility specific details are provided in Subsidiary Arrangements and Facility Attachments which are binding between Canada and the IAEA. The Additional Protocol requires Canada to disclose extensive details on all its nuclear activities and allows the IAEA to carry out inspections at any location. The international obligations on Canada are implemented through the regulations associated with the *Nuclear Safety and Control Act* and associated licence conditions. The CNSC is responsible for implementing the Canada/IAEA safeguards agreement and Additional Protocol.

In addition to the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste*; and the *Treaty on the Non-Proliferation of Nuclear Weapons*, Canada is involved in a number of international agreements that address nuclear waste management, including:

- The *Convention on the Physical Protection of Nuclear Material*;
- The *Convention on Nuclear Safety*;
- The *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*; and
- The *Antarctic Treaty*.

The above treaties, conventions and agreements provide a general framework of considerations within which Canada is committed to operate.

Table A5-1 Key Federal Legislation Governing Nuclear Waste in Canada

LEGISLATION	SIGNIFICANCE
Legislation Related To Nuclear Substances	
Nuclear Energy Act	Legislative framework for development and utilization of nuclear energy.
Nuclear Safety and Control Act	Establishes the CNSC to replace the AECB to regulate the use of nuclear energy and materials to protect health, safety, security and the environment and to respect Canada's international commitments on the peaceful use of nuclear energy.
Nuclear Liability Act	Creates obligation for nuclear operators to prevent injury to health, or damage to property, from nuclear material at the facility (or while it is being transported).
Nuclear Fuel Waste Act	Establishes the NWMO; requires financing mechanism to fund nuclear fuel waste management over the long term.
Canadian Environmental Assessment Act	Requires an environmental assessment of new nuclear waste management facilities.
Transportation of Dangerous Goods Act, 1992	Nuclear substances are classed as "dangerous goods" and fall under this act and its regulations, unless exempted by the *Packaging and Transport of Nuclear Substances Regulations* under the *Nuclear Safety and Control Act*.
Canadian Environmental Protection Act, 1999	Governs environmental aspects of inter-provincial shipments of hazardous wastes and recyclable materials.

Provincial, Territorial & Municipal Requirements

Although Canada's constitutional division of power confers the authority to regulate nuclear energy to the federal government, it does not exclude provincial and territorial authority to regulate related matters within the provincial domain.

There may be some aspects of siting, construction and/or operation of a central used fuel management facility that may be determined to be governed by provincial legislation. The legislative areas listed below may be relevant.

- Transportation: Most provinces and territories include nuclear substances in legislation and regulations addressing the transportation of dangerous goods within that province or territory;

- Emergency preparedness: Provincial governments are responsible for protecting public health and safety, property and the environment within their borders. Provincial emergency preparedness legislation often requires that a plan be formulated to address off-site responses to emergencies at nuclear facilities;

- Environmental assessment and approvals: Provincial legislation requiring the assessment of potential environmental effects of an activity, plan or program may apply to some aspects of our work;

- Other areas of legislation, for example governing endangered species; environmental protection; heritage protection or preservation; water resources protection; occupational health and safety; and/or labour relations may be determined to be relevant.

In addition various permits, licences and approvals will be required and provincial policies and guidelines may come into play at the site-specific stage. Provincial legislative, regulatory, permitting and policy requirements will vary from one province to the next. Municipalities, which derive their authority from provincial legislation, may have requirements that may also be relevant (e.g. permits, codes, standards and/or by-laws). The NWMO will need to ensure that all applicable requirements are met.

Appendix 6 / Nuclear Waste Management in Other Countries

Thirty-two countries in the world use nuclear energy to generate electricity. Together they operate more than 400 nuclear power reactors. Different approaches and programs for the long term management of used nuclear fuel are being considered by the various countries. Some, like Canada, France and the United Kingdom, are undertaking studies of policies and strategies aimed at determining the most appropriate means for the long-term management of used nuclear fuel. A number of countries have determined that they plan to construct a geological repository but are at different stages in the process of site selection. Switzerland and Japan are in the early stages of site selection for deep geological repositories; Finland, the United States and Sweden, are in the latter stages. Still other countries have postponed consideration of the issue, or have extended their planning process for a few decades.

The need for long-term management of used nuclear fuel has been recognized since the beginning of the nuclear programs, yet there are not, at this time, any operating licensed facilities. The task of implementation has proven more challenging than expected. While there has been considerable research undertaken on the science and technology of management options, most programs have faced challenges of delays in implementation and public acceptance. As a consequence the status of the active programs changes regularly. Table A6-1 is a brief overview of the current interim storage practices, and the approach for and status of long term management programs for used nuclear fuel in 12 countries. It is current to the time of production of this report.

Table A6-1 International Nuclear Waste Management Programs

COUNTRY	REACTORS	INTERMEDIATE STORAGE	LONG-TERM MANAGEMENT
Canada	22*	Used fuel is stored in wet and dry interim storage facilities at the nuclear generating stations.	NWMO studies approaches for long-term management and its recommendations are submitted to government in November 2005 for review and subsequent decision by the government.
Finland	4	Interim storage of spent fuel is at the nuclear generating stations in either water pool or dry storage facilities (CASTOR-type cask).	In 1983 the government established guidelines for long-term management of nuclear waste in Finland, including interim milestones for progress towards disposal "in an irrevocable manner". In 1987/88 the decision-making process and roles and responsibilities were clarified. In 1994 all imports and exports of nuclear waste were prohibited, and in 1999 the government required that retrievability was to be maintained. Following a site selection process and agreement by the host community, Parliament, through a Decision-in-Principle, approved a site for a spent fuel repository in 2001; construction of an underground rock characterization facility started in mid-2004; and the licence process for the repository is scheduled to start in 2012.
France	59	Spent nuclear fuel is first stored in water at the reactor site, it is then transported to a pool-type, away-from-reactor facility at the La Hague reprocessing plant (operated by Cogema) until it is reprocessed. The plutonium recovered is recycled into mixed-oxide fuel (MOX). High-level waste is vitrified and stored at Cogema's facilities.	In 1991 the French government established a 15-year research program with three main areas of study: • Research on partitioning & transmutation; • Options for retrievable or non-retrievable disposal in deep geologic formations; • Conditioning and long-term surface storage techniques for the waste. Draft reports on underground geological storage, surface storage and separation/transmutation were issued in June 2005. A global evaluation report on the three areas of research will be issued by the end of 2005; the government will submit a report on a proposed strategic direction early in 2006 for consideration by the French Parliament.
Germany	17*	As of December 2003 all nuclear power plants have approval for on-site interim storage of spent fuel. Previously, after storing used fuel in water filled pools to cool, utilities were required to either send the used fuel for reprocessing, or send the fuel (and the vitrified wastes from reprocessing) to a centralized interim storage facility. Germany has four 'centralized' and one 'on-site' interim storage facilities.	Since 1998 the policy of the coalition government in Germany has been for direct geological disposal of spent fuel and no reprocessing after 2005. The new *Atomic Energy Act* came into force in 2002; construction of new nuclear power plants is prohibited and the use of existing plants is limited. A working group developed recommendations on a selection procedure for a final disposal site, which the Federal Government is currently reviewing. The aim is for an operational final storage site, for all radioactive waste, to be available as of 2030.

Table A6-1 (cont'd) International Nuclear Waste Management Programs

COUNTRY	REACTORS	INTERMEDIATE STORAGE	LONG-TERM MANAGEMENT
India	14	Stored in wet pools; then reprocessed.	Repository planned but not sited.
Japan	53	Used fuel stored on site before being sent abroad for reprocessing; domestic reprocessing plant being built.	Siting process underway to seek volunteer community for deep geological repository for disposal of wastes arising from reprocessing. Geo-scientific research is being conducted at two locations: investigations of crystalline rock occur in Mizunami City, Gifu Prefecture; investigations of sedimentary rock occur at Horonobe, Hokkaido.
Republic of Korea (South Korea)	18	Stored at reactor sites; work underway to establish spent fuel dry storage systems at 4 NPP; Korea recently decided to separate the sites for a low and intermediate level radioactive waste disposal facility and the site for a spent fuel interim storage facility; plans for a centralized interim facility by 2016.	In 1997 the Korean Atomic Energy Commission adopted a research and development plan for high level radioactive waste (HLW) disposal. Currently work is ongoing to finalize the Korean repository concept for HLW disposal and to undertake a system performance assessment. The combined research output will be submitted to the government to guide the development of a national policy for HLW disposal.
Russia	27	Used fuel is reprocessed; uranium is recycled; plutonium stored for future use.	Four geological disposal facilities are planned to begin operation in 2025-2030.
Sweden	10*	Used fuel is transported via ship and stored at CLAB, a centralized, interim underground wet storage facility.	Following years of research and feasibility studies the Swedish government endorsed a plan in 2001 for site selection for a deep geological repository. Investigations on two sites began in 2002; an application for a repository is expected in 2008 and construction to start in 2010, with a target for operations around 2017.
Switzerland	5	High level wastes are transported to a centralized dry, interim, storage facility owned by ZWILAG, operating since 2001. Spent nuclear fuel is stored in various wet and dry, centralized and site specific facilities. The *Nuclear Energy Act* (which came into force in February 2005) contains a 10-year moratorium on reprocessing starting July 2006.	Switzerland is considering construction of a national repository for disposal of spent nuclear fuel and high level wastes in a deep geological formation. Nagra (the National Cooperative for the Disposal of Radioactive Waste) conducts research projects in two underground rock laboratories, the Grimsel Test Site (Canton Bern) in granitic rock and the international Mont Terri Rock Laboratory (Canton Jura) in Opalinus Clay.

Table A6-1 (cont'd) International Nuclear Waste Management Programs

COUNTRY	REACTORS	INTERMEDIATE STORAGE	LONG-TERM MANAGEMENT
UK	31	Used fuel is reprocessed; vitrified wastes stored above ground for 50 years.	The government established a new organization (CoRWM) in 2003 to investigate options for a long-term management approach and recommend the best option, or combination of options in 2006. Work to date has produced a short-list of options to be taken forward for detailed assessment (deep geological disposal, phased deep geological disposal, near-surface disposal (for limited volumes) and long-term interim storage).
USA	104	Used fuel stored at reactor sites.	Construction licence application being prepared for deep geological repository at Yucca Mountain, Nevada. The U.S. Department of Energy is planning to submit a licence application perhaps in 2006.

*Note; On August 12, 2005 Ontario Power Generation announced that two units at the Pickering nuclear generating station in Canada would not be returned to service. The Orbrigheim nuclear power plant in Germany was shut down in May 2005; the Barseback-2 nuclear power plant in Sweden was shut down in May 2005. A more complete review of international waste management programs is contained in NWMO Background Paper 7-6, "A Comparative Overview of Approaches to Management of Spent Nuclear Fuel and High Level Wastes in Different Countries" Charles McCombie, Bengt Tveiten **www.nwmo.ca/internationalapproaches**

Appendix 7 / NWMO's Roundtable on Ethics

After ten years of study and public hearings on the concept of deep geological disposal of used nuclear fuel (1989 to 1998), an environmental assessment panel chaired by Blair Seaborn (the "Seaborn Panel") concluded in their 1998 report that the concept had not been demonstrated to have broad public support. It therefore did not have the required level of acceptance to be adopted as Canada's approach for managing nuclear fuel wastes. The Panel identified the absence of an ethical and social framework within which to assess options as an important issue.

From its inception, the NWMO has committed itself to adhering to the highest ethical standards both in its procedures and in its assessment of management options. To guide it in this matter, the NWMO created a Roundtable on Ethics in 2003. The Roundtable members were selected as both trained and practicing ethicists in a variety of disciplines including business, health, law and public policy. Brief biographies of Roundtable members are included in Appendix 1.

As part of its mandate, the Roundtable identified what the relevant ethical standards are, in its judgment, and organized them into an "Ethical and Social Framework" designed to be responsive to suggestions made by the Seaborn Panel. Rather than issue what could appear to be dogmatic statements, the Framework was designed to express the ethical standards concerned as a series of questions for the NWMO to ask itself. The Framework was first published by the NWMO in April, 2004 and was intended to be a living document. A revision to this document was published in March 2005.

Context

Early on in the study process, the Roundtable advised the NWMO to embed ethical and value considerations in all aspects of its study, including the design of the study process as well as the outcome or recommendation itself. In saying this, the NWMO understood the Roundtable to mean that ethical considerations should be discussed openly and in the context of making judgments on the substantive issues of the study, rather than used as an additional and distinct set of criteria to be applied to decision making. The NWMO first reported this direction from the Roundtable in *Asking the Right Questions?* (NWMO 2003).

Ethics treated as an overarching consideration: This recommendation by the Roundtable influenced NWMO's overall approach to the study in a number of ways. For instance, in the NWMO's first discussion document, "Ethical Considerations" were treated as an overarching aspect among the ten questions to be asked and answered in the study. Along with "Institutions and Governance", "Engagement and Participation in Decision making", "Aboriginal Values", "Synthesis and Continuous Learning", Ethical Considerations were identified as among the questions which apply to all aspects of the framework. As the discussion document explained, ethical considerations and the other overarching aspects, "together … ensure that insight is drawn not only from the perspective of specific disciplines, but also from a more holistic, overarching perspective."

Ethical considerations addressed through consideration of the main substantive areas of the study: In the NWMO's second discussion document, the NWMO attempted to incorporate value and ethical considerations in the influence diagrams for each of the eight objectives which had emerged from the ten question framework. A key ethical consideration, 'Fairness', was also included as an objective in its own right.

Focus on common ground but points of divergence also considered: From the inception of the study, and through successive iterations, the NWMO has attempted to be directed in its work by citizen values and concerns. This effort reflects the NWMO's understanding that the most important ethical choices to be made are in fact values-based decisions that, as much as possible, require the involvement of society at large. An ethical process involves engaging a broad cross-section of society in informed dialogue on the core human issues

to be addressed. An ethical outcome or recommendation involves being responsive to the values and concerns of society at large. It is for this reason that the NWMO sponsored a National Citizens' Dialogue on values with a random cross-section of citizens to elicit these values. These values were elaborated, and ultimately confirmed through a number of dialogue initiatives, as appropriate for use in selecting a management approach. These initiatives included: discussion sessions conducted across the country with the interested public; public attitude research conducted with a random sample of the public; and national and regional stakeholder dialogues.

From the inception of the study, the NWMO has also attempted to identify and understand not only the common ground which citizens share, but also the issues on which there is active debate and divergence. The attempt was made to document both the common ground and points of divergence clearly in the NWMO's second discussion document, and to refine this discussion through the *Draft Study Report* and *Final Study Report*. With no ethical absolute, and in the face of uncertainty, the NWMO understood that an ethical approach and outcome requires the type of pluralistic and multi-party assessment which formed the foundation for our dialogue and assessment activities.

Consideration of the needs of future generations in decision-making today: The NWMO has understood that given the longevity of the hazard posed by used nuclear fuel, the needs of and potential impacts on future generations must be considered in any decision about long term management made today. The NWMO has, therefore, attempted to explicitly address matters of 'equity' or fairness both within the current generation and across generations including humans and other species. The NWMO first specifically engaged citizens in a dialogue on this issue as part of the National Citizens' Dialogue on values, and then subsequently in the dialogues which followed. Citizen direction on the appropriate balancing of the needs of current generations with those of future generations in used fuel management decision-making became a fundamental component of the study. In addition, the assessment of approaches was explicitly considered within two timeframes (within seven generations and beyond seven generations), selected to bring greater clarity to equity considerations.

Principles

The NWMO has adopted the principles suggested by the Roundtable in its "Ethical and Social Framework":

- As guiding principles for the assessment of the approaches in the study. The principles identified in the Roundtable's document are the basis for the six ethical principles contained in the Assessment Framework described in the NWMO's second discussion document and embedded throughout the consideration of the eight objectives;

- As guiding principles and process considerations for one of the first tasks to be addressed in implementation of any centralized management approach – siting of the facility. These principles, and the associated questions identified in the Roundtable's document, are suggested as the starting point for a siting process which will ultimately need to be developed collaboratively with those potentially affected.

These principles were an explicit subject of dialogue following release of the NWMO's second discussion document, including the discussion sessions conducted across the country with the interested public, the quantitative research conducted with a random sample of the public, and the national and regional dialogues. These principles were confirmed through the dialogue as appropriate for use in selecting a management approach.

Both the process used to formulate the approach, and the substance of the approach itself, were designed to be responsive to the ethical principles, questions and issues raised by the Roundtable and outlined in its "Ethical and Social Framework" document.

"Ethical and Social Framework" Suggested by Roundtable on Ethics

The "Ethical and Social Framework", as drafted by the Roundtable on Ethics, is reproduced in its entirety below. The NWMO suggests that this framework receive further consideration by the NWMO and Canadians for the guidance it may provide concerning the implementation of the management approach selected by the Government of Canada.

"Ethical and Social Framework" Suggested by Roundtable on Ethics

March 4, 2005

Nuclear Waste Management Organization Roundtable on Ethics

The Roundtable on Ethics has developed the following Ethical and Social Framework within which to consider the management of spent nuclear fuel, as was recommended by the Environmental Assessment Panel in its report to the federal cabinet. The Roundtable recommends that the NWMO adopt this framework, publish it in NWMO documents and on the NWMO website, and conduct its activities in the light of it. The Roundtable may refine the framework further as the work of the NWMO progresses.

Andrew Brook
Wesley Cragg
Georges Erasmus
David MacDonald
Arthur Schafer
Margaret Somerville

Ethical and Social Framework

Recognizing that everyone contributing to the NWMO's work seeks to use procedures and make recommendations that are ethically sound, NWMO commits itself to embed ethics in all its activities. The aim is to ensure that its work, its ultimate recommendations, and their implementation reflect the highest ethical standards. To assist NWMO in achieving its ethical goals, the Roundtable on Ethics has constructed a framework of questions designed to guide its deliberations and its ultimate recommendations. These questions aim to identify basic values, principles, and issues.

The ethical principles incorporated in the framework include: respect for life in all its forms, including minimization of harm to human beings and other sentient creatures; respect for future generations of human beings, other species, and the biosphere as a whole; respect for peoples and cultures; justice (across groups, regions, and generations); fairness (to everyone affected and particularly to minorities and marginalized groups); and sensitivity to the differences of values and interpretation that different individuals and groups bring to the dialogue. These principles apply both to the consultative and decision-making procedures used by NWMO and to the recommendations that it will make.

Given the large stockpile of highly radioactive spent fuel that already exists or will be created in the lifespan of existing reactors and that will be hazardous for thousands of years, some solution to managing this material as safely and effectively as possible must be found.

The goal is to find and implement an ethically sound management approach. However, if no ethically sound management approach exists, adopting the ethically least-bad option available to deal with existing and committed spent fuel would be justified.

By contrast, the creation of new spent

fuel (that is, beyond what already exists or will be created in the lifespan of existing reactors) and, thereby, the issue of its disposal, must be judged by the standard of full ethical soundness. If the best current proposal does not meet this standard, then it would not be justified to create new material. To justify creating new spent fuel from an ethical point of view, there must be a management solution that is ethically sound, not just least bad. (The other ethical issues associated with nuclear power generation would have to be resolved, too, problems such as the effects of uranium mining and mine tailings, vulnerability of spent fuel to terrorist attacks, safety of the reactors, danger of diversion for nuclear weapons, and whether increased nuclear power generation can be justified, given the available options.) Moreover, even a least-bad option acceptable for the existing problem might cease to be acceptable if there were changes in the nature of the spent fuel, such as adding spent enriched fuel.

In short, a solution that is ethically acceptable for dealing with existing spent fuel is not necessarily a solution that would be ethically acceptable for dealing with new or changed materials. Thus, a question that urgently needs to be addressed is whether NWMO is dealing simply with existing materials and those that will be created in the lifespan of existing reactors or also with substantial additional spent fuel? And this is no less than the question: What will the future of nuclear power in Canada be?

Ethical Questions Relevant to the NWMO's Procedures

Some of the questions that arise concerning procedures are:

- Who should participate in the decision-making process?
- What principles should guide consultations, deliberations, and the making of decisions?
- When facts are in dispute or unavoidably uncertain, how should NWMO proceed?

These general questions give rise to more specific ones. The list of questions that follow is not meant to be exhaustive. For each question, the principle(s) involved is/are in boldface type.

Q1. Is NWMO conducting its activities in a way appropriate to making public policy in a **free, pluralistic, and democratic society**? In particular, are its activities **open, inclusive, and fair** to all parties, giving everyone with an interest in the matter an opportunity to have their views heard and taken into account by NWMO? Are groups most likely to be affected by each spent fuel management option, including the transportation required by some of the options, being given full opportunity to have their views heard and taken into account by NWMO? Is NWMO giving special attention to aboriginal communities, as is mandated by the governing legislation?

Q2. Are those making decisions and forming recommendations for NWMO **impartial**, their deliberations not influenced by conflict of interest, personal gain, or bias?

Q3. Are groups wishing to make their views known to NWMO being provided with the **forms of assistance** they require to present their case effectively?

Q4. Is NWMO committed to basing its deliberations and decisions on the **best knowledge**, in particular, the best natural science, the best social science, the best aboriginal knowledge, and the best ethics – relevant to the management of nuclear materials, and to doing assessments and formulating recommendations in this light? Equally, have limits to the current state of knowledge, in particular **gaps** and areas of **uncertainty** in current knowledge, been publicly identified and the interpretation of their importance publicly discussed and justified?

Q5. Does NWMO provide a **justification** for its decisions and recommendations? In particular, when a balance is struck among a number of competing considerations, is a justification given for the balance selected?

Q6. Is NWMO conducting itself in accord with the **precautionary approach**, which first seeks to **avoid harm and risk of harm** and then, if harm or risk of harm is unavoidable, places the burden of proving that the harm or risk is ethically justified on those making the decision to impose it?

Q7. In accordance with the doctrine of **informed consent**, are those who could be exposed to harm or risk of harm (or other losses or limitations) being **fully consulted** and are they willing to accept what is proposed for them?

Ethical Questions Relevant to NWMO's Recommendations
As before, key ethical principles are in boldface type.

Q8. Do NWMO's recommendations reflect **respect for life**, whatever form it takes, wherever it occurs, and whenever it exists (now and into the foreseeable future)? In particular, are NWMO's recommended solutions likely to protect human beings, including future generations, other life forms, and the biosphere as a whole into the indefinite future?

Q9. Is a reasonable attempt being made to determine, in so far as it is possible to do so, the **costs, harms, risks, and benefits** of the options under consideration, including not just financial costs but also physical, biological, social, cultural, and ethical costs (harm to our values)?

Special ethical issues arise with respect to risk assessment in the nuclear industry. For example, might some scenarios be so horrendous that even a slight risk of their occurrence would be morally unacceptable or unacceptable by Canadians?

Q10. If implemented, would NWMO's recommendations be **fair**?

This question breaks down into a number of sub-questions:

Are the beneficiaries of nuclear power (past, present and perhaps future) bearing the costs and risks of managing spent fuel and other nuclear materials in need of treatment? Do the recommended provisions avoid imposing burdens on people who did not benefit from the activities that created the spent fuel?

Are costs, risks, and benefits to the various regions affected by the use, possible transport, and disposal of the materials being distributed fairly?

Are the interests of future generations and nonhuman life forms being respected?

Are the rights of individuals and minorities being respected, especially vulnerable individuals and minorities?

Q11. Do the recommended provisions protect the **liberty** of future generations to pursue their lives as they choose, not constrained by unresolved problems caused by our nuclear activities? Do the recommended provisions maximize the range of choice open to future generations?

Important Specific Issues
In connection with Q8 to Q11, at least four specific issues merit special consideration.

1. Monitoring, remediation, and, if needed, reversal. Are sound provisions being made to check on whether management provisions are working as designed? If problems appear, are provisions being made to gain the access needed to fix them? Is the issue of reversal if something goes seriously wrong being taken into account?

2. Risk reduction vs. access. What is the appropriate balance between reducing risk to the greatest extent possible and retaining access to the materials, for remediation, for example, or to recover valuable materials from them?

3. Permanent or interim? Is it ethically acceptable to seek a permanent solution now or would it be preferable to recommend an interim solution in the hope that future technological improvements might significantly lower the risks or diminish the seriousness of the possible harms?

4. Lessons to be learned. What lessons can we learn for the future of the nuclear power generation industry from the problem of management of spent fuel and the NWMO's efforts to resolve it?

In closing, we will repeat a point made earlier. Because we must manage already-existing and already-committed spent fuel in some way, here the least-bad option is an ethically acceptable option. By contrast, new spent fuel – whether generated by new reactors, by replacing existing reactors as they reach the end of their serviceable life, or by importing material from other countries – is ethically another matter altogether. For the creation of new spent fuel to be ethically justified, it would have to be shown that there exists a management option that is ethically sound, not just least bad. (Other ethical issues to do with nuclear power generation such as the ones mentioned above would have to be resolved, too.)

In its final review of the *Draft Study Report*, the Roundtable endorsed the NWMO's recommendation as a way to manage current and currently-planned used nuclear fuel, which was the scenario at the focus of their deliberation.

They strongly emphasized that their acceptance of the recommendation for the treatment of that waste must be distinguished from the treatment of any "new" waste. The ethical standards that should be applied to deal with waste from existing fuel and those that would apply to the generation of waste as a result of a decision to expand nuclear power or to continue production beyond facilities' current lifespans are not the same. Endorsement of this recommendation for current and currently-planned used fuel should, therefore, *not* be taken as endorsement of this approach for a scenario in which new used nuclear fuel is produced. A scenario of new used nuclear fuel was not considered by the Roundtable.

Appendix 8 / Influences for the Assessment of Management Approaches

The NWMO's assessment framework features eight objectives:

- Fairness
- Public health and safety
- Worker health and safety
- Security
- Economic viability
- Community well-being
- Environmental integrity
- Adaptability.

For each objective, the factors that may influence the capacity to perform well against the objective were identified and mapped. The resulting "influence diagrams" created for each of the eight objectives, acted as a road map for assessment. For each objective, except for Fairness, an assessment was conducted in two timeframes: in the near term defined as the next seven generations or approximately 175 years; and, in the longer term defined as beyond 175 years. For a more complete description of this work see www.nwmo.ca/understandingthechoices.

Objective 1: Fairness

To ensure fairness (in substance and process) in the distribution of costs, benefits, risks and responsibilities, within this generation and across generations.

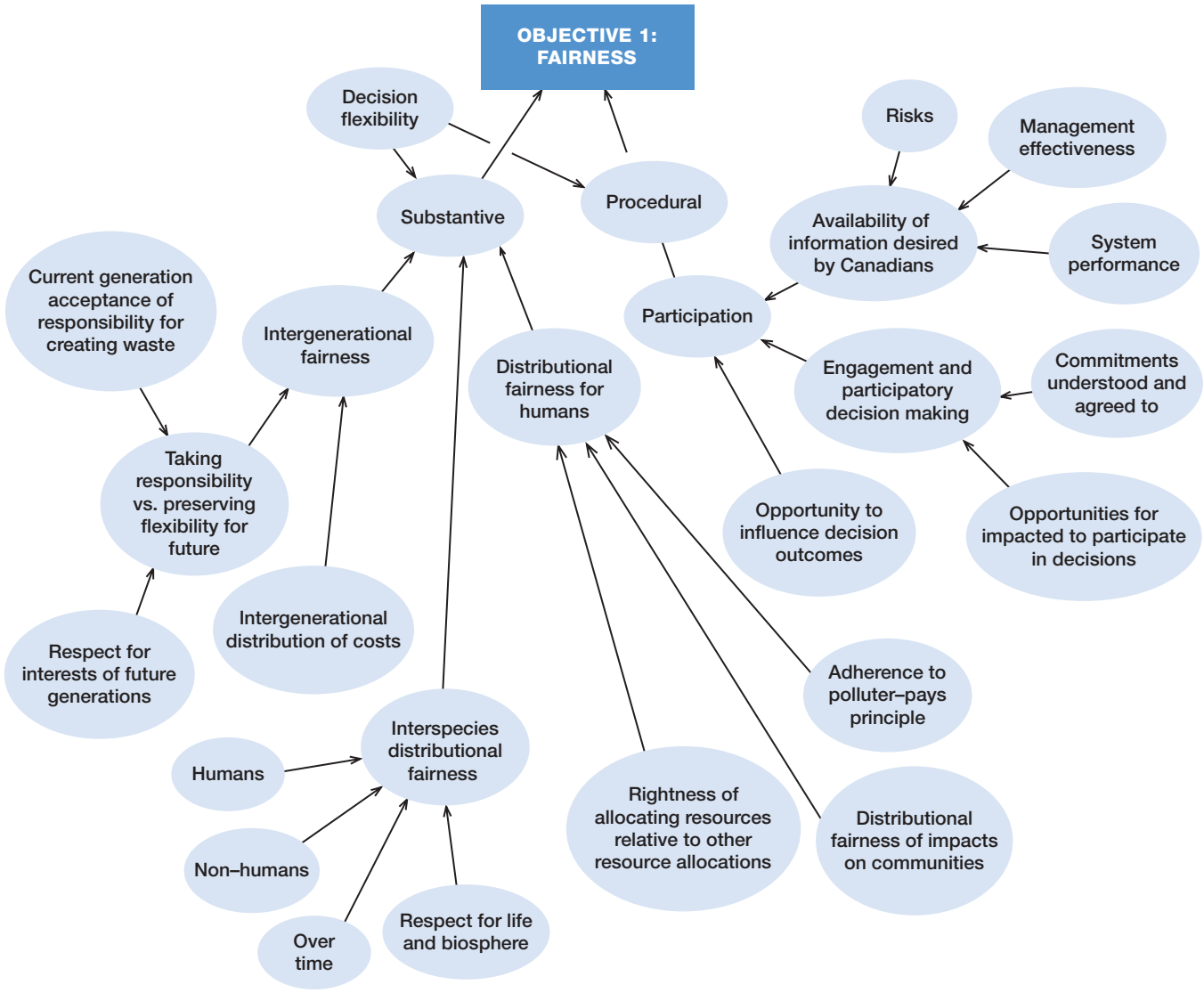
The selected approach should produce a fair sharing of costs, benefits, risks and responsibilities, now and in the future. In addition, fairness means providing for the participation of interested citizens in key decisions through full and deliberate public engagement during different phases of decision-making and implementation.

In our assessment of fairness, the NWMO considered issues of both substantive and procedural fairness.

Substantive fairness focuses on the content or substance of the approach. It includes consideration of how the costs and benefits associated with the approach would be distributed among different people and between humans and other species. It also includes consideration of intergenerational fairness. A key question for intergenerational fairness is the balance struck between the desire that the current generation take responsibility for resolving the problem once-and-for-all versus the desire not to overly constrain future generations by the choices we make today.

Procedural fairness focuses on the processes used and is mainly a function of the degree to which the approach would allow for the participation of concerned citizens in key decisions about how the approach would be implemented. This, in turn, depends in part on the opportunities for decision-making provided by the approach and the availability of information that would be helpful for driving those decisions. The complete list of influences considered is identified in the diagram opposite.

Figure A8-1 Fairness Influence Diagram



Objective 2: Public Health and Safety

To ensure public health and safety.

Public health ought not to be threatened due to the risk that people might be exposed to radioactive or other hazardous materials. Similarly, the public should be safe from the threat of injuries or deaths due to accidents during used nuclear fuel transportation or other operations associated with the management of used nuclear fuel.

In assessing the options against public health and safety, the NWMO considered many factors, depicted graphically in the influence diagram below. We believe that any management system employed will result in direct or indirect risks to the health and safety of affected individuals or communities that must be fully acceptable according to current safety standards. The possibilities of unplanned events that could present unexpected risks or stresses must be considered, and appropriate contingency action provided. There should not be foreseeable outcomes of the approach that lead to greater risks to the public from the used nuclear fuel facility at any time in the future than is acceptable today.

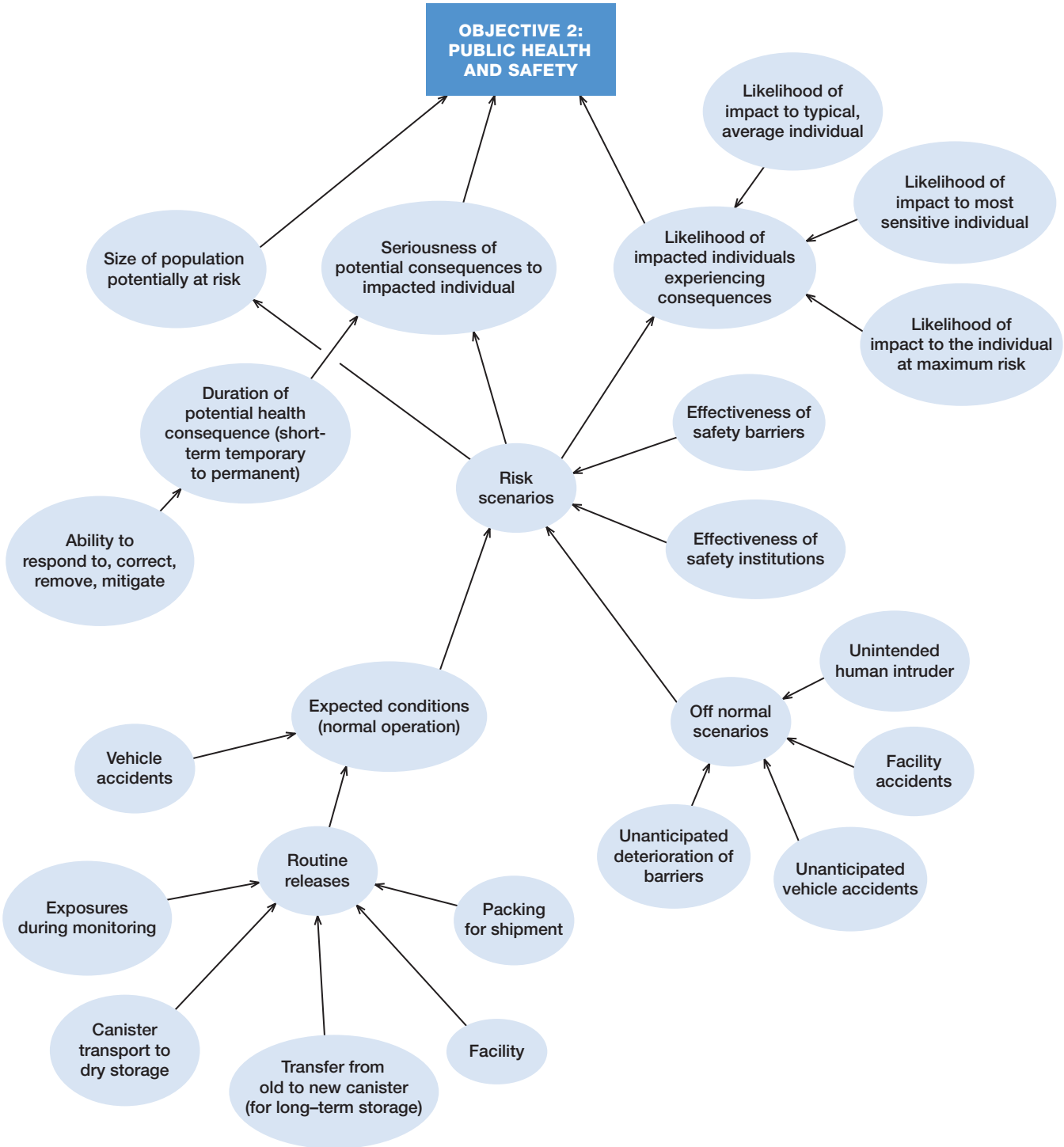
The physical, chemical and radiological characteristics of used nuclear fuel, and their hazards, are well understood. Those hazards need to be managed to prevent unreasonable risk, and licensing requirements and compliance verification by the Canadian Nuclear Safety Commission ensure that the effectiveness of any management approach will be monitored.

The following diagram depicts the scope of influences that were considered. Risks were estimated under normal, expected operating conditions and under "off-normal" scenarios in which members of the public might be inadvertently exposed to hazards associated with the various approaches.

Under normal operating conditions, risks associated with the following operations were considered: packing for shipment, transfer from old to new canisters, vehicle accidents, canister transport to dry storage and exposures during monitoring.

Other risk scenarios considered included unanticipated deterioration of the natural and engineered barriers constructed to isolate the fuel, large-scale transportation accidents (e.g., the wreck of a train carrying used nuclear fuel), facility accidents, and unintended human intrusion.

Figure A8-2 Public Health and Safety Influence Diagram



Objective 3: Worker Health and Safety

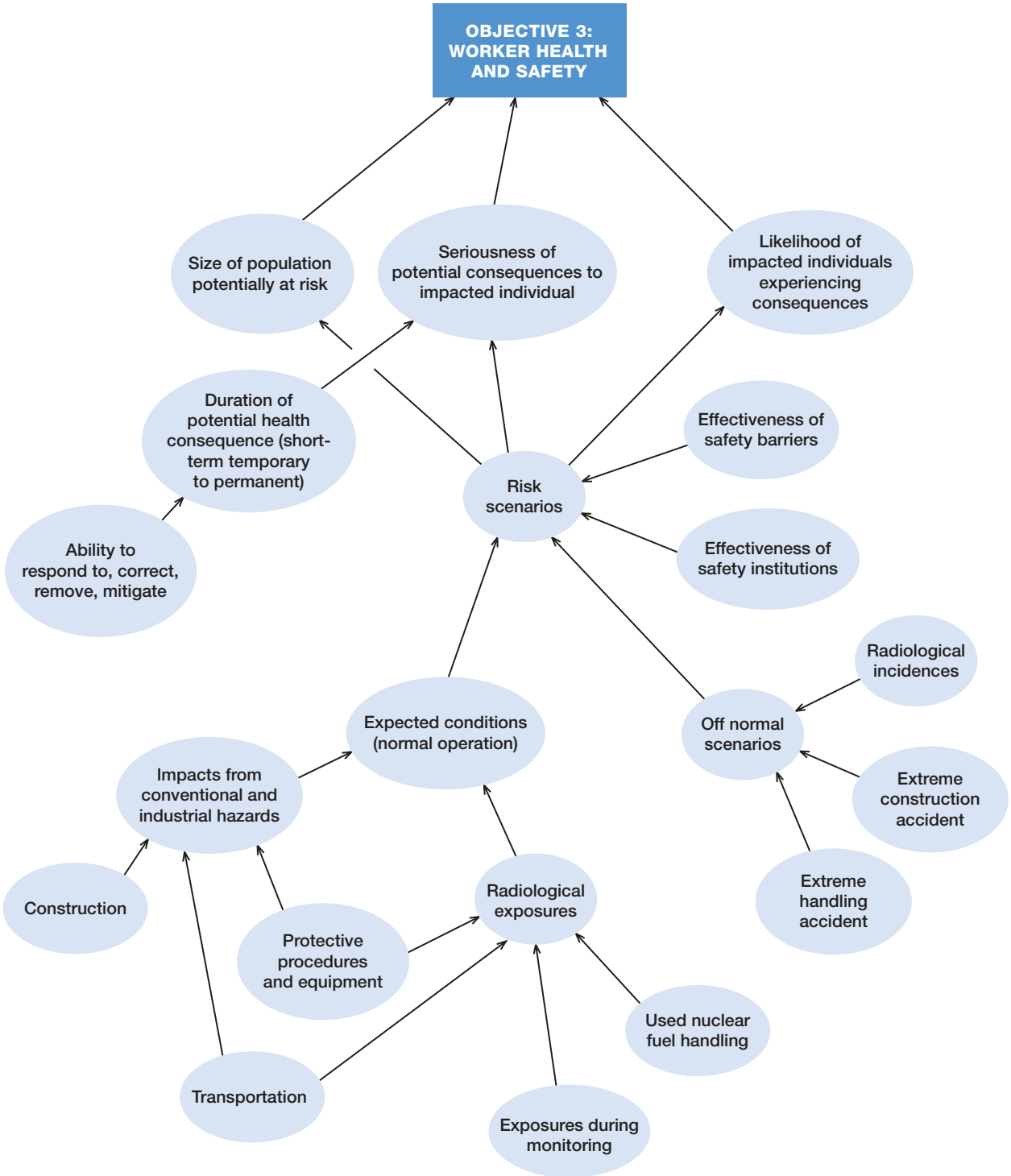
To ensure worker health and safety.

Construction, mining and other tasks associated with managing used nuclear fuel can be hazardous. The selected approach should not create undue or large risks to the workers who will be employed to implement it.

In assessing options for impacts on worker health and safety, the NWMO considered a number of factors. The management system and the technologies used, the design, the construction methods and the operational and monitoring procedures should be such that, in addition to complying with good engineering practices and all industrial safety regulations, workers involved with the used nuclear fuel facility should not be subject to risks of harmful exposures, chronic or accidental, greater than those acceptable to Canadian or international authorities at the time of construction. Workers engaged in future monitoring or maintenance activities should not be subject to risks greater than those acceptable today. The complete list of influences considered is identified in the following diagram.

Risks were separately estimated for two time periods. They were estimated based on normal, expected operating conditions and under "off-normal" scenarios in which workers might be inadvertently exposed to hazards associated with the various approaches. Under normal operating conditions, worker risks associated with the following operations were considered: construction, transportation, fuel handling, and monitoring. The main "off-normal" risk scenarios considered included an extreme construction accident, accidental radiological exposures and extreme fuel handling accidents.

Figure A8-3 Worker Health and Safety Influence Diagram



Objective 4: Community Well-Being

To ensure community well-being.

Implications for the well-being of all communities with a shared interest (including host community, communities in the surrounding region and on the transportation corridor, and those outside of the vicinity who feel affected) should be considered in the selection and implementation of the management system and related infrastructure. A broad range of implications must be considered, including those relating to economic activity, environmental disruption and social fabric and culture.

The assessments with respect to community well-being considered both the likely economic impacts of the approach, and the potential effects on social and cultural qualities of affected communities. On the economic side, consideration was given to potential effects on property values, jobs and businesses. Potential social and cultural impacts include raising fears and concerns of citizens and the risk of community polarization (e.g., contrasting beliefs between those who support and those who oppose locating a facility near their community). Some residents may see living near a radioactive waste management facility as placing a stigma on their community. The list of influences considered is depicted in the diagram opposite.

Figure A8-4 Community Well–Being Influence Diagram

Objective 5: Security

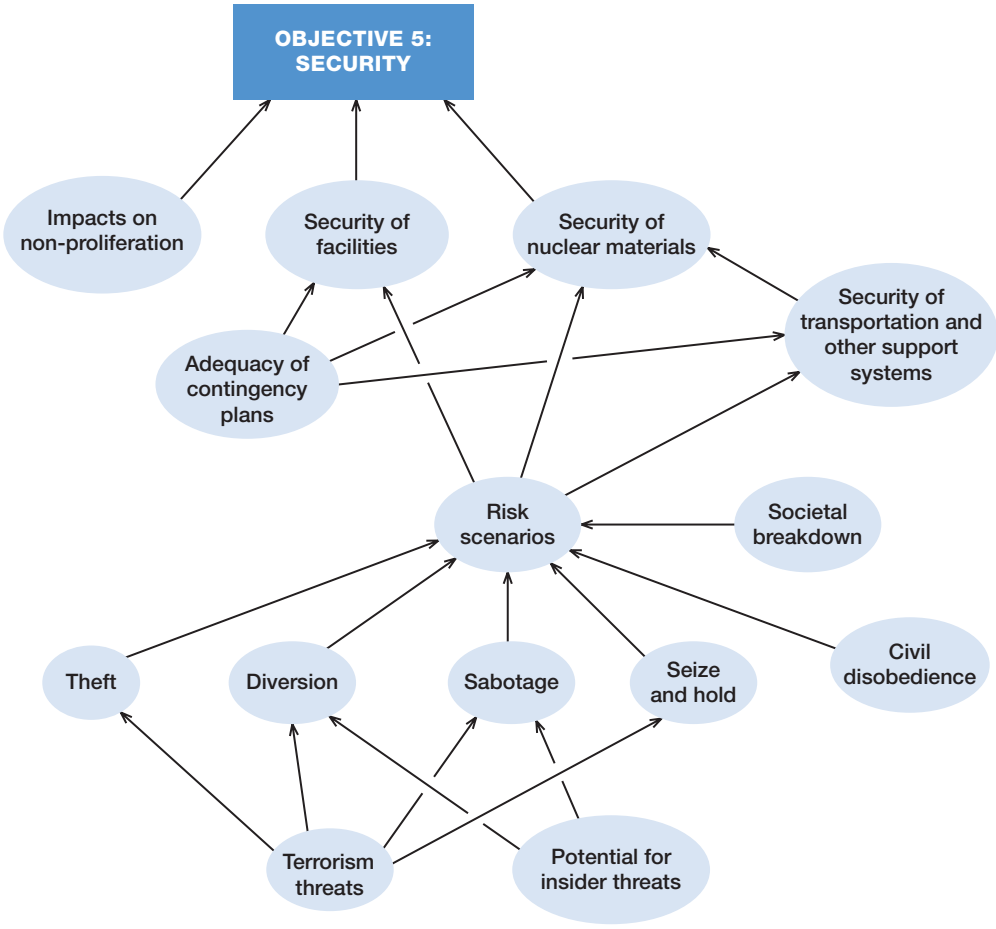
To ensure security of facilities, materials and infrastructure.

The selected management approach needs to maintain the security of the nuclear materials and associated facilities. For example, over a very long time-frame, the hazardous materials involved ought to be secure from the threat of theft, despite possibilities of terrorism or war.

An approach must provide for the security of both nuclear materials and the facilities that store or use them. The loss of nuclear material would likely pose health and safety risks to Canadians and others. The loss of nuclear material could also trigger concerns in relation to international safeguards and non-proliferation obligations. In this context, security and safeguards are fundamental requirements that go beyond protecting the health and safety of Canadians.

To assess security, the vulnerability of each approach to various risk scenarios was considered. The risk scenarios included terrorism and potential "insider" threats focused on theft, diversion, sabotage, and "seize and hold" strategies. The adequacy of contingency plans and the robustness of the approach under scenarios involving societal breakdown and civil disobedience were also considered. The influences considered are outlined in the diagram opposite.

Figure A8-5 Security Influence Diagram



Objective 6: Environmental Integrity

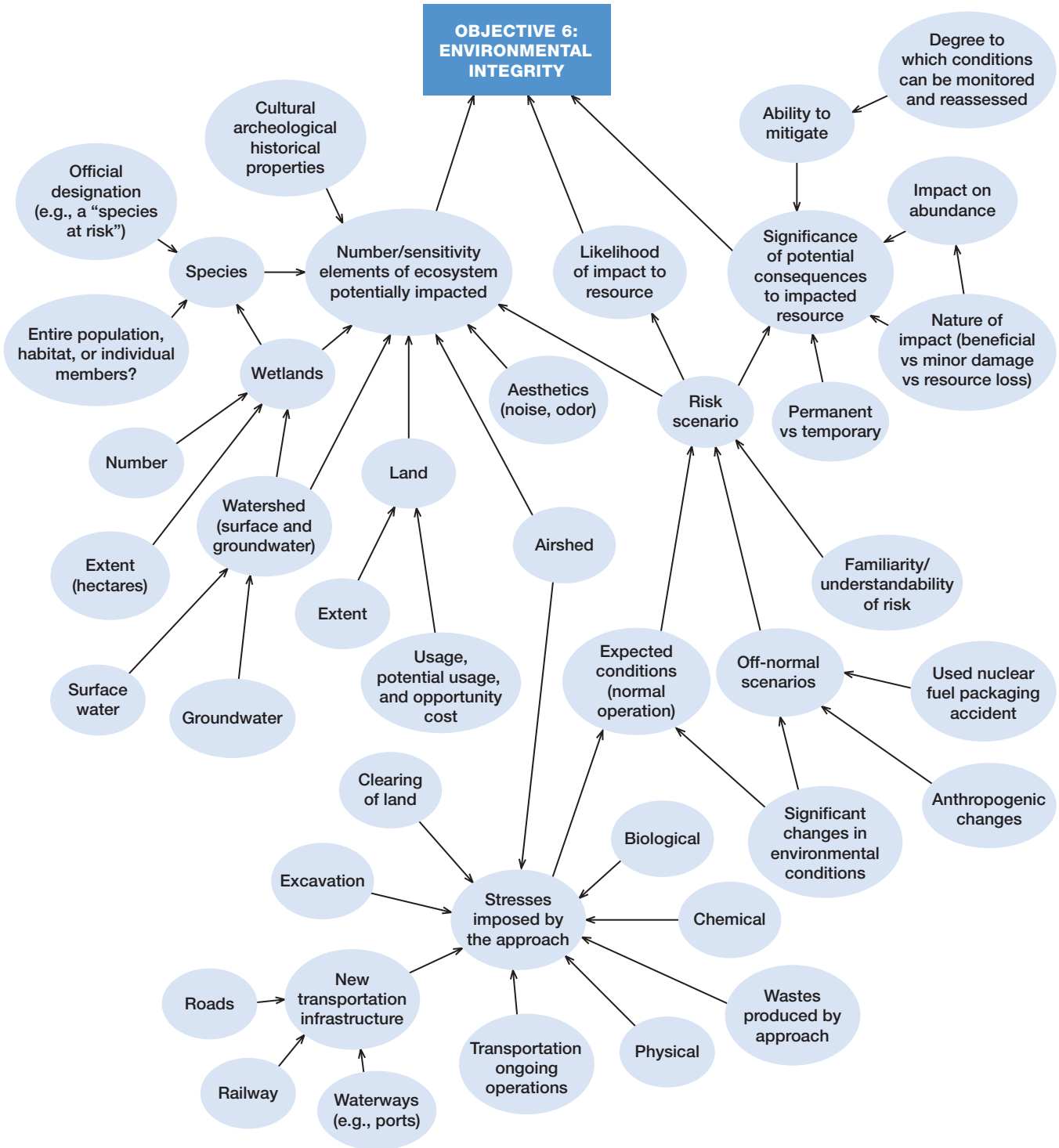
To ensure environmental integrity.

The selected management approach needs to ensure that environmental integrity is maintained over the long term. Concerns include the possibility of localized or widespread damage to the environment or alteration of environmental characteristics resulting from chronic or unexpected release of radioactive or non-radioactive contaminants. Concerns also include stresses and damage associated with new infrastructure (such as roads and facilities) and operations (e.g., transportation).

Assessing the degree of impact each approach would have on the natural environment required consideration of many factors, including the number and sensitivity of ecosystem elements that would potentially be affected, the likelihood of impact to each type of resource, and the significance of the potential consequences to affected resources. Many different types of valued and environmentally sensitive resources could be affected, including plants and animals, land, surface water, groundwater and the air (e.g., through air pollution created during the construction of a new facility). Also included in the assessment were various aesthetic impacts, such as noise, and visual changes to the natural scenery. As in the case of other objectives, it is necessary to consider not only the stresses that each approach would produce assuming that the approach performs as expected, it is also necessary to consider the possibility of "off-normal" risk scenarios. The complete list of influences considered is expressed in the influence diagram opposite.

It is difficult to precisely forecast the environmental impacts of the various approaches. This is especially true in the cases of the geological repository and centralized storage approaches because the impacts of each approach depend greatly on where the new facilities would be located, something that is not yet known. The long time-frames involved complicate forecasts for all approaches.

Figure A8-6 Environmental Integrity Influence Diagram



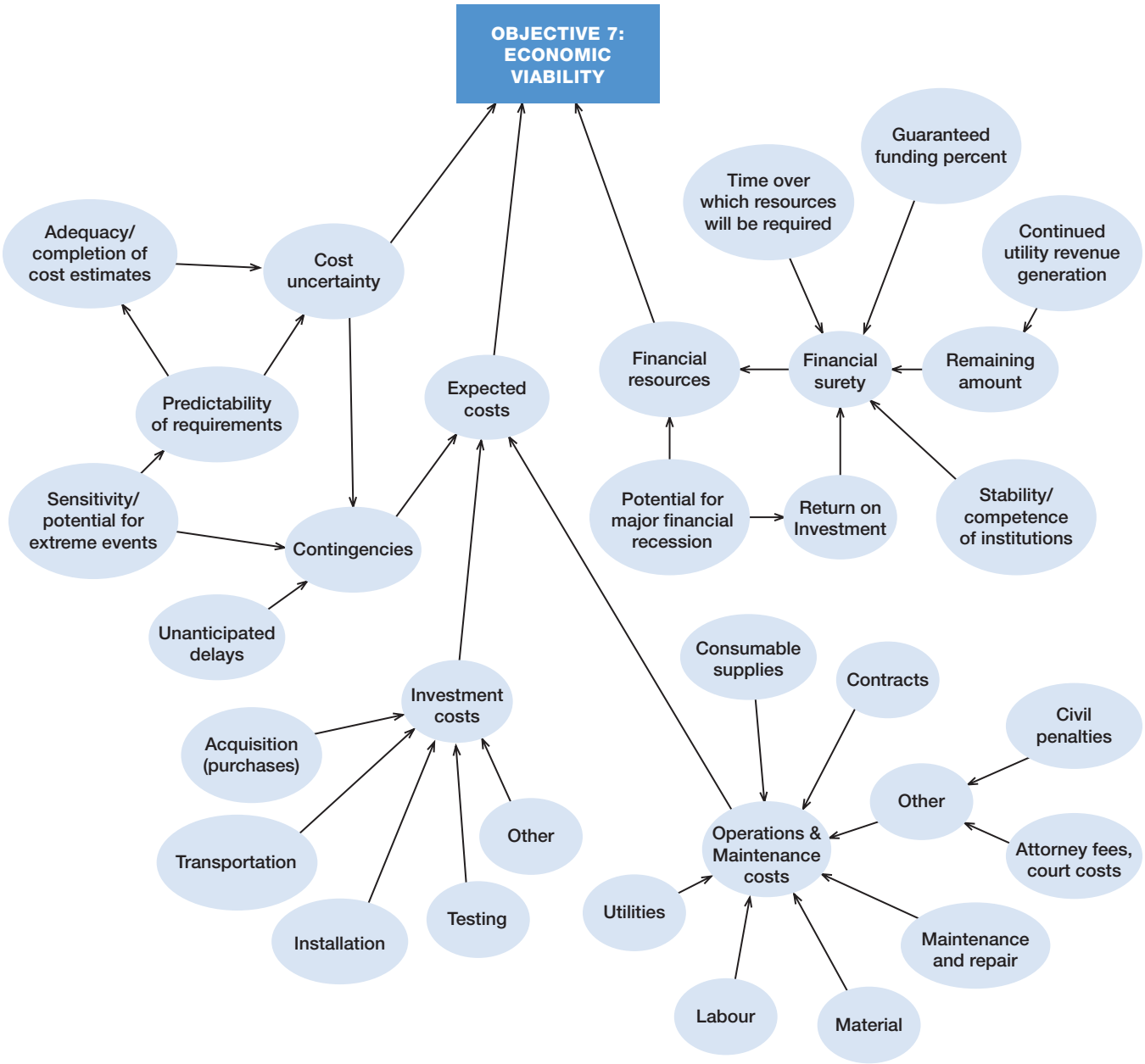
Objective 7: Economic Viability

To design and implement a management approach that ensures economic viability of the waste management system, while simultaneously contributing positively to the local economy.

Economic viability refers to the need to ensure that adequate economic resources are available to pay the costs of the selected approach, now and in the future. The cost must be reasonable. The selected approach ought to provide high confidence that funding shortfalls that would threaten the assured continuity of necessary operations will not occur.

Assessing the economic viability of the approaches required considering the likelihood that financial resources would be available to pay the costs recognizing that these costs are uncertain and, especially in the case of the reactor site and centralized storage approaches, would continue over a very long time. The complete list of influences considered is depicted opposite.

Figure A8-7 Economic Viability Influence Diagram



Objective 8: Adaptability

To ensure a capacity to adapt to changing knowledge and conditions over time.

The selected management approach should be robust in the face of new or unforeseen circumstances. The approach should provide flexibility to future generations to change decisions; not place burdens or obligations on future generations that will constrain them. The approach should be able to function satisfactorily in the case of unforeseen events.

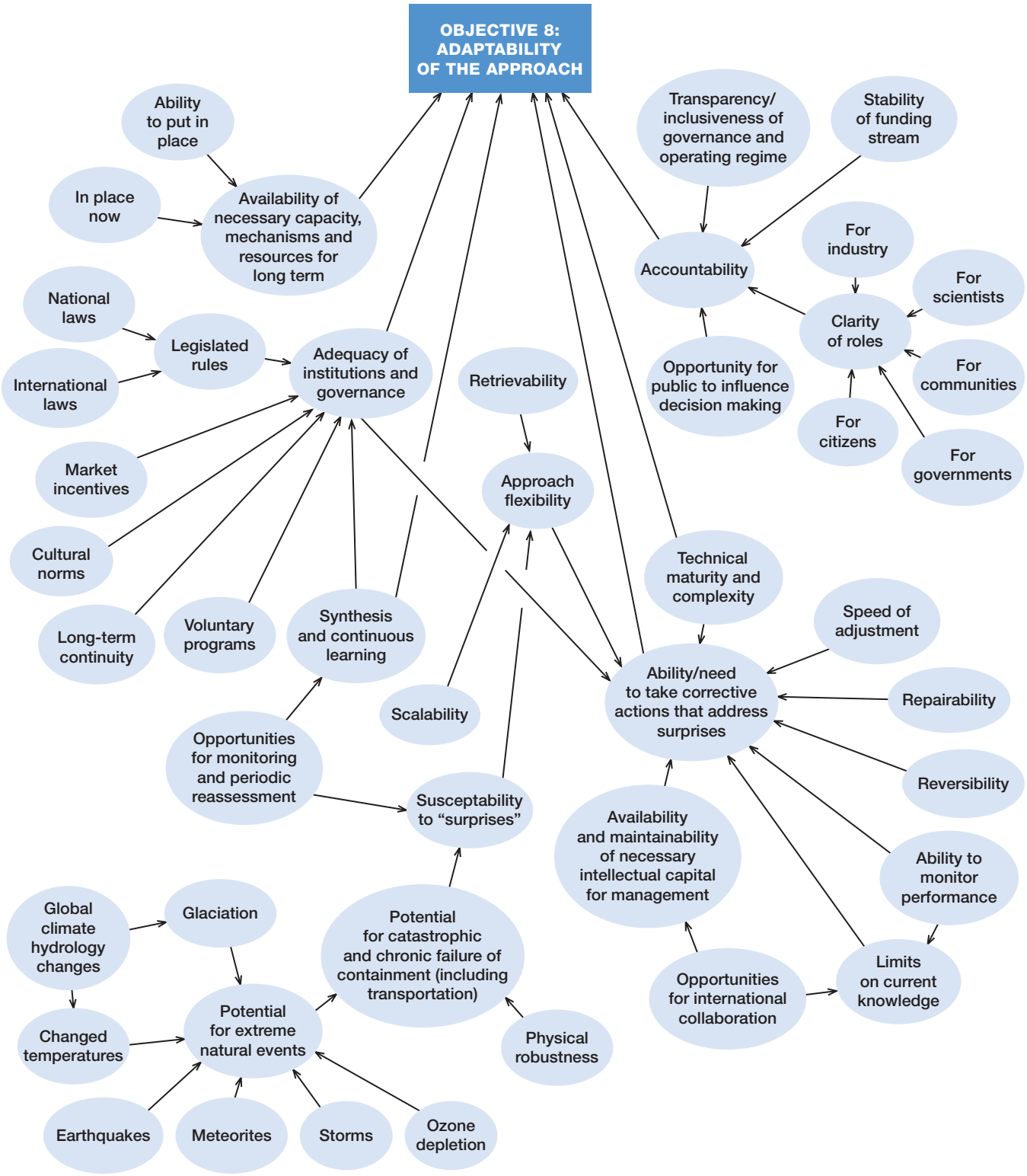
There was much discussion on this objective by citizens during the dialogue following release of the second NWMO discussion document. Although there appeared to be broad agreement on the importance of this objective, some debate was raised concerning how best to characterize or define the objective. Should the adaptability of an approach be defined primarily on the basis of the flexibility in future decision-making that it provides? Should the adaptability of an approach be defined primarily on the basis of the robustness it provides in the face of changing environmental conditions?

The NWMO has proceeded in a way which understands that both of these are potentially important influences on the adaptability of a management approach even though the measures one might put in place to achieve flexibility might directly conflict with the measures one might put in place to achieve physical robustness. What is required to make an approach adaptable in the near term may not be the same as what is required to make an approach adaptable in the very long term. Given the long time-frames for which any management approach will need to effectively contain and isolate used nuclear fuel, the balancing of such tensions is integral to both understanding what adaptability means for this issue and assessing the approaches on it.

The NWMO has approached adaptation as a general strategy of systems for attaining or maintaining a goal in the face of changing environmental circumstances. "Adaptability" is here defined as the set of characteristics of an option that are expected to make a management approach robust with respect to the widest range of possible social and environmental scenarios in the long-term future. To be "adaptable" is to be capable of responding well to changes in environmental and social conditions, over a wide range of such possible changes.

Assessing the adaptability of each approach required consideration of many factors, including whether there are opportunities to adapt to changing knowledge or circumstances during the period when the various stages of the project are being implemented. It also included consideration of the robustness of the operation of the option to contain and isolate the waste, and/or ease of taking corrective action to ensure continued containment and isolation, in response to a wide variety of expected challenges to system integrity over the very long term. These challenges might include extreme natural events, deficiencies in option performance as designed, and unavailability of any institutional controls or systems that may be required. The complete list of influences considered is depicted opposite.

Figure A8-8 Adaptability Influence Diagram



Appendix 9 / Other Methods Considered

The *Nuclear Fuel Waste Act* (*NFWA*) requires the NWMO to study approaches based on three methods for the long-term management of used nuclear fuel: deep geological disposal in the Canadian Shield; storage at nuclear reactor sites; and centralized storage, either above or below ground. The *NFWA* allows the NWMO to consider other management approaches in the course of its study.

Methods Receiving International Attention

The first NWMO discussion document, *Asking the Right Questions?*, identified 11 other methods that have been advanced in the past by governments, industry and researchers. The NWMO Assessment Team did not include these additional methods in its preliminary assessment. However, it did suggest keeping a "watching brief" on three methods receiving international attention: reprocessing, partitioning and transmutation; deep borehole placement; and international repository (see Chapter 5).

Reprocessing, Partitioning and Transmutation involve chemical and physical processes to recover and recycle the fissionable isotopes in used nuclear fuel. These processes were considered in our study in light of the ongoing international work to understand their potential for managing used nuclear fuel in the long term. Our research into these areas was further motivated by the high level of interest registered by Canadians in knowing more about the possibility of "recycling" or "reusing" used fuel, practices that we have come to expect in many other areas of our life. Interested in opportunities to "recycle" in the context of used nuclear fuel, and intrigued by international work on transmutation as a potential for reducing the long-term hazard of used nuclear fuel, Canadians expressed a desire for the NWMO to report back on our findings and determinations concerning these options. (See NWMO background papers on reprocessing, partitioning and transmutation by Jackson (2005) available at www.nwmo.ca/partitioningandtransmutation and www.nwmo.ca/implicationsrpt).

Reprocessing is the application of chemical and physical processes to used nuclear fuel for the purpose of recovering and recycling fissionable isotopes.

Partitioning involves a further series of physical and chemical processes to separate various isotopes from used nuclear fuel for further conditioning, treatment or long-term management.

Transmutation refers to the transformation of radioactive isotopes from used nuclear fuel into non-radioactive or stable isotopes by bombarding the target isotopes with neutrons or other particles.

Reprocessing

Most of the existing used fuel in the world was produced in Light Water Reactors (LWR's) which are not operated in Canada. Used fuel from LWR's contains a significant amount of fissile material, twice as much as natural uranium. Thus, it has always been recognized that used fuel has the potential for recycling. Indeed, of the 260,000 tonnes of used power reactor fuel produced in the world to date, about one-third (85,000 tonnes) has already been reprocessed in large commercial facilities to recover the uranium and plutonium for eventual recycling. Most of these reprocessing facilities are located in Europe. They are capable of reprocessing about 40 percent of the used fuel arising from these power reactors. For reasons largely related to weapons proliferation concerns, the United States government has banned domestic commercial reprocessing since 1977, while pursuing research on more proliferation-resistant processes.

Reprocessing technology was first developed 60 years ago to extract weapons-grade plutonium-239 for the nuclear weapons programs of the United States, the United Kingdom and Russia, and later in the military

programs of countries such as France, China and India. This initial military-related interest has significantly influenced the choice of fuel cycle-related infrastructure subsequently used by civilian nuclear power programs in these and other countries.

Reprocessing can take place after the used nuclear fuel is removed from the reactor and is allowed to cool for a number of years. The fuel is moved in large lead and steel casks to a reprocessing facility. There, it is dissolved in nitric acid while the volatile radioactive isotopes are mostly contained. Several separation and segregation processes are then used to isolate the different streams of products including uranium, plutonium, highly radioactive liquid waste; and less radioactive solids, liquids and gases. Reprocessing simply rearranges the components of the used nuclear fuel, but does not reduce the overall quantity or toxicity of the radioactive material.

Power reactors in Canada use the CANDU system. At present, these reactors use a once-through fuel cycle, meaning the nuclear fuel is placed in the reactor one time and then discharged for interim storage and future long-term management. Therefore, there has been no need for Canada to reprocess used nuclear fuel for reuse or recycling in a nuclear reactor. Nevertheless, it is recognized that other nuclear fuel cycles aimed at the optimum use of uranium and/or plutonium could at some point be implemented in Canada and some of these fuel cycles could involve reprocessing. While there is no purely technical obstacle to reprocessing, the abundant reserves of natural uranium in Canada suggest that it is unlikely Canada would need to implement reprocessing in the near future. Canada is a leader in uranium mining, and Canadian uranium reserves are far from being depleted. The cost of reprocessing used nuclear fuel is high, and is not about to be exceeded in the near future by the cost of mined natural uranium.

The specific composition of used CANDU fuel offers very little incentive to reprocess used fuel in Canada in the foreseeable future if the sole purpose is to recover uranium. In fact, the uranium recovered from used CANDU fuel would be similar in isotopic composition to the low-level wastes arising from the light water fuel enrichment process (i.e., depleted uranium). Used CANDU fuel contains very little fissile material, much less than natural uranium, and the only economic incentive for recycling would be to recover the small amounts of plutonium it contains (about 0.3 percent).

NWMO cost estimates, based on extrapolation from the LWR reprocessing costs (see the 'Harvard' study by Bunn et al. 2003), suggest that reprocessing used fuel from CANDU reactors could increase the cost of nuclear electricity by as much as 20 percent if no credit is taken for recycling the plutonium. Even with a credit for recycling, the reprocessing option would add five to ten percent to the cost of electricity, as much if not more than the entire cost of long-term waste management and reactor decommissioning. For example, reprocessing costs for CANDU fuel have been estimated to be about $1,500 per kg uranium. The current (July 2005) price of uranium (U3O8) is about $80 per kg. The total cost to reprocess 3.7 million used CANDU fuel bundles, which contain about 71,000 tonnes of uranium, would be about $107 billion.

Reprocessing used fuel is potentially economically feasible in the future, but only in the case of a continuing nuclear fission reactor program in Canada. It must be acknowledged that economic conditions could be much different in 50 or 300 years. Waste management approaches that ensure accessibility to the used fuel for a sufficiently long time would provide the adaptability and flexibility to enable future generations to make decisions on the case for reprocessing.

The cost of building the necessary industrial capacity to undertake reprocessing and the need to commit to an expanded and multi-generational nuclear fuel cycle are significant limitations for Canada. With this technology, there would still be radioactive wastes to manage and reprocessing would increase the types of wastes and the risks of spreading technology that could be used for production of nuclear weapons.

While some countries such as the United Kingdom, France, Russia and Japan continue to reprocess used fuel, other countries such as the United States, Germany and Switzerland have issued a ban or moratorium on reprocessing.

For a number of reasons, reprocessing as a management approach for used nuclear fuel is considered to be highly unlikely as a viable scenario for Canada at this time.

The necessary facilities are expensive, and they inevitably produce residual radioactive wastes that could be more difficult to manage than used nuclear fuel in its un-reprocessed form. Reprocessing also requires a commitment to a continuing nuclear fuel cycle, and it potentially separates out material that could be used in the production of nuclear weapons in the course of the process.

Partitioning and Transmutation

Reprocessing and recycling of the plutonium recovered from used CANDU fuel would eliminate the most active component of the wastes (plutonium-239) after 1,000 years, and would thus reduce the long-term toxicity of some of the wastes. Eventually, a process called partitioning and transmutation using nuclear reactions initiated by neutrons, protons, or even photons from lasers may be able to transform some of the other radioactive components (not plutonium or uranium) which have been separated (or partitioned) into non-radioactive isotopes, or into isotopes with shorter half-lives, which would be hazardous for a shorter period of time.

If in the future there were a decision to further process CANDU fuel for the purpose of reducing the volume of high-level radioactive waste and toxicity of the fuel, there would need to be significant advances in the partitioning of certain isotopes and in transmutation. As opposed to reprocessing, which is routinely carried out on a commercial scale, partitioning and transmutation is still in its early developmental stage. Introduction of partitioning and transmutation on a commercial scale would require an additional process step at the back-end of the nuclear fuel cycle and a commitment to the continued use of nuclear energy by current and future generations. Exposure risk would increase appreciably due to the complexity of the fuel cycle and the multiple processing steps involved in partitioning and transmutation. As is the case for reprocessing, there would be further risk of encouraging technology that could be used for production of nuclear weapons. Costs are very difficult to determine, and the time-frame for investments would span many decades, imposing financial limitations with uncertain outcomes.

While partitioning and transmutation might reduce the volume and the toxicity of the used nuclear fuel to be managed, there are practical limitations to the technology and it would not avoid the need for long-term management of the residual high-level radioactive wastes that would be produced.

Transmutation, now in the research phase, has the potential to completely eliminate some short-lived fission products and long-lived minor actinides thereby rendering them harmless. However, some long-lived fission products in used nuclear fuel, such as iodine-129 which has a half-life of 16 million years, are not good candidates for transmutation due to limitations in their inherent nuclear properties. Thus, iodine-129 would remain a component in the residual radioactive waste forms resulting from transmutation. Iodine-129 is the key radionuclide in postclosure safety assessments for deep geological repository concepts because of its long half-life and mobility once it enters the geosphere. It would be unaffected by reprocessing, partitioning and transmutation. Since over 90 percent of the iodine-129 is tightly bound in the uranium matrix of the used fuel and uranium is relatively stable at repository depth (e.g., uranium ore deposits are a natural analogue for the stability of a deep geological repository for used fuel), the long-term benefits of removing and treating this radioisotope are likely very small.

Transmutation research and development programs including experimental accelerator driven transmutation facilities are underway in Europe, Japan, the United States, China, Russia, South Korea and other countries. Partitioning and transmutation continue to be the subject of international study, particularly in France, where substantial funds have been devoted to examining their feasibility as a complementary option for managing used fuel in the future. Based on this research, the scientific and technical foundation is not yet sufficiently advanced for implementation. Long-term management of the residual radioactive

Table A9-1 Methods of Limited Interest

METHOD	CONTRARY TO INTERNATIONAL CONVENTIONS	INSUFFICIENT PROOF-OF-CONCEPT
Dilution & Dispersion	X	X
Disposal at Sea	X	X
Disposal in Ice Sheets	X	X
Disposal in Space		X
Rock Melting		X
Disposal in Subduction Zones		X
Direct Injection		X
Sub-Seabed Disposal		X

materials would still be required. In a recent report from France, the Office parlementaire d'évaluation des choix scientifiques et technologiques, Assemblée nationale, reported that "transmutation at an industrial scale is not foreseeable at best before 2040" (Bataille and Birraux 2005).

The possibility of transmuting various radioactive isotopes has only been demonstrated in the laboratory. As it is too soon to demonstrate that it would be commercially feasible with the volume of used nuclear fuel that exists in Canada, the NWMO recommends keeping a "watching brief" on the findings concerning partitioning and transmutation. Systematic monitoring of this technology and other areas of evolving scientific research will continue to be an important function of the NWMO to stay abreast of current developments concerning the long-term management of used nuclear fuel.

Deep Borehole Placement involves placing used fuel packages at depths of several kilometres in boreholes with diameters of typically less than one metre. Packages would be stacked on top of one another in each borehole, separated by layers of bentonite or cement.

Although very deep borehole placement may hold some potential as a method for the disposal of small quantities of radioactive waste, it would be difficult to implement and ensure isolation and containment of larger quantities of used nuclear fuel.

The concept of an International Repository (or even a regional repository), which would involve the transboundary movement of used nuclear fuel, does not contravene any international treaty. However, most countries subscribe to the self-sufficiency principle under which they are responsible for any waste they produce. An international repository may become more attractive for some countries in future years, but it is not a decision to be made solely by Canada. It will be important for Canada to continue to monitor developments in this area of radioactive waste management.

Methods of Limited Interest

The following used nuclear fuel management methods have been investigated to varying degrees over the past 40 years and in some cases are still being advocated by a few individuals or organizations. None are being implemented anywhere, nor are they part of any national research and development program. Some are contrary to international conventions. The methods of limited interest and the reasons for screening them out are shown in Table A9-1.

The following discussion of these methods of limited interest is adapted from the NWMO document *Understanding the Choices*, Appendix 4 / Screening Rationale for Methods of Limited Interest.

Dilute and Disperse differs from all other used nuclear fuel management methods in that there would be no containment of the waste or isolation from the environment. One method

involves dissolving used nuclear fuel in acid, neutralizing the solution and discharging it slowly down a pipeline into the sea. Another possibility would be to transport the used fuel solution by tanker to the open ocean and release it there. The discharge site and rate would be such that radiation doses to people would never exceed internationally accepted limits.

In principle, dilution and dispersion of radioactive waste is not considered to be sound environmental practice. This method has never seriously been proposed for used nuclear fuel because, similar to disposal at sea, it would be prohibited by international conventions. Dilution and dispersion is not included in any national or international research and development programs.

(Note: Canadian authorities regulate the emission of very small quantities of radioactivity into air and water from operating nuclear facilities).

Disposal at Sea would involve placing packaged used nuclear fuel on the bed of the deep ocean. The packaging would consist of canisters designed to last for a thousand years or more. The used fuel would be in a solid form that would release radionuclides into the ocean very slowly when the canisters fail. The site would be one where the water is a few kilometres deep, so that the used fuel would not be disturbed by human activities and there would be substantial dilution of radionuclides before they reach the surface environment.

Sea disposal was investigated by the Nuclear Energy Agency's Seabed Working Group. It would be an extension of the 'sea dumping' method which was used for disposal of solid low level radioactive waste until the early 1980s and which is now prohibited under international conventions. Sea disposal is prohibited by international conventions and is not included in any national or international research and development programs.

Disposal in Ice Sheets would involve placing containers of heat-generating used nuclear fuel in very thick, stable ice sheets, such as those found in Greenland and Antarctica. Three concepts have been suggested. In the "meltdown" concept, containers would melt the surrounding ice and be drawn deep into the ice sheet, where the ice would refreeze above the used fuel containers creating a thick barrier. In the "anchored emplacement" concept, containers would be attached by surface anchors that would limit their penetration into the ice by melting to around 200-500 metres, enabling possible retrieval for several hundred years before surface ice covers the anchors. Lastly, in the "surface storage" concept, containers would be placed in a storage facility constructed on piers above the ice surface. As the piers sank, the facility would be jacked up to remain above the ice for perhaps a few hundred years. Then the entire facility would be allowed to sink into the ice sheet and be covered over.

There has been very little work on disposal in ice sheets because there has never been enough confidence about predicting the fate of the used nuclear fuel and because of the potential for release of radionuclides into the ocean. Disposal of radioactive waste in Antarctica is prohibited by international treaty and Denmark has indicated that it would not allow such disposal in Greenland. Disposal in ice sheets is not included in any national or international research programs.

Disposal in Space would permanently remove used nuclear fuel from the Earth by ejecting it into outer space. Destinations that have been considered include the sun and ejection beyond the solar system. Because of the high cost estimate for each payload using present day technology, this method has been suggested for disposing of only small amounts of the most toxic waste materials.

Space disposal has never been included in any major research and development program. Considerable further processing of the used nuclear fuel with its associated high costs would be required. Concerns about the risk of an accident and the potential risk to human health and the environment have been reinforced by the U.S. Space Shuttle Challenger and Columbia accidents.

Rock Melting would involve placing used nuclear fuel in liquid or solid form in an excavated cavity or a deep borehole. Heat generated by the used fuel would then accumulate, resulting in temperatures sufficient to melt the surrounding rock and dissolve the radionuclides in a growing sphere of molten material. As the rock cools, it would crystallize

and incorporate the radionuclides in the rock matrix, dispersing the used fuel throughout a larger volume of rock.

In a variation of this method, the heat-generating waste would be placed in containers, causing the rock around the containers to melt, sealing the used fuel in place. Research was carried out on this method in the late 1970s and early 1980s, when it was developed to the level of engineering design. The design involved a shaft or borehole that led to an excavated cavity at a depth of two to five kilometres. It was estimated, but not demonstrated, that the used nuclear fuel would be immobilized in a volume of rock one thousand times larger than the original volume of the used fuel. Another early proposal was to use weighted containers of heat-generating used fuel that would continue to melt the underlying rock, allowing them to move downwards to greater depths with the molten rock solidifying above them.

There was renewed interest in rock melting in the 1990s in Russia, particularly for the disposal of limited volumes of specialized material such as plutonium. Russian scientists have also proposed that used nuclear fuel could be placed in a deep shaft and immobilized by a nuclear explosion, which would melt the surrounding rock. There have been no practical demonstrations that rock melting is feasible or economically viable. This method is not being investigated in the national program of any country.

Disposal in Subduction Zones would involve placing used nuclear fuel in a subducting or descending plate of the earth's crust. As subduction zones are invariably offshore, this concept can also be considered as a variant of placement in the sea or beneath the seabed. Either tunneling or deep sub-seabed boreholes could theoretically be used to emplace the used nuclear fuel close to an active subduction zone. Free-fall penetrators could also be used.

Disposal of used nuclear fuel in subduction zones has not received significant attention by the radioactive waste management community in Canada or abroad for several reasons. Potential sites for such a disposal facility are very limited and offshore. In Canada, used fuel transportation distances from the nuclear reactor sites to a subduction zone, such as the Juan de Fuca plate located about 100 kilometres off the coast of Vancouver Island, would be significant. Monitoring and retrieval of used fuel would be more difficult compared with land-based deep geological repositories. And there is concern about whether used nuclear fuel buried in subduction zones might return to the surface environment via volcanic eruptions. It has also been suggested by some that this method could be seen as a form of sea disposal which would be prohibited by international conventions.

Although there remains some interest in Canada concerning the concept of disposing of used nuclear fuel in subduction zones, there is insufficient proof of concept to recommend it as an appropriate approach at this point in time.

Direct Injection would involve the injection of liquid radioactive waste directly into a layer of rock deep underground. Although used for the disposal of liquid hazardous and low-level waste in the U.S. in the past, this technique has only ever been used for liquid high-level waste in the former Soviet Union, at a number of locations usually close to the waste-generating sites.

Direct injection requires detailed knowledge of subsurface geological conditions, as it does not incorporate any man-made barriers. There would be no control of the injected material after disposal and retrieval would be impossible. There are many technical unknowns which would require extensive research to gain the necessary degree of confidence that this method would be appropriate for a specified site. Although the option would not contravene international conventions, it would not be consistent with the spirit of international guidance on the long-term management of used nuclear fuel. Current published assessments indicate no substantive advantages to this method. It is not being pursued in any country as a means of dealing with an entire national inventory of used nuclear fuel.

Sub-Seabed Disposal would involve burial of used nuclear fuel containers in a suitable geological setting beneath the deep ocean floor. The disposal sites would be ones where the sediments are plastic and have a high capacity to absorb radionuclides, and where the water is several kilometres deep. The main sub-seabed disposal concept would use missile-

shaped canisters called "penetrators" to hold the solid waste. They would be dropped from ships, and bury themselves to a depth of a few metres in the sediments on the ocean floor. The idea behind the concept is that the waste form, inner canister, penetrator and sediments would provide sufficient protection to prevent the release of radionuclides into the ocean for thousands of years or more. When release finally does take place, it would occur very slowly and there would be substantial dilution. Another variation of this option would use deep sea drilling technology to stack used nuclear fuel packages in holes drilled to a depth of 800 metres, with the uppermost container about 300 metres below the seabed. An alternative "sub-seabed" option would be to access a location deep beneath the ocean floor via on-land shafts and drifts. In this instance, the ocean itself would serve as a last line of defense. The theory is that if contaminants were to escape and move to the ocean environment, their volume would be small and the buffering and diluting capacity of the ocean would mitigate the consequences.

Sub-seabed disposal was investigated extensively in the 1980s, primarily under the auspices of the Seabed Working Group set up by the Nuclear Energy Agency (NEA) of the Organization for Economic Co-operation and Development (OECD). Canada participated in this group, as did the United States, the United Kingdom, Japan and several European countries. Research on sub-seabed disposal effectively ceased when it became clear that there would always be intense political opposition. Ocean access to a sub-seabed repository is now prohibited by international conventions.

References

Bataille, M. and C. Birraux. 2005. Projecting into the future: a new law in 2006 to ensure the sustainable management of radioactive waste. A report by Mr. Christian Bataille, MP for the Nord Department and Mr. Claude Birraux, MP for the Haute-Savoie Department, on "The Advances and Prospects Regarding Radioactive Waste Management". Abstract. Office parlementaire d'évaluation des choix scientifiques et technologiques, Assemblée nationale. Paris, France.

Bunn, M., S. Fetter, J.P. Holdren and R. van der Zwaan. 2003. The economics of reprocessing vs. direct disposal of spent nuclear fuel. Belfer Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University. Report DE-FG26-99FT4028. Massachusetts, USA.

Jackson, D.P. 2005. Implications of reprocessing, partitioning and transmutation on long-term management of used nuclear fuel in Canada. Background Paper 6-14 prepared by David P. Jackson, McMaster University for the Nuclear Waste Management Organization, February 2005. (Available at www.nwmo.ca).

Appendix 10 / Used Fuel Scenarios

1. Introduction

In 2003, the NWMO convened a diverse team of individuals largely from across Canada to design a series of scenarios that would span a wide range of alternative plausible futures. The scenarios were prepared to highlight the possible impact of radioactive waste management decisions under a variety of futures with their associated uncertainties over the timeframes of 25 years, 175 years, 500 years and 10,000 years (GBN 2003). In 2004, the NWMO Assessment Team reviewed these scenarios and selected three of them (two pessimistic scenarios and one optimistic scenario) against which to test the preliminary findings of the evaluation of management approaches against a variety of futures (Ben-Eli et al. 2004). The three test scenarios were:

Test Scenario 1 is an optimistic scenario in which institutions remain strong, stable, respected and vigilant in perpetuity. The generation of used nuclear fuel ends with the current fleet of nuclear reactors working to their design life and not beyond. No new technical solution is found for treating the used fuel. Thus, in an overall sense, while care must be taken in perpetuity, society's overall capacity to address the issue of used nuclear fuel is high. This test scenario is split into two sub-scenarios. In Test Scenario 1-A, the "polluter pays" principle is adhered to for all three management approaches (Deep Geological Disposal in the Canadian Shield, Storage at Nuclear Reactor Sites and Centralized Storage). In Test Scenario 1-B, the principle is only truly maintained for the disposal option. For the storage options, resources from future generations are eventually required to cover the cost of repackaging and maintenance thus the "polluter pays" principle is not fully respected.

Test Scenario 2 is more pessimistic than Scenario 1. Here, nuclear energy is abandoned because of a loss of public trust; there is extreme social, political and institutional instability, mass migration of populations, fossil fuel use rises, climate change goes to the extreme, food costs rise, population shrinks by half and many are driven to subsistence lifestyles.

Test Scenario 3 is also pessimistic. While the economy is strong, energy demand is high and nuclear dependency is also high; weapons proliferate and security issues are grave; the gap between rich and poor widens and social instability results; totalitarian rule is imposed, greatly reducing personal freedoms; the threat of nuclear war is real but doesn't occur; society teeters.

The Assessment Team found that on nearly all of the objectives identified as necessary for an acceptable management approach, the deep geological repository concept is likely to perform better in the long term than the other waste management alternatives.

The NWMO has reflected on these scenarios and asked itself how much used fuel and what types of used fuel will need long-term management in Canada, and could the proposed management approaches accommodate the projected volume and types of used fuel?

To answer these questions, it was necessary to examine how much used fuel exists today and estimate how much used fuel would be produced in the future.

To understand the impact of the uncertainty associated with estimates of used fuel on its recommended management approach, the NWMO developed a number of possible future used fuel scenarios.

2. Current Inventory of Used Fuel

As discussed in Appendix 4, at the end of 2004, there were approximately 1.87 million used fuel bundles in Canada. The total number of used fuel bundles that will eventually be produced will depend on a number of factors such as the actual production values at each of the nuclear generating stations, future decisions by the operators of nuclear generating stations on refurbishment or life extension of existing reactors, and whether or not new nuclear reactors are built in Canada. For example:

- In 2004, Bruce Power submitted an application with the Canadian Nuclear Safety Commission (CNSC) for the refurbishment of Bruce A nuclear generating station, including the possibility of using new slightly enriched uranium (~ 1% uranium-235) in the CANDU reactors at Bruce. The proposed refurbishment at Bruce would extend the operational life of the reactors to 2043. Also, if the Bruce reactors operate with slightly enriched uranium, then there is the potential for used nuclear fuel with slightly different characteristics than are currently produced in Canada.

- In July 2005, the Province of New Brunswick announced that it would proceed with the planned refurbishment of the Point Lepreau reactor beginning in 2008. This decision could extend the service life of the Point Lepreau reactor by 25 to 30 years.

- In August 2005, Ontario Power Generation Inc. announced that it would not proceed with the planned refurbishment of Unit 2 and Unit 3 at the Pickering A nuclear generating station. The estimated operating lives for Pickering A Units 1 and 4 have been extended to 2023.

Future decisions on refurbishment or new reactor builds will likely be made by the provincial governments in Ontario, Québec and New Brunswick, possibly in conjunction with the Government of Canada. Thus, there continues to be uncertainty regarding the number of used fuel bundles that will eventually be produced in Canada.

3. Reference Used Fuel Scenario

The conceptual designs and cost estimates for long-term management approaches, prepared for the Joint Waste Owners (JWO) of used fuel and submitted to the NWMO, are based on a projected inventory which assumes that the Pickering, Bruce and Darlington reactors in Ontario will operate an average of 40 years, the Point Lepreau reactor in New Brunswick will operate 25 years, and the Gentilly reactor in Québec will operate 30 years (CTECH 2002; 2003a; 2003b). In this scenario, the existing reactors would be shut down after their respective 25, 30 and 40-year average lifetimes. This reference scenario could be considered a gradual "phase out" for the existing fleet of reactors in Canada at the end of their lives. The projected used fuel inventory was prepared in 2001 and estimated to be 3,557,451 bundles which were rounded up to 3.6 million bundles for conceptual design and cost estimating purposes.

In 2004, the JWO submitted summaries of cost estimates for the various long-term management approaches to the NWMO (JWO 2004a; 2004b; 2004c). These cost estimates were adjusted to reflect a revised estimate of the number of used fuel bundles that would be produced based on a common average nuclear reactor life of 40 years. This revised 2004 estimate is 3,665,094 fuel bundles or a rounded value of 3.7 million fuel bundles. (www.nwmo.ca/costsummaries)

In 2005, the installed nuclear generation capacity in Canada consists of 22 reactors for a total of 16,000 MW, although several Ontario units are currently shut down and may not be restarted. Based on previous operating experience, if all of these CANDU reactors were operational, they would generate approximately 100,000 used fuel bundles annually or about 6.25 bundles per MW-year of electrical energy production.

The projected number of bundles was also provided by the JWO for an average station life of 30 years (3.0 million bundles) and an average station life of 50 years (4.4 million bundles), reflecting uncertainty in the projected future estimates.

The change in the reference scenario from about 3.6 million to 3.7 million fuel bundles (< 3%) would not have a significant impact on the conceptual designs for long-term management facilities. The larger value is more conservative from a design and cost perspective, but not materially different than the original estimate since the reference designs were prepared using the projected number of used fuel bundles rounded up to the nearest 100,000 bundles.

A reference used fuel scenario based on 3.6 (or 3.7) million used fuel bundles is considered to be a reasonable projection assuming that the existing fleet of nuclear reactors in Canada have an average operational life of 40 years. Note that 3.7 million used fuel bundles would have a mass of about 71,000 tonnes of uranium for long-term management.

In 1962, the first demonstration of commercial nuclear power in Canada began with the Nuclear Power Demonstration reactor in Rolphton, Ontario. The first unit of the Pickering A Nuclear Generating Station commenced operation in 1971. The last unit of the Darlington reactors in Ontario will potentially reach 40 years of operation in 2033. Therefore, the reference 3.6 million fuel bundle scenario represents about 70 years of CANDU nuclear reactor operation in Canada.

In 2004, the NWMO commissioned a third-party review of the conceptual designs and cost estimates for the various long-term management approaches submitted by the JWO. The report found that all of the conceptual designs have sufficient flexibility to accommodate increased used fuel capacity in the future by constructing either incremental additions or completely new facilities. Further discussions in 2004 between the NWMO and the JWO confirmed that the modular designs of the long-term management approaches are sufficiently robust to accommodate more used fuel bundles or fewer used fuel bundles in the future, relative to the reference assumption of 3.6 million bundles.

4. National Energy Board Scenario

The National Energy Board report on Canada's energy future looked at two plausible energy futures for Canada, both of which assume a growth in electrical generation of 1.8 percent per year until 2025 (NEB 2003):

1. Supply Push scenario assumes that energy technology advances gradually and Canadians take limited action to limit the impact on the environment. The main focus is maintaining security of energy supply and a push to develop known resources of energy in Canada. The Supply Push scenario would see a resurgence of coal-fired plants in addition to gas-fired generation, hydraulic and nuclear.

2. Techno-Vert scenario assumes that energy technology advances rapidly and Canadians take broad action to limit impact on the environment by using environmentally friendly products and cleaner-burning fuels. The Techno-Vert scenario would see gas-fired generation, hydraulic, and a shift towards cleaner coal-burning technology, wind power and advanced nuclear reactors such as AECL's Advanced CANDU Reactor (ACR), which uses slightly enriched uranium.

The National Energy Board predicts a rise in Canada's electrical generating capacity from about 110,000 MW in 2000 to about 150,000 MW by 2025. For the Supply Push and the Techno-Vert scenarios, electrical generation by nuclear power is assumed to be about 13 to 15 percent, respectively. Under the Techno-Vert scenario, installed nuclear generation capacity in Canada could rise from the current 16,000 MW to about 22,500 MW by 2025. Assuming standard CANDU reactor technology, 22,500 MW of nuclear generation would produce about 140,000 used fuel bundles per year of operation in Canada.

5. Other Future Used Fuel Scenarios

The National Energy Board's report and the NWMO's discussions with Canadians have identified a need for the NWMO to explore other future used fuel scenarios in addition to the reference "3.6 million bundle" scenario provided by the JWO. Four other used fuel scenarios have been developed by the NWMO, which can be used for a high-level evaluation, and comparison with the reference used fuel scenario. They should be considered as "what-if" scenarios to test the robustness of the NWMO analysis of approaches for long-term management of used nuclear fuel. The scenarios have been designed to illustrate a broad range of future scenarios that include an "early" phase

out of nuclear power and a continuing nuclear reactor program in Canada with a mixture of nuclear generation types.

These other scenarios have been examined to understand the potential impact of future circumstances on the technical aspects of the management approaches (e.g. facility size, used fuel transportation requirements, duration of activities). They have not been evaluated explicitly to assess the broader range of social and ethical factors which are reflected in the eight objectives of the comprehensive comparative assessment, summarized in Chapter 8.

5.1 Future Scenario 1: Early Nuclear Phase Out

At the end of 2004, there were about 1.87 million used fuel bundles in Canada. With several reactors shut down, the production rate for used fuel is about 85,000 bundles per year. By the end of 2005, there is expected to be about 2 million bundles of used fuel in Canada. For this future scenario, the existing nuclear reactors are assumed to be gradually shut down over a five-year period starting in 2007.

Under an Early Nuclear Phase Out scenario, the total used fuel inventory by 2012 is projected to be 2.5 million used CANDU fuel bundles distributed over the seven reactor sites in Canada. For the central facility long-term management options, both the used fuel transportation period and the used fuel placement period could be reduced to about 20 years.

The potential implications of a future Early Nuclear Phase Out scenario would be similar to the 3 million used fuel bundle scenario which has been costed by the JWO. The long-term management facilities for 2.5 million used fuel bundles (48,000 tonnes of uranium) would be smaller than the current reference designs but still significantly larger than the planned used fuel management facilities in Finland (about 2,600 tonnes uranium) or Sweden (about 9,500 tonnes).

5.2 Future Scenario 2: Existing Reactor Refurbishment and Life Extension

Under the Existing Reactor Refurbishment and Life Extension scenario, the existing fleet of CANDU reactors in Canada is assumed to continue operation until the reactors have reached an average life of 50 years. Most of the material would be standard used CANDU fuel, although there may be some bundles from the Bruce reactors with slightly enriched uranium. The number of bundles produced for this 50 year operating scenario would be about 4.4 million. This total used fuel inventory is assumed to be reached by 2043 when the last reactor unit at Darlington achieves 50 years of operation.

The number of reactor sites in Canada would remain constant at seven. For the central facility long-term management options, both the used fuel transportation period and the used fuel placement period could be increased to about 40 years.

The potential implications of a future Existing Reactor Refurbishment and Life Extension scenario with 4.4 million used fuel bundles have been costed by the JWO. The long-term management facilities for 4.4 million used fuel bundles (84,000 tonnes of uranium) would be slightly larger than the current reference designs. However, it should be noted that this used fuel inventory is less than half of the 10 million bundles assumed by Atomic Energy of Canada Limited and incorporated in their conceptual designs (AECL 1994).

5.3 Future Scenario 3: Continuing CANDU Nuclear Program

The Continuing CANDU Nuclear Program scenario assumes the existing fleet of CANDU reactors continues operation and are refurbished or replaced with additional nuclear generation. While it is recognized that the used fuel could be a mixture of standard CANDU and slightly enriched uranium fuel, the used fuel inventory is conservatively based on standard CANDU bundles. The nuclear generation supply would be based on maintaining nuclear power at 15 percent of the total energy supply in Canada (NEB 2003). Therefore, the current 16,000 MW of nuclear generation would be increased to 22,500 MW by 2025.

Beyond 2025, energy supply and demand in Canada is uncertain. For the Continuing CANDU Nuclear Program scenario, nuclear generation is assumed to remain constant at 22,500 MW for an additional 200 years, or roughly 3 times the current projected life of 70

years for commercial nuclear power production in Canada. Reprocessing of used fuel for reuse in future reactors is not assumed to occur due to the high cost of reprocessing CANDU fuel and the abundance of uranium resources in Canada. The used fuel inventory for the Continuing CANDU Nuclear Program scenario would be approximately 30 million bundles, two million as of 2005 and an additional 28 million by about 2200.

The number of reactor sites in Canada is assumed to increase from the current seven to ten sites. For the central facility long-term management options, both the used fuel transportation period and the used fuel placement period could be increased to 250 years in order to maintain the currently assumed rate of handling 120,000 bundles per year.

The Continuing CANDU Nuclear Program scenario with 30 million used fuel bundles would likely result in a long-term management facility containing three times the 10 million bundle inventory assumed by Atomic Energy of Canada Limited in 1994. The operating period of the management facility would be substantially longer (several hundred years).

5.4 Future Scenario 4: Mixture of Continuing Nuclear Reactor Generation

The Mixture of Continuing Nuclear Reactor Generation scenario maintains nuclear power at 15 percent of the total energy supply in Canada (NEB 2003). The current 16,000 MW of nuclear generation is assumed to increase to 22,500 MW by 2025 and remain constant for the next 200 years. Reprocessing of used CANDU fuel is not assumed for economic reasons.

For the Mixture of Continuing Nuclear Reactor Generation scenario, nuclear generation in Canada is assumed to be a mixture of standard CANDU reactors with natural and slightly enriched uranium, Advanced CANDU Reactors and Pressurized Water Reactors. The amount of used fuel produced over the next 200 years would depend on the exact mix of nuclear reactors and their operating periods, which is uncertain. The amount of used fuel produced can be reduced roughly by the uranium-235 enrichment factor. The fissile uranium-235 content in natural uranium is 0.7 percent; slightly enriched uranium fuel has 0.8 to 1.2 percent; Advanced CANDU Reactor fuel has about two percent and Pressurized Water Reactors fuel has about four percent. As a result, some of these reactors may produce about one quarter to one half the used fuel of a standard CANDU reactor.

For purposes of this future scenario, it is assumed that future nuclear generation in Canada would be dominated by Advanced CANDU Reactors and Pressurized Water Reactor. The number of used fuel bundles (or equivalent bundles in the case of pressurized water reactors) produced in Canada by about the year 2200 is assumed to be 15 million bundles, or half the assumed inventory for the Continuing CANDU Nuclear Program scenario.

The number of reactor sites in Canada is assumed to increase from the current seven to ten sites. For the central facility long-term management options, both the used fuel transportation period and the used fuel placement period could be increased to about 250 years but at a reduced handling rate of about 60,000 bundles (or equivalent) per year. Note that fuel enriched with uranium-235 has a higher burn-up and is consequently thermally hotter than used natural uranium fuel. In general, designs for used fuel containers have a thermal limit. Similar used fuel containers may hold less enriched fuel than natural uranium used fuel, depending on their cooling time out of reactor.

The potential implications of a future Mixture of Continuing Nuclear Reactor Generation scenario with 15 million used fuel bundles are that it would likely result in a long-term management facility that is one and a half times the inventory assumed by Atomic Energy of Canada Limited in 1994, although the operating period of the long-term management facility would be substantially longer (several hundred years).

References

AECL. 1994. Environmental impact statement on the concept for disposal of Canada's nuclear fuel waste. Atomic Energy of Canada Limited Report, AECL-10711, COG-93-1. Chalk River, Ontario.

Ben-Eli, M., J. Neate, J. Facella, A. Hodge, T. Issacs, W. Leiss, M. Margolick, K. Moshonas Cole and F. Roots. 2004. Assessing the options future management of used nuclear fuel in Canada. An NWMO Assessment Team Report prepared for the Nuclear Waste Management Organization, June 2004. (Available at www.nwmo.ca/assessmentteamreport)

CTECH. 2002. Conceptual design for a deep geologic repository for used nuclear fuel. CTECH Report 1106/MD18085/REP/01. (Available at www.nwmo.ca/geologicaldisposal)

CTECH. 2003a. Conceptual designs for reactor-site extended storage facility alternatives for used nuclear fuel. CTECH Report 1105/MD18084/REP/12. (Available at www.nwmo.ca/reactorstorage)

CTECH. 2003b. Conceptual designs for four centralized extended storage facility alternatives for used nuclear fuel. CTECH Report 1105/MD18084/REP/08. (Available at www.nwmo.ca/centralstorage)

GBN. 2003. Looking forward to learn: future scenarios for testing different approaches to managing used nuclear fuel in Canada. Background Paper 8-5 prepared by Global Business Network for the Nuclear Waste Management Organization. (Available at www.nwmo.ca/scenarios)

JWO. 2004a. Costs of alternative approaches for the long-term management of Canada's nuclear fuel waste. Reactor-site extended storage approach. A submission to the Nuclear Waste Management Organization by Ontario Power Generation, Hydro-Québec, New Brunswick Power and Atomic Energy of Canada Limited. January 2004, Rev. 00. (Available at www.nwmo.ca/reactorcosts)

JWO. 2004b. Costs of alternative approaches for the long-term management of Canada's nuclear fuel waste. Centralized extended storage facility approach. A submission to the Nuclear Waste Management Organization by Ontario Power Generation, Hydro-Québec, New Brunswick Power and Atomic Energy of Canada Limited. March 2004, Rev. 02. (Available at www.nwmo.ca/centralstoragecosts)

JWO. 2004c. Costs of alternative approaches for the long-term management of Canada's nuclear fuel waste. Deep geologic disposal approach. A submission to the Nuclear Waste Management Organization by Ontario Power Generation, Hydro-Québec, New Brunswick Power and Atomic Energy of Canada Limited. March 2004, Rev. 01. (Available at www.nwmo.ca/disposalcosts)

NEB. 2003. Canada's energy future. Scenarios for supply and demand to 2025. National Energy Board Report Cat. No. NE23-15/2003E, ISBN 0-662-33858-8, Calgary Alberta. (Available at www.neb-one.gc.ca/energy/SupplyDemand/2003/index_e.html)

Appendix 11 / Building the Information Foundation – Engagement and Research

The NWMO has benefited from the knowledge, advice and counsel of many specialists from Canada and abroad, and from citizens across Canada. Reports from these dialogues are available at www.nwmo.ca/dialoguereports.

A) Engagement Activities

As of August 31, 2005, approximately 50,000 people expressed interest in our study by visiting our web site. We conservatively estimate that more than 18,000 citizens have contributed, including more than 500 specialists in scientific (natural and social sciences) and technical disciplines related to the management of used nuclear fuel.

Early in its work the NWMO initiated approximately 250 Conversations About Expectations with individuals and organizations to learn what they expected from the NWMO study and how they wanted to see it conducted.

National Citizens Dialogue on Values

The NWMO partnered with the Canadian Policy Research Networks (CPRN) to bring together 462 citizens for a dialogue about their underlying values and expectations. The goal was to understand how the public at large approaches the complexities involved in the long-term management of used nuclear fuel. The Dialogue took place between January and March 2004, in 12 locations across the country:

Halifax	Moncton	Québec City
Vancouver	Montréal	Toronto
London	Calgary	Thunder Bay
Sudbury	Ottawa	Saskatoon

Participants were randomly selected by a polling firm to be representative of the Canadian population. Using quantitative and qualitative data from the dialogue sessions, CPRN analyzed the results and reported on the core values Canadians would like to see drive decision-making. The full report is available at: www.nwmo.ca/canadianvalues.

13-1. Responsible Action – Citizens' Dialogue on the Long-term Management of Used Nuclear Fuel, Judy Watling, Judith Maxwell, Nandini Saxena, Suzanne Taschereau, Canadian Policy Research Networks. July 2004.

13-2. National Citizens' Dialogue: Video Overview, Canadian Policy Research Networks. July 2004.

Nuclear Host Community Dialogues

The NWMO recognized early that communities which currently store used nuclear fuel have special experience, insights and perspectives which should be drawn upon to inform the NWMO study. Each of these communities was visited.

- Community Dialogue: Report of the Planning Workshop. Glenn Sigurdson CSE Consulting Inc. and Barry Stuart.

In October 2003 a Community Dialogues Planning Workshop was convened in Toronto to develop ways of enabling reactor site communities to participate meaningfully in the process. Twenty-one individuals participated, representing various perspectives including: environment, labour, industry, business, citizen, health and local government. They were drawn from communities in the vicinities of the seven nuclear storage sites in Canada: Point Lepreau in New Brunswick; Gentilly in Québec; Darlington, Pickering, Bruce and Chalk River in Ontario; and Whiteshell in Manitoba.

- Community Dialogue Workshop. Hardy Stevenson and Associates, February 2005.

In February 2005 participants from the 2003 workshop were reconvened for a two-day session in Toronto to review the NWMO's second discussion document *Understanding the Choices* and to seek their input on the preliminary assessment of the management options and the NWMO's implementation strategy. The two-day dialogue included an exercise designed to assist participants in their understanding of the assessment framework presented in the document and was followed by an in-depth discussion of the questions posed

in *Understanding the Choices*. Thirteen participants attended these sessions.

Reports of the Community Dialogue Workshops are available on the NWMO website: www.nwmo.ca/workshopreports.

8-4. Community Dialogue: Report of the Planning Workshop. Glenn Sigurdson CSE Consulting Inc. and Barry Stuart.

10-8. Community Dialogue Workshop. Hardy Stevenson and Associates, February 2005.

Other Dialogues with Nuclear Host Communities

Throughout its study the NWMO has conducted ongoing dialogue and study updates through meetings with individual Mayors, and through the Canadian Association of Nuclear Host Communities. Citizens from reactor site communities participated in the Information and Discussion sessions held across Canada from October to December 2004.

Also, at their request, information has been presented to citizen groups, advisory committees, local health committees, municipal councils and planning committees in nuclear communities. Among them:

Ajax City Council
Ajax Rotary Club
Citizens for Renewable Energy/
Great Lakes United (Kincardine area)
Darlington Site Planning Committee
Deep River Area Mayors
Deep River CNS
Durham Nuclear Health Committee
Inverhuron District Ratepayers
Association (IDRA)
Municipalité Régionale de Comté
de Pontiac (MRC Pontiac), Québec
Pickering City Council
Pickering Community Advisory Committee
Pickering Council Management Forum
Point Lepreau Generating Station
Community Liaison Committee
Port Elgin Chamber of Commerce
Renfrew Concerned Citizens
South Bruce Impact Advisory Committee

National and Regional Stakeholder Dialogues

- Report on National Stakeholder and Regional Dialogues Regarding NWMO Discussion Document 1 *Asking the Right Questions?* DRPA Canada. 2004.

In March and April 2004, the NWMO held national and regional dialogues in Ottawa, North Bay, Montréal, and Fredericton. These meetings brought together seventy-three people and organizations with a history of involvement in the subject of how Canada should manage its nuclear fuel wastes and others with an interest in similar public policy issues. Participants were asked to critically review the NWMO's first discussion document, *Asking the Right Questions?*

Dialogues consisted of an introductory half-day session, followed by an electronic dialogue, and several weeks later, a full-day facilitated discussion in which participants returned to address a range of topics in depth and to explore their views further.

- Dialogue: National Stakeholders and Regional Dialogue Sessions. Hardy Stevenson and Associates Final Report, February 2005.

The National and Regional Dialogues were re-convened in January and February 2005 to review the NWMO's second discussion document *Understanding the Choices* and to seek input on the preliminary assessment of the management options and the NWMO's implementation strategy. Fifty-nine people participated in these re-convened dialogues held in Toronto, Mississauga, Fredericton and Montréal. The two-day sessions included an exercise designed to assist participants in their understanding of the assessment framework presented in *Understanding the Choices* and was followed by an in-depth discussion of the questions posed in the document.

Project findings for both the initial and follow-up national and regional dialogues are available on the NWMO website at: www.nwmo.ca/workshopsandroundtables.

10-2. Report on National Stakeholder and Regional Dialogues Regarding NWMO Discussion Document 1 *Asking the Right Questions?*. DRPA Canada. 2004.
1. National Stakeholders and Regional Dialogue Sessions: Final Report, DPRA.
2. National Stakeholders and Regional Dialogue Sessions: Appendices, DPRA.

10-6. Dialogue: National Stakeholders and Regional Dialogue Sessions. Hardy Stevenson and Associates Final Report, February 2005.

E-Dialogues

Royal Roads University, facilitated by Dr. Ann Dale, conducted four internet-based e-dialogues on behalf of the NWMO:

- On October 26, 2004 risk and uncertainty in the management of nuclear waste was explored by the following panelists: Norm Rubin of Energy Probe, William Leiss of the School of Policy Studies at Queen's University, Andrew Stirling of Science and Technology Policy Research at the University of Sussex, Environmental Studies at Williams College, and David Shoesmith of the Department of Chemistry at the University of Western Ontario.

- On November 29, 2004 approximately 75 young people were engaged in four e-roundtables to consider the assessment framework proposed by the NWMO in its second discussion document and to apply this framework to the three options for managing used nuclear fuel under study. Participants drew from Parliamentary Interns, Action Canada Senior Policy Fellows, Top Forty Under Forty, members of the doctoral science cohort across North America, youth wings of the three major political parties, Royal Roads students, graduates and Trudeau Scholars.

- On February 10, 2005, decision-making under conditions of risk and uncertainty was explored by the following panelists: Christopher Henderson of the Delphi Group, Norm Rubin of Energy Probe, Jim MacNeill formerly of the Brundtland Commission and of the World Bank's Independent Inspection Panel, and Andy Stirling from the University of Sussex. Interested public were invited to view the dialogue and post comments.

From October 2004 to February 2005 the Royal Roads website which accommodated the NWMO e-dialogues recorded 3203 visits.

- From July 1 through to August 14, 2005 Royal Roads University hosted an open E-Forum inviting all interested Canadians to engage in a discussion concerning the appropriateness of NWMO's *Draft Study Report* and recommended approach. The forum was opened with an interview with NWMO President Elizabeth Dowdeswell by Anne Dale. In total, 577 individuals either participated in or viewed the E-Forum dialogue.

Reports on the E-dialogues are available at: www.nwmo.ca/edialogues.

14-1. E-Dialogue on Risk and Uncertainty: October 26, 2006. Royal Roads University.

14-2. E-Dialogue Among Young Canadians: November 29, 2004. Royal Roads University.

14-3. E-Dialogue on Decision-Making under Conditions of Risk and Uncertainty: February 10, 2005. Royal Roads University.

14-4. Final Report: Nuclear Waste Management Organization Public E-Forum: August 2005. Royal Roads University.

Information and Discussion Sessions

- Community Information and Discussion Sessions Discussion Document 2 *Understanding the Choices*, DPRA Canada, Inc. February 2005.

Between September and December 2004, 880 citizens participated in well-advertised public information and discussion sessions convened in every province and territory in Canada. The purpose was to inform Canadians about the NWMO study and to engage them in a dialogue about the preliminary descriptions of long-term nuclear waste management approaches and the framework being proposed to compare them.

One-hundred and twenty meetings occurred in:

Bécancour	Clarington	Charlottetown
Edmonton	Edmundston	Fredericton
Goose Bay	Halifax	Huntsville
Iqaluit	Kenora	Kingston
London	Montréal	Musquash
Ottawa	Owen Sound	Pembroke
Pickering	Pinawa	Québec City
Regina	Rivière-du-Loup	Rouyn-Noranda
Sept-Îles	St. John's	Sudbury
Thunder Bay	Timmins	Toronto
Vancouver	Whitehorse	Winnipeg
Yellowknife		

Summary reports from each of these sessions and a comprehensive report summarizing all of the activities and discussions are available on the NWMO website: **www.nwmo.ca/infoand discussion**.

15-1. Information and Discussion Sessions Regarding NWMO's Discussion Document #2 – *Understanding the Choices*, DPRA Canada. February 2005.

15-2. Bécancour: Information Session: Summary Report: French Version, DPRA Canada. February 2005.

15-3. Bécancour: Information Session: Summary Report: English Version, DPRA Canada. February 2005.

15-4. Bécancour: Discussion Session: Summary Report: French Version, DPRA Canada. February 2005.

15-5. Bécancour: Discussion Session: Summary Report: English Version, DPRA Canada. February 2005.

15-6. Charlottetown: Information Session: Summary Report, DPRA Canada. February 2005.

15-7. Charlottetown: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-8. Clarington: Information Session: Summary Report, DPRA Canada. February 2005.

15-9. Clarington: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-10. Durham Nuclear Health Committee: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-11. Edmonton: Information Session: Summary Report, DPRA Canada. February 2005.

15-12. Edmonton: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-13. Edmunston: Information Session: Summary Report, DPRA Canada. February 2005.

15-14. Fredericton: Information Session: Summary Report, DPRA Canada. February 2005.

15-15. Fredericton: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-16. Goose Bay: Information Session: Summary Report, DPRA Canada. February 2005.

15-17. Halifax: Information Session: Summary Report, DPRA Canada. February 2005.

15-18. Halifax: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-19. Huntsville: Information Session: Summary Report, DPRA Canada. February 2005.

15-20. Huntsville: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-21. Iqaluit: Information Session: Summary Report, DPRA Canada. February 2005.

15-22. Iqaluit: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-23. Kenora: Information Session: Summary Report, DPRA Canada. February 2005.

15-24. Kenora: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-25. Kingston: Information Session: Summary Report, DPRA Canada. February 2005.

15-26. Kingston: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-27. London: Information Session: Summary Report, DPRA Canada. February 2005.

15-28. London: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-29. Montréal: Information Session: Summary Report: French Version, DPRA Canada. February 2005.

15-30. Montréal: Information Session: Summary Report: English Version, DPRA Canada. February 2005.

15-31. Montréal: Discussion Session: Summary Report: French Version, DPRA Canada. February 2005.

15-32. Montréal: Discussion Session: Summary Report: English Version, DPRA Canada. February 2005.

15-33. Musquash: Information Session: Summary Report, DPRA Canada. February 2005.

15-34. Musquash: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-35. Ottawa: Information Session: Summary Report, DPRA Canada. February 2005.

15-36. Ottawa: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-37. Owen Sound: Information Session: Summary Report, DPRA Canada. February 2005.

15-38. Owen Sound: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-39. Pembroke: Information Session: Summary Report, DPRA Canada. February 2005.

15-40. Pembroke: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-41. Pickering: Information Session: Summary Report, DPRA Canada. February 2005.

15-42. Pickering: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-43. Pinawa: Information Session: Summary Report, DPRA Canada. February 2005.

15-44. Pinawa: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-45. Québec: Information Session: Summary Report: French Version, DPRA Canada. February 2005.

15-46. Québec: Information Session: Summary Report: English Version, DPRA Canada. February 2005.

15-47. Québec: Discussion Session: Summary Report: French Version, DPRA Canada. February 2005.

15-48. Québec: Discussion Session: Summary Report: English Version, DPRA Canada. February 2005.

15-49. Regina: Information Session: Summary Report, DPRA Canada. February 2005.

15-50. Regina: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-51. Rivière-du-Loup: Information Session: Summary Report: French Version, DPRA Canada. February 2005.

15-52. Rivière-du-Loup: Information Session: Summary Report: English Version, DPRA Canada. February 2005.

15-53. Rivière-du-Loup: Discussion Session: Summary Report: French Version, DPRA Canada. February 2005.

15-54. Rivière-du-Loup: Discussion Session: Summary Report: English Version, DPRA Canada. February 2005.

15-55. Rouyn: Information Session: Summary Report: French Version, DPRA Canada. February 2005.

15-56. Rouyn: Information Session: Summary Report: English Version, DPRA Canada. February 2005.

15-57. Rouyn: Discussion Session: Summary Report: French Version, DPRA Canada. February 2005.

15-58. Rouyn: Discussion Session: Summary Report: English Version, DPRA Canada. February 2005.

15-59. Sept-Îles: Information Session: Summary Report: French Version, DPRA Canada. February 2005.

15-60. Sept-Îles: Information Session: Summary Report: English Version, DPRA Canada. February 2005.

15-61. Sept-Îles: Discussion Session: Summary Report: French Version, DPRA Canada. February 2005.

15-62. Sept-Îles: Discussion Session: Summary Report: English Version, DPRA Canada. February 2005.

15-63. St. John's: Information Session: Summary Report, DPRA Canada. February 2005.

15-64. Sudbury: Information Session: Summary Report, DPRA Canada. February 2005.

15-65. Sudbury: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-66. Thunder Bay: Information Session: Summary Report, DPRA Canada. February 2005.

15-67. Thunder Bay: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-68. Timmins: Information Session: Summary Report: Revised, DPRA Canada. February 2005.

15-69. Timmins: Discussion Session: Summary Report: Revised, DPRA Canada. February 2005.

15-70. Toronto: Information Session: Summary Report, DPRA Canada. February 2005.

15-71. Toronto: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-72. Vancouver: Information Session: Summary Report, DPRA Canada. February 2005.

15-73. Vancouver: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-74. Whitehorse: Information Session: Summary Report, DPRA Canada. February 2005.

15-75. Winnipeg: Information Session: Summary Report, DPRA Canada. February 2005.

15-76. Winnipeg: Discussion Session: Summary Report, DPRA Canada. February 2005.

15-77. Yellowknife: Information Session: Summary Report, DPRA Canada. February 2005.

15-78. Yellowknife: Discussion Session: Summary Report, DPRA Canada. February 2005.

Dialogue on the *Draft Study Report*

- Dialogue on the *Draft Study Report*, Stratos, Inc. 2005

A series of six dialogue sessions in six cities across five provinces (Manitoba, Saskatchewan, New Brunswick, Québec, and Ontario) was held during the period of June 22 to July 20, 2005. The objectives of the dialogue sessions were to provide opportunities for participants to comment on the draft NWMO recommendation and *Draft Study Report*; provide for an exchange of views; and provide the NWMO with the opportunity to improve the recommendation before it was finalized.

With the exception of Manitoba, each of the provinces chosen have direct involvement in the nuclear fuel cycle. Manitoba was included in response to a request for a dialogue in Pinawa, due to its long-standing involvement with the Atomic Energy of Canada Limited Whiteshell Laboratories and the Underground Research Laboratory located near that community. Participants were invited to the sessions on the basis of their prior involvement with NWMO activities and research and their expressed interest in the NWMO's work. One hundred and sixty-nine people participated in the dialogue.

The Dialogues were held:

- Manitoba: June 22, 2005: Pinawa
- Saskatchewan: June 28 & 29, 2005: Saskatoon
- New Brunswick: July 5 & 6, 2005: Saint John
- Québec: July 8 & 9, 2005: Trois-Rivières
- Ontario: July 15 & 16, 2005: Toronto and July 18 & 19, 2005: North Bay

Reports of the Public Dialogues on the *Draft Study Report* are available on the NWMO website: www.nwmo.ca/dsrdialogue.

10-9. Dialogue on the *Draft Study Report*, Stratos, Inc. 2005

1. NWMO DSR Dialogue Summary Report, Stratos, Inc. 2005.
2. NWMO DSR Dialogue Summary Pinawa, MB, Stratos, Inc. 2005.
3. NWMO DSR Dialogue Summary Saskatoon, SK, Stratos, Inc. 2005.
4. NWMO DSR Dialogue Summary Saint John, NB, Stratos, Inc. 2005.
5. NWMO DSR Dialogue Summary Trois-Rivières, QC, Stratos, Inc. 2005.
6. NWMO DSR Dialogue Summary Toronto, ON, Stratos, Inc. 2005.
7. NWMO DSR Dialogue Summary North Bay, ON, Stratos, Inc. 2005.

Open Houses

A series of Open Houses were held in June and July 2005 in reactor site communities; Ontario: Pickering, Clarington, Kincardine, Pembroke, and Deep River; Québec: Bécancour; and New Brunswick, Saint John. Citizens in these communities were provided the opportunity to learn about the *Draft Study Report* and the recommended approach and to give the NWMO their thoughts on the *Draft Study Report* and recommended approach. Sixty-eight people attended these Open Houses.

Open Houses were held in:

- Saint John – June 23 & 24, 2005
- Bécancour – June 17 & 18, 2005
- Pembroke – July 21, 2005
- Deep River – July 22, 2005

- Pickering – June 13 & 14, 2005
- Clarington – June 23 & 24, 2005
- Kincardine – June 10 & 11, 2005

Roundtable on Ethics

The Roundtable on Ethics was composed of individuals expert in the field of ethics in a variety of disciplines. The Roundtable's role was to assist the NWMO in the development and application of the analytical framework to be used to assess the management approaches. The Roundtable on Ethics was tasked to help the NWMO make explicit, and ensure, the systematic integration of ethical considerations in the development and application of the framework. The Roundtable met several times over the study period in order to provide advice and feedback to the NWMO throughout the study process. Members of the Roundtable were: Andrew Brook, Wesley Cragg, Georges Erasmus, the Hon. David MacDonald, Arthur Schafer, and Margaret Somerville.

Reports from the Roundtable on Ethics are available at www.nwmo.ca/ethicsroundtable.

2-7. Ethical and Social Framework. NWMO Roundtable on Ethics

Workshops and Roundtables

Workshops and meetings have been convened to explore specific topics and key issues. These sessions include:

8-1. Environmental Aspects of Nuclear Fuel Waste Management. Robert W. Slater, Coleman Bright and Associates, and Chris Hanlon, Patterson Associates.

8-2. Technical Aspects of Nuclear Fuel Waste Management. McMaster Institute for Energy Studies, McMaster University.

8-3. Drawing on Aboriginal Wisdom: A Report on the Traditional Knowledge Workshop. Joanne Barnaby, Joanne Barnaby Consulting.

8-5. Looking Forward to Learn: Future Scenarios For Testing Different Approaches to Managing Used Nuclear Fuel in Canada, Global Business Network (GBN).

10-1. Report on Discussion with Senior Environmental and Sustainable Development Executives. Carole Burnham Consulting and Robert J. Readhead Limited.

10-3. Roundtable Dialogue with Youth at the International Youth Nuclear Congress – Summary Report. DRPA Canada. 2004.

10-4. Roundtable Dialogue with Durham Nuclear Health Committee – Summary Report. DRPA Canada. 2004.

10-5. Public Policy Forum: Implementing a Strategy for the Long-term Management of Used Nuclear Fuel. Public Policy Forum, December 2004. Results of a Roundtable with Senior Opinion Leaders conducted by Public Policy Forum in December 2004.

10-7. NWMO Workshop on Nature of the Hazard. Stratos Inc. 2005.
1. A Participant's Statement on Characterizing the Nature of the Hazard of Used Nuclear Fuel.
2. Facilitator's Report on NWMO Workshop on the Nature of the Hazard of Used Nuclear Fuel, Stratos.
3. Background Document, NWMO.
4. Agenda, NWMO.

10-10. Dialogue with the Durham Nuclear Health Committee on Choosing a Way Forward – The NWMO Draft Study Report. Stratos, Inc. 2005

The NWMO initiated and responded to requests for information sessions and presentations. The following illustrates the variety:

Atomic Energy Canada Limited Research and Development Advisory Panel
Canadian Nuclear Association
Canadian Nuclear Society
Canadian Nuclear Workers Council
The Deep River Science Academy
Federation of Northern Ontario Municipalities
GLOBE 2004
Greater Saskatoon Chamber of Commerce
International Youth Nuclear Congress
Lakehead University
Manitoba Institute of Management
NACE (Corrosion Society)
North Saskatoon Business Association
Nuclear Waste Watch
Ontario Bar Association
Timmins Citizen's Group
United Church of Canada
University of Toronto
Various Community Events
York University

Public Attitude Research

An important component of the NWMO outreach has been to track the views of Canadians through public attitude research including discussion groups and telephone surveys.

- In November and December 2002 an independent research company conducted 14 discussion sessions in Pickering, London, Thunder Bay, Saskatoon, Vancouver, St. John and Trois-Rivières to help identify a range of needs and expectations of Canadians regarding the NWMO study.

- The same issues were explored in a national telephone survey of 1,900 scientifically selected people representative of a cross-section of Canadians and 700 individuals living in nuclear site communities.

- A survey on the NWMO website explored similar issues and was accessible to all visitors to the website.

- In December, 2003, six discussion sessions were held with 54 participants in North Bay, Kanata and Mississauga to gauge their reaction to the first NWMO discussion document, *Asking the Right Questions?*

- Similar questions were asked in a national telephone survey of 1900 Canadians from coast-to-coast and 700 citizens from nuclear site communities in spring, 2004.

- A survey on the NWMO website explored similar issues and was accessible to all visitors to the website.

- In late 2004/early 2005, 10 focus groups with 96 participants were convened in Pickering, Sault Ste. Marie, Windsor, St. John and Québec City. These sessions followed the release of NWMO's second discussion document, *Understanding the Choices*, and were designed to provide insight into how people approach trade-offs and balances that will be required in developing a recommendation for the long-term management of used nuclear fuel.

- A survey on the NWMO website explored similar issues and was accessible to all visitors to the website.

- In June and July 2005, 24 discussion sessions were held with 223 participants in Saskatoon, Regina, London, Clarington, Toronto, Kenora, Sudbury, Kingston, Montréal, Trois Rivières, Saint John, and Fredericton to gauge their reaction to NWMO's *Choosing a Way Forward – Draft Study Report*.

- In July 2005 a national telephone survey of 1,900 randomly selected Canadians from coast-to-coast and 700 citizens in nuclear site communities were asked to comment on the key elements of the Adaptive Phased Management Approach.

- A survey on the NWMO website explored similar issues and was accessible to all visitors to the website.

Reports on the Public Attitude Research are available at: www.nwmo.ca/publicattitude research.

12-1. Phase 1: Report on Discussion Sessions. Navigator Limited.

12-2. Phase 1: Report on Nation-Wide Survey. Navigator Limited.

12-3. Phase 2: Report on Discussion Findings. Navigator Limited.

12-4. Phase 2: Report on Nation-Wide Survey. Pollara Inc.

12-5. Phase 3: Report on Discussion Group Research Findings. Navigator Limited.

12-6. Phase 4: Report of Findings from Discussion Groups on the Draft Recommendations: Summary Report. Navigator Limited.

12-7. Phase 4: Report on Nation-Wide Survey. Veraxis Research & Communications

Website

The NWMO website was the central site for communicating publicly the many background papers, technical reports, submissions and ongoing NWMO discussion documents. People were invited to review documentation on the NWMO website and submit their comments and thoughts on the long-term management of used nuclear fuel. The NWMO website was visited 264,218 times between February 2003 and August 2005.

In that period, the website was visited by 51,122 unique visitors, 9,925 of which visited the website two or more times, based on Web Trends reporting. In that same period, more than 191 submissions were made to the website.

B) Aboriginal Dialogue

The purpose of the Aboriginal dialogue is to build the foundation for a long-term positive relationship between the NWMO and the Aboriginal peoples of Canada.

- In the early stages of its work, the NWMO initiated a number of activities to explore the nature of the NWMO's engagement and involvement with Aboriginal peoples. Initially letters announcing the creation of the organization were distributed to selected Aboriginal organizations. This was followed by letters of invitation to all those Aboriginal groups and organizations that participated in the Federal Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel hearings. During Phase 1 of the NWMO Study, Conversations about Expectations, the NWMO also contacted and/or met with aboriginal representatives of organizations and communities that resided near existing nuclear power plants or waste storage sites, and other Aboriginal leaders who had a significant role in public policy matters, to introduce the NWMO and invite initial comment on the work before us.

The NWMO met with representatives of various federal government agencies including:

- Natural Resources Canada – which was responsible for and had initiated contribution agreements with the national Aboriginal organizations to consult on long-term nuclear fuel waste management

- Environment Canada, Aboriginal Policy & Intergovernmental Coordination Unit – which had extensive experience in and was developing guidelines for consultation with First Nations

- Canadian Environmental Assessment Agency Staff responsible for the Aboriginal consultations on the five year review of the CEA Act.

Also early in 2003, the NWMO convened an informal discussion with eleven Aboriginal leaders about the approach the NWMO might adopt in developing an Aboriginal engagement program. These were individuals who are engaged in work with Aboriginal political organizations, the private sector, government and universities. Throughout this early phase of discussion, the NWMO was advised to examine ways in which Traditional Knowledge could be incorporated into the NWMO study, to invite Aboriginal participation in all of the NWMO study activities, and to support initiatives where Aboriginal peoples could design and implement discussions amongst themselves to understand and assess the issues and take part in the discussion of options for the long-term management of used nuclear fuel.

As a result, the NWMO has worked in collaboration with and provided support to a total of 15 national, regional, and local Aboriginal organizations across Canada. Each dialogue initiative was unique, reflecting the needs, concerns value systems and/or decision-making process of the organization and people represented. A range of different dialogue processes have resulted involving some 2,500 participants. Together these various initiatives have significantly informed the NWMO study and have provided a rich experience to draw on in the years ahead. Reports from the various Aboriginal dialogues are posted on the NWMO website at www.nwmo.ca/aboriginaldialogues. Following is a brief overview of the key activities in each of the Aboriginal dialogues.

National Associations

The Assembly of First Nations (AFN)

The AFN established a core team that included a project Coordinator plus four regional coordinators (Northern Ontario, Southern Ontario, West/North, and Quebec/East). A National Working Group was established to guide the dialogue process that included the core team as well as various representatives from the regions. In addition, a Regional Chiefs Environmental Council was created and convened to initiate the dialogue. Early in the work of the NWMO, the AFN met with NWMO representatives and attended a number of NWMO study activities including the Scenarios Workshop and the Traditional Knowledge Workshop. In addition to reporting the results of their discussions, the AFN commissioned an environmental scan that provided an overall context for their review of the used nuclear fuel issue. Part way through their process, responsibility for First Nations discussions in the Maritimes (New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador) was transferred to the Atlantic Policy Congress of First Nations Chiefs (see below).

In addition to many informal discussions, the AFN has conducted the following meetings:

- Working Group Meeting – Ottawa, July 14 – 15, 2004
- Regional Chiefs Panel on the Environment Meeting – Winnipeg, September 8/9, 2004
- Working Group Meeting – Ottawa, October 27, 2004
- Regional Forum, Ontario South – Toronto, November 18, 2004
- Regional Forum, Ontario North – Wauzhuskh Onigum First Nation, November 23, 2004
- Regional Forum, Canada West, Prince Albert, Saskatchewan – November 30, 2004
- Working Group Meeting (National Update) – Ottawa, May 13, 2005
- Working Group Meeting – Ottawa, June 14, 2005
- Regional Forum, Quebec – Ottawa, July 26, 2005

Lastly, a briefing by the NWMO on the *Draft Study Report* was provided to Ottawa staff on May 13, 2005.

11-AFN-1 Nuclear Fuel Waste Dialogue: Phase II Annual Report, April 26, 2005

11-AFN-2 First Nations Nuclear Fuel Waste Dialogue, Working Group Meeting #1 Report, August 19, 2004

11-AFN-3 First Nations Nuclear Fuel Waste Dialogue, Working Group Meeting #2 Report, November 30, 2004

11-AFN-4 Nuclear Waste Management Regional Forum: Toronto, Ontario (Ontario South), December 17, 2004

11-AFN-5 Nuclear Waste Management Regional Forum: Wauzhushk Onigum First Nation (Ontario North), December 17, 2004

11-AFN-6 Nuclear Waste Management Regional Forum: Prince Albert, Saskatchewan (Canada West), December 17, 2004

11-AFN-7 Nuclear Fuel Waste Dialogue: Phase II Regional Forum – Summary Report, January 31, 2005

11-AFN-8 Nuclear Fuel Waste Dialogue: Phase II Progress Report, January 31, 2005

11-AFN-9 Nuclear Fuel Waste Dialogue: Interim Report # 1, July 5, 2004

11-AFN-10 Background Paper: First Nations Environmental Stewardship, November 2004

11-AFN-11 First Nations Nuclear Fuel Waste Dialogue Working Group Meeting #3 Report, July 2005

Métis National Council (MNC)

The MNC Nuclear Dialogue was overseen by the MNC Environment Committee. The MNC Environment Committee began its exploration of the nature of its dialogue process early in 2004. In December 2004, the Committee held a training session to ensure a common information base and allow Governing Members to discuss information dissemination, collection, and the dialogue process. March 21-22, 2005, the MNC Environment Committee met in Calgary, AB to discuss their progress regarding the Used Nuclear Fuel dialogues.

Used Nuclear Fuel workshops were held across the Métis National Council Territory involving four of the five Governing Members of the MNC.[1] Métis Nation – Saskatchewan was not able to initiate their workplan due to unforeseen circumstances.

Lastly, a briefing by the NWMO on the *Draft Study Report* was provided to Ottawa staff on May 13, 2005. In summary the following workshops and meetings (see Table A11-1) were convened as part of the MNC Nuclear Dialogue.

11-MNC-1 Nuclear Fuel Waste Initiative: Annual Progress Report, for the period 2004 to 2005, May 2005

11-MNC-2 Metis Nation of Ontario Community Dialogue Roundtables, January to February, 2005. Nuclear Waste Management Dialogue Process: Final Activity Report 2004/2005, May 2005

11-MNC-3 Nuclear Fuel Waste Initiative: Final Technical Report, for the period 2003 to 2005, July 2005

11-MNC-4 Response to the Nuclear Waste Management Organization's Report *Choosing a Way Forward: The Future Management of Canada's Used Nuclear Fuel*, August 2005

[1] The five MNC Governing Members are: The Métis Provincial Council of British Columbia, Métis Nation of Alberta, Métis Nation – Saskatchewan, Manitoba Métis Federation and Métis Nation of Ontario.

Table A11-1 Métis National Council – Dialogue Activities

GOVERNING MEMBERS	WORKSHOP LOCATION	PARTICIPANTS	WORKSHOP DATES	NUMBER OF PARTICIPANTS
Métis Provincial Council of British Columbia	Kelowna, B.C.	Captains of Natural Resources	April 2 – 3, 2005	9
	Northeastern B.C.	Elders	March 29 – 31, 2005	15
Métis Nation of Alberta	Edmonton, AB	Regional	March 23 – 24, 2005	60
Manitoba Métis Federation Regional Meetings	Flin Flon, MB	Regional	April 16, 2005	19
	Thompson, MB	Regional	April 17, 2005	15
	Lac Du Bonnet, MB	Regional	April 21, 2005	18
Manitoba Métis Federation Focus Groups	Winnipeg	Elders	April 22, 2005	21
	Winnipeg	Women	April 22, 2005	21
	Winnipeg	Youth	April 22, 2005	21
Métis Nation of Ontario	Midland, ON	Regional	January 14, 2005	77
	Hamilton, ON	Regional	January 22, 2005	43
	Ft. Francis, ON	Regional	January 30, 2005	38
	Timmins, ON	Regional	February 5, 2005	67
	Sudbury, ON	Regional	February 11, 2005	86
	Thunder Bay, ON	30 Community Council President's Meeting	February 18 – 19, 2005	30
Métis National Council	Newspapers and On-line	Citizens at large	January – June, 2005	7
Total Participants				**547**

Congress of Aboriginal Peoples (CAP)

CAP initiated its dialogue program with a meeting of its National Steering Committee on December 7, 2004 to discuss the national and regional programs and the initiation of the regional dialogues.

The following dialogue sessions were subsequently held:

- CAP – Western Office, Calgary, January 14, 2005
- Native Council of Prince Edward Island, Charlottetown, February 5, 2005
- New Brunswick Aboriginal Peoples Council, Fredericton, February 26, 2005
- Labrador Métis Nation Dialogue Session, Goose Bay, February 26, 2005
- Native Council of Nova Scotia Direct Mail/Key Informant Interviews, February/March 2005
- Federation of Newfoundland Indians Dialogue with 9 Band Councils, March 2005
- United Native Nations of British Columbia, Vancouver, March 29, 2005
- National Workshop, June 17, 2005 Ottawa
- Aboriginal Council of Manitoba – CAP questionnaire distributed and analyzed, Spring 2005
- CAP National Youth Council. Special Session, 14 April 2005

11-CAP-1 Summary of Key Observations Regarding NWMO Discussion Document 2, *Understanding the Choices*, January 2005

11-CAP-2 First Interim Report to Nuclear Waste Management Organization – Dialogue Sessions on NWMO's Recommendation for the Long-term Management of Nuclear Fuel Waste, December 14, 2004

11-CAP-3 Preliminary Commentary on: *Choosing a Way Forward – The Future Management of Canada's Used Nuclear Fuel*, July 2005

11-CAP-4 Third Interim Report to the Nuclear Waste Management Organization – July 2005

11-CAP-5 Final Report to the Nuclear Waste Management Organization – September 2005

Inuit Tapiriit Kanatami (ITK)

The ITK shared with the NWMO a preliminary plan for an Inuit specific consultation in the fall of 2003. This evolved in an Inuit Specific Dialogue on the Long-Term Management of Nuclear Fuel Waste which included two-day workshops in each of the four regional land claims regions:

- Iqualiut, Nunavut, November 9-10, 2004
- Inuvik, Inuvialuit Settlement Region, November 17-18, 2004
- Kuujuak, Nunavik, Northern Quebec, January 27-28, 2005
- Makkovik, Nunatsiavut, Labrador, February 9-10, 2005

A special session on nuclear fuel waste management took place during the National Inuit Conference on the Environment in February 2004. The ITK also held a special session with National Inuit Youth at the National Inuit Youth Summit, Nain, Nunatsiavut – March 28-30, 2005, organized by the National Inuit Youth Council. A briefing by the NWMO on the *Draft Study Report* was provided to Ottawa staff on May 19, 2005.

11-ITK-1 2005 Board of Directors Resolution, June 2005

11-ITK-2 Final Report on the National Inuit-Specific Dialogues on the Long-Term Management of Nuclear Fuel Waste in Canada – Determining the National Inuit-Specific Perspective, June 2005

11-ITK-3 Quarterly Report on the National Inuit Specific Dialogues on the Long-Term Management of Nuclear Fuel Waste (January to March 2005), March 31, 2005

11-ITK-4 Year-End Report on the National Inuit Specific Consultation on the Long-Term Management of Nuclear Fuel Waste (March 31, 2003 to March 31, 2004), March 2004

11-ITK-5 Quarterly Report on the National Inuit Specific Consultation on the Long-Term Management of Nuclear Fuel Waste (April 1, 2004 to June 15, 2004), July 2004

11-ITK-6 Quarterly Report on the National Inuit Specific Dialogues on the Long-Term Management of Nuclear Fuel Waste (July 15, 2004 to October 15, 2004), October 2004

11-ITK-7 Quarterly Report on the National Inuit Specific Dialogues on the Long-Term Management of Nuclear Fuel Waste (October 16, 2004 to December 15, 2004)

11-ITK-8 Discussion Document #1: *Asking the Right Questions?* – Comments Prepared by ITK, March 2005

11-ITK-9 Discussion Document #2: *Understanding the Choices* – Comments Prepared by ITK, March 2005

11-ITK-10 ITK Review of the NWMO Discussion Document #3: *Choosing a Way Forward*, August 2005

11-ITK-11 Quarterly Report National Inuit Specific Dialogues on the Long-Term Management of Nuclear Fuel Waste (April to June 2005), June 2005

Pauktuutit Inuit Women's Association

The Pauktuutit Inuit Women's Association brought together women from across the Arctic to a workshop in Ottawa on November 4, 2004.

11-P-1 Pauktuutit Inuit Women's Association Workshop: Managing Canada's Radioactive Waste: November 2004, December 2004

Native Women's Association of Canada (NWAC)

NWAC convened a workshop in Ottawa June 14, 2005 with representatives from across Canada.

11-NWAC-1 National Consultation on Nuclear Fuel Waste Management, Nuclear Fuel Waste Report: June 2005.

Regional/Local Organizations

Ontario Métis Aboriginal Association (OMAA)

The Ontario Métis Aboriginal Association began an exploration of the issues associated with the NWMO work in the early days of the study. Following a workshop and the development of a position paper on the NWMO study process, two Program Coordinators were commissioned to oversee the OMAA nuclear dialogue. An initiating Board workshop was held in Sault Ste. Marie in September 2004 and a final Board workshop was held in Thunder Bay in July 2005. Between these workshops, 65 community meetings were held throughout Ontario reaching some 1,300 people as summarized in Table A11-2.

Table A11-2 Ontario Métis Aboriginal Association – Community Meetings

DATE	LOCATION	PARTICIPANTS
December 1, 2004	Elliot Lake	20
December 27, 2004	Spanish	14
December 29, 2004	Iron Bridge	9
January 3, 2005	Echo Bay	3
January 4, 2005	Thessalon	8
January 5, 2005	Orillia	7
January 6, 2005	Port McNicoll	19
January 6, 2005	Midland	26
January 7, 2005	Gravenhurst	6
January 7, 2005	Midland	50
January 8, 2005	Midland	17
January 8, 2005	Owen Sound	2
January 13, 2005	Kenora	7
January 13, 2005	Kenora	60
January 14, 2005	Kenora	100
January 14, 2005	Vermilion Bay	
January 15, 2005	Wabigoon	16
January 16, 2005	Dryden	14
January 18, 2005	Fort Frances	9
January 19, 2005	Rainy River	3
January 20, 2005	Sioux Lookout	9
January 22, 2005	Ignace	7
January 24, 2005	Thunder Bay	14
January 25, 2005	Hurkett	11
January 26, 2005	Terrace Bay	15
January 27, 2005	Nipigon	13
January 30, 2004	Sturgeon Falls	77 (minimum)
January 31, 2005	Chelmsford	75 (minimum)
February 3, 2005	Pembroke	36
February 3, 2005	Pembroke	22
February 4, 2005	Pembroke	11
February 4, 2005	Pembroke	28
February 4, 2005	Arnprior	12

Table A11-2 (cont'd) Ontario Métis Aboriginal Association – Community Meetings

DATE	LOCATION	PARTICIPANTS
February 5, 2005	Renfrew	39
February 6, 2005	Renfrew	37
February 6, 2005	Matawatchan	29
February 7, 2005	Bancroft	92 (minimum)
February 8, 2005	Peterborough	25
February 13, 2005	Iroquois	17
February 13, 2005	Cornwall	9
February 14, 2005	Trenton	11
February 15, 2005	Kingston	6
February 16, 2005	Belleville	32
February 17, 2005	Smiths Falls	25
February 18, 2005	Brockville	17
February 19, 2005	Napanee	16
February 22, 2005	Renfrew	20
February 23, 2005	Haliburton	41
March 2, 2005	Noelville	24
March 3, 2005	Britt	16
March 3, 2005	Spanish	3
March 18, 2005	Ottawa	9
March 19, 2005	Windsor	63
March 20, 2005	Chatham	44
March 20, 2005	Sarnia	4
March 21, 2005	Hamilton	3
March 22, 2005	Welland	6
March 23, 2005	Wawa	9
March 25, 2005	Chapleau	8
March 25, 2005	Iroquois Falls	5
March 26, 2005	Timmins	12
March 27, 2005	Cochrane	17
March 28, 200	Geraldton	n/a
March 29, 2005	Thunder Bay	19

Additional discussions were held in mall-based information sessions. Questionnaires were distributed and analyzed. A web site was created and used to distribute information and compile reaction.

11-OMAA-1 Ontario Métis Aboriginal Association Nuclear Waste Management Initiative, April 2005

11-OMAA-2 Nuclear Waste Management: OMAA Presentation to OMAA Board of Directors, April 2004

11-OMAA-3 OMAA Position Paper on Phase II of the Nuclear Waste Management Process, April 2004

11-OMAA-4 Ontario Métis Aboriginal Association Phase 4, Nuclear Waste Management Initiative Phase 4, September 2005

Northern Saskatchewan Local Dialogues

The Sakitaawak Métis Society, hosted a community retreat at Amyot Lake near Beauval, Saskatchewan on October 21-23, 2004 bringing together representatives from 19 towns and villages, five First Nations, the uranium mining industry and the NWMO. A short video on the long term management of used nuclear fuel was developed including a proposal for development of materials in native languages.

A follow-up dialogue was held in La Ronge, Saskatchewan on May 25-26, 2005.

A Youth Dialogue was held near Ile-a-la-Crosse on August 3, 2005 as part of a Youth Wellness Conference organized by the Youth Program of the Ile-a-la-Crosse Friendship Centre. Some 200 young people participated from First Nations and Metis communities. Written comments from 91 were received.

On August 4th a half-day discussion was held between the NWMO and representatives of the English River First Nation in Patruanak, Saskatchewan.

11-SM-1 Northwest Saskatchewan Site-Specific Dialogue, January 2005

11-NS-1 *Choosing A Way Forward*: Report – La Ronge, Saskatchewan Dialogue, August 25, 2005

11-NS-2 12th Annual Youth Outdoor Wellness Conference, Northwest Saskatchewan – Youth Dialogue Report, August 29, 2005

Eabametoong First Nation, Fort Hope, Ontario

Community elders from the Eabametoong First Nation, Fort Hope, Ontario led a four-part process in 2004 aimed at exploring all of the issues related to the long-term management of used nuclear fuel in Canada, and in particular, implications for Aboriginal peoples. In addition many informal discussions were held involving some 300 people in the community. Meetings throughout this process were held in Ojibwa, Oji-Cree, or Cree. A proposal was written for development of native language capacity and for ongoing dialogue involving their communities and others. Following a pre-DSR-release briefing in the Community on May 19, 2005, residual funds were earmarked for a community review of the *Draft Study Report*.

11-E-1 Eabametoong First Nation Nuclear Waste Dialogue Report – September 2004 to January 2005, February 2005

East Coast First People's Alliance, New Brunswick (ECFPA)
The East Coast First People's Alliance, New Brunswick brought together non-status, off-reserve and unaffiliated Aboriginals in New Brunswick for a workshop in Bathurst on November 6-7, 2004.

11-EC-1 East Coast First Peoples Alliance Position Paper: Report from Workshop in Bathurst, November 2004

11-EC-2 Letter Report Summarizing Survey Results to 262 members; January 2005

Western Indian Treaty Alliance (WITA)
The Western Indian Treaty Alliance, (Congress of Aboriginal Peoples of Saskatchewan Inc., Indian Council of First Nations of Manitoba Inc., and Native Council of Canada – Alberta) representing non-status, off-reserve and unaffiliated Aboriginals in Alberta, Saskatchewan and Manitoba formed a Steering Committee and arranged regional meetings in Edmonton and Regina and The Pas, Manitoba.

11-WITA-1 Initial Commentary on the Nuclear Waste Management Organization Discussion Document *Understanding the Choices*. (WITA First Interim Report: Alberta), December 2004

11-WITA-2 Analysis of NWMO Discussion Document of August 2004 – *Understanding the Choices* (WITA First Interim Report: Manitoba), December 2004

11-WITA-3 Initial Commentary on the Nuclear Waste Management Organization Discussion Document (WITA First Interim Report: Saskatchewan), December 2004

11-WITA-4 Congress of Aboriginal Peoples Saskatchewan, Dialogue: Nuclear Waste Management Final Report, September 2005

Atlantic Policy Conference of First Nation Chiefs (APCFNC)
By mutual agreement with the Assembly of First Nations, in the fall of 2004, the APCFNC assumed responsibility for the First Nations dialogue in Newfoundland and Labrador, Prince Edward Island, Nova Scotia, and New Brunswick. As a result, the APCFNC convened two workshops to review the Discussion Documents:

- Fredericton, New Brunswick, January 20, 2005
- Truro, Nova Scotia, January 31, 2005

In a second phase of activity following publication of the *Draft Study Report*, the APCFNC held an additional three meetings:

- Big Cove, New Brunswick, June 8, 2005 (focus group)
- Fredericton, June 9, 2005 (focus group)
- Halifax (regional workshop – all maritimes), July 11-12, 2005

11-APC-1 Atlantic Policy Congress of First Nations Chiefs Nuclear Waste Management Dialogue: Final Report, March 2005

11-APC-2 Atlantic Policy Congress of First Nations Chiefs Nuclear Waste Management Dialogue: Final Report, July 2005

11-APC-3 Atlantic Policy Congress of First Nations Chiefs Nuclear Waste Management Dialogue: Interim Report, January 2005

Union of New Brunswick Indians (UNBI)

The Union of New Brunswick Indians began exploring the issues associated with nuclear fuel waste management in the early days of the NWMO study.

The UNBI held a series of dialogues on the NWMO *Draft Study Report* in the summer of 2005:

- Fort Folly, FN, July 20, 2005
- Woodstock, FN, July 25, 2005
- St. Mary's, FN, July 26, 2005
- Tobique, FN, August 2, 2005
- Madawaska FN, August 2, 2005
- Oromocto, Woodstock, FN, August 3, 2005
- Kingsclear, FN, August 3, 2005
- Eel Ground, FN, August 4, 2005
- Red Bank, FN, August 4, 2005
- Big Cove, FN, August 5, 2005
- Pabineau, FN, August 9, 2005
- Eel River Bar, FN, August 16, 2005

A Provincial Workshop was held on August 18, 2005 in Red Bank.

11-UNBI-1 Nuclear Waste Management & First Nations in New Brunswick (Final Report), August 29, 2005

Federation of Saskatchewan Indian Nations (FSIN)

The Federation of Saskatchewan First Nations conducted a series of dialogues on the NWMO *Draft Study Report* in the summer of 2005. The following presentations/meetings were convened.

- Thunderchild First Nation – Chief and Council
- Onion Lake First Nation – Chief and Council
- James Smith First Nation – Summer Science Youth Camp
- English River First Nation – Summer Science Youth Camp
- Mistawasis First Nation – Chief and Council
- Agency Chiefs Tribal Council – Senior Management
- Big River First Nation – Chief and Council
- Pelican Lake First Nation – Chief and Council
- Witchekan Lake First Nation – Chief and Council
- Federation of Saskatchewan Indian Nations Youth Assembly in Yorkton, Saskatchewan

At the time of writing, the following are being scheduled or initial meetings have been held to explore the idea of a discussion.

Waterhen Lake First Nation
Pelican Narrows First Nation
Hatchet Lake First Nation
Fond du Lac First Nation
Black Lake First Nation
Buffalo River First Nation
Muskowekwan First Nation
Kawacatoose First Nation
George Gordons First Nation
Beardy's/Okemasis First Nation

11-FSN-1 Nuclear Waste Dialogue Final Report, August 26, 2005

Continuing Local Dialogue, Ontario First Nations

The fall of 2005 has seen a series of initial meetings in six to eight Ontario First Nations communities as part of an ongoing process of dialogue at the local level that will continue after NWMO has filed its report with the Minister of Natural Resources Canada. At time of writing, the following have been approached: Eabametoong First Nation (Fort Hope) (Agreed); Fort Severn (Agreed); Webequie (Agreed); Couchiching (Appointment to be made); Attawapiskat (Appointment to be made); Aroland (Agreed); Long Lake #58 (Agreed); Constance Lake (Agreed); Wahta Mohawks (Appointment to be made); Mohawks of Akwesasne (Appointment to be made).

Elders' Forum, August 25-27, 2005

At the end of August, an Elders' Forum was convened at the Odawa Native Friendship Centre in Ottawa. The Forum brought together 23 elders from across Canada to:

- Review with participants the work of the NWMO since its inception in November 2002 and the draft strategy that has evolved through discussions with Canadians over the past two years;
- Learn what participants' reactions are to the draft strategy; and
- Discuss ongoing involvement of Elders and how we can best engage with Canada's Aboriginal community in the years to come.

Elders' were offered the opportunity to name an accompanying youth support person. Nineteen young people participated in this capacity. In part, the forum was intended as a means to bring holders of Aboriginal Traditional Knowledge to the table in their own right to review the challenge of managing used nuclear fuel over the long term.

The Report of the Forum is available at: www.nwmo.ca/aboriginaldialogues.

11-EF-1 Report of the Elders' Forum, Ottawa, 2005

Building Relationship: The NWMO Aboriginal Dialogue

Canada is home to a million Aboriginal people. Since its inception, the NWMO has sought dialogue with this community regarding how Canada should best manage its used nuclear fuel over the long term.

11-ABO-1 Building Relationship - The NWMO Aboriginal Dialogue 2003 – 2005

This report summarizes the dialogue in terms of overall goal and objectives, the evolving context and role of the Aboriginal community in this country, the 15 national and regional/local organizations that participated, the observations that they offered, and the lessons learned as input for continued dialogue in the future.

C) Submissions

As of August 2005, the NWMO has received 191 submissions on our Study. They are all posted on our website www.nwmo.ca/submissions. The NWMO continues to receive submissions which will be posted on our website once permission is received from the author(s).

The authors of these submissions are listed below:

Armitage, Stephen
Atcheson, Joyce
Baglien, Brandon
Baird, Jim
Barrett, Freda
Beaton, Brian
Beaudoin, Robert
Bradford, Lori
Brady-MacAulay, Lauren
Brain, Steve
Brenciaglia, Giovanni
Burns, Terry
Brydges, Doug
Calabretta, Daniel
Campbell, James
Canadian Association of Nuclear Host Communities
Canadian Nuclear Society
CANTEACH
Catherwood, Lorne
Chandler, Neil
Chisel, Leslie
Citizens for Alternatives to Chemical Contamination
Citizens for Renewable Energy (CFRE)
Citizens Network on Waste Management
Clyde, Tom
Computare
Coxworth, Ann
Cullimore, D. Roy
Cuttler & Associates Inc.
Craik, Neil
Curry, N. Royce
Daley, Andrew
Darnley, Arthur
Davies, David
Devlin, Ian
Doherty, Michael
Don't Waste Michigan

Draak, Marcella
Drummond, Norma
Duncan, Ian
Dykyj, Jerry
Earley, John
Eno, Robert
Farrugia-Uhalde, Ann Marie
Fernandes, Antonio
Franta, Jaro
Freed, Sahaja
Grand Council of the Crees
Griffiths, Franklyn
Gurnham, John
Harti, Jeff
Harley, Mary Lou
Hakli, Don
Hillsburg, Genevieve
Hiner, Richard
InSite & Solutions
Jackson Consulting (UK) Ltd.
Joe, Mendleson
Jones, Deborah
Klein, Ruth
Kuhn, Richard
Lange, Bruce
Lawson, Tom and Pat
Lee, David
Lee, Kai
Lekivetz, Bob
Levesque, Dean
Levesque, Larry
Lockhart, James
Mann, Navdeep
Marczak, Eva
Marczak, John
Martino, Jason
Mather, Allan
Mattmer, Ron
Mcivor, Alastair
Meneley, Daniel
Moss, Kate
Mroueh, Youssef
Murphy, Brenda
National Council of Women of Canada
Norman, Jason
Nuclear Information and Resource Service
Olson, Don
Ottensmeyer, Peter
Paul, Derek
People for Nuclear Responsibility, Thunder Bay
Perreault, Gerald
Polanyi, Michael
Rao, Mohan
Radiological Evaluation and Action Project
Rawlingson, Malcolm Stewart
Rennie, Richard
Riley, George
Robertson, J.A.L.
Sabourin, Gilles
Saint John Citizens Coalition for Clean Air
Schenkel, Walter
Scott, John
Shrives, Ken
Schwimmer, Sorin
Stanley, Anna
Steed, Roger G.
Steeves, Keith W.
Strickert, Graham
Sutherland, John
Temmer, Rebecca
The Regional Municipality of Durham
Thériault, Sophie
Thompson, Paul
Threndyle, Gene
Town of Ajax
Treichel, Judy
Tuer, Bill
Turnbull, Ian
United Church of Canada
Van Vliet, Pieter
Williams, Martin
Wright, James R.
Wright, Jim
Ylonen, George

D) Background Papers

The NWMO has benefited from an extensive series of background research papers. They are all available on-line at www.nwmo.ca/backgroundpapers.

Supporting documents for the NWMO study, that is, those that further elaborate on an element of our study, are marked by an asterisk.

All of our background research, which includes papers, technical reports, engagement activities and submissions to the NWMO, are reference documents that significantly influenced our thinking.

As a standard practice background papers were peer reviewed before they were accepted by the NWMO and posted on the NWMO website. In the case of background papers on "Guiding Concepts" and "Social and Ethical Considerations", independent comment was solicited and posted with each paper in lieu of the peer review process.

Guiding Concepts

1-1. Sustainable Development and Nuclear Waste. David Runnalls, IISD.

1-2. The Precautionary Approach to Risk Appraisal. Andy Stirling, University of Sussex.

1-3. Adaptive Management in the Canadian Nuclear Waste Program. Kai N. Lee, Williams College.

1-4. Nuclear Waste Management in Canada: The Security Dimension. Franklyn Griffiths, University of Toronto.

1-5. Risk and Uncertainty in Nuclear Waste Management. Kristen Shrader-Frechette, University of Notre Dame.

1-6. Thinking about Time. Stewart Brand, The Long Now Foundation.

1-7. Drawing on Aboriginal Wisdom. Joanne Barnaby, Joanne Barnaby Consulting.

1-8. Non Proliferation Aspects of Spent Fuel Storage and Disposition. Thomas Graham Jr. and James A. Glasgow, Morgan Lewis.

1-9. Is Safekeeping of Radioactive Waste Preferable to Disposal? The Importance of Semantics. Colin Allan and Paul Fehrenbach, Atomic Energy of Canada Ltd.

The NWMO asked experts in the field to comment on the Guiding Concepts papers, on the way in which the concepts have been defined, and implications for the long-term management of used nuclear fuel.

1-A Lloyd Axworthy: Comments on "Nuclear Waste Management in Canada: The Security Dimension", Franklyn Griffiths.

1-B William Leiss: Comments on "Risk and Uncertainty in Nuclear Waste Management", Kristen Shrader-Frechette.

1-C Edwin Lyman: Comments on "Nuclear Waste Management in Canada: The Security Dimension", Franklyn Griffiths.

1-D Charles McCombie: Comments on "Adaptive Management in the Canadian Nuclear Waste Program", Kai N. Lee.

1-E Robert Morrison: Comments on "Sustainable Development and Nuclear Waste", David Runnalls.

1-F Ortwin Renn: Comments on "The Precautionary Approach to Risk Appraisal", Andy Stirling.

Social and Ethical Dimensions

2-1. Ethics of High Level Nuclear Fuel Waste Disposal in Canada. Peter Timmerman, York University.

2-2. Social Issues Associated with the Atomic Energy of Canada Limited Nuclear Fuel Waste Management and Disposal Concept. Mark Stevenson, MAS Consulting.

2-3. Key Social Issues Related to Nuclear Waste, or What Do Canadians Want to Do About Nuclear Waste?. Maria Paez-Victor, Victor Research.

2-4. Long-Term Management of Nuclear Fuel Waste – Issues and Concerns Raised at Nuclear Facility Sites 1996 – 2003. Chris Haussmann and Peter Mueller, Haussmann Consulting.

2-5. Overview of European Initiatives: Towards a Framework to Incorporate Citizen Values and Social Considerations in Decision-Making. Kjell Andersson, Karita Research.

2-6. A Review of Waste Facility Siting Case Studies Applicable to Spent Nuclear Fuel Management Facilities and Associated Infrastructure. DPRA Inc.

* 2-7. Ethical and Social Framework. NWMO Roundtable on Ethics.

2-8. NWMO Response to Seaborn.

The NWMO asked selected individuals working in the field to provide additional comment on the issues raised in this series of papers.

2-A Ian J. Duncan: Social and Ethical Considerations "Canada's Used Nuclear Fuel – What to do with it!"

2-B Charles McCombie: Ethical Considerations "Status of Geological Repositories for Used Nuclear Fuel, Appendix B Ethical Issues".

2-C J.A.L. Robertson: "Nuclear Energy – An Ethical Choice".

Health and Safety

3-1. Status of Radiological Protection Technologies and Operational Procedures Related to High-level Radioactive Waste Management (HLRWM). Candesco Research Corporation.

3-2. Human Health Aspects of High-level Radioactive Waste. John Sutherland, Edutech Enterprises.

3-3. Status of Canadian and International Efforts to Reduce the Security Risk of Used Nuclear Fuel. SAIC.

3-4. Considerations in Developing a Safety Case for Spent Nuclear Fuel Management Facilities and Associated Infrastructure in Canada. K. Moshonas Cole, P.R. Reid and R.C.K. Rock, Candesco Research Corporation.

3-5. A Risk-Based Monitoring Framework for Used Fuel Management. Nava C. Garisto, SENES Consultants Ltd.

1. Appendix A: Deep Geological Disposal. Nava C. Garisto, SENES Consultants Limited.
2. Appendix B: Storage at Reactor Sites. Nava C. Garisto, SENES Consultants Limited.
3. Appendix C: Risk From Exposure to Ionizing Radiation. Nava C. Garisto, SENES Consultants Limited.
4. Appendix D: Radiological Benchmarks for Non-Human Biota. Nava C. Garisto, SENES Consultants Limited.

Science and Environment

4-1. Status of Biosphere Research related to High-level Radioactive Waste Management. ECOMatters.

4-2. Characterizing the Geosphere in High-Level Radioactive Waste Management. Jonathan Sykes, University of Waterloo.

4-3. Natural and Anthropogenic Analogues – Insights for Management of Spent Fuel. Paul McKee and Don Lush, Stantec Consulting.

4-4. The Chemical Toxicity Potential of CANDU Spent Fuel. Don Hart and Don Lush, Stantec Consulting.

4-5. Review of the Possible Implications of Climate Change on the Long-Term Management of Spent Nuclear Fuel. Gordon A. McBean Ph.D., FRSC.

4-6. Review of the Implications of Microbiological Factors on the Long-term Management of Used Nuclear Fuel. D. Roy Cullimore, Ph.D. R.M., Droycon Bioconcepts Inc.

Economic Factors

5-1. An Examination of Economic Regions and the *Nuclear Fuel Waste Act* (*NFWA*). Richard Kuhn, University of Guelph and Brenda Murphy, Wilfred Laurier University.

5-2. Status of Financing Systems for High-level Radioactive Waste Management. GF Energy, LLC.

5-3. Considerations for the Economic Assessment of Approaches to the Long-Term Management of High-Level Nuclear Waste. Charles River Associates Canada Limited.

5-4. Economic and Financial Aspects of the Long-Term Management of High-Level Nuclear Waste: Issues and Approaches. Charles River Associates Canada Limited.

Technical Methods

6-1. Status of Reactor Site Storage Systems for Used Nuclear Fuel. SENES Consultants Ltd.

6-2. Status of Centralized Storage Systems for Used Nuclear Fuel. Mohan Rao and Dave Hardy, Hardy Stevenson and Associates.

6-3. Status of Geological Repositories for Used Nuclear Fuel. Charles McCombie, McCombie Consulting.

6-4. Status of Nuclear Fuel Reprocessing, Partitioning and Transmutation. David Jackson, David Jackson and Associates.

6-5. Range of Potential Options for Used Nuclear Fuel. Phil Richardson and Marion Hill, Enviros Consulting Ltd.

6-6. Status of Transportation Systems for High-level Radioactive Waste Management. Wardrop Engineering Inc.

6-7. Status of Storage, Disposal and Transportation Containers for the Management of Used Nuclear Fuel. Kinectrics.

6-8. Review of the Fundamental Issues and Key Considerations Related to the Transportation of Spent Nuclear Fuel. Gavin J. Carter, Butterfield Carter and Associates, LLC.

6-9. Conceptual Designs for Used Nuclear Fuel Management.

1. JWO: Overview of Conceptual Designs for Used Nuclear Fuel Management. Joint Waste Owners.

2. JWO: Summary Presentation of Conceptual Designs for Used Nuclear Fuel Management. Joint Waste Owners.

* 3. Conceptual Designs for Reactor-site Extended Storage Facility Alternatives for Used Nuclear Fuel. CTECH.
   a. Reactor-site Extended Storage: Facility Alternative Illustrations. Joint Waste Owners.
   b. Alternatives for the Pickering, Bruce and Darlington Reactor Sites
      i. Alternatives for the Pickering, Bruce and Darlington Reactor Sites: Main Report. CTECH.
      ii. Alternatives for the Pickering, Bruce and Darlington Reactor Sites: Supporting Figures. CTECH.
      iii. Alternatives for the Pickering, Bruce and Darlington Reactor Sites: Supporting Tables. CTECH.
   c. Alternatives for Atomic Energy of Canada Limited's Chalk River and Whiteshell Laboratory Sites. CTECH.
      i. Alternatives for Atomic Energy of Canada Limited's Chalk River and Whiteshell Laboratory Sites: Main Report. CTECH.
      ii. Alternatives for Atomic Energy of Canada Limited's Chalk River and Whiteshell Laboratory Sites: Supporting Figures. CTECH.

d. Alternatives for Hydro-Québec's Gentilly Reactor Site
   i. Alternatives for Hydro-Québec's Gentilly Reactor Site: Main Report. CTECH.
   ii. Alternatives for Hydro-Québec's Gentilly Reactor Site: Supporting Figures. CTECH.
e. Alternatives for New Brunswick Power's Point Lepreau Site. CTECH.
   i. Alternatives for New Brunswick Power's Point Lepreau Site: Main Report. CTECH.
   ii. Alternatives for New Brunswick Power's Point Lepreau Site: Supporting Figures. CTECH.

* 4. Conceptual Designs for Four Centralized Extended Storage Facility Alternatives for Used Nuclear Fuel
   a. Centralized Extended Storage: Main Report. CTECH.
   b. Centralized Extended Storage: Supporting Figures 1. CTECH.
   c. Centralized Extended Storage: Supporting Figures 2. CTECH.
   d. Centralized Extended Storage: Supporting Figures 3. CTECH.
   e. Centralized Extended Storage: Supporting Figures 4. CTECH.
   f. Centralized Extended Storage: Supporting Figures 5: General. CTECH.
   g. Centralized Extended Storage: Illustration. CTECH.
   h. Centralized Extended Storage: Appendix A. CTECH.
   i. Centralized Extended Storage: Decontamination Cells. CTECH.
   j. Centralized Extended Storage: Repackaging. CTECH.

* 5. Conceptual Design for a Deep Geologic Repository for Used Nuclear Fuel
   a. Deep Geologic Repository: Main Report. CTECH.
   b. Deep Geologic Repository: Figures. CTECH.
   c. Deep Geologic Repository: Illustration. CTECH.
   d. Deep Geologic Repository: Appendix A. CTECH.
   e. Deep Geologic Repository: Annex 1. CTECH.
   f. Deep Geologic Repository: Annex 2. CTECH.
   g. Deep Geologic Repository: Annex 3. CTECH.
   h. Deep Geologic Repository: Annex 4. CTECH.
   i. Deep Geologic Repository: Annex 5. CTECH.
   j. Deep Geologic Repository: Annex 6. CTECH.
   k. Deep Geologic Repository: Annex 7. CTECH.
   l. Technology Program for Deep Geologic Repository.
      i. Deep Geologic Repository Technology Program – Annual Report 2004. OPG.
      ii. Deep Geologic Repository Technology Program – Annual Report 2003. OPG.
      iii. Deep Geologic Repository Technology Program – Annual Report 2002. OPG.
      iv. Deep Geologic Repository Technology Program – Annual Report 2001. OPG.
      v. Deep Geologic Repository Technology Program – Annual Report 2000. OPG.
      vi. Used Fuel Disposal Program, Annual Technical Report 1999. OPG.

m. Response to Technical Comments raised during Environmental Assessment of AECL Disposal Concept. OPG.
    i. Compilation of Technical Comments Submitted by Participants in the Federal Environmental Assessment Panel Review of the Nuclear Fuel Waste Management and Disposal Concept, with Responses. OPG.

* 6. Conceptual Designs for Transportation of Used Nuclear Fuel to a Centralized Facility. Cogema Logistics.
    a. Conceptual Designs for Transportation of Used Nuclear Fuel to a Centralized Facility: Main Report. Cogema Logistics.
    b. Appendix A: Figures. Cogema Logistics.
    c. Appendix B: Basis and Interfaces. Cogema Logistics.
    d. Appendix C: Road Transport Feasibility of IFTC/BM and DSCTP. Cogema Logistics.
    e. Appendix D: Conceptual design and description for all the UFTS components "All Road". Cogema Logistics.
    f. Appendix E: Conceptual design and description for all the UFTS components "Mostly Rail". Cogema Logistics.
    g. Appendix F: Conceptual design and description for all the UFTS components "Mostly Water". Cogema Logistics.
    h. Appendix G: The COGEMA LOGISTICS Railroad Terminal at Valognes. Cogema Logistics.
        i. Appendix H: The Real Time Tracking System. Cogema Logistics.
    j. Logistics of Transportation of Used Fuel to a Centralized Facility: Report of Study. Cogema Logistics.
    k. Logistics of Transportation of Used Fuel to a Centralized Facility: Appendix A. Cogema Logistics.
    l. Logistics of Transportation of Used Fuel to a Centralized Facility: Sample Shipping Schedule. Cogema Logistics.
    m. Road and Rail Transportation: Illustrations. Cogema Logistics.
    n. Container Illustrations. Cogema Logistics.
    o. Dry and Wet Loading of Transportation Modules. Cogema Logistics.
    p. Intermodal Transfer. Cogema Logistics.

* 7. Cost Summaries
    a. Cost Summary: Reactor-site Extended Storage. Joint Waste Owners.
    b. Cost Summary: Centralized Extended Storage. Joint Waste Owners.
    c. Cost Summary: Deep Geologic Repository. Joint Waste Owners.

* 8. Financing The Management of Nuclear Fuel Waste in Support of the *Nuclear Fuel Waste Act*
    a. JWO: Financing The Management of Nuclear Fuel Waste in Support of the *Nuclear Fuel Waste Act*. Joint Waste Owners, February 2005.
    b. JWO: Financing the Management of Nuclear Fuel Waste in Support of the *Nuclear Fuel Waste Act*. July 2005.

* 6-10. Review of Conceptual Engineering Designs for Used Nuclear Fuel Management in Canada. ADH Technologies Inc.

* 6-11. Validation of Cost Estimating Process for Long-Term Management of Used Nuclear Fuel. ADH Technologies Inc. and Charles River Associates Canada Ltd.

* 6-12. Long-term Used Nuclear Fuel Waste Management – Geoscientific Review of the Sedimentary Sequence in Southern Ontario. Martin Mazurek, Rock-Water Interaction, Institute of Geological Sciences, University of Bern, Switzerland.

* 6-13. Conceptual Designs for Used Nuclear Fuel Management in Sedimentary Rock. RWE NUKEM Ltd.
  1. 6-13A Deep Geologic Repository in Sedimentary Rock, RWE NUKEM Ltd.
  2. 6-13B Centralized Extended Storage (CRC concept) in Sedimentary Rock, RWE NUKEM Ltd.
  3. 6-13C Selection of Sedimentary Rock Formation Type for Review, RWE NUKEM Ltd.

6-14. Implications of Reprocessing, Partitioning and Transmutation on Long-term Management of Used Nuclear Fuel in Canada. David P. Jackson, McMaster University.

6-15 Adaptive Phased Management Draft Technical Description, NWMO.

* 6-16 Adaptive Phased Management Cost Estimate Summary Report. Golder Associates Ltd. and Gartner Lee Limited.

* 6-17 Validation of Cost Estimating Process for Adaptive Phased Management, of the Long Term Management of Used Nuclear Fuel. A.W. Hooker Associates Ltd.

* 6-18 Adaptive Phased Management Technical Description, NWMO.

Institutions and Governance

7-1. Status of the Legal and Administrative Arrangements for Waste Management in Canada. OCETA (Ontario Centre for Environmental Technology Advancement).

7-2. Status of the Legal and Administrative Arrangements for Low-level Radioactive Waste Management (LLRWM) in Canada. Paul Rennick, Rennick and Associates.

7-3. Status of the Legal and Administrative Arrangements for High-level Radioactive Waste Management (HLRWM). Mark Madras and Stacey Ferrara, Gowling Lafleur Henderson LLP.

7-4. Legal and Administrative Provisions for Radioactive Waste Management within the North American Free Trade Agreement (NAFTA). Aaron Cosbey.

7-5. Status of Canadian Expertise and Capabilities related to High-level Radioactive Waste Management. George Bereznai, UOIT (University of Ontario Institute of Technology).

7-6. Comparative Overview of Approaches to Management of Spent Nuclear Fuel and High Level Wastes in Different Countries. Charles McCombie and Bengt Tveiten.

7-7. Relevance of International Experiences in the Sound Management of Chemicals to the Long Term Management of Used Nuclear Fuel In Canada. John Buccini.

7-8. Review of the *Canadian Environmental Assessment Act* (*CEAA*) Process in Relation to Nuclear Waste Management. Robert S. Boulden, Boulden Environmental Consulting.

7-9. Review of the CNSC Licensing Process in Relation to Spent Fuel Management. J.F. Lafortune and F. Lemay, International Safety Research.

7-10. Review of the Legal and Administrative Aspects of the Non-Proliferation Treaty in Relation to Spent Nuclear Fuel Management. Mark Madras and Stacey Ferrara, Gowling Lafleur Henderson LLP.

7-11. Methodologies for Assessing Spent Nuclear Fuel Management Options. ETV Canada Inc., OCETA, Risk Wise Inc. and Science Concepts International.

7-12. Education and Training in Nuclear Waste Management. ITC School of Underground Waste Storage and Disposal.

7-13. The Public Policy Context for Nuclear Liability in Canada. William Leiss & Associates Ltd.

E) Assessments

* 9-1. Assessing the Options. The NWMO Assessment Team Report. Michael Ben-Eli, John Neate, Jo-Ann Facella, Anthony Hodge, Thomas Isaacs, William Leiss, Michael Margolick, Katherine Moshonas Cole, Fred Roots.

Upon release of the Assessment Team Report, the NWMO approached three individuals to learn their perspectives:

9-A Thomas Isaacs
9-B Tim McDaniels
9-C Barry Stuart

* 9-2a. Assessment of Benefits, Risks and Costs of Management Approaches for Used Nuclear Fuel by Illustrative Economic Region, Golder Associates Limited and Gartner Lee Limited.

* 9-2b. Assessment of Benefits, Risks and Costs of a Proposed Adaptive Phased Management Approach By Illustrative Economic Region, Golder Associates Limited and Gartner Lee Limited.

* 9-3. Review of Means for Avoiding or Mitigating Significant Socio-Economic Effects in the Implementation of Managing Used Nuclear Fuel, Golder Associates Limited and Gartner Lee Limited.

Also see 3-5 A Risk-Based Monitoring Framework for Used Fuel Management. Nava C. Garisto, SENES Consultants Ltd.

F) NWMO Discussion Documents

The NWMO Study was built around three milestone documents, each followed by a round of public engagement and dialogue. Each discussion document and accompanying Executive Summary provided an update on the study, keeping people informed of NWMO thinking at every stage and inviting comment from interested citizens.

** Discussion Document 1: Asking the Right Questions? The Future Management of Canada's Used Nuclear Fuel*

This document began a process of dialogue which sought an approach to the long-term management of used nuclear fuel. It was a first step in defining the issue, communicating potential choices and proposing a way of assessing the alternatives.

This discussion document:

- Described the NWMO legislative mandate, and how we proposed to undertake the study;
- Shared, for discussion, some of the broad issues and concerns that arose in early conversations with Canadians;
- Outlined the initial thinking about building an "analytical framework" for assessing different approaches; and
- Provided information on alternative technical methods for managing used nuclear fuel.

This document is available at **www.nwmo.ca/askingtherightquestions**.

The Executive Summary of this document is available in English and French.

**** Discussion Document 2: Understanding the Choices***

This document:

- Reported what the NWMO had learned from citizens and experts;
- Described what the management options being studied might look like;
- Outlined how the framework to assess them had evolved; and
- Presented a preliminary assessment of the approaches for public discussion.

This document is available at **www.nwmo.ca/understanddingthechoices**.

The Executive Summary of this document is available in English and French.

**** Draft Study Report: Choosing a Way Forward: The Future Management of Canada's Used Nuclear Fuel***

Choosing A Way Forward was the third major report published over the course of the NWMO study. This report reflected the synthesis of ideas from the two years of engagement with citizens and specialists, and proposed a course of action.

This document is available at: **www.nwmo.ca/draftstudyreport**.

The Executive Summary of this document is available in English, French, Ojibway, Cree and Ojicree.

Appendix 12 / Glossary

We offer this glossary to present and explain the terms and phrases that we have used in the course of this study. In some cases definitions are the same as used by others (Webster's dictionary; Canadian Nuclear Safety Commission, etc.) However in other cases they are different. We do this not to agree or disagree with other sources, but to provide clarity around our intent and our meaning.

Adaptive management is a combination of management, research, and monitoring so that credible information is gained and management activities can be modified by experience.

Biosphere is the environment where life exists.

Becquerel is the standard international unit of radioactivity in a material equal to the activity resulting from the decay of one nucleus of radioactive matter in one second.

Borehole is a hole drilled into the earth.

Cask is a mobile durable container for enclosing and handling nuclear fuel waste for storage and transport.

Centralized facility means a facility used for the extended storage or geological placement of used nuclear fuel. The facility would be located at a single, central location and would accept used nuclear fuel from all reactor sites in Canada.

Communities of interest, in the context of the NWMO study, refers to a group of people who share a common interest or purpose. For example, they may live in close proximity to each other, or they may share a common concern or knowledge, and have come together to pursue specific interests.

Container is the vessel into which the waste form is placed for handling, transport, storage and/or eventual placement in a deep geological repository; also the outer barrier protecting the waste from external intrusions. The waste container is a component of the waste package.

Closure refers to administrative and technical actions directed at a repository at the end of its operating lifetime – for example covering the waste (for a near surface repository) or back-filling and/or sealing (for a geological repository and the passages leading to it) and termination or completion of activities in any associated structures.

Contingency (Financial) refers to an additional amount or percentage added to any cash flow item to cover reasonable variability in forecasts. Interest rates, inflation and other variables cannot be forecast with certainty. The size of a contingency is determined by the level of detail within a cash flow forecast and the level of risk mitigation that is required.

Crystalline rock is a generic term for igneous rocks and metamorphic rocks as opposed to sedimentary rocks.

Decommissioning is the closing of a nuclear facility at the end of its life.

Deep geological disposal is the placement of used nuclear fuel deep underground where both natural and engineered barriers shield it from humans and the environment. Deep geological disposal is studied as Option 1 in this report.

Deliberative survey is a public opinion research tool that provides people with background information and multiple perspectives to help inform the views they express.

Design life is the period during which a facility or component is expected to perform according to the technical specifications to which it will be or was engineered.

Dialogue brings people from all walks of life together and encourages them to work through difficult issues, learning from each other as they listen to and understand perspectives that are different from their own. Participants examine their own thinking, and through talking with each other, identify areas on which they can agree, while acknowledging differences.

Disposal is to manage used nuclear fuel in a manner that is conclusive, without the intention of retrieval or further use.

Dry storage is the interim placement of used fuel in specially engineered dry containers after its removal from wet storage pools.

Economic regions are broad-based geographic units based on census divisions and used for analysis of regional economic activity. There are 76 economic regions in Canada.

Escalator is the rate at which future costs are expected to grow on an annual basis. These figures are frequently tied to rates of inflation, but may be composed of a number of variables.

Flexibility refers to a ready capability to adapt to new, different or changing requirements.

Fissile refers to a nuclide that can be induced to fission by an incoming neutron. Only a few nuclides can fission (i.e., the splitting of a nucleus with the release of energy) and there is only one naturally occurring fissile nuclide, U-235. Other fissile nuclides are U-233 and some isotopes of plutonium (Pu-239 and Pu-241), but none of these occurs in nature to any appreciable extent.

Half-life is, for a radionuclide, the time required for the activity to decrease, by a radioactive decay process, by half.

Influence diagram is a tool used in multi-attribute analysis for mapping the principal interacting factors that influence the capacity of an option to perform well on a particular objective.

Isotopes are any two or more forms of an element having identical or very closely related chemical properties and the same atomic number but different atomic weights or mass numbers.

Joint Waste Owners (JWO) refers to corporations that own Canada's used nuclear fuel: Ontario Power Generation Inc., Hydro-Québec, NB Power Nuclear and Atomic Energy of Canada Limited.

Management approach is a strategy for the long-term care of used nuclear fuel which encompasses a particular technical method or sequence of methods, and the conditions necessary for its successful implementation, including societal requirements, related infrastructure, institutional and governance arrangements.

Mitigation refers to actions or measures undertaken with the objective to avoid, or reduce the severity of adverse impacts.

Multi-attribute utility-analysis methodology is a step-by-step decision support methodology that facilities a comprehensive assessment of various options against multiple objectives.

Ordovician sedimentary rock consists of bedrock formations such as shale and limestone bedrock formations that were laid down approximately 450 to 500 million years ago.

Partitioning involves a series of physical and chemical processes to separate various isotopes from used nuclear fuel for further conditioning, treatment or long-term management.

Plutonic rock is intrusive igneous rock formed at considerable depth beneath the surface of the earth by cooling of magma.

Precautionary approach/principle (we use these expressions interchangeably) As defined in the Government of Canada's *A Framework for the Application of Precaution in Science-based Decision Making about Risk*, which outlines guiding principles for the application of precaution to science-based decision making for the protection of health and safety and the environment and the conservation of natural resources: "The application of "precaution", "the precautionary principle" or "the precautionary approach" recognizes that the absence of full scientific certainty shall not be used as a reason for postponing decisions where there is a risk of serious or irreversible harm."

Present value is the amount of money that must be invested today to earn compound interest in order to yield enough future value to cover costs at a known period in time.

Real return is the actual return on an investment after removing the effect of inflation.

Repository is nuclear facility where used fuel is placed deep underground.

Reprocessing is the application of chemical and physical processes to used nuclear fuel for the purpose of recovering and recycling fissionable isotopes.

Retrievability is the ability to remove waste from where it has been placed.

Safeguards are activities by which the IAEA can verify that a State is living up to its international commitments not to use nuclear programs for nuclear-weapons purposes.

Safety is the protection of individuals, society and the environment, from the harmful or dangerous effects of used nuclear fuel, now and in the future.

- **Passive safety** refers to safety systems that do not rely on continuing human activities or intervention to ensure safety.
- **Active safety** refers to safety systems that do rely on continuing human activities or intervention to ensure safety.

Seaborn Panel refers to the Nuclear Fuel Waste Disposal Concept Environmental Assessment Panel, under the Chairmanship of Blair Seaborn, established in 1989 by the Government of Canada under the federal *Environmental Assessment and Review Process Guidelines Order* to review the safety and acceptability of AECL's concept of geological disposal of nuclear fuel wastes in Canada.

Security is a condition in which a referent entity or process is made and kept safe against harmful acts, events and situations (which are not of a social construction). Activities include threat, vulnerability and consequence assessments, and mitigation activities. Includes both physical and policy considerations.

Sedimentary rock is a type of rock resulting from the consolidation of loose material that has accumulated in layers.

Sievert is the standard international unit that indicates the biological damage caused by radiation. The biological damage depends on the type and energy of the radiation.

Storage is a method of maintaining used nuclear fuel in a manner that allows access, under controlled conditions, for retrieval or future activities.

Subduction zone is a descending plate of the earth's crust.

Technical method is the technology, technical process or procedure for handling used nuclear fuel. It is one part of a management approach.

Transmutation refers to the transformation of radioactive isotopes from used nuclear fuel into non-radioactive or stable isotopes by bombarding the target isotopes with neutrons or other particles.

Underground characterization facility is an underground research, rock mass characterization and deep repository technology demonstration facility which is constructed at the site for long-term management of used nuclear fuel. The facility is designed to be located adjacent to, and at the same depth as, the deep geological repository.

Used nuclear fuel means the irradiated fuel bundles removed from a commercial or research nuclear fission reactor.

Waste (Nuclear Fuel) is a fuel bundle from a commercial or research nuclear reactor that has served its intended purpose and has been removed from the reactor.

Wet storage is the interim storage of used nuclear fuel in water-filled pools after its removal from the reactor.

Appendix 13 / Acronyms

ACR	Advanced CANDU Reactor
AECL	Atomic Energy of Canada Limited
ASN	Authorité de Sûreté Nucléaire – Nuclear Safety Commission (France)
BAPE	Bureau d'audiences publiques sur l'environnement – (Public Environmental Hearing Board)
BEIR	Biological Effects of Ionizing Radiation
CANDU	CANada Deuterium Uranium
CANUTEC	Canadian Transport Emergency Centre of the Department of Transport
CEAA	*Canadian Environmental Assessment Act* (administered by the Canadian Environmental Assessment Agency)
CLAB	Centralized Interim Underground Wet Storage Facility (Sweden)
CNS	Canadian Nuclear Society
CNSC	Canadian Nuclear Safety Commission
CoRWM	Committee on Radioactive Waste Management (UK)
CPRN	Canadian Policy Research Networks
CRL	Chalk River Laboratories
DGR	Deep Geological Repository
DOE	Department Of Energy (US)
HLW	High Level Waste
HLRWM	High Level Radioactive Waste Management
HQ	Hydro-Québec
HRL	Hard Rock Laboratory (Sweden)
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
JWO	Joint Waste Owners
LLRWM	Low Level Radioactive Waste Management
LWR	Light Water Reactors
MOX	Mixed-Oxide Fuel
MUA	Multi-attribute Utility Analysis
MW	Megawatt

NAFTA	North American Free Trade Agreement
NAGRA	National Co-operative for the Storage of Nuclear Waste (Switzerland)
NBP	New Brunswick Power
NEA	Nuclear Energy Agency
NEB	National Energy Board
NFWA	*Nuclear Fuel Waste Act*
NPD	Nuclear Power Demonstration
NSCA	*Nuclear Safety and Control Act*
NWMO	Nuclear Waste Management Organization
OECD	Organization for Economic Co-operation and Development
ONFA	Ontario Nuclear Funds Agreement
OPG	Ontario Power Generation Inc.
PV	Present Value
PWR	Pressurized Water Reactor
SLOWPOKE	Safe Low-Power Critical Experiment
SDR	SLOWPOKE Demonstrator Reactor
SKB	Swedish Nuclear Fuel and Waste Management Company
UF	Used Fuel
UCF	Underground Characterization Facility
UNSCEAR	United Nations Scientific Committee on the Effects of Nuclear Radiation
URL	Underground Research Laboratory
ZWILAG	Interim storage facility for radioactive waste (Switzerland)

Advisory Council
to the NWMO

Mr. Kenneth Nash
Chairman of the Board of Directors
Nuclear Waste Management Organization
49 Jackes Avenue
Toronto, Ontario
M4T 1E2

September, 2005

Dear Mr. Nash,

On behalf of the Advisory Council to the Nuclear Waste Management Organization (NWMO), I am pleased to submit our comments on the NWMO study.

Having examined the study, we provide comments on the study process and the management approaches, as required of the Advisory Council under section 8 of the *Nuclear Fuel Waste Act*.

Respectfully submitted on behalf of the members of the Advisory Council,

The Honourable David Crombie
Advisory Council Chair

Copy: NWMO Advisory Council:

Dr. David Cameron	Ms. Helen Cooper	Mr. Gordon Cressy
Dr. Frederick Gilbert	Ms. Eva Ligeti	Dr. Derek Lister
Mr. Donald Obonsawin	Dr. Daniel Rozon	

September 22, 2005

Nuclear Waste Management Organization Advisory Council Final Report

Section 1 → Introduction

This report fulfills our obligations under the *Nuclear Fuel Waste Act* (*NFWA*), as members of the Advisory Council, to comment on the process, report and recommendations of the Nuclear Waste Management Organization (NWMO).

Section 1 provides an overview of the mandate, process and approach taken by the Advisory Council. Section 2 provides our assessment of the process undertaken by NWMO. In Section 3, we provide our evaluation of the approach to nuclear waste management proposed by the NWMO. Finally, in Section 4 we offer some final thoughts and recommendations for future initiatives.

1.1 Background

The *Nuclear Fuel Waste Act* (an Act respecting the long-term management of nuclear fuel waste) aims:

> "to provide a framework to enable the Governor in Council to make, from the proposals of the waste management organization, a decision on the management of nuclear fuel waste that is based on a comprehensive, integrated and economically sound approach for Canada."

The Act required the NWMO, at the end of three years, to submit a study setting out its proposed approaches for the management of nuclear fuel waste and to recommend one of those approaches for adoption. The study was obliged by the *Nuclear Fuel Waste Act* to examine at least the following approaches: deep geological disposal; storage at nuclear reactor sites; and centralized storage, either above or below ground. The examination of other approaches was not precluded by the legislation.

The Act also established an Advisory Council charged with the responsibility of examining the study and commenting on the approaches for the management of nuclear fuel waste contained in the study. The NWMO was required to submit those comments to the Minister along with its study.

The NWMO Advisory Council was established by the NWMO Board of Directors in the fall of 2002. It comprises nine individuals with a range of perspectives, knowledge and experience that includes nuclear engineering, environmental sustainability, public policy, Aboriginal affairs and citizen engagement (see list of members in Appendix 1 of NWMO *Final Study Report*).

1.2 Advisory Council Process

Over the past three years we have worked in a variety of ways to develop our assessment of the work of the NWMO. We have also provided advice on a continual basis in the interest of assisting the Organization to undertake the best possible process within the mandate and time limits established by the legislation. We learned from each other, invited experts in various fields to speak to us, made site visits to explore current nuclear waste management processes in various jurisdictions, observed public engagement activities, and debated numerous issues among ourselves and with others engaged in the NWMO process. These activities allowed us to develop shared knowledge and understanding about a wide range of technical, social, ethical, economic and political dimensions of nuclear waste management. They also allowed us to appreciate the complexity of the discussions that the Canadian public and decision-makers would need to have regarding the choice of an appropriate approach for nuclear waste management.

In January 2005 we issued a statement describing "How the Advisory Council of the Nuclear Waste Management Organization Intends to Fulfill its Mandate" (see Appendix A). The statement included a summary of the requirements of the *Nuclear Fuel Waste Act* pertaining to the Advisory Council and to the study being undertaken by the NWMO. We outlined our relationship with the NWMO (see section 1.2.1 below) and described four criteria that we would use to guide our evaluation of the NWMO process and study (section 1.3). In addition, we highlighted one other issue

that has been a source of ongoing concern and deliberation. We noted that:

> "The legislation is silent on the question of the quantity of nuclear fuel waste that is to be managed by the recommended approach. In its examination and selection of management approaches, the NWMO will have to address the matter of capacity, and therefore of quantity. How much nuclear waste is it assumed that any given management approach will be able to handle? This question is tied to the larger policy question of the future of nuclear energy in Canada."

> "The Advisory Council would be critical of an NWMO recommendation of any management approach that makes provision for more nuclear fuel waste than the present generating plants are expected to create, unless it were linked to a clear statement about the need for broad public discussion of Canadian energy policy prior to a decision about future nuclear energy development. The potential role of nuclear energy in addressing Canada's future electricity requirements needs to be placed within a much larger policy framework that examines the costs, benefits and hazards of all available forms of electrical energy supply, and that framework needs to make provision for comprehensive, informed public participation."

We were not alone in raising these points. As the NWMO notes, many participants in the engagement process put forward impassioned arguments about energy policy and the future of nuclear power (Section 1.3 of *Final Study Report*). We note that the NWMO states that the "study process and evaluation of options was intended neither to promote nor penalize Canada's decisions regarding the future of nuclear power". Indeed the *Nuclear Fuel Waste Act* does not provide the NWMO with either the jurisdiction or the mandate to influence the future of nuclear power.

The NWMO also considered the issue of the quantity of used nuclear fuel to be addressed and Appendix 10 describes a number of potential scenarios, ranging from early nuclear phase out to considerable expansion. The reference used fuel scenario employed in NWMO's assessment of the four options is based on the existing and expected spent fuel associated with existing nuclear reactors. This would be approximately 3.6 million used fuel bundles assuming that the existing fleet of nuclear reactors in Canada have an average operational life of 40 years. With plant refurbishments, the average life cycle could increase to 50 years, bringing the total number of used fuel bundles to more than 4.4 million. This range is well within the provisions of the NWMO study.

An increase in the installed capacity of nuclear reactors in Canada beyond the current 16000 MW would lead to a significant increase in the quantity of used nuclear fuel. In addition, a nuclear expansion scenario would likely entail fuel enrichment and new reactor technology, with spent fuel possessing new characteristics. These could affect the performance of the disposal technology and introduce a change in the outlook on reprocessing. Such technical aspects were not considered by NWMO in its study, which focused on existing facilities using natural uranium fuel.

We conclude that it is appropriate to plan for the quantity and type of used nuclear fuel expected for NWMO's reference used fuel scenario as well as refurbishments of the existing fleet of reactors, representing a range of 3.6 to 4.4 million bundles. However we emphasize, as did many other participants in the process, that any significant change in the amount or type of used fuel to be managed (whether due to phase out or expansion of the nuclear program) should trigger a review of the work undertaken by the NWMO to date.

1.2.1 Relationship between the Advisory Council and the NWMO

The legislation required us to provide independent commentary on the NWMO's study and its conclusions once they were completed. However, we felt that it would be most constructive to operate on a "no surprises" basis by providing ongoing advice about the NWMO process as it took place. Accordingly, we undertook to learn as much as possible about the NWMO's work and to meet regularly with NWMO management to provide comments and suggestions. Our Chair made regular reports about our work at Board meetings of the NWMO. The President updated us at each of our meetings on NWMO's activities and invited feedback, advice and suggestions on next steps. A detailed account of the advice provided by the Advisory Council and the actions taken by the NWMO in response is provided in a chart posted on the Organization's website (see "Advisory Council Tracking Matrix" at www.nwmo.ca/actracking). We found the NWMO to be very responsive to our advice, resulting in changes and adjustments in its process, communications and recommendations.

The Advisory Council Tracking Matrix provides information about the interactions between the NWMO and the Council in six broad categories:

1. Operations
2. Briefings/Site Visits
3. Workplan
4. Annual Reports
5. Discussion Documents and Study Reports
6. Engagement.

In the area of **Operations**, we created a framework for interactions between the NWMO and the Advisory Council, including in-camera meetings as well as discussions with NWMO staff and Board of Directors. This recognized our dual functions of providing independent comment and also ongoing advice to the NWMO.

Our **Briefings and Site Visits** were designed to allow us to learn as much as possible about the work of the NWMO, perspectives of various stakeholders, and current knowledge and practices in Canada and overseas. Details are provided in sections 1.2.2 and 1.2.3 below.

Our advice on the **Workplan** included a wide range of discussions and comments on the NWMO's statement of vision, mission and values, annual business plans and research designs. For example, we encouraged the NWMO to incorporate more expertise in Ontario geology, to seek the perspectives of young people, to publish its workplan as a "roadmap", to arrange peer reviews of the Joint Waste Owners' work on concepts and costs, and to report on how the NWMO was responding to the findings of the Seaborn Panel.

We provided advice to the NWMO on the content and direction of its **Annual Reports**. In addition, we wrote independent letters to the Minister of Natural Resources on the work undertaken by the NWMO in 2003 and 2004 and tabled them at the same time as the NWMO's annual reports (March 2004 and March 2005 respectively).

We provided comments on the structure and content of NWMO's **Discussion Documents and Study Reports** to assist in ensuring that they provided appropriate information to increase public understanding and stimulate public dialogue. We emphasized the importance of describing how the public helped to shape the questions, process and findings addressed in NWMO's study. We suggested that the NWMO highlight the ways in which two parallel tracks of work with different participants – public engagement and expert analysis – led to convergence on many key findings. Council members also provided wording for specific areas of text, such as parts of Appendix 9 in the *Final Study Report* on reprocessing, partitioning and transmutation. We requested clarification on a number of points contained in *Choosing a Way Forward*, the *Draft Study Report* issued by the NWMO in May 2005. This resulted in adjustments in the *Final Study Report* in such areas as Aboriginal dialogue, ethics, suitability of sedimentary rock, cost estimation, nuclear liability, replicability of the assessment, socially acceptable standards of safety, the option of centralized shallow storage, the underground characterization facility and the definition of a willing host.

With respect to Engagement, Council members offered advice on ways to implement effective public engagement and ensure meaningful dialogue with Canadians. For example, we recommended benchmarking to track changes in opinions and views throughout the course of the NWMO's study. This was accomplished by NWMO's public opinion research. We also encouraged the NWMO to use a wide variety of engagement techniques, to develop interactive website capability, to convene dialogues in communities that do not host nuclear facilities, to use multi-media to communicate its work, and to incorporate opportunities for participants to learn about the intricacies of the assessment process.

The Council also established a Sub-Committee on Aboriginal engagement to examine how the contributions of Aboriginal peoples were being addressed in the NWMO's work, to provide advice on Aboriginal engagement, and to encourage the NWMO to incorporate the expertise that resides in traditional Aboriginal knowledge. See Section 2 for further elaboration of our views about the engagement initiatives and Aboriginal dialogue.

1.2.2 Meetings

During the past three years we convened regularly in full and half-day sessions as well as conference calls. Our meetings incorporated briefings and dialogues with NWMO staff, in-camera sessions, and guest presentations and discussions. The guests included people whom we invited, people who were suggested by the NWMO, and others who requested meetings with us. Our chairman, David Crombie, represented the Advisory Council at meetings of the NWMO Board of Directors, and the Council participated in a number of joint sessions with the Board.

Members of the Advisory Council attended, as observers, a number of the NWMO's citizen dialogues, national and regional meetings and public information and discussion sessions in various locations across the country in order to hear first hand the comments of Canadians.

The experts and stakeholders who met us to discuss a range of topics are listed in Table 1. For example, we held an early session in 2003 with Mr. Blair Seaborn, the former Chairman of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel. This session allowed us to hear from Mr. Seaborn on the range of public concerns registered with his Panel and some of the key issues that were raised in his Panel's report, including comments on public consultations. We also met the Reverend Lois Wilson to benefit from her perspectives and reflections from the Panel process. We were particularly interested in exploring the ethical issues that arose in that process, including the issue of safety from both technical and social perspectives.

We received a briefing by the Joint Waste Owners on the scope of technical research those companies had undertaken with respect to the conceptual engineering designs, transportation systems and cost estimates for each technical method.

We received a presentation by the Canadian Nuclear Safety Commission regarding its roles and responsibilities and the role it will play in the licensing of any approach for the long-term management of used nuclear fuel.

Officials from the Energy Sector of Natural Resources Canada provided a briefing on the role of nuclear power in the context of Canada's energy supply. We also met officials from the Uranium and Radioactive Waste Division, Natural Resources Canada to provide them with an update on our work.

In March 2003, members of the Advisory Council participated in an NWMO meeting with the Minister of Natural Resources Canada at that time, the Honourable Herb Dhaliwal, sharing with the Minister some of their own perspectives and reflections on the NWMO process to date. In January 2005, a member of the Council accompanied NWMO Chair Ken Nash and President Elizabeth Dowdeswell to a meeting with the Honourable R. John Efford, current Minister of Natural Resources Canada, and reported on the Advisory Council's approach to its mandate and the ways in which the Council was providing ongoing guidance to the NWMO.

Table 1 Participants in Meetings of the Advisory Council

WHO	WHEN
Blair Seaborn, former Chairman of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel	January 2003
Ric Cameron, ADM, Energy Sector, Natural Resources Canada	January 2003
Jaime Watt, Chair and Dianne LeBreton, Consultant, Navigator (focus group research)	January 2003
Linda Keen, President and CEO, Cait Maloney, Director General, Directorate of Nuclear Cycle and Facility Regulation and Richard Ferch, Director, Director General's Office, Canadian Nuclear Safety Commission	March 2003
Senator Lois Wilson, former Commissioner on the Seaborn Panel	March 2003
Ken Nash, Chair and Frank King, Director, Nuclear Waste Engineering and Technology, Ontario Power Generation	May 2003
Judith Maxwell, President, Canadian Policy Research Network	January 2004, May 2004
Nuclear Waste Watch members – David Martin, Sierra Club of Canada; Marion Odell, International Institute of Concern for Public Health; Shirley Farlinger, Science for Peace / International Institute of Concern for Public Health / University Women's Organization; Theresa McClenaghan, Canadian Environmental Law Association; Nest Pritchard, Ontario Voice of Women	March 2004
NWMO Assessment Team Members – Michael Ben-Eli, President, Cybertec Consulting Group, and Tom Isaacs, Director, Office of Policy, Planning and Special Studies, Lawrence Livermore National Laboratory,	May 2004
NWMO Roundtable on Ethics Members – Andrew Brook, Professor of Philosophy, Carleton University Arthur Shafer, Director of the Centre for Professional and Applied Ethics, University of Manitoba, and Margaret Somerville, Professor of Law and Medicine, McGill Centre for Medicine, Ethics and Law, McGill University	October 2004
Joanne Barnaby, facilitator, Aboriginal Traditional Knowledge workshop	October 2004
David Hallman, The United Church of Canada and Climate Change Programme Coordinator and Mary Lou Harley, Member, Nuclear Issues Writing Group for Justice, Global and Ecumenical Relations Unit, United Church of Canada	October 2004
Murray Elston, President and CEO, Canadian Nuclear Association and Jeremy Whitlock, President, Canadian Nuclear Society	February 2005
Marvin Stemeroff, Principal, Gartner Lee Ltd. and John Davis, Principal, Golder Associates	February 2005
Peter Brown, Director, Uranium and Radioactive Waste Division and Carmel Létourneau, Senior Policy Advisor, Uranium and Radioactive Waste Division, Natural Resources Canada	March 2005

A member of Council attended the Euradwaste'04 meetings in Luxembourg to learn more about the collaborative research being conducted in Europe on a range of topics related to nuclear waste management, including community and socio-political considerations, stakeholder engagement, and research and development.

In 2004, the Advisory Council met with representatives of Nuclear Waste Watch, a network of 34 organizations concerned about high-level radioactive waste and nuclear power in Canada.

The convener of the 2003 Aboriginal Traditional Knowledge Workshop attended one of our meetings to address the topic of drawing on Aboriginal wisdom to formulate ethical guidelines.

Representatives of the United Church of Canada met us to provide their positions on nuclear issues and their views on some of the societal and ethical considerations.

We received a presentation from the Roundtable on Ethics, in order to understand and discuss the ethical and social framework they were developing.

The Canadian Policy Research Network reported on the findings from the National Citizens' Dialogue, a highlight of the NWMO's research into citizen values in 2004.

In May 2004 the Council received a presentation from members of the Assessment Team and discussed their methodology and findings. In February 2005 we met with representatives of Gartner Lee Ltd. and Golder Associates who briefed us on their comparative assessment of costs, benefits and risks associated with the three management options specified in the *NFWA*.

We met with representatives of the Canadian Nuclear Association and Canadian Nuclear Society to learn about the perspectives of these organizations on the long-term management of used nuclear fuel.

Our work is documented in records of discussion from our meetings as well as the chart we used to assist in tracking our activities and to support the preparation of this report. These documents are posted on NWMO's web site.

1.2.3 Site visits

In order to learn about current practices in Canada as well as relevant activities in the US and Europe, members of the Council participated in a number of site visits for research purposes.

Several Council members visited the Pickering Nuclear Generation Station in Ontario in May 2003 to tour Unit 3 of the plant and receive a briefing and tour of the station's wet and dry interim storage facilities for used nuclear fuel.

In May 2003 Derek Lister and NWMO President Elizabeth Dowdeswell toured the Underground Research Laboratory at Whiteshell, Pinawa, Manitoba operated by Atomic Energy of Canada Ltd. They also met with AECL staff and with the Mayor of Pinawa.

Several members of the Advisory Council visited the Yucca Mountain Disposal Project in Nevada to learn about the US Department of Energy's experiences with preparing a repository for used fuel. Discussions with DOE staff in Las Vegas provided valuable insights into their public engagement processes.

In November 2002, Fred Gilbert had an opportunity while in Helsinki, Finland, to meet with Dr. Juhani Vira, Director of Research at Posiva Oy (the agency implementing the Finnish program for the long-term management of used fuel) to review the site selection process and discuss the nuclear energy situation in Finland.

Eva Ligeti participated in a Canadian delegation (including NWMO representatives) that visited Rauma, Finland in October 2004. The site visit included meetings with officials from Posiva Oy to explore Finland's plans for long-term management of used nuclear fuel, in terms of both the policy underpinnings and the progress in implementation.

1.3 Evaluation Approach

In fulfilling our legislative obligations to provide an independent review of the work of the NWMO, we gave considerable thought to the criteria we would use for evaluation. In developing them, we considered the mandate of the NWMO, the requirements of the legislation, and the experience of the Seaborn Panel. The criteria were published in our January 2005 statement "How the Advisory Council of the Nuclear Waste Management Organization Intends to Fulfill its Mandate" (Appendix A).

The four criteria are:

- **Comprehensiveness.** Did the NWMO study properly consider all of the available reasonable alternative approaches? Did it thoroughly cover the three required options? Does the report adequately address all of the elements stipulated in the legislation with respect to each of the options?

- **Fairness and balance.** Has the analysis supporting the NWMO report given appropriate weight to all relevant evidence, neglecting none of significance? Does the study give adequate consideration to diverse points of view and recognize the interests of minority positions? Is there any evidence of bias or partiality in the analysis and recommendations? Does the recommended policy choice emerge logically out of the careful and considered weighing of the pros and cons of the respective alternatives?

- **Integrity.** Did the NWMO process provide sufficient opportunity for public engagement? Were Aboriginal peoples, concerned stakeholders, and potentially or actually affected communities given real opportunities to make their views known? Were these views responsibly considered and appropriately taken into account? Were available sources of expertise and specialized experience sought out and utilized effectively? Were 'state of the art' processes of public consultation, ethical reflection, socio-economic analysis, technical and scientific study, financial forecasting, and impact assessment employed? Was international comparative experience adequately considered?

- **Transparency.** Did the NWMO make its plans and timetable clear to the interested public? Did it share information with citizens in a timely fashion so that they had the capacity to participate effectively in the process? Did it simplify technical data and complex scientific matters honestly and effectively to assist in the development of public understanding? Did the Organization allow sufficient time for comment, input and reaction from stakeholders and the general public?

Section 2 → The NWMO Process

2.1 Overview of NWMO's Process

The NWMO undertook a complex and iterative process in four phases that involved (1) setting the expectations for the study, (2) exploring the fundamental issues, (3) assessing the options and (4) formulating the recommendation. Throughout these four phases, the NWMO engaged citizens to help develop an understanding of the requirements for an appropriate management approach for Canada, and specialists to help develop an understanding of the practicable options available to address these requirements. The NWMO's work can be described in terms of four linked streams of work: general public engagement, Aboriginal engagement, professional expertise, and the assessment process. All these streams of activity were informed by a set of ethical principles that were treated as over-arching considerations for NWMO's process and outcomes.

Engagement: The NWMO used a wide variety of engagement techniques, including workshops, public information and discussion sessions, open houses, youth workshops, public attitude research (focus groups and telephone survey), a scenarios exercise, an ethics roundtable, meetings with political representatives and international agencies, written submissions, e-dialogue and interactions with the Advisory Council.

Aboriginal engagement: The NWMO's Aboriginal engagement incorporated collaborative agreements with all six national Aboriginal organizations and seven regional/local organizations, an outreach program with First Nations of Ontario, involvement of Aboriginal peoples in all NWMO activities, a workshop on Traditional Knowledge and Aboriginal Wisdom, a program to increase Aboriginal language capacity regarding nuclear waste management, and an Elder's forum.

Professional expertise: More than 60 expert papers were commissioned on a wide range of topics including social and ethical dimensions, health and safety, science and environment, economic factors, technical methods, conceptual engineering designs, cost estimates, risk assessment, and institutions and governance.

Assessment: The NWMO formulated a list of 10 questions that their engagement initiatives suggested that Canadians wanted to have addressed, within the limits of the NWMO mandate. An ethical and social framework was developed based on citizen and Aboriginal values and concerns, ethical principles, future scenarios and societal context. Technical information was introduced from the background papers, engineering design work and cost estimates. Eight objectives were identified to guide the assessment of the four used nuclear fuel management options under consideration.

2.2 Advisory Council Evaluation of NWMO's Process

This section provides the Advisory Council's evaluation of the key elements of the NWMO's process according to the four criteria that we developed to guide our work – comprehensiveness, fairness and balance, integrity, and transparency (see Section 1). We also include some recommendations for future phases of the work of the NWMO, recognizing the opportunity to build on the work undertaken to date.

2.2.1 Engagement

The Advisory Council finds that the NWMO had an extensive and sophisticated engagement program, which was effectively conducted within the limits of the NWMO's mandate and the relatively short time frame allocated to the process by the *Nuclear Fuel Waste Act*. The public engagement program addressed one of the major deficiencies of previous work on nuclear waste management in Canada as identified by the Seaborn Panel, namely that there had been insufficient consultation with Canadians on the proposed management approach. The NWMO employed innovative techniques that were a significant advance in comparison with traditional methods of outreach and provided a great variety of ways for people to participate.

The NWMO process provided opportunities for participation by concerned stakeholders, potentially or actually affected communities and the general public. Despite the usual challenges of attempting to engage large numbers of people in consultations about public policy, we believe that the diverse participation provided

a good reflection of the range of different opinions to be found among stakeholders and the general public. The NWMO made an effort to engage citizens across the country, with a heavier emphasis on those communities that host existing nuclear facilities (Ontario, New Brunswick and Quebec) and uranium mines (Saskatchewan). We feel that this was an appropriate balance, recognizing that interest would be higher in the communities with direct experience and that the Provinces that have benefited most from the industry should bear most of the responsibility for dealing with its wastes.

NWMO went to great lengths to record and consider all points of view, and minority opinions are presented throughout the analysis. NWMO endeavoured to reach people other than those who have an expressed interest in nuclear waste management, particularly through the use of the National Citizens Dialogue and the public attitude research.

Although it is typically difficult to secure the participation of young people in engagement initiatives of this nature, the NWMO made an effort in this regard, including a workshop with young people who were participating in an International Youth Nuclear Congress, a youth dialogue convened in Saskatchewan, involvement of young people in the Aboriginal Elders Forum, presentations at universities, and the e-dialogue.

We observed that for the most part, information was generally shared with citizens in a timely fashion so that they could participate effectively in the process. On the whole, technical data and complex scientific matters were simplified and honestly presented to assist in the development of public understanding. However, we also observed that adequate technical and cost information was not always available when needed by participants in the engagement process, particularly in the early phases of the work.

Throughout the process, the NWMO went to great lengths to ensure transparency and open discussions of its work. It provided background documents and drafts of its reports for independent analysis and comment, and clearly demonstrated how it was responding to public and technical input.

2.2.2 Aboriginal Engagement

We found that the NWMO's engagement activities with Aboriginal peoples were slow to get started, but are now going in the right direction. The Advisory Council recognizes that the three year time constraint imposed on the NWMO by the federal legislation was a particular limiting factor in undertaking comprehensive consultations with Aboriginal peoples. Such consultations need adequate time to accommodate the consensual, measured processes that are traditional to Aboriginal peoples, as well as the large geographic distances, language barriers and cultural complexity involved.

The NWMO's work with the Elders, the development of discussion and technical background materials in Aboriginal languages, the traditional knowledge workshops, efforts to involve Aboriginal peoples in general NWMO activities, and the participation of over 3000 Aboriginal peoples over the past three years testify to the NWMO's numerous outreach efforts to Aboriginal peoples. It is noteworthy that the NWMO has been able to sign engagement agreements with six national and seven regional/local organizations. However the Advisory Council wishes that more regional/local agreements had been signed earlier in the process, especially with Aboriginal peoples in the Canadian Shield territories.

The Advisory Council recognizes that the current engagement activities with Aboriginal peoples represent only the beginning of a longer and more involved and inclusive relationship. As Justice Berger recently noted in his July 2005 memorandum to the NWMO, we must remember the statement of the 1987 World Commission on Environment and Development (Brundtland Commission) that tribal people "must be given a decisive voice in the formulation of resource policy in their areas". Justice Berger emphasized that it is the Aboriginal peoples who mainly live on a permanent basis in the more remote parts of the Canadian Shield. The Aboriginal peoples consider their ancient territories as the true dwelling place of generations and consequently will have an important contribution to make to any management processes involving the Canadian Shield. It will be important for the

NWMO to provide the necessary tools and processes required to achieve that goal.

In the next phases of the process, NWMO will have to proceed with more formal consultations with Aboriginal peoples, especially as the siting options become better defined and focused. The NWMO will need to be mindful of the evolving guidelines for consultations with Aboriginal peoples that are emerging from recent and ongoing decisions by the Supreme Court of Canada. For its part, the NWMO will need to better define its own legal and social requirements and expectations of future consultations with Aboriginal peoples.

There is also a need for greater clarification of the fiduciary obligations of the Federal Government in the consultation process with Aboriginal peoples. There should be greater clarity on the scope and purpose of any further consultations by the Federal Government in future phases, including an understanding of how those consultations might complicate, complement or enhance the engagement initiatives of the NWMO.

Engagement and consultation with Aboriginal peoples should become both more complex and more focused as the next phases of NWMO's work proceed. There is a great opportunity for the NWMO to build on its efforts to date and engage in a meaningful and inclusive consultation process with Aboriginal peoples in its future work.

2.2.3 Professional Expertise

The NWMO incorporated extensive professional expertise into its work and covered in depth a wide range of knowledge and experience within the time available. For the most part, all the key areas were covered, providing a satisfactory base for the conclusions of the study. Looking ahead, we believe that it would be advantageous for NWMO to increase the capacity of its own staff to provide more in-house expertise on the complex technical and scientific matters that must be addressed in future phases.

2.2.4 Assessment

The NWMO assessment process was thorough and covered all the key considerations. It identified 14 alternative approaches and provided justification for screening out unacceptable ones. The three required options, as well as the fourth recommended option, were carefully evaluated, and the NWMO addressed all elements stipulated in the legislation. The analysis supporting the NWMO report gave appropriate weight to all relevant evidence, neglecting none of significance.

We found that the recommended policy choice emerges logically out of the careful and considered weighing of the pros and cons of the alternatives. One area of focus for our deliberations was the replicability of the assessment process. The Assessment Team was composed of a diverse group of individuals with a broad range of expertise. This team designed the assessment process so that it was transparent, traceable and comprehensive. Various techniques were used to engage interested citizens in components of the process, including a simulation of the scoring process and detailed discussion of the objectives and findings of the assessment exercise. In addition, the NWMO engaged consultants Golder Associates and Gartner Lee Ltd. to further develop and enhance the work undertaken by the Assessment Team. The public discussions and the work of the Golder/Gartner Lee team provided substantial additional credibility to the assessment. Nonetheless, in future work, we recommend that assessments should be fully replicated to increase confidence in the results.

We also focused considerable discussion on social and ethical matters because of their critical importance in gaining acceptance for any proposed management approach. The NWMO's strategy of integrating social and ethical factors along with technical and economic considerations represents groundbreaking work in the international context of nuclear waste management. Continued public engagement will be required to build on this important element in the next phases of the process.

2.2.5 Conclusion

Overall, we conclude that, within the stipulated statutory limits to which it was subject, the NWMO conducted a process that was comprehensive, transparent, and clearly exhibits fairness, balance and integrity.

Section 3 → Adaptive Phased Management

3.1 Support for Adaptive Phased Management

The NWMO has made a thorough assessment of the three options mandated by the *Nuclear Fuel Waste Act* and developed an improved approach - Adaptive Phased Management (APM). Each of the four options studied by the NWMO has been shown through extensive analysis to possess various combinations of risks and benefits, from both a technical and a social perspective.

Our review of the risks and benefits associated with each option confirms that APM is the best of the options because it provides Canadians with a comprehensive roadmap for dealing responsibly with Canada's existing nuclear wastes. It retains major advantages of the original three options and minimizes risks and disadvantages. Recognizing that we are currently in the middle of the 40/50 year expected life span of existing nuclear reactors, APM provides a mechanism for a portion of their revenue to be allocated to dealing with their wastes, while not foreclosing on choices properly left to the best judgment of succeeding generations. APM also engages the Canadian public at key decision points along the way and provides a process to allow the NWMO to adapt the management system so that it achieves a socially acceptable standard of safety.

3.2 Benefits of Adaptive Phased Management

The most significant benefit of APM is that it is based on a progressive, adaptive process that, if given sufficient time, commitment, resources and leadership, has the potential to provide a socially acceptable solution for existing and expected used nuclear fuel from Canada's current fleet of reactors. We note that the importance of the process is clearly recognized by NWMO in its statement that "the most profound challenge lies not in finding an appropriate technical method, but in the manner in which the management approach is implemented" (Section 8.2 on Streams of Analysis in *Final Study Report*).

APM also addresses one of the major conclusions of the Seaborn Panel – that social issues had not been adequately addressed in developing the concept for deep geological disposal of used nuclear fuel that was presented to the Panel. We believe that APM has the potential to address this limitation and achieve a standard of safety that is both technically sound and socially acceptable.

In the following text, we describe some specific benefits of APM. However, we emphasize that in order for APM to realize these benefits, the process must be implemented with integrity, requiring sufficient time and resources for each step to be undertaken fully.

Ethical Framework – APM is designed to be an ethical management approach that would engage a broad cross-section of society in informed dialogue and explicitly respond to societal values and concerns.

Fairness to Future Generations – APM recognizes that fairness requires that financial responsibility for the management of used fuel from existing nuclear facilities should reside with the generations that are benefiting from the power being generated. It also provides a management approach for both the short and long term, while ensuring that future generations will have opportunities to make genuine choices at appropriate points in the process.

Continuous Learning – the APM management approach is designed to incorporate continuous learning and the application of emerging science and technologies, both specific to the site and from work being undertaken in Canadian institutions and in other countries. In particular, the underground characterization facility will provide valuable opportunities to undertake research to further describe the site, experiment with relevant technologies, and demonstrate the safety and effectiveness of proposed methods for handling and monitoring the used fuel.

Addressing Uncertainty – the NWMO recognizes that some participants in the process questioned whether the current level of technical expertise is enough to make decisions on a solution that will have implications for many future generations. APM is designed to address uncertainties by providing time for continual development of technical expertise and a series of points at which important decisions can be made in an open and transparent manner with public accountability.

Security – the option of interim shallow storage of the used nuclear fuel at the centralized site in the near term provides the opportunity to reduce the risks (e.g. security) associated with above-ground storage at a number of current facilities in several Provinces. It also allows preparations to be made for the orderly decommissioning of existing nuclear facilities once their useful life is over. Over the long term, centralized containment in a deep geological repository will provide the most secure end-point currently identified. In addition, because containment in a deep geological repository relies on a combination of engineered and geological barriers to contain and isolate the used fuel, it has the potential to be effective in the event that social institutions that may be in place hundreds or thousands of years from today can no longer ensure the safety of the site.

3.3 Outstanding Considerations

We recognize the considerable amount of work undertaken by the NWMO to develop the APM approach. However, within the APM framework, there are still a number of outstanding questions that will need to be addressed as the NWMO proceeds to the next phases of its work. Some of the key questions are noted below.

- **Cost Estimates –** the NMWO has undertaken a considerable body of work to identify the costs of each of the four management options. Future work will need to provide more details, for example to specify the incremental costs associated with managing smaller or greater amounts of used fuel, within the range established in the reference used fuel scenario described in Appendix 10.
- **Liability –** the *Nuclear Liability Act* is currently under review to improve victim compensation, clarify key provisions, clarify federal responsibilities and address technical problems. As decisions are made in the future regarding NWMO's liability, it will be necessary to adjust NWMO's cost estimates accordingly.
- **Rock Formations –** the NWMO has concluded that both the crystalline rock of the Canadian Shield and Ordovician sedimentary rock are potentially suitable for a deep geologic repository. However the option to use sedimentary rock was introduced relatively late in NWMO's study process, and limited work has been undertaken in Canada to date on Ordovician sedimentary rock to determine its suitability for this purpose. It is therefore premature to consider Canadian sedimentary and crystalline rock as equivalent options until more research has been undertaken on the former.

Section 4 → Final Thoughts and Recommendations

In this section we draw on the experiences of the past three years to provide some final thoughts and recommendations on the following topics:

- Future governance of the NWMO
- Adaptive Phased Management
- Engagement
- Aboriginal engagement
- Advisory Council
- Energy policy

4.1 Future Governance of the NWMO

We found that the NWMO operated with integrity and transparency to manage a complex study process over the past three years, within the confines of the mandate and the deadlines provided. The characteristics of integrity and transparency will continue to be essential in the future to ensure that the NWMO has credibility and public trust.

In Section 10.7 of the *Final Study Report*, NWMO provides a good assessment of its future governance requirements. We emphasize the importance of expanding the Board of Directors to include a broader range of interests than those of the nuclear waste producers. This should provide diverse and independent viewpoints to assist the Organization as it moves into the operational phases of its work.

In addition, we recommend that, consistent with NWMO's public mandate:

1) The criteria used to define the composition of the Board should be communicated to the public.

2) The Board should adopt a policy of voluntarily adopting the standard of transparency required by the *Access to Information Act*.

4.2 Adaptive Phased Management

We conclude that NWMO's Option 4 – Adaptive Phased Management – is a progressive, adaptive process that, if given sufficient time, commitment, resources and leadership, has the potential to provide a socially acceptable solution for existing and expected used nuclear fuel from the current fleet of reactors. We emphasize that the process should be fully implemented with integrity, as designed by the NWMO. For example, it is possible that a decision will be made that a centralized shallow underground storage facility is not required, but such a decision should emerge from the anticipated process, including meaningful public engagement and full consideration of all social, ethical and technical factors.

Therefore, we recommend that:

1) APM should be implemented with the appropriate leadership, resources and time to undertake the process as described in NWMO's *Final Study Report*.

4.3 Engagement

NWMO's engagement process over the past three years was characterized by a wide range of techniques, openness and depth of discussion, and transparency.

As the NWMO moves into the next phase of work, we recommend that:

1) The NWMO should continue to meet the high standards of engagement established to date, reach out to a broad cross-section of Canadians and seek diverse opinions.

2) Intensive engagement efforts should be undertaken with communities of interest, including potential "willing host" communities.

3) Increased emphasis should be placed on reaching out to young people because the long time frame of nuclear waste management places important responsibilities on future generations.

4) A strong educational program should be provided to deepen public understanding and facilitate informed decision-making.

4.4 Aboriginal Engagement

The NWMO's engagement activities with Aboriginal peoples will continue to be a critical element of the process. Although Aboriginal engagement initiatives got off to a slow start, they are now going in the right direction, and will provide a good foundation for a more involved and inclusive relationship.

We recommend the following measures to build on this foundation:

1) Hire Aboriginal staff and set up an Aboriginal advisory committee with diverse membership to ensure that Aboriginal perspectives are integrated into NWMO initiatives and processes.

2) Continue to engage Aboriginal elders.

3) Improve communications, with communications tools and technical materials appropriate to Aboriginal peoples, in the languages of the Aboriginal peoples involved.

4) Involve traditional knowledge holders in the broader processes of the selected management approach.

5) Go beyond the "traditional knowledge" focus of Aboriginal involvement and better involve Aboriginal peoples in the broader discussions of the selected management approach.

6) Work with the Federal Government to ensure ongoing funding for local capacity building.

7) Continue to focus on appropriate consultation initiatives at the local level.

4.5 Advisory Council

The Advisory Council will continue to play an important role in the next phases of NWMO's work. As this work evolves from a study to implementation, it is appropriate to review the composition of the Advisory Council to ensure that it includes the appropriate range of knowledge, expertise and perspectives, including those of young people. For example, it will be especially important during the site selection process for the Advisory Council to be able to comment with a range of viewpoints on such issues as social acceptability, the public interest and transparency.

Section 10.7 of the *Final Study Report* recognizes the need to review the mandate and composition of the Advisory Council, and we, the current Advisory Council, will be pleased to assist the NWMO with this task.

4.6 Energy Policy

The NWMO Study Report provides a framework for proceeding to address existing and expected used nuclear fuel from the current fleet of reactors. However we emphasize, as did many of the participants in the engagement process, that it does not provide a green light for expansions of nuclear power production beyond the lifespan of the current fleet. As we said in Section 1, any significant change in the amount or type of used fuel to be managed should trigger a review of the work undertaken by the NWMO to date. Such a review should be undertaken in the context of a discussion of federal, provincial and territorial energy policies in Canada, not only for nuclear power, but also for all other forms of energy. Indeed, the need for a broad Canadian perspective was highlighted by the recent proposal of provincial and territorial leaders at their Council of the Federation meeting in Banff to develop a pan-Canadian energy strategy (11 August 2005 Communiqué).

We believe that a public policy discussion about energy in Canada is needed – regardless of any proposals for phase out or expansion of nuclear power. This was a recurring theme in NWMO's engagement activities, with many participants being reluctant to discuss processes to deal with wastes from the generation of nuclear power in the absence of an

understanding of the role of nuclear energy in Canada's future.

Recognizing that responsibility for energy in Canada is shared among the federal, provincial and territorial governments, we recommend that:

1) The federal government should work with the provincial and territorial governments to facilitate a national public policy discussion about future energy supplies in Canada.

2) There should be no expansion or reduction of nuclear power generation at the provincial or territorial levels without public policy discussion about future energy supplies within those jurisdictions.

Appendix A → How the Advisory Council of the Nuclear Waste Management Organization Intends to Fulfill its Mandate

January 22, 2005

The Legislation

The *Nuclear Fuel Waste Act* (an Act respecting the long-term management of nuclear fuel waste) aims:

> "to provide a framework to enable the Governor in Council to make, from the proposals of the waste management organization, a decision on the management of nuclear fuel waste that is based on a comprehensive, integrated and economically sound approach for Canada."

The Act requires the waste management organization, at the end of three years, to submit a study setting out its proposed approaches for the management of nuclear fuel waste and to recommend one of those approaches for adoption.

The Act also establishes an Advisory Council charged with the responsibility of examining the study and giving written comments on it to the Nuclear Waste Management Organization (NWMO). The NWMO, for its part, is required to submit those comments to the Minister along with its study. Section 12 of the legislation, which discusses the study, imposes an obligation on the Advisory Council to comment on the approaches for the management of nuclear fuel waste contained in the study. While it does not specifically require the Council to comment on the NWMO's recommendations, that requirement can be reasonably inferred from the obligation to comment on 'the study' and 'the approaches', which will of course contain the recommendations.

The NWMO Study

The NWMO's study is obliged to examine at least the following approaches: deep geological disposal; storage at nuclear reactor sites; and centralized storage, either above or below ground. The examination of other approaches is not precluded by the legislation. For each proposed approach the NWMO must include the following:

- Detailed technical description;
- Specification of an economic region for implementation;
- A comparison of benefits, risks and costs with those of the other approaches;
- The associated ethical, social and economic considerations;
- A description of the waste management services to be offered by the NWMO;
- An implementation plan (description of activities, timetable, means of avoiding or minimizing significant socio-economic effects on a community's way of life or its social, cultural or economic aspirations, and a program of public consultation);
- A summary of comments arising out of consultation with the general public and with aboriginal peoples;
- A financial formula to cover the costs;
- A cost-sharing formula allocating costs to waste producers; and
- The form and amount of any financial guarantees provided by the nuclear energy corporations.

Finally, the study is required to recommend one of the approaches thus described.

This, then, is the nature of the study on which the Advisory Council is obliged to provide written comments.

The Advisory Council's Approach

The legislation creating the Nuclear Waste Management Organization and its Advisory Council is very broad. Within the framework of the legislation, we – as members of the Advisory Council – see our responsibilities in the following way.

As part of our obligation to examine and give written comment on the NWMO's study at the end of the three-year period, we believe it is appropriate for the Council to learn about the ongoing work of the NWMO and for the Council to express its views about that work as it is being done. Accordingly, members of the Advisory Council decided at its establishment in October 2002 to meet regularly with NWMO management and to offer ongoing advice about the conduct of their undertaking. To date we have had 13 formal meetings with NWMO staff as well as four meetings with members of the NWMO Board of Directors. Our work is recorded in the minutes posted on the Organization's web site. At the end of the three-year process, we intend to post the Tracking Matrix we used to assist us in tracking our activities and in supporting the preparation of our written comments on the NWMO study.

In fulfilling its legislative obligations, the Advisory Council will offer written comments and observations on the work and study of the NWMO.

The Council will review and comment on the **comprehensiveness** of the NWMO study. Did it properly consider all of the available reasonable alternative approaches? Did it thoroughly cover the three required options? Does the report adequately address all of the elements stipulated in the legislation with respect to each of the options?

The Council will review and comment on the **fairness and balance** of the study. Has the analysis supporting the report given appropriate weight to all relevant evidence, neglecting none of significance? Does the study give adequate consideration to diverse points of view and recognize the interests of minority positions? Is there any evidence of bias or partiality in the analysis and recommendations? Does the recommended policy choice emerge logically out of the careful and considered weighing of

the pros and cons of the respective alternatives?

The Council will review and comment on the **integrity of the NWMO process**. Did the process provide sufficient opportunity for public engagement? Were Aboriginal peoples, concerned stakeholders, and potentially or actually affected communities given real opportunities to make their views known? Were these views responsibly considered and appropriately taken into account? Were available sources of expertise and specialized experience sought out and utilized effectively? Were 'state of the art' processes of public consultation, ethical reflection, socio-economic analysis, technical and scientific study, financial forecasting, and impact assessment employed? Was international comparative experience adequately considered?

The Council will review and comment on the **transparency of the process**. Did the NWMO make its plans and timetable clear to the interested public? Did it share information with citizens in a timely fashion so that they had the capacity to participate effectively in the process? Did it simplify technical data and complex scientific matters honestly and effectively to assist in the development of public understanding? Did the Organization allow sufficient time for comment, input and reaction from stakeholders and the general public?

In conclusion, there is one other issue that requires comment. The legislation is silent on the question of the quantity of nuclear fuel waste that is to be managed by the recommended approach. In its examination and selection of management approaches, the NWMO will have to address the matter of capacity, and therefore of quantity. How much nuclear waste is it assumed that any given management approach will be able to handle? This question is tied to the larger policy question of the future of nuclear energy in Canada.

The Advisory Council would be critical of an NWMO recommendation of any management approach that makes provision for more nuclear fuel waste than the present generating plants are expected to create, unless it were linked to a clear statement about the need for broad public discussion of Canadian energy policy prior to a decision about future nuclear energy development. The potential role of nuclear energy in addressing Canada's future electricity requirements needs to be placed within a much larger policy framework that examines the costs, benefits and hazards of all available forms of electrical energy supply, and that framework needs to make provision for comprehensive, informed public participation.

CONTACT US

ON-LINE:

The NWMO invites all interested individuals and organizations to review our public engagement activities, discussion documents, reports and research on our website at **www.nwmo.ca**.

OR CONTACT US AT:

Nuclear Waste Management Organization
49 Jackes Avenue
Toronto, Ontario
Canada M4T 1E2

TELEPHONE:

416.934.9814

TOLL FREE:

1.866.249.6966

Design **Hambly & Woolley Inc.** www.hamblywoolley.com

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION

SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

certified

process chlorine free

100% post-consumer

permanent archival

bio gas energy

Appendix E: Commitments Made in the Initial Project Description

Commitments Made in the Initial Project Description Appendix

Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project

APM-REP-05000-0217-R000

December 2025

Prepared by: Nuclear Waste Management Organization (NWMO)

Nuclear Waste Management Organization

1. Purpose and Overview

This appendix has been prepared to consolidate and clearly present all commitments made by the Nuclear Waste Management Organization (NWMO) in the Initial Project Description (IPD). Its purpose is to supplement the conclusions outlined in the IPD and to support the potential development of Tailored Impact Statement Guidelines for the Project and risk-informed planning during the early phases of the assessment process.

The commitments have been categorised into six thematic sections, and each section provides the specific commitments associated with its respective theme:

- Baseline Data Collection Commitments (Section 2)
- Environmental Design Features (Section 3)
- Mitigation, Protection and Enhancement Measure Commitments (Section 4)
- Monitoring Commitments (Section 5)
- Reconciliation and Engagement Commitments (Section 6)
- Climate Change Commitments (Section 7)

2. Baseline Data Collection Commitments

The NWMO has already undertaken extensive and technically rigorous field programs to verify site suitability and to inform the preliminary safety assessment work that supported site selection. The results of additional work will be included in future regulatory submissions and will be completed to further support the initial licence application and the federal impact assessment process. A summary of the baseline data collection commitments is presented in Table 2-1.

Table 2-1: Baseline Data Collection Commitments

Initial Project Description Section	Commitment or Plan for Future Data Collection
14.1 Meteorological Environment	NWMO commits to continue collecting and analyzing meteorological data at the site to inform DGR design and regulatory submissions.
14.2 Geology & Geological Hazards	NWMO commits to additional data collection activities, including shallow well installation, borehole drilling, logging and testing, 3D seismic surveys, surface mapping and geophysical studies. These efforts aim to improve understanding of surficial and near-surface geotechnical conditions and bedrock fracture zones. Microseismic monitoring and seismic hazard assessments will also continue.
14.3 Geochemistry of Mined/Excavated Materials	NWMO commits to perform additional leachate testing of excavated rock and complete a testing program to confirm the non-acid generating and non-toxic nature of repository horizon rock.
14.4 Topography, Soil & Sediment	NWMO commits to complete additional studies and sampling of soil and sediment at select locations as part of ongoing site characterization.
14.5 Atmospheric, Acoustic & Visual	NWMO commits to continue the baseline air quality program, conduct seasonal baseline noise data collection, and perform campaign-based light data collection.
14.6 Groundwater & Surface Water	NWMO commits to conduct additional baseline studies for hydrogeology (including shallow well nests and long-term monitoring), continue

Initial Project Description Section	Commitment or Plan for Future Data Collection
	groundwater quality and surface water quality data collection, and maintain ongoing hydrology measurements.
14.7 Vegetation, Riparian, Wetland	NWMO commits to undertake additional field studies for rare, culturally important, and invasive plants, further characterize wetland and riparian biodiversity, and integrate environmental media data with biodiversity studies.
14.8 Fish & Fish Habitat	NWMO commits to conduct fish community surveys, benthic invertebrate studies, and further fish characterization studies to confirm important habitats and food web interactions.
14.9 Birds, Migratory Birds, Habitat	NWMO commits to conduct additional studies for migratory, upland breeding, waterbird, and raptor communities, including community-level studies for abundance, habitat use, and food web linkages using appropriate survey methods.
14.10 Terrestrial Wildlife & Habitat	NWMO commits to conduct further studies for moose and other ungulates, community surveys for carnivores, population-level studies for small mammals, and additional studies for semi-aquatic mammals, bats, amphibians, reptiles, and invertebrates as warranted.
14.11 Species at Risk (SAR) & Habitat	NWMO commits to conduct additional field studies to verify the presence and distribution of SAR and provincially rare species, confirm breeding/probable breeding, assess habitat needs, continue habitat suitability modeling.
14.13 Ambient Radioactivity	NWMO commits to continue the participatory tissue sampling program, implement a targeted campaign for representative sampling of traditional foods, continue collecting radiological parameters in environmental media, and complete geochemical analysis of naturally occurring radioactive materials in bedrock.
Section 15 Health, Social and Economic Context	NWMO commits to update or produce additional Social, Cultural, Economic, and Health Baseline studies as required by regulatory processes, through engagement with First Nation and Metis communities. Update to the Social, Cultural, Economic and Health Baseline studies could include: • Updates to include outcomes of engagement with First Nations and Métis communities. • Completing and documenting a targeted campaign for representative sampling of traditional foods. • Update population and demographic data with the 2026 Census data, once available. • Updating the infrastructure and services baseline section to reflect infrastructure planning between 2023–2027.

3. Environmental Design Features

Environmental design features are proactive measures integrated into the planning and design of the Project to prevent or minimize environmental impacts. These features are "built-in" to the Project's physical layout, engineering systems, and operational procedures. Unlike mitigation measures, which are developed and applied after the identification potential effects, environmental design features are incorporated during the initial planning and design phase, before any potential environmental effects are identified. Environmental design features form the foundation of the Project's environmental protection strategy, while mitigation measures are identified and implemented to further avoid, minimize, mitigate or offset potential effects that are identified. Table 3-1 describes key environmental design features for the Project. The environmental design features presented in Table 3-1 is not a comprehensive list but highlights key environmental design features described in the initial Project Description. The NWMO is committed to implementing environmental design features into all phases of the Project.

Table 3-1: Environmental Design Features

Environmental Design Feature	Description	Project phase
A multi-barrier system includes natural and engineered barriers to avoid the release of radioactive waste from used nuclear fuel. The multi-barrier system includes: • **Fuel cladding and ceramic used fuel pellet** • **The used-fuel containers** • **Bentonite clay buffer/seals** • **Repository sealing system** • **Engineered room-end seals and post emplacement** • **The host geosphere**	**Fuel cladding and the ceramic used fuel pellet (engineered barrier):** fuel cladding (metallic tubes) and ceramic fuel pellets act as inherent containment layers within the used fuel itself. These components resist degradation and limit radionuclide mobility, adding redundancy to the engineered containment system.	• Operations • Decommissioning and closure • Post-closure
	The used-fuel container (engineered barrier): a corrosion-resistant, copper-coated vessel designed to provide durable primary containment of radioactive material. Its robust structure ensures isolation during the operational phase and for thousands of years post-closure, significantly reducing the risk of radionuclide release.	
	Bentonite clay buffer (engineered barrier): Highly compacted bentonite blocks and granular bentonite surround containers and seal tunnels, creating a low-permeability zone that slows water ingress and chemically buffers conditions. This design minimizes corrosion and radionuclide transport, complementing both natural and engineered barriers.	
	Repository sealing system (engineered barrier): Seals made of bentonite, high-performance concrete, and other engineered materials, close placement rooms, tunnels, and shafts during closure. These structures prevent groundwater movement and maintain isolation of waste, ensuring long-term containment integrity.	
	Host geosphere (natural barrier): The host geosphere is included in the multi-barrier system because its stable geological environment provides long-term isolation and extremely slow groundwater movement, reducing the potential for contaminant migration. Its natural properties (i.e., slow permeability, geochemical buffering, and physical shielding) complement engineered barriers, ensuring safety for thousands to millions of years even after engineered barriers degrade.	
Certified transportation packages	Certified transportation packages are robust, specially engineered containers used to safely transport used nuclear fuel by road or rail from interim storage sites to the Deep Geological Repository (DGR). Each package is certified by the Canadian Nuclear Safety Commission (CNSC) and is designed to withstand severe impact, fire, and immersion, while providing radiation shielding and leak-tight containment. At the DGR, these packages are received, unloaded in shielded facilities, and then decontaminated, before being sent back to the fuel owners.	• Operations

Environmental Design Feature	Description	Project phase
Remote handling, shielding, hot cells and airlocks	In the Used Fuel Packaging Plant (UFPP), used nuclear fuel is received and handled remotely within shielded "hot cells" that are constructed with thick concrete and/or metallic walls, lead glass windows, and closed-circuit television cameras for remote viewing. Airlocks and shielding ensure that workers are protected from radiation exposure, and all fuel transfers and processing steps are performed without direct human contact, minimizing the spread of contamination and external exposure, and enhancing both worker safety and environmental protection.	• Operations
Battery-powered underground mobile fleet	All underground emplacement-related activities, such as transporting and placing used fuel containers, are planned to be performed with battery-powered vehicles. This approach reduces diesel emissions, improves underground air quality, and minimizes the environmental footprint of repository operations, supporting both worker safety and environmental protection	• Operations
Dedicated, independent ventilation circuits	These circuits provide separate airflow paths for different operational areas, specifically, one ventilation circuit serves the emplacement (operations) areas, while another serves the excavation (construction) areas. This segregation ensures that air from active excavation, which may contain dust or contaminants, does not mix with the clean air supplied to areas where used fuel containers are being emplaced, thereby enhancing worker safety and environmental protection.	• Site preparation and construction • Operations
Segregation and dedicated systems for conventional, hazardous, and radioactive wastes	Separate waste streams are maintained throughout the facility. Conventional wastes (such as construction debris and domestic refuse) are collected and managed independently from hazardous wastes (like solvents, oils, and chemicals), and both are kept entirely separate from radioactive wastes generated during fuel handling, packaging, and decontamination processes. Radioactive wastes, including low-level and intermediate-level waste, are managed using dedicated containment, storage, and treatment systems, with interim storage facilities and engineered barriers to prevent cross-contamination and ensure regulatory compliance. This segregation minimizes environmental risks, supports worker safety, and ensures that each waste type is handled, treated, and disposed of according to its specific regulatory and safety requirement.	• Site preparation and construction • Operations • Decommissioning and closure
Centralized site layout and location of linear and surface infrastructure	Surface infrastructures were intentionally designed to avoid environmentally sensitive features where possible. Sensitive areas, such as wetlands, watercourses, and habitats for species at risk have been identified through baseline and site characterization activities. The NWMO has designed the site layout to cluster or group major surface facilities, such as the Used Fuel Packaging Plant, shafts, and storage areas, within a compact footprint, minimizing land disturbance, and fuel use. Infrastructure routing, including roads, rail, and utilities, were carefully planned to use existing disturbed areas where possible and to avoid or minimize crossing sensitive features, thereby reducing potential impacts on local ecosystems and supporting environmental protection.	• Site preparation and construction

Environmental Design Feature	Description	Project phase
Reuse of overburden and excavated rock	The reuse of overburden and excavated rock is an environmental design feature that minimizes waste and reduces the need for new material extraction. During site preparation and construction, suitable overburden and rock material from excavation activities are reused for building access roads, laydown areas, and other site infrastructure, while material not suitable for reuse is managed in dedicated storage areas. This approach helps limit the project's environmental footprint and supports sustainable resource management.	• Site preparation and construction
Engineered site drainage and erosion/sediment control features	These features include perimeter ditching, collection ponds, and sediment traps designed to capture runoff, settle out solids, and prevent uncontrolled discharge to the environment, thereby protecting local water bodies and minimizing environmental impacts	• All Project phases
Site water management	NWMO proposes to establish an integrated water management system for the site to manage water from the underground and surface facilities The Project features an integrated water management system that collects, transfers, treats, discharges and monitors all contact water from surface and underground facilities. This system includes pumps, collection ponds, treatment plants, and controlled discharge infrastructure and instrumentation so that water released to the environment meets regulatory standards for the receiving environment.	• All Project phases
Emissions-control and energy-efficient systems	The project employs emissions control devices on all equipment and prioritizes energy-efficient systems, such as LED lighting and fuel-efficient machinery, to reduce air emissions and energy consumption. These measures help minimize the Project's carbon footprint and support compliance with regulatory requirements for air quality and greenhouse gas management.	• All Project phases
Acoustic controls	Acoustic controls are implemented through the use of exhaust mufflers or silencers, equipment enclosures and/or building layouts to reduce noise emissions from construction and operation activities. By enclosing or dampening noisy equipment, the Project design mitigates noise levels to minimize sensory disturbance.	• Site preparation and construction • Operations

CNSC = Canadian Nuclear Safety Commission; DGR = Deep Geological Repository; LED = light emitting diode; NWMO = Nuclear Waste Management Organization; UFC = used fuel container; UFPP = Used Fuel Packaging Plant.

4. Mitigation, Protection and Enhancement Measure Commitments

Mitigation and environmental protection measures refer to actions taken to reduce the severity of environmental effects that cannot be entirely avoided. NWMO is committed to implementing mitigation and environmental protection measures throughout the life of the Project so that any residual environmental effects are managed in accordance with regulatory requirements and best practices. Enhancement measures are proposed for positive of beneficial effects identified and are intended to enhance Project benefits or increase the likelihood they are realized.

Table 4-1 summarizes mitigation, protection and enhancement measures that have been identified in the IPD, and NWMO is committed to implementing these measures as part of the Project. The mitigation measures in Table 4-1 are included for the applicable intermediate and valued components identified in the IPD. However, mitigation measures may be applicable to mitigate effects to multiple intermediate or valued components (e.g., mitigation measures applicable to surface water quality are also applicable to fish and fish habitat).

NWMO will continue to engage with Wabigoon Lake Ojibway Nation (WLON), other Indigenous groups, the Township of Ignace and regulatory agencies on the selection and refinement of mitigation, protection and enhancement measures as the Project progresses. In addition to engagement feedback, detailed studies, modelling, and analysis will be used to define site-specific mitigation measures as the Project advances through the integrated impact assessment and licensing process, so that mitigation remains effective and responsive to new information and evolving conditions.

Mitigation, protection and enhancement measures will be documented in applicable programs and plans, such as the Environmental Protection Program within NWMO's Management System.

Table 4-1: Mitigation, Protection and Enhancement Measure Commitments

Effects to intermediate and valued components	Mitigation, Protection and Enhancement Measures	Project Phase
Air quality	Apply water or approved dust suppressants to unpaved roads, as required.	• All Project phases[(a)]
	Reduce vehicle speeds on unpaved roads	
	Maintain emissions control devices on all equipment.	
	Implement a project-specific Environmental Protection Program and Effluent and Emissions Plan, in accordance with licence requirements.	
Greenhouse gases	Limit unnecessary engine idling and reduce vehicle speeds on unpaved roads	• All Project phases
	Regularly service vehicles and heavy equipment	
	Monitor and manage energy use for efficiency.	
	Implement a greenhouse gas management plan.	
Noise, vibration and light	Follow NPC-300 for noise control	• All Project phases
	Follow NPC-119 and OPSS-120 to limit vibration	
	Outfit internal combustion engines with muffler systems	
	Maintain roads to reduce noise and vibration	
	Implement a project-specific Conventional Health and Safety Program, in accordance with licence requirements.	
Hydrogeology	Dewatering activities will be completed in accordance with provincial permitting requirements.	• Site preparation and construction
	Design, maintain, and monitor the underground dewatering system to manage groundwater inflows.	
Hydrology and surface water quality	To the extent practical, work in sensitive areas would be scheduled to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation (e.g., spring freshet).	• Site preparation and construction
	Install and maintain appropriate erosion and sediment control measures, as required.	
	Discharge treated effluent to minimize effects from changes in velocity.	• Site preparation and construction Operations
	Develop appropriate discharge flow rates and monitor treated effluent flow to address erosion concerns.	
	Monitor treated effluent and treated sewage flow and quality.	
Topography, soils and sediment	Implement applicable best management practices for excess soil management included in Province of Ontario Management of Excess Soil Guideline.	• Site preparation and construction
	Minimize areas of vegetation clearing and soil disturbance.	
	Minimize steepness and length of slopes of disturbed areas and stockpiled soils.	
	Use clearing equipment that minimizes surface disturbance, soil compaction, and topsoil loss, where feasible.	

Effects to intermediate and valued components	Mitigation, Protection and Enhancement Measures	Project Phase
	Implement progressive reclamation and revegetation of disturbed areas no longer required.	• Site preparation and construction • Operations
	Reclaim and revegetate areas where non-permanent Project facilities have been decommissioned.	
Fish and fish habitat	The NWMO will develop, prior to site preparation and construction, and implement throughout site preparation, construction, and operations, procedures to prohibit non-local NWMO employees and contractor personnel from engaging in recreational hunting, fishing, or the use of all-terrain vehicles or snowmobiles within the Project area or surrounding lands during off-duty hours.	• All Project phases
	Where possible, schedule in water activities to avoid work during DFO's Ontario Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat .	• Site preparation and construction • Operations
	Apply DFO's Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act* to minimize potential adverse effects on aquatic resources.	
	Employ construction methods that avoid or minimize the potential to cause injury or mortality to fish or disturb nearby habitats, to the extent practicable.	
	Construct in water infrastructure in adherence with the conditions of any permits or authorizations from the appropriate regulatory agencies.	
	Locate the intake screen above the bottom of the waterbody to prevent entrainment of sediment and aquatic organisms associated with the bottom area.	
	Design and install a fish screen on the freshwater intake to avoid or reduce entrainment or impingement of fish, in accordance with DFO's Freshwater Intake End of Pipe Fish Screen Guideline.	
	If required, develop a fish habitat offsetting plan consultation with DFO and engagement with WLON and other First Nations and Indigenous groups.	
Vegetation, riparian and wetland environments	Minimize areas of vegetation clearing and soil disturbance.	• Site preparation and construction
	Mark clearly with an applicable setback distance and avoid known rare plants, where feasible. Where disturbance to rare plants is unavoidable, compensation would be considered following discussion with WLON and applicable regulators.	
	Use native species or non-aggressive, non-native species appropriate for the conditions for revegetation.	• All Project phases
	Inspect construction equipment prior to arriving at site and clean, if required.	• Site preparation and construction
	Implement a Project-specific Environmental Protection Program that includes actions to avoid and limit invasive plant species, in accordance with licence requirements.	• All Project phases

Effects to intermediate and valued components	Mitigation, Protection and Enhancement Measures	Project Phase
Migratory and species at risk birds	Site preparation and construction activities that might interfere with breeding or nesting migratory birds will avoid the sensitive nesting period of mid-April through late August, to the extent possible.	• Site preparation and construction
	If site preparation and construction activities cannot be avoided during the sensitive nesting period, bird nest sweeps will be completed (by a qualified professional) to check for presence of nests and bird mating and/or nesting behaviour.	
	During applicable migratory periods, vegetation clearing will be limited. If vegetation clearing is required, nest sweeps will undertaken to avoid disruption to breeding birds.	
	Employ construction methods that avoid or minimize the potential to cause injury or mortality to migratory and/or species at risk birds or disturb nearby habitats, to the extent practicable.	
Terrestrial wildlife and wildlife habitat	Enforce speed limits and reporting procedures for wildlife collisions or observances along the access road and rail spur	• All Project phases
	If bats are observed nesting, roosting, or hibernating, do not disturb them, to the extent practicable. Contact the MECP and ECCC to discuss measures for the safe removal/relocation and to identify further measures that could prevent future access	
	If species at risk are identified, contact the MECP and ECCC to discuss measures for the safe removal/relocation and to identify further measures that could prevent future access.	
Non-Indigenous Social, Health and Environmental Conditions	Communicate transportation plans with WLON, the Township of Ignace and other local communities.	• All Project phases
	Develop and implement human resource policies (e.g., EFAP) to assist workers in finding information and referral services for family-related resources, as required.	
	Implement and enforce the Code of Conduct, provide training to staff and contractors and include confidential reporting and support mechanisms	
	Establish an Implementation Committee to provide a forum for regular communication and information exchange between the NWMO and host community and Nation for effective management of the Hosting Agreements commitments and for the early resolution of issues and/or disputes that may arise.	
	Implement benefits and conditions according to the Hosting Agreements.	

a) All phases of the Project includes site preparation and construction, operations, decommissioning and closure.
DFO = Fisheries and Oceans Canada; ECCC = Environment and Climate Change Canada; EFAP = Employee and Family Assistance Program; MECP = Ontario Ministry of the Environment, Conservation, and Parks; NWMO = Nuclear Waste Management Organization; WLON = Wabigoon Lake Ojibway Nation.

5. Monitoring Commitments

Environmental monitoring is used to verify the predicted effects and to measure compliance with future permit conditions. Monitoring is also used to identify any unanticipated effects and provide input into adaptive management to limit these effects. Typically, monitoring includes one or more of the following categories, which may be applied during the development of the Project:

- **Regulatory compliance monitoring:** monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation, conditions of approval, and NWMO commitments (e.g., inspecting the installation of a sediment and erosion control measures and monitoring the quality of water discharged from the Project). Compliance monitoring is also completed to confirm that Project activities are undertaken in ways that maintain environmental conditions within or below protective thresholds.
- **Follow-up monitoring**: programs designed to test the accuracy of effects predictions, reduce or address uncertainties, determine the effectiveness of mitigation, or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., implementation of adaptive management).

As outlined in the Initial Project Description, NWMO is making initial commitments to monitoring through the site preparation, construction, operation and decommissioning and closure phases, which are summarized in Table 5-1.

During the extended monitoring period of the Decommissioning and Closure phase, the facility would be monitored to confirm the performance and safety of the system prior to final sealing, decommissioning and closure of the repository. Extended monitoring would be conducted to confirm the long-term safety and performance of the system. In addition, some preventive maintenance might be required. Monitoring at repository depth is tentatively planned for occur over approximately 70 years. NWMO is committed to undertaking this extended monitoring; however, the scope of the extended monitoring program will be defined near the conclusion of the Operations phase, prior to submission of the Licence to Decommission application. To this end, specific monitoring commitments presented in the Initial Project Description are limited to the site preparation and construction and operations phases.

The NWMO recognizes that the Initial Project Description has presented preliminary conclusions, as the completion of the quantitative modelling to describe anticipated effects has not yet been completed. Nevertheless, there is a high level of confidence in the proposed mitigation and protection measures, which are grounded in proven practices and established regulatory standards.

Monitoring programs will be developed and refined over time, as the Project progresses through the integrated impact assessment and licencing processes. Quantitative modelling, analysis, as well as engagement activities with WLON and Ignace can influence the depth and scope of these programs. Outcomes of this analysis and engagement will inform regulatory compliance and follow-up monitoring plans and procedures, including the Environmental Monitoring Plan, part of the Environmental Protection Program within NWMO's Management System. The Environmental Monitoring Plan would be developed in accordance with applicable provincial and federal requirements, including, but not limited to Ontario's Ambient Air Quality Criteria, Federal Environmental Quality Guidelines, the federal *Fisheries Act*, and CNSC's licencing requirements.

Table 5-1: Monitoring Commitments

Intermediate and Valued Components	Monitoring Commitment	Project Phase
Air quality	Implement a Project-specific Environmental Monitoring Plan that includes monitoring of ambient air quality, as required, in accordance with licence requirements.	• Site preparation and construction • Operations
Climate change	Monitor and manage energy use for efficiency.	
Groundwater	Monitor the underground dewatering system to manage groundwater.	
	Implement a Project-specific Environmental Monitoring Plan that includes monitoring of groundwater quality, as required, in accordance with licence requirements.	
• **Hydrology** • **Surface Water Quality** • **Sediment**	Monitor treated effluent and treated sewage flow and quality.	
	Perform routine inspection and maintenance of containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment	
	Implement a Project-specific Environmental Monitoring Plan that includes monitoring of water levels and surface water quality, as required, in accordance with licence requirements.	
Topography, soils and sediment	Monitor slope stability during site preparation and construction of facilities	• Site preparation and construction
	Monitor site clearing, contouring, and excavation activities for signs of admixing, compaction, and erosion	
	Monitor soil transport and stockpiling activities for signs of erosion	
	Implement a Project-specific Environmental Monitoring Plan that includes monitoring of sediment quality, as required, in accordance with licence requirements.	• Site preparation and construction • Operations
Fish and fish habitat	Implement a Project-specific Environmental Monitoring Plan that includes monitoring of changes to fish habitat, as required, in accordance with licence requirements.	• Site preparation and construction • Operations

In addition to the NWMO's initial monitoring commitments, NWMO is also working with WLON to implement environmental monitoring. In combination with standard Project monitoring processes, Indigenous monitoring would be used to verify Project performance and to determine if mitigations and controls are effective in protecting the receiving environment.

Adaptive management measures may also be proposed to address the uncertainties associated with the effects predictions and mitigation. Adaptive management is a planned and systematic process for continual improvement of environmental management policies and practices by assessing the effectiveness and associated outcomes. Adaptive management provides a structured approach to decision making that emphasizes accountability and explicitness but also allows for flexibility to identify and implement new mitigation measures or to modify existing ones during the lifespan of a project.

Adaptive management requires careful implementation, monitoring, evaluation of results, and adjustment of objectives and practices. Where uncertainties associated with effects predictions and mitigations exist, adaptive management would be used to improve knowledge over time through an iterative process that provides the information required to increase confidence to make decisions

that reduce uncertainty and improve risk management outcomes. Actions stemming from adaptive management may include more intensive or focused monitoring, specific studies focused on better understanding of a particular change in measurement indicator and associated environmental Where monitoring identifies the need for adaptive management and modified or additional measures, the NWMO will develop and implement these as soon as feasible to mitigate adverse effects and notify WLON, the Township, the CNSC and other applicable regulatory authorities within a reasonable timeframe. The NWMO will report annually on the results of monitoring programs to WLON, the Township, and the CNSC in accordance with the Licence Conditions Handbook, confirming the effectiveness of mitigation and verifying that the Project is achieving its intended outcomes.

6. Reconciliation and Engagement Commitments

The NWMO recognizes that sustained engagement are foundational to the successful planning and implementation of the Project. Over more than two decades, the NWMO has worked collaboratively with Indigenous Nations, including the Wabigoon Lake Ojibway Nation (WLON), and with public and interested parties, to build relationships grounded in respect, trust, and transparency. The commitments outlined in the following table reflect the NWMO's ongoing journey to advance reconciliation, uphold Indigenous rights and jurisdiction, and ensure inclusive, adaptive engagement with all potentially affected communities. These commitments are through engagement with WLON, the Township of Ignace, regulatory agencies and other interested parties, and are guided by both the NWMO's Reconciliation Policy and Indigenous Knowledge Policy. Through these actions, the NWMO seeks to foster collaborative decision-making and support community well-being so that the Project is developed in a manner that honors the values, priorities, and aspirations of Indigenous and local communities, now and for future generations. Table 6-1 summarizes NWMO's reconciliation and engagement commitments for the Project documented in the Initial Project Description and will continue to evolve through collaborative dialogue and engagement with host First Nation and community, other Indigenous groups, regulatory agencies and interested parties as the Project progresses.

In addition to the commitments presented in the Initial Project Description documented in Table 6-1, the NWMO will fulfill all conditions and commitments established in its Hosting Agreements with Wabigoon Lake Ojibway Nation and the Township of Ignace, including those related to engagement, participation, and communication about the Project. Through implementation of these agreements, the NWMO will also advance commitments related to economic development, procurement, training, learning, environmental protection, monitoring, and regulatory processes.

Table 6-1: Reconciliation and Engagement Commitments

Initial Project Description Section	Commitment
Acknowledgment of Truths	The NWMO commits to build respectful relationships, and to seek the free, prior, and informed consent of impacted peoples of WLON before proceeding with development of the Project.
Acknowledgment of Truths	The NWMO will respect WLON sovereignty and will aim to align our work with Anishinaabe Values, emphasizing protection and stewardship of land, water, and all Creation and will respect their traditional governance systems.
Acknowledgment of Truths	The NWMO is on a reconciliation learning journey. The NWMO has and will continue to build on advice and guidance received from the Council of Elders and Youth and the Indigenous communities with whom it has a relationship.
Acknowledgment of Truths	The NWMO is committed to respecting the Aboriginal rights and treaties of First Nation and Métis peoples.
Acknowledgment of Truths	The NWMO will work with the Crown regarding the Crown's duty to consult and accommodate, as guided by decisions of the Supreme Court of Canada in fulfilling the NWMO's obligations under the *Nuclear Fuel Waste Act* (NFWA).
Acknowledgment of Truths	All of the NWMO's work with respect to Indigenous Peoples will be guided by Reconciliation.
v. Objectives and Overview	the NWMO is committed to a process that includes Indigenous voices, respects Indigenous rights, and supports collaboration on the Project in a manner that builds trust.
3. Building Relationships with Anishinaabe Peoples of Wabigoon Lake Ojibway Nation and Other Indigenous Groups in Canada	The NWMO will work to address the Calls for Justice, with particular attention to number 13, which pertains to extractive and development industries.
	The NWMO will continue to apply Indigenous Knowledge to both technical safety and community well-being aspects of the Project when given permission to do so by the Indigenous Knowledge holders.
3.3 Plan for Future Indigenous Engagement and Participation	The NWMO will also engage with any other Indigenous group that may be affected by the carrying out of the Project.
	In addition to the NWMO working with WLON on its Indigenous-led assessment based on its sovereign process, the NWMO will work together with WLON on the Impact Statement.
	The NWMO will seek to design and conduct communications, participation and engagement activities to reflect community-specific preferences.
4.4 Plan for Future Public and Interested Parties Engagement	The NWMO is committed to maintaining open communication and engagement with interested parties at every stage of the Project. Building on the years of engagement that have already occurred, the NWMO will extend an invitation to the public and interested parties to participate in dialogue about the Project.
	The NWMO will also hold open sessions so that members of the public who have not yet begun to engage with the NWMO can join the conversation.
	The NWMO will engage, participate or maintain dialogue with the public and interested parties to understand and implement the most suitable methods of engagement for the Project during the regulatory decision-making. The NWMO will also seek opportunities to confirm that the methods in which they are engaged remain preferable and make efforts to improve where possible.

Initial Project Description Section	Commitment
	The NWMO will provide scheduled updates on the Project and licencing and impact assessment progress to applicable regulatory agencies and will host public information sessions or events to provide information about and updates on the Project and solicit feedback on key issues and concerns.
4.6 Engagement Requirements	As a requirement of the CNSC licensing process, the NWMO will develop a Public Information Program and Disclosure Protocol in accordance with CNSC REGDOC-3.2.1, Public Information and Disclosure. The NWMO will meet all requirements as described in the regulatory documents.
	As required by the NFWA, the NWMO will actively engage on the safety of the DGR and the social and economic programs that will be developed with the host communities to address the effects of the Project.
	The NWMO will continue to involve the CNSC and other regulators in conversations with the public.
	Interests and concerns, including identification of key interests, concerns, areas of focus and how the NWMO will address them will continue to be tracked and incorporated into the design of the Project, where appropriate and feasible.
	The NWMO is committed to adapting engagement activities to accommodate interested parties' reasonable preferences, ensuring inclusivity by including GBA Plus considerations in engagement planning, and reflecting their interests effectively.
9.1 Overview	For all phases of the Project, the NWMO will work collaboratively with the host First Nation WLON to understand and uphold appropriate cultural and environmental monitoring practices, including any ceremonial requirements prior to the commencement of activities. WLON's ceremony and cultural protocols will be respected, with specific practices to be confirmed in dialogue with the Nation.
9.4 Site Preparation (Initial Licencing)	Discussions with WLON and the Ontario Ministry of Transportation (MTO) will be undertaken to confirm the best connection options at the potential intersection of Highway 17 and the access roads. Any changes to Highway 17 will be undertaken in accordance with the requirements established by the Province of Ontario.
Section 13. Biophysical Environment	The NWMO will honour its Reconciliation Policy , Indigenous Knowledge Policy and Water Statement and seek to engage with identified communities for engagement.
Section 19.1 Other Legislative Requirements and Application of Precedents	The NWMO will continue to work collaboratively with WLON and the Township of Ignace to ensure their perspectives are appropriately reflected in ongoing analyses and mitigation planning.
	Prior to site preparation, the NWMO will collaborate with WLON and the Township of Ignace to confirm the suitability of proposed mitigation measures and develop follow-up and monitoring programs.
Section 21 Potential Effects to Anishinaabe People of WLON and Other Indigenous Groups Identified in Section 3	The NWMO will continue to engage with WLON and other Indigenous groups that may be affected by the Project to understand potential pathways of impact on their environment and well-being. In

Initial Project Description Section	Commitment
Section 21.2 IPD Conclusions for Potential Effects to WLON's Anishinaabe People and Other Indigenous Peoples	The NWMO will work collaboratively with WLON and other potentially affected Indigenous groups to understand and address social determinants of health related to the Project, which could include non-negligible adverse effects to mental and physical health and effects to vulnerable Indigenous populations.
	The NWMO is committed to working in partnership with the community and in accordance with appropriate data governance protocols to ensure that Indigenous Knowledge and Indigenous subject matter expertise inform the planning and implementation of the Project.

DGR = deep geological repository; GBA Plus = Gender Based Analysis Plus; NFWA = Nuclear Fuel Waste Act; NWMO = Nuclear Waste Management Organization; REGDOC = regulatory document; WLON = Wabigoon Lake Ojibway Nation.

7. Climate Change Commitments

The NWMO is committed to advancing the Project in a manner that supports Canada's climate change objectives and ability to meet its climate change commitments.

Section 22 of the Initial Project Description provides an estimate of net greenhouse gas emissions that will be expected to result from construction and operation of the Project. The maximum annual scope 1 and 2 emissions are estimated to be 14,480 and 10,834 tonnes of carbon dioxide equivalent for the construction and operations phase, respectively. In both cases, the majority of these emissions are expected to arise from the use of the heating plant which contributes to 88 per cent and 95 per cent of the total emissions calculated for the construction and operations phases, respectively. Compared to Canada's 2023 national total, the Project's CO2e contribution is negligible while the Project's role in facilitating the use of nuclear power to reduce CO2e in Canada is considerable.

Regardless, NWMO has included commitments in the Initial Project Description to align with requirements of federal requirements and guidelines, including the Strategic Assessment of Climate Change and prioritize the implementation of best available technologies and environmental practices to reduce direct greenhouse gas emissions between start of site preparation and construction activities. Prior to operation, the NWMO shall develop and implement a Greenhouse Gas Management Plan that demonstrates how the Project will:

- prioritize the use of best available technologies and environmental practices to reduce direct and indirect GHG emissions
- identify measures to minimize reliance on offsets and enhance operational efficiency; and
- maintain consistency with the federal regulatory framework and climate policy in force at the time.

The NWMO will provide the Greenhouse Gas Management Plan to the IAAC, Environment and Climate Change Canada, and Indigenous consultation communities prior to operation.

For more information, please contact:

Nuclear Waste Management Organization
22 St. Clair Avenue East, Fourth Floor
Toronto, ON M4T 2S3, Canada
Tel.: 416.934.9814 Toll free: 1.866.249.6966
Email: contactus@nwmo.ca
Website: nwmo.ca

@nwmocanada
/company/nwmocanada

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

© 2025 Nuclear Waste Management Organization