Appendix 6.6-B

Ajax South Groundwater and Surface Water Site Investigation

AJAX PROJECT

Environmental Assessment Certificate Application / Environmental Impact Statement for a Comprehensive Study

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BGC Project Memorandum

To:	**KGHM Ajax Mining Inc.**	**Doc. No.:**	**1125-007-M03-2014**
Attention:	**Nettie Ore**	**cc:**	
From:	**Cassandra Koenig and Trevor Crozier**	**Date:**	**August 26, 2015**
Subject:	**Ajax Project EA – Ajax South Groundwater and Surface Water Site Investigation**		
Project No.:	**1125-007-02-04**		

1.0 INTRODUCTION

In accordance with the work plan and proposal submitted to KGHM Ajax Mining Inc. (KAM) on October 18, 2013 (BGC 2013a), BGC Engineering Inc. (BGC) has prepared this memorandum summarizing the 2014 groundwater and surface water investigations conducted for the Ajax project. Field work for these investigations was completed by BGC between February 11 and June 6, 2014.

The purpose of the investigation was to design and implement a baseline groundwater and surface water monitoring system to collect data during 2014 that will be used to support the Ajax project Environmental Assessment (EA). Data collected from the baseline monitoring system will be included in the baseline groundwater and surface water reports being completed for the EA. Baseline data will also be integrated into the groundwater flow model and water balance model (WBM) currently being updated as part of the EA studies.

The project general arrangement (GA) was revised in late 2013 with the relocation of proposed site facilities to the south of Jacko Lake (Ajax South Project). The 2014 investigation program was therefore designed around the new locations for the proposed open pit, the tailings storage facility (TSF) footprint, and west mine rock storage facilities (WMRSF) located south of Jacko Lake. The East and South Mine Rock Storage Facilities (EMRSF and SMRSF) were also considered in the monitoring system design.

2.0 SCOPE OF WORK

The scope of work completed as part of the 2014 site investigation included the following tasks:

- Optimized the planned locations and installations of previously selected groundwater monitoring points as defined in the scope of work (BGC, 2013a);
- Observing borehole drilling and designing and observing monitoring well installations (including borehole logging and airlift testing) for 29 installations at 17 locations;
- Development and hydraulic testing of newly installed monitoring wells;
- Installing pressure transducers in all of the new wells;
- Completing two snowpack surveys prior to the 2014 snowmelt within the Keynes Creek and Peterson Creek (Upper) watersheds;
- Establishing a streamflow monitoring station and installing streamflow gauging instrumentation (i.e., pressure transducers in still well) at Keynes Creek, and;
- Collecting manual streamflow measurements and training KGHM Ajax staff on conducting manual streamflow measurements at all of the established streamflow gauging sites.

The results of these site investigation tasks are summarized in the following sections.

3.0 OBJECTIVES AND RATIONALE

Monitoring well locations were initially selected based on the following site investigation rationale:

- To supplement baseline groundwater level data collection from the previously existing monitoring network on site around the revised arrangement of mine facilities;
- To monitor seasonal groundwater levels and vertical gradients in specific areas of interest (i.e., potential recharge and discharge zones, interpreted groundwater divides, within mapped and interpreted hydrostratigraphic units);
- To evaluate hydrogeologic conditions for siting of proposed EMRSF, SMRSF and TSF seepage and runoff collection facilities;
- To establish possible compliance and water quality monitoring locations between the proposed project and existing off-site (i.e., privately owned) domestic wells located upstream from Jacko Lake;
- To investigate soil and rock hydraulic properties below proposed dam foundations and within and/or down-gradient from the proposed TSF; and,
- To investigate the potential for regional geologic structure (i.e., the Edith Lake Fault Zone, ELFZ) to influence groundwater flow, pressures and quality.

The originally proposed locations and installations in BGC (2013a) were revised and optimized throughout the field program based on discussions with KAM staff and available archaeological, ecological and land ownership clearances. Site specific conditions and materials likely to be intersected during drilling were also considered as part of the optimization process so that the proposed monitoring rationale for the program was achieved and target aquifer(s) were intercepted. Any revisions made to the proposed network were communicated to and approved by KAM at the time field work was completed. Table 1 summarizes the final groundwater monitoring wells installed as part of the 2014 field program. The proposed monitoring rationale and completion rationale for each groundwater monitoring installation are also included in Table 1. Monitoring well locations are shown on Drawing 01; drilling and installation details are discussed in Section 3.

To obtain surface water data representative of undisturbed (i.e., existing) site conditions downstream of Jacko Lake, a streamflow monitoring station was established at Keynes Creek. Keynes Creek is a tributary watershed to Peterson Creek that will be affected by construction of the proposed TSF (Drawing 01).

4.0 2014 FIELD WORK

4.1. Borehole Drilling, Airlift Testing and Monitoring Well Installation

A total of 29 boreholes were drilled for the groundwater monitoring program at 17 locations around the proposed TSF, WMRSF, SMRSF and EMRSF footprints (Drawing 01). Drilling was completed between February 11 and March 10, 2014. Drill hole logs are provided in Appendix A. Nested (shallow and deep) completions were installed at the majority of drilling locations. The monitoring wells include either a “D” or an “S” designation that refers to either a deep (D) or a shallow (S) installation. An intermediate installation was installed at BGC14-003, which is identified with a letter “I”. Eighteen (18) of the monitoring wells were completed in bedrock and 11 monitoring wells were completed in overburden. As-built installation diagrams are provided in Appendix B. Separate boreholes were drilled for each well at all monitoring locations.

Drilling services were provided by JR Drilling Central Ltd. (JR), out of Kamloops, BC, using a dual rotary drill rig equipped with a 900 cubic feet per minute (cfm)/350psi air compressor. No drilling additives or muds were used during the drilling process. The boreholes were drilled by advancing a 152 mm (6-inch) dia. steel casing with drive shoe and tricone bit into the ground. Stratigraphic horizons were logged from drill return materials. Grab samples of drill returns were collected at approximately 1.5 m (5 ft) intervals and/or when notable changes in lithology and borehole moisture were encountered. Bedrock lithology was interpreted based on the mapping of Massey et al., (2005) and lithologies logged in previously existing drillholes near each drilling location (Table 1). Drill cutting samples were provided to KAM geologists at the end of the field program and are currently being stored on site[1]. After groundwater was encountered, airlift testing was conducted at approximately 10 to 20 m depth intervals as drilling progressed.

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[1] Logged bedrock lithology in the BGC14 boreholes should be verified by KAM geologists using the drill cuttings currently being stored on site.

Monitoring wells consisting either of 51 or 102 mm (2 or 4-inch) diameter schedule 40 PVC piping with 010-slot screens were installed into all boreholes[2]. Well screens were completed with 10/20 silica sand packs placed around the screened intervals. Final screened intervals were determined based on conditions encountered in the field; screens were either placed at the bottom of boreholes, or boreholes were backfilled to specified horizons with bentonite chips and capped by a 1 to 1.5 m (3 to 5 ft) top layer of silica sand before well screens were placed. Boreholes were filled with approximately 1.5 m (5 ft) of silica sand above well screen tops. Coated bentonite pellet seals (1.5 to 2 m or 5 to 6 ft thick) were placed above sand packs to confirm that targeted monitoring intervals were isolated. The boreholes were subsequently grouted to the ground surface using a tremie placement method and grout mixture comprised of a 10:4:1 ratio of water:cement:bentonite by weight. The steel drill casings were gradually retracted during the well installation process to facilitate sandpack, bentonite and grout placement through unstable formation materials. Various lengths of steel casing were kept in the ground to provide surface completions for the monitoring wells, together with locking well caps. The boreholes were revisited within 2 to 3 weeks following drilling and any grout settlement observed was topped up to the ground surface by placing bentonite chips between the casing and drill hole. The chips were hydrated to attain an adequate surface seal in the borehole.

Drill hole and well construction details, the proposed monitoring rationale and optimized completion rationale (as determined in the field) for each borehole are summarized in Table 1. Airlift testing results are provided in Table 2. General conditions encountered during drilling, airlift testing results, and well construction activities are described in detail in the following sections. Well locations are shown in plan on Drawing 01 and borehole log and well completion details are provided in Appendix A.

4.1.1. TSF Monitoring Wells

The TSF groundwater monitoring points consist of 15 wells installed at 8 locations around the proposed TSF footprint. The subsurface conditions encountered at these locations consisted of between 2 to 20 m of overburden overlying bedrock interpreted to belong to the Nicola Volcanics based on the bedrock geology mapped by the BCGS (Massey et al., 2005). Thicker accumulations of overburden were noted in the north near Jacko Lake and the Peterson Creek valley (i.e., in boreholes BGC14-002 and 003 at approximately 15 and 20 m, respectively).

The number of monitoring well installations and depths were adjusted based on conditions encountered in the field (i.e., observed static water levels, borehole moisture conditions, the

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[2] The majority of monitoring wells were constructed with 81 mm (2-inch) schedule 40 PVC piping. Monitoring wells installed at BGC14-004, 005, 006, 007 and 008 were installed with 102 mm (4-inch) schedule 40 PVC piping. Previous mapping and borehole data indicated that some holes would intersect high yielding fluvial/glaciofluvial deposits, thus larger diameter wells were planned to facilitate sampling these wells with a submersible pump.

degree of bedrock weathering interpreted from drill returns and drilling conditions as noted by JR). Shallow installation depths of monitoring wells around the TSF footprint varied from 3 to 20 m below ground surface (bgs), and deep installations varied from 17 to 58 m bgs. Details summarizing the rationale for monitoring well completion at specific boreholes are provided in Table 1. Groundwater inflows to boreholes through overburden were not measurable from airlift tests in the TSF footprint area. Estimated well yields to bedrock boreholes in this area ranged from less than 1 US GPM (0.06 L/s) at BGC14-016 and 017D to 4 US GPM (0.25 L/s) at BGC14-003D (Table 2).

In general, shallow monitoring well installations within overburden were completed at the first encounter with groundwater or to target moisture zones noted during drilling. A shallow completion was included at BGC14-001 despite a lack of observed moisture in the borehole. This completion was included in order to monitor potential seasonal fluctuations that may be associated with surface water. An intermediate installation was added to the program at BGC14-003 to target a confined gravel and sand layer (up to 4 m thick) noted at the base of the overburden that may be associated with the Peterson Creek Aquifer. During the grouting process of BGC14-003I, a bentonite pellet bridge formed. Approximately 37 feet of steel casing was left in the ground in order to preserve the well. The shallow installation at BGC14-012 targets a thin, saturated sand and gravel layer, approximately 1 m thick, (from 2 to 3 m bgs) overlying silt above bedrock.

Deep installations into bedrock were generally completed across observed water bearing zones, or intervals of increased weathering as interpreted from drilling-return materials (i.e., gravelly sub-rounded particles and/or evidence of oxidation). Variable degrees of bedrock weathering were noted during drilling; drill returns from bedrock encountered within BGC14-001D, 003D and 010 were unweathered to slightly weathered, whereas zones of weathered bedrock within BGC14-002D, 011D, 012D and 016 were interpreted at depths between 22 and 28 m bgs. A weathered zone within bedrock (water producing and with trace gravel in drill returns) at BGC14-011S was noted at approximately 15 m bgs. Increasing weathering with depth was noted at BGC14-017D below a depth of approximately 18 m. No water bearing zones were noted during drilling of BGC14-010. As such, a 12 m (40 ft) well screen was installed into the borehole targeting a potential zone of moisture (at approximately 47 m bgs) and the depth horizon of a nearby water body (at approximately 940 m asl).

Average water levels measured in the wells installed around the TSF footprint as of October 2014 vary from 0.9 m above ground (i.e., mild artesian conditions) at BGC14-017D to 10.4 m bgs at BGC14-001D.

4.1.2. SMRSF Monitoring Wells

Ten monitoring wells were installed into boreholes at six locations around the proposed SMRSF footprint. The overburden overlying bedrock in this area was between 11 and 24 m thick. Bedrock in some holes was interpreted to belong to the Nicola Volcanics (i.e., BGC14-007D and 015D) and the Iron Mask Hybrid Diorite (BGC14-008) based on the geologic mapping of Massey et al., (2005). As noted in the boreholes drilled around the TSF footprint, thicker accumulations of overburden were noted in the SMRSF boreholes to the north near the Peterson Creek valley. Overburden materials encountered at BGC14-007 consist of glaciofluvial sands and gravels to an approximate depth of 6 m underlain by 10 m of silty sands and silts. At BGC14-008, glaciofluvial materials are limited to approximately 3 m deep and are underlain by 21 m of gravelly silt interpreted as till. Overburden ranging between 11 and 19 m thickness consisting primarily of silts and silty sands were also noted adjacent Humphrey Creek in BGC14-013, 014 and 015. Shallow installation depths of monitoring wells around the SMRSF footprint varied from approximately 4.5 to 19 m bgs, and deep installations varied from 23 to 54m bgs.

Groundwater inflow to boreholes through overburden during drilling was generally unmeasurable around the SMRSF footprint, with a maximum estimated rate of 1 US GPM (0.06 L/s) at BGC13-013 from airlift tests. Estimated well yields to bedrock boreholes in this area ranged from 1 US GPM (0.06 L/s) at BGC14-009 to 3 US GPM (0.19 L/s) at BGC14-013 (Table 2).

Overall, overburden drilling conditions were dry to moist within the boreholes drilled around the SMRSF footprint. With the exception of BGC14-007S and BGC14-015S, shallow installations in this area targeted zones of moisture noted within overburden during drilling. Drilling conditions at BGC14-007 were dry. However, as the intent of monitoring at this location was to monitor potential bedrock/overburden gradients at the limits of the mapped Peterson Creek aquifer, a groundwater monitoring well was installed between 14 and 17 m into the silt unit at this location. At BGC14-015, saturated glaciofluvial sands and gravels were encountered at approximately 9 m bgs. A 6 m (20 ft) screen was installed from 9 to 15 m bgs at BGC14-015S to target these materials.

As with the overburden boreholes, drilling conditions at many of the deeper bedrock boreholes drilled around the SMRSF footprint were dry to moist. Deep installations into bedrock targeted zones of moisture and/or increased weathering noted during drilling. A minimal degree of weathering was interpreted from drilling and moisture conditions and cuttings recovered at BGC14-007, 008, and 015. With the exception of the saturated glaciofluvial sands noted at BGC14-015 above, drilling of the borehole for BGC14-015D (i.e., into bedrock) was dry. The bedrock at BGC14-009 was interpreted as unweathered down to approximately 48 m bgs, where moisture was noted and sub-rounded drill cuttings were noted. Zones of weathered bedrock within BGC14-014D and BGC14-013 were noted at depths of approximately 22 and 28 m bgs, respectively. The weathered zone at BGC14-014D was only slightly moist whereas the zone encountered at BGC14-013 was saturated.

Average water levels measured in the wells installed around the SMRSF footprint as of October 2014 vary from 0.8 m above ground (i.e., mild artesian conditions) at BGC14-015D to 22.8 m bgs at BGC14-007D.

4.1.3. EMRSF Monitoring Wells

Four monitoring wells were installed into boreholes at three locations around the proposed EMRSF footprint. Subsurface conditions encountered in this area consisted of 43 and 63 m of overburden at BGC14-005 and BGC14-004, respectively, and 14 m of overburden at BGC14-006. Approximately 47 m fluvial/glaciofluvial sand and gravel interpreted to belong to the mapped Peterson Creek Aquifer was encountered at BGC14-004. At BGC14-005, approximately 15 m of fluvial/glaciofluvial sand was encountered during drilling. The sand units were intercepted below 15-20 m of tills consisting of sand and silt. Subsurface conditions at BGC14-006 consisted of 14 m of alternating sands and silts, with a minor layer of sand and gravel. Bedrock around the footprint of the EMRSF footprint is interpreted to belong to the Iron Mask Hybrid Diorite based on the geologic mapping of Massey et al., (2005).

One shallow installation (i.e., BGG14-006S) was completed around the EMRSF footprint. Shallow standpipe piezometers were previously installed at two of the target drilling locations for the EMRSF (i.e., BGC13-021 near BGC14-004 and BGC14-022 near BGC14-005) as a part of a drilling program completed by BGC in 2013. Groundwater level data collected from the piezometers installed in 2013 will be paired with data collected from BGC14-004 and BGC14-005 to support the project EA. In the initial work plan (BGC, 2013a), it was proposed that BGC14-006 (planned hole ED-5) would be paired with data from monitoring wells installed into boreholes drilled as a part of companion (i.e., condemnation and/or geotechnical) drilling programs planned for 2014. BGC14-006S was added to the BGC drilling program during the optimization process, because plans for companion drilling programs were not yet available. The installation completed at BGC14-006S was screened from approximately 11 to 14 m within a silty sand unit above the bedrock contact. No measureable groundwater inflow was noted while drilling this borehole.

The installations at BGC14-004 and 005 were intended to target the mapped Sugarloaf Bedrock aquifer below the glaciofluvial sands of the Peterson Creek aquifer. The glaciofluvial sands encountered above bedrock at BGC14-004 were highly productive (i.e., estimated up to 100 US GPM (6.3 L/s) from airlift tests), whereas bedrock at the end of the hole was found to produce groundwater at approximately 4 US GPM (0.25 L/s). As no weathered zones or weathered cuttings were observed at BGC14-004 during drilling, the well was screened at the bottom of the borehole. In both BGC14-005 and BGC14-006D, water was first encountered near the bedrock contact. The screen for BGC14-005 was completed into bedrock near the bottom of the borehole, which produced groundwater at approximately 1 US GPM (0.06 L/s) when airlift tested. The screen for BGC14-006D was completed within a moist weathered zone noted between approximately 19 and 27 m bgs. Groundwater inflow to this zone is estimated at less than 1 US GPM (0.06 L/s) based on an airlift test conducted at the bottom of the borehole.

Average water levels measured in the wells installed around the EMRSF footprint as of June, 2014 vary from 7.0 m bgs in BGC4-006D m to 14.9 m bgs in BGC14-005.

4.2. Monitoring Well Development

The newly installed monitoring wells were developed between March 1 and June 5, 2014. At the request of KAM, two additional wells (KAX-14-114 and 128S) drilled by Klohn Crippen Berger Limited (KCBL) near Jacko Lake were added to the development program on May 30, 2014. Initial project scheduling delays in January due to permitting constraints (and a resultant delayed drilling start date) postponed the well development schedule to partially coincide with the spring thaw, which began in early March, 2014. This resulted in challenging and/or potentially unsafe access to many of the well sites. Access limitations combined with specific well conditions (i.e., increased sediment load and/or slow recoveries in some wells) further prolonged the well development component of the program. Well development was completed as a joint effort between BGC, KAM and Knight Piesold (KP) field staff. Daily communication between BGC, KAM and KP was maintained in order to prioritize the development of wells for the water quality sampling program (being completed by KP) and to optimize the schedule and criteria for well development completion given the above constraints.

The well development procedure involved the removal of approximately 10 well volumes of water from the boreholes. Wells that were dry after installation were not developed. Well development was conducted through gentle surging of well screens using a Waterra and footvalve with surge block pumping system. A Waterra inertial hydrolift electric pump was used to assist with actuation of tubing at the well heads. Physicochemical parameters (i.e., pH, electrical conductivity, temperature, dissolved oxygen, colour and turbidity) of the outflow water were monitored using a Horiba U-52 water quality system that was calibrated at the beginning of each shift. Depth to water was also monitored with a water level tape throughout the development process. Water removed from the monitoring wells during well development was discharged into the sumps constructed for borehole drilling.

Footvalves and surge blocks were passed fully across the well screens at least twice during the development process, raising or lowering the assembly at 0.5 to 1.0 m intervals. In wells with partially saturated screens, surging was only completed between the static water level and screen bottom. In general, surging of an interval within a well screen was considered to be complete once physicochemical parameters were stable and turbidity values were less than 250 NTU. Following the second pass of the well screen, a final “polish” was completed to remove residual sediment from the bottom of each well. This was completed by removing the surge block from the pumping assembly and purging approximately 20 L of water with the footvalve.

It was determined that 7 wells would not meet the 250 NTU criteria as a result of slow water level recovery (i.e., on the order of several days to weeks) or excessive amounts of silt within the well creating blockages in the Waterra tubing. As a result of discussions between BGC, KAM and KP about these well conditions, the development criteria were relaxed in the interest of keeping to the data collection (i.e., water quality sampling) schedule.

Monitoring wells for which criteria were relaxed included BGC14-006S, BGC14-008D, BGC14-014D, BGC14-015S, BGC14-017S, BGC14-017D and KAX-14-128S. During the development of KAX-14-128S and BGC14-006S, the Wattera tubing became clogged with sediment. Bailers were used to develop these two wells to overcome the sediment load. After removal of more than 10 well volumes of water from BGC14-014D, BGC14-015S and BGC14-017D, the turbidity of water removed was still greater than 250 NTU. However, the field measured chemical parameters were stable and well development was considered complete; dissolved and total metals concentrations for samples collected from these wells will need to be interpreted carefully.

Wells BGC14-004 and BGC14-008D may be contaminated with grout, both wells have elevated pH values (i.e., 11.28 and 13.46, respectively) and the water recovered was cloudy or light grey. BGC14-008D and BGC14-017S were found to recover very slowly and it was not practical to continue development at these monitoring wells.

A summary of well development observations is provided in Table 3.

4.3. Well Response Tests

Well response (i.e., falling and rising head) tests were completed in the monitoring wells between March 5 and June 6, 2014 to assess the hydraulic conductivity of the saturated materials intersected by the well screens. Tests were completed as soon as possible following well development and/or water quality sampling, depending upon schedule priority as noted above. Well response tests were also completed in the two wells installed by KCB (noted in Section 3.2), at the request of KAM.

Rising and falling head tests were conducted in the majority of wells using solid slugs constructed of 0.04 m (1.5-inch) or 0.05 m (2-inch) diameter PVC pipe filled with sand and capped at both ends. Water level recovery was monitored using data loggers and a water level tape. Both falling head (FH) and rising head (RH) tests were carried out in each of the wells tested with solid slugs. The slugs were de-contaminated using phosphate-free detergent and tap water, and subsequently rinsed with de-ionized water before test initiation at each well.

Single rising head hydraulic tests were conducted in a number of wells (i.e., BGC14-006S, 008D, 014D, 015S, 017S and 017D) due to long water level recovery times. Single rising head tests were initiated between May 28 and June 1, 2014 and involved bailing between 9.5 and 95 L (2.5 and 25 USG) of water from the PVC well casings. Water level recoveries were monitored both manually and with dataloggers for the first hour following test initiation. Longer term recovery data were collected using dataloggers, which were retrieved from the wells between two and 28 days following the tests. As the recovery time for the water level in BGC14-008D was expected to take several weeks, rising head test data were not available immediately after water was bailed from this well. Rising head test data for BGC14-008D was provided to BGC by KGHM field staff in July, 2014. .

Well response tests were not completed in BGC14-001S, 007S, 007D, 008S and 014S as these wells were dry (or water levels were near the well screen bottom) during the field monitoring program. A slug test was completed in KAX-14-128S on June 6, 2014. Datalogger measurements were corrected for fluctuations in barometric pressure recorded by transducers located at the well heads. Test results are discussed in Section 4.1.

4.4. Datalogger Installations into Groundwater Monitoring Wells

Solinst-brand pressure transducers were deployed at all of the newly installed groundwater monitoring wells to collect groundwater levels at a set frequency during the baseline monitoring period. Loggers were deployed between approximately 2 and 8 m below static water levels with the wells and programmed to collect synchronous measurements with the transducers installed within the existing network on site (i.e., 4 times per day at 6AM, 12PM, 6PM and 12AM). Loggers were also installed at monitoring wells BGC14-001S, 007S, 007D, 008S and 014S, which were dry at installation. The rationale for deploying loggers at dry locations was to monitor potential interactions with surface water following snowmelt. Datalogger deployment details are summarized in Table 4. The Solinst Levelogger Manual is included in Appendix C.

4.5. Snowpack Surveys

BGC conducted snow surveys in the Keynes Creek watershed and upper watershed of Peterson Creek on two separate dates: February 26-27, 2014 and March 18-19, 2014. The objective of the snow survey was to measure snow water equivalence (SWE) at distributed locations in the two watersheds. The snow survey of February 26-27, 2014 was restricted to the Keynes Creek watershed, as the Upper Peterson Creek watershed was inaccessible (the access road was impassable by snowmobile due to fallen trees). The subsequent survey included Upper Peterson Creek, but much of the snow in Keynes Creek had melted by this point. Measured SWE on the two survey dates is summarized in Table 5. For the February survey, snow was observed to be often missing on south facing slopes and the tops of hills and deepest in valley bottoms on north aspects. A wind slab had formed on most aspects and the snowpack was faceted below. Average SWE observed in the Keynes Creek watershed in February was 66 mm, although this value does not account for snow-free areas in the watershed. Further discussion of snow-free areas is provided in BGC (2015).

4.6. Streamflow Measurements and Establishment of Gauging Stations

There are five (5) streamflow gauging stations located at Ajax:

- JACINF – Monitors the primary inflow to Jacko Lake (Peterson Creek) and provides a record of natural unregulated flows in the study area.
- JACLAKE – Monitors the water level in Jacko Lake and flow over the spillway, if there is any.
- PETER – Monitors the flows in Peterson Creek downstream of Jacko Lake, and includes flows from JACLAKE and JACSEEP.

- JACSEEP – Monitors the seepage and low level outlet release from Jacko Lake through the earth-fill embankment (flows from JACLAKE and JACSEEP combine to give an indication of the total flows leaving Jacko Lake).
- KEYNES – Established near the mouth of Keynes Creek in 2014 by BGC to evaluate runoff from the proposed TSF watershed. Keynes Creek is at a significantly lower average elevation than JACINF, therefore it will be used to evaluate runoff for the small, lower elevation tributaries around the proposed mine site.

With the exception of KEYNES, manual streamflow measurements were completed at the gauging stations by KP from 2008 to 2011. These measurements were used to generate rating curves for each of the stations, which is a fixed relation between water level and discharge at a point in a stream. The rating curves allow the water levels measured by the station pressure transducers to be converted to streamflow. The primary means of measuring discharge employed by KP was the velocity-area method. However, the frequent occurrence of extremely low flows required the use of the volumetric method also. With this method, streamflow is measured by recording the volume of water entering a container over a set period of time. KEYNES had not been established as a gauging station at the time of KP's data collection.

In 2014, BGC and KAM staff continued the streamflow measurements. During the period from May to October 2014, eleven measurements were taken at PETER and JACINF, nine at JACLAKE, and five at KEYNES. A majority of the streamflow measurements were taken with an OTT MF Pro current meter. This current meter automatically calculates discharge and its electromagnetic sensor head is ideal for use in low-flow environments. Streamflows in KEYNES were minimal throughout this period, as such only the volumetric method was employed at this station. No measurements were taken at JACSEEP in 2014, as the lake was overflowing through the spillway through much of the summer and as such, the low level outlet was not operating.

BGC installed dataloggers in March 2014 at each of the gauging stations. The loggers were programmed to collect measurements at 10 minute intervals. With the exception of KEYNES, the loggers installed at all stream gauging stations are Solinst-brand Leveloggers. A HOBO® data logger and barometric logger were installed at the KEYNES station. Logger installation details are included in Table 4. Each station is also equipped with a fully surveyed one meter staff gauge plate, within a stable gauging pool. These were installed by BGC in March 2014 at KEYNES and by KP in August 2008 at the other four stations (Photos 01 to 05). Loggers were downloaded by BGC staff on May 6, 2014 and by KAM staff at regular intervals the remainder of the year. The Solnist Levelogger Manual is provided in Appendix C and the Hobo data logger manual is in Appendix D. The OTT MF pro manual is provided in Appendix E.

The Solinst and HOBO® pressure transducers are non-vented. Therefore, both water and atmospheric pressure are recorded by the dataloggers, and the resulting water levels need to be corrected for atmospheric pressure. The barometric logger installed at KEYNES will be used for this correction.

5.0 ANALYSIS AND RESULTS

5.1. Well Response Tests

The guidelines for analyses of slug tests prescribed by Butler (1998) were used to help select the appropriate analytical method for interpretation of well response data. In general, the KGS (Hyder et al., 1994) unconfined solution for wells screened below the water table was used to estimate hydraulic conductivity (K) and, where appropriate, the aquifer storage coefficient (S), (i.e., in cases where S was not implausibly low for the materials being tested). The Hvorslev (1951) unconfined method was used to estimate K from test data where a reasonable match to the KGS (1998) solution could not be obtained. The Cooper et al., (1967) analytical solution for a confined aquifer was used for the analysis of test data from monitoring wells BGC14-015S, 015D, 017S and 017D, as these wells are artesian.

The results of the analyses are summarized in Tables 6 and 7 together with logged geology and the interpreted hydrostratigraphic unit (HSU) of screened intervals. Type curve fits to test data are provided in Appendix F.

With the exception of BGC14-012S (which is interpreted to be screened within colluvium), the best fit values for K estimated at the Ajax South monitoring wells fall within the range of previously compiled estimates for similar materials in the project area (BGC (2013b) and Table 7). Table 7 shows that:

- The geometric mean K value estimated for the Nicola Group (8E-08 m/s) is slightly lower than values from previously compiled results (1E-07);
- The geometric mean K value estimated for fluvial/glaciofluvial sands (3E-06 m/s) is lower than values from previously compiled results (2E-05 m/s);
- The geometric mean K values estimated for the Iron Mask Hybrid (2E-07 m/s) is slightly higher than values from previously compiled results (6E-08 m/s), and;
- The geometric mean K value estimated for the glacial till deposits (1E-07 m/s) is similar to the value from previously compiled results (2E-07 m/s).

The above values are considered acceptable estimates of K as each is within the range of standard values reported by Freeze and Cherry (1979) for the respective material types. Previous estimates for colluvium or lacustrine deposits in the project area are not available; however a value of 9E-04 m/s is considered acceptable for colluvium (i.e., at BGC14-012S) and a value of 1E-07 m/s is considered acceptable for lacustrine deposits (i.e., in the upper component of the screened materials logged by KCBL in KAX-14-128S) based on standard values for these types of materials (Freeze and Cherry, 1979).

The range of best estimates for S from the well response tests, along with previously compiled S estimates are also provided in Table 6. Previous estimates of S at the site are limited to values calculated from the results of the pumping test conducted at the west side of the proposed pit and north west from Jacko Lake (BGC, 2011) and best fit estimates to hydraulic head data in the numerical groundwater model developed for the project feasibility study (FS). Table 7 shows that:

- The geometric mean of S values estimated from test data collected from the current program for the Nicola Group (2E-04 m^{-1}), the Iron Mask Hybrid unit (8E-05 m^{-1}) and for glacial till deposits (3E-03 m^{-1}) are higher than geometric mean values from previously compiled results (1E-06, 1E-06 and 1E-08 m^{-1}, respectively), and;
- The S value estimated from test data conducted as part of the current program at BGC14-003I (2E-05 m^{-1}), is lower than the estimated value for glaciofluvial deposits from previously compiled results (1E-04 m^{-1}).

Estimates of S values were not obtained for colluvium or lacustrine deposits (i.e., from test data at BGC14-012S and KAX-14-128S) due to the uncertainty with fitting the analysis type curves to the test data.

With the exception of the S value obtained for BGC14-003I, the above estimates are above the range of representative specific storage values reported by Maidment (1993) for various sediment or rock types (i.e., 1E-5 to 1E-07 m^{-1} for igneous and metamorphic rocks as well as for compacted sediments). These results should therefore be interpreted with caution and verified against aquifer test data that may become available in the future.

5.2. Edith Lake Fault Zone Wells

With the revised project layout that includes positioning the TSF near to, and upgradient from the interpreted surface expression of the ELFZ, some investigation of the hydraulic character of this fault is warranted to support the EA. Therefore, part of the rationale for installing monitoring wells BGC14-001S/D, 002S/D, 013 and 015S/D was to collect data to assist with evaluations of the existing and potential hydraulic effect(s) of the ELFZ on the adjacent groundwater flow system.

The well locations were planned based on regional mapping of the ELFZ by the British Columbia Geological Survey (Logan and Mihalynuk, 2005). Monitoring wells BGC14-002S/D and 015S/D were installed on the hanging wall (HW) side and BGC14-001S/D and 013 were installed on the foot wall (FW) side of the mapped trace of the fault. The purpose of installing wells on either side of the mapped trace of the fault was to investigate potential differences in hydrogeology on either side of the feature (e.g., significant differences in geology, degrees of weathering, hydraulic conductivity, groundwater levels, hydraulic gradients, and/or water quality) that could influence groundwater flow in the area. A summary of the observations made during the site investigation and groundwater data collected to date for these wells is provided in Table 8. Based on this information, the following observations are made:

- Estimated yields from wells installed on the FW side (i.e., wells BGC14-001D, 001S and 013) range from 2.4 to 3.2 US GPM (0.15 to 0.20 L/s);

- Estimated yields from airlift tests in wells installed on the HW side (i.e., wells 002S, 002D 015S and 015D) were low (0.8 US GPM or 0.05 L/s in BGC14-002D) or unmeasurable
- The K values estimated at wells installed into bedrock around the mapped trace of the fault near the TSF (BGC14-001D and 002D at 2E-06 and 4E-06 m/s, respectively) are higher than the K values estimated at wells installed into bedrock around the mapped trace of the fault near the SMRSF (BGC14-013 and 015 at 2E-08 and 9E-09 m/s, respectively);
- Hydraulic conductivity does not appear to be dependent on location relative to the fault zone (i.e. K is similar on both the FW and HW sides of the fault), and;
- During drilling of monitoring wells BGC14-002D and 013, distinct yellowish-brown coloured drill cuttings were noted coincident with softer drilling conditions, potentially indicating horizons of preferential weathering or gouge associated with the ELFZ. In BGC14-002D this zone was encountered at approximately 20 m bgs (or 904 m asl) and at approximately 29 m bgs (or 962 m asl) in BGC14-013.

The above observations do not provide conclusive evidence that the ELFZ is present and was intersected by the groundwater monitoring wells; however, these observations may indicate the presence of gouge and/or more advanced weathering associated with a fault structure(s). Detailed mapping and intrusive site investigations to evaluate the presence/absence and, if present, the orientation, thickness and hydraulic character of the fault were recommended by BGC in 2014. Preliminary structural mapping work was completed around the fault trace in the fall of 2014 and geotechnical drilling around the fault trace under the direction of BGC is planned for 2015. The results of these investigations have been provided to KAM under separate cover.

5.3. Monitoring Wells Near or Within the Peterson Creek Aquifer

Several boreholes in the drilling program were planned to target the Peterson Creek Aquifer partially with the intent of delineating the aquifer thickness near the southern extent (near the SMRSF footprint) as well as to the northern extent (near the EMRSF footprint) of its mapped limits. These boreholes include BGC14-007D/S and 008D/S in the south and BGC14-004 and 005 in the north.

In the south, only shallow (i.e., within 6 m bgs) and thin (2-3 m thick) accumulations of sand potentially associated with the Peterson Creek Aquifer were intercepted at BGC14-007D/S and 008D/S. An installation was not completed within these materials at BGC14-007S because drilling conditions were dry. BGC14-008S was screened within these materials for monitoring of vertical gradients.

In the north, BGC14-004 and 005 encountered 63 and 43 m thicknesses of saturated aquifer sands, respectively. Both wells were screened within the bedrock below the sand and gravel aquifer, to be monitored in conjunction with shallower wells previously installed by BGC at these locations (i.e., BGC13-021 at BGC14-004 and BGC13-022 at BGC14-005).

6.0 SUMMARY OF DATA COLLECTION FOR BASELINE ASSESSMENTS

6.1. Groundwater Level Monitoring

Groundwater levels (manual measurements and data downloads) from the Ajax South monitoring wells were collected by KAM field staff on 3 occasions in 2014 (i.e., mid-February, mid-August and early October). Manual measurements and data downloads were provided to BGC in electronic format following each monitoring event. Upon receipt of the data, BGC completed quality assurance/quality control (QA/QC) reviews of the data to identify general instrument maintenance needs and actively troubleshoot with KAM field staff through the baseline data collection period to ensure these needs are met. Following each QA/QC review, data were integrated into BGC's existing database for the project for use in numerical groundwater flow model updates and baseline groundwater quantity assessment. As per the approved scope of work, groundwater level data synthesis and compilation for the BGC14-series monitoring wells will be completed and included in the hydrogeology baseline report.

6.2. Surface Water Monitoring

Flow measurements were collected twice a month by KAM staff until the beginning of October 2014. Data were downloaded from all loggers at gauging stations at this time. These logger data and manual streamflow measurements were sent electronically to BGC for incorporation into the baseline hydrology and water balance modeling studies being completed for the EA. As per the approved scope of work, data synthesis and compilation for all of the streamflow gauges will be completed and included in the surface water baseline report.

7.0 CLOSURE

BGC Engineering Inc. (BGC) prepared this document for the account of KGHM Ajax Mining Inc. (KAM). The material in it reflects the judgment of BGC staff in light of the information available to BGC at the time of document preparation. Any use which a third party makes of this document or any reliance on decisions to be based on it is the responsibility of such third parties. BGC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this document.

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Yours sincerely,

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REFERENCES

BGC (2011), Ajax Project Feasibility Study - Prototype Dewatering Well and Pumping Test. Report prepared by BGC Engineering Inc. for Abacus Mining and Exploration Corporation, dated September 10, 2011, Doc. No.:0712-003-M01-2011.

BGC (2013a) Proposal for Groundwater Program Design, Ajax Project. Dated October 18, 2013, 39p.

BGC (2013b), Ajax Copper/Gold Project - Baseline Groundwater Hydrology Assessment Final Report. Report prepared by BGC Engineering Inc. for KGHM Ajax Mining Inc., June 28, 2013.

BGC (2013c), Ajax Water Balance Model - DRAFT, Project Memorandum in draft.

BGC (2015), Ajax Project 2014 Streamflow Monitoring Report - DRAFT. Report prepared by BGC Engineering Inc. for KGHM Ajax Mining Inc., dated March 19, 2015.

Butler, J. J. (1998), The Design, Performance and Alalysis of Slug Tests. Lewis Publishers, CRC Press, Florida, 252 p

Freeze, R. A., and J. A. Cherry (1979), Groundwater, 2nd ed., 604 pp., Prentice Hall, New Jersey.

Hvorslev, M. J. (1951), Time lag and soil permeability in Ground-Water Observations, edited, p. 50, Waterways Experiment Station, U.S. Army Corps of Engineers, Vicksburg.

Hyder, Z, J.J. Butler, Jr., C.D. McElwee and W. Liu, 1994. Slug tests in partially penetrating wells, Water Resources Research, vol. 30, no. 11, pp. 2945-2957.

Knight Piesold (2013), Ajax Project 2012 Hydrometeorology Report, Report prepared by Knight Piesold for KGHM Ajax Mining Inc., dated March 12, 2013.

Logan, J. M., and M. G. Mihalynuk (2005), Porphyry Cu-Au deposits of the Iron Mask batholith, Southeastern British Columbia, Geological Fieldwork 2004 – Paper 2005-1, B.C. Geological Survey.

Maidment, R. (1993), Handbook of Hydrology, 1400 pp., McGraw-Hill.

Massey, N. W. D., D. G. MacIntyre, P. J. Dejardins, and R. T. Cooney (2005), Digital geology map of British Columbia, *B.C. Ministry of Energy, Mines, and Petroleum Resources, Geological Survey Branch Open File 2005-2*.

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TABLES

Table 1. Summary of 2014 Ajax South Monitoring Well Installations.

Location	Well ID	Proposal Hole ID	Easting (m)[1]	Northing (m)[1]	Ground Elevation (m asl)[1]	Hole Depth (m bgs)	Depth to Bedrock (m bgs)	Screen Bottom (m bgs)	Screen Top (m bgs)	Sandpack Bottom (m bgs)	Sandpack Top (m bgs)	PVC Stickup (m ags)	PVC Dia (in)	Target Hydrostratigraphy (HSU)	Logged Lithology at Well Screen	Interpreted HSU Based on Mapping and Log data[3]	Proposed Monitoring Rationale	Optimized Completion Description
TSF	**BGC14-001D**	T-2	682286	5608796	934	29.6	5.2	24.1	18.0	24.7	17.1	0.83	2	Nicola Volcanics	Bedrock (Nicola Volcanics)	Nicola Group	Potential GW discharge location; compliance monitoring and evaluations for seepage collection/interception down gradient of TSF; evaluate GW levels and on ELFZ foot wall.	6 m (20 ft) screen installed from 18 to 24 m (60 to 80 ft) bgs to target potential permeable zone within bedrock below static water level.
TSF	**BGC14-001S**	T-2	682286	5608796	934	6.4	5.5	5.5	4.0	6.4	3.7	0.84	2	Till/Undivided deposits	Silt, sand and gravel (Fluvial/Till)	Glacial Till Deposits	Potential GW discharge location; compliance monitoring and evaluations for seepave collection/interception down gradient of TSF; Evaluate GW levels and quality on ELFZ foot wall.	Dry well, however, 1.5 m (5 ft) screen installed above bedrock to target zone of gravel and potential surface water interactions. Monitor well with datalogger to determine whether gravel zone becomes saturated over the course of the year.
TSF	**BGC14-002D**	T-3	682756	5608900	923	29.9	15.2	22.9	16.8	23.8	15.9	0.73	2	Nicola Volcanics	Weathered Bedrock (Nicola Volcanics)	Nicola Group	Potential GW discharge location; compliance monitoring and evaluations for seepave collection/interception down gradient of TSF; Evaluate GW levels and quality on ELFZ hanging wall.	6 m (20 ft) screen installed into bedrock, targeting two moisture zones. Target roughly coincides with creek level.
TSF	**BGC14-002S**	T-3	682756	5608900	923	15.7	15.2	15.2	9.1	15.7	8.5	0.85	2	Till/Undivided deposits/Fluvial/Glaciofluvial	Silt with gravel, trace sand and clay (Till)	Glacial Till Deposits	Potential GW discharge location; compliance monitoring and evaluations for seepave collection/interception down gradient of TSF; Evaluate GW levels and quality on ELFZ hanging wall.	6 m (20 ft) screen installed into silt targeting moisture zones noted during drilling.
TSF	**BGC14-003D**	T-4	683544	5608858	896	32.3	22.0	31.4	28.4	32.3	26.2	1.20	2	Nicola Volcanics	Bedrock (Nicola Volcanics)	Nicola Group	Vertical hydraulic gradients and water level fluctuations in potential GW discharge location.	3 m (10 ft) screen installed into bedrock targeting bedrock interactions with overburden aquifer system.
TSF	**BGC14-003I**	NA	683544	5608858	896	22.0	20.1	19.8	16.8	20.4	15.5	0.82	2	N/A	Gravel and sand (Fluvial/Glaciofluvial)	Fluvial and Glaciofluvial Sands	Vertical hydraulic gradients and water level fluctuations in potential GW discharge location.	3 m (10 ft) screen installed into confined gravel and sand layer, for potential interactions with Peterson Creek Aquifer
TSF	**BGC14-003S**	T-4	683544	5608858	896	11.3	-	11.3	9.8	11.3	9.1	0.80	2	Fluvial/Glaciofluvial	Silt (Till)	Glacial Till Deposits	Vertical hydraulic gradients and water level fluctuations in potential GW discharge location.	1.5 m (5 ft) screen installed in silt unit, targeting shallow system and interactions with surface water.
TSF	**BGC14-010**	T-9	681730	5607414	978	78.3	11.0	58.2	46.0	59.7	44.2	0.89	2	Till/Undivided deposits	Bedrock	Nicola Group	Compliance monitoring and evaluations for seepage collection/interception down gradient of TSF.	Groundwater not encountered within overburden. 12 m (40 ft) screen installed from 46 to 58 m (157 to 197 ft) bgs into bedrock targeting zone of moisture at approx. 47 m bgs and depth horizon of nearby water body at approx. 57 m bgs.
TSF	**BGC14-011D**	T-5A	682796	5605945	1027	29.6	5.5	29.6	23.5	29.6	22.6	0.88	2	Till/Undivided deposits/Fluvial/Glaciofluvial	Bedrock	Nicola Group	Vertical hydraulic gradients and water level fluctuations in potential GW divide location.	6 m (20 ft) screen installed into weathered zone of bedrock containing trace gravel in drill returns.
TSF	**BGC14-011S**	T-5A	682796	5605945	1027	18.3	5.5	18.3	15.2	18.3	14.3	0.91	2	Till/Undivided deposits/Fluvial/Glaciofluvial	Weathered Bedrock (Nicola Volcanics)	Nicola Group	Vertical hydraulic gradients and water level fluctuations in potential GW divide location.	3 m (10 ft) screen installed into weathered bedrock from 15 to 18 m (50 to 60 ft) bgs at first encounter with GW, targeting 2 GPM water producing zone.
TSF	**BGC14-012D**	T-1	681950	5608373	924	29.6	5.2	25.0	20.4	26.2	19.2	0.91	2	Nicola Volcanics	Bedrock (Nicola Volcanics)	Nicola Group	Potential GW discharge location; compliance monitoring and evaluations for seepage collection/interception down gradient of TSF.	4.5 m (15 ft) screen installed over first encounter with water in bedrock. Screen targeting oxidized and potentially high permeability and weathered zone.
TSF	**BGC14-012S**	T-1	681950	5608373	924	3.4	-	3.4	2.7	3.4	2.1	0.89	2	Colluvium	Gravel and sand (Glaciofluvial)	Colluvium	Potential GW discharge location; compliance monitoring and evaluations for seepage collection/interception down gradient of TSF.	0.6 m (2 ft) screen installed into sand and gravel and first encounter with water in overburden. Monitoring for potential surface water interactions within shallow sand and gravel. Screened unit is underlain by silt, water possibly perched.
TSF	**BGC14-016**	SD-6	685348	5607041	1038	29.6	1.8	29.6	23.5	29.6	22.6	0.89	2	Nicola Volcanics	Bedrock	Nicola Group	Potential GW discharge zone from TSF to SMRSF; evaluations for SMRSF seepage and runoff collection facilities.	6 m (20 ft) screen instaled into bedrock upon first encounter with GW.
TSF	**BGC14-017D**	T-4A	685540	5605928	1038	29.6	4.0	29.6	23.5	29.6	22.6	0.91	2	Colluvium/Till	Bedrock	Nicola Group	Compliance monitoring and evaluations for seepage collection/interception down gradient of TSF.	6 m (20 ft) screen installed in weathered bedrock zone targeting zones of moisture.
TSF	**BGC14-017S**	T-4A	685540	5605928	1038	5.2	4.6	4.6	3.0	5.2	2.7	0.89	2	Colluvium/Till	Silt (Till)	Glacial Till Deposits	Compliance monitoring and evaluations for seepage collection/interception down gradient of TSF.	1.5 m (5 ft) screen installed in colluvium/till, targeting moisture zones.

Table 1. Summary of 2014 Ajax South Monitoring Well Installations.

Location	Well ID	Proposal Hole ID	Easting (m)[1]	Northing (m)[1]	Ground Elevation (m asl)[1]	Hole Depth (m bgs)	Depth to Bedrock (m bgs)	Screen Bottom (m bgs)	Screen Top (m bgs)	Sandpack Bottom (m bgs)	Sandpack Top (m bgs)	PVC Stickup (m ags)	PVC Dia (in)	Target Hydrostratig-raphy (HSU)	Logged Lithology at Well Screen	Interpreted HSU Based on Mapping and Log data[3]	Proposed Monitoring Rationale	Optimized Completion Description
SMRSF	**BGC14-007D**	SD-1	685324	5608722	924	29.6	24.4	29.6	26.5	29.6	25.9	0.76	4	Nicola Volcanics	Bedrock (Nicola Volcanics)	Nicola Group	Vertical hydraulic gradients between Peterson Creek Aquifer and underlying bedrock; evaluations for SMRSF seepage and runoff collection facilities.	Dry well, however, 3 m (10 ft) screen installed into bedrock targeting potential bedrock aquifer system. Monitor well with datalogger to understand if gravel zone becomes saturated over the course of the year.
SMRSF	**BGC14-007S**	SD-1	685324	5608722	924	17.4	-	17.4	14.3	17.4	12.8	0.89	4	Fluvial/Glaciofluvial or Till (Peterson Creek Aquifer)	Silt with gravel (Till)	Glacial Till Deposits	Vertical hydraulic gradients between Peterson Creek Aquifer and underlying bedrock; evaluations for SMRSF seepage and runoff collection facilities.	Dry well, however, 3 m (10 ft) screen installed into colluvium/till an increased gravel zone. Glaciofluvial sediments limited to top 2.5 m of borehole. Monitor well with datalogger to understand if gravel zone becomes saturated over the course of the year.
SMRSF	**BGC14-008D**	SD-2	686107	5608923	877	29.6	15.9	29.6	26.5	29.6	25.0	0.81	4	Iron Mask Hybrid Diorite	Bedrock (Iron Mask Hybrid)	Iron Mask Hybrid	Potential GW discharge zone; vertical hydraulic gradients between Peterson Creek Aquifer and underlying bedrock; evaluations for SMRSF seepage and runoff colection facilities.	3 m (10 ft) screen installed into bedrock targeting potential bedrock aquifer system.
SMRSF	**BGC14-008S**	SD-2	686107	5608923	877	6.1	-	6.1	4.6	6.1	3.7	0.86	4	Fluvial/Glaciofl-uvial (Peterson Creek Aquifer)	Sand and gravel (Glaciofluvial)	Fluvial and Glaciofluvial Sands	Potential GW discharge zone; vertical hydraulic gradients between Peterson Creek Aquifer and underlying bedrock; evaluations for SMRSF seepage and runoff colection facilities.	1.5 m (5 ft) screen installed in zone of moisture within gravel unit, targeting shallow system and interactions with surface water.
SMRSF	**BGC14-009**	SD-3	686799	5608547	901	54.0	4.0	54.0	47.9	54.0	46.9	0.89	2	Iron Mask Hybrid Diorite	Bedrock (Iron Mask Hybrid)	Iron Mask Hybrid	Water level fluctuations in slope; evaluations for SMRSF seepage and runoff collection facilities.	6 m (20 ft) screen installed into bedrock targeting zone of moisture (possible fracture zone).
SMRSF	**BGC14-013**	SD-5	686466	5606777	984	30.5	11.3	30.5	27.4	30.5	26.5	0.75	2	Nicola Volcanics	Weathered Bedrock	Nicola Group	Evaluate GW levels and quality on ELFZ foot wall.	3 m (10 ft) screen installed into bedrock targeting highly weathered zone with silty, clayey, yellowish brown drill returns, with highest yield in hole (2.7 GPM).
SMRSF	**BGC14-014D**	SD-4A	686672	5607810	984	29.6	18.9	29.6	23.5	29.6	22.6	0.89	2	Nicola Volcanics	Weathered Bedrock	Nicola Group	Vertical hydraulic gradients and water level fluctuations in slope; seepage water quality.	6 m (20 ft) screen installed into moderately weathered bedrock, targeting moisture zones encountered near end of borehole ("breaks in dust" described by driller).
SMRSF	**BGC14-014S**	SD-4A	686672	5607810	984	18.9	-	18.9	12.8	18.9	12.2	0.89	2	Till/Undivided deposits or Fluvial/Glaciofluvial	Silt, sand and trace gravel (Till)	Glacial Till Deposits	Vertical hydraulic gradients and water level fluctuations in slope; seepage water quality.	6 m (20 ft) screen installed into silt unit, targeting zones of moisture. Glaciofluvial materials in hole limited to 3 m bgs at this location.
SMRSF	**BGC14-015D**	SD-4	686773	5606920	976	29.6	11.6	29.6	23.5	29.6	22.3	0.94	2	Nicola Volcanics	Bedrock (Nicola Volcanics)	Nicola Group	Evaluate GW levels and quality on ELFZ hanging wall; seepage water quality monitoring well down gradiend from SMRSF.	6 m (20 ft) screen installed into bedrock targeting moisture zones encountered near end of borehole ("break in dust" described by driller).
SMRSF	**BGC14-015S**	SD-4	686773	5606920	976	11.3	-	11.3	8.2	11.3	7.6	0.89	2	Fluvial/Glaciofluvial or Till	Sand with trace silt to silty (Glaciofluvial)	Glacial Till Deposits	Evaluate GW levels and quality on ELFZ hanging wall; seepage water quality.	6 m (20 ft) screen installed into gravel and sand, targeting saturated materials.
EMRSF	**BGC14-004**	ED-1	687746	5609526	869	78.3	63.7	78.3	72.2	78.3	68.3	0.86	4	Iron Mask Hybrid Diorite (Sugarloaf Bedrock Aquifer)	Bedrock	Iron Mask Hybrid	Vertical hydraulic gradients between Peterson Creek Aquifer and underlying Sugarloaf Hill Bedrock Aquifer.	6 m (20 ft) screen installed into bedrock, targeting mapped Sugarloaf bedrock aquifer. Data from this location will be paired with data collected from BGC13-021.
EMRSF	**BGC14-005**	ED-2	687161	5609519	877	50.5	43.3	50.5	47.2	50.5	46.0	0.86	4	Iron Mask Hybrid Diorite (Sugarloaf Bedrock Aquifer)	Bedrock (Iron Mask Hybrid)	Iron Mask Hybrid	Vertical hydraulic gradients between Peterson Creek Aquifer and underlying Sugarloaf Hill Bedrock Aquifer.	3 m (10 ft) screen installed into bedrock, targeting mapped Sugarloaf bedrock aquifer. Data from this location will be paired with data collected from BGC13-022.
EMRSF	**BGC14-006D**	ED-5	687288	5610779	940	29.6	14.0	26.5	20.4	29.6	19.2	0.76	4	Iron Mask Hybrid Diorite	Weathered Bedrock (Iron Mask Hybrid)	Iron Mask Hybrid	Evaluate seasonal GW fluctuations at topographic divide; data to support Aberdeen Effects Assessment.	6 m (20 ft) screen installed into weathered bedrock.
EMRSF	**BGC14-006S**	NA	687288	5610779	940	14.3	-	14.0	11.0	14.3	9.5	0.80	4	NA	Silty sand (Till)	Glacial Till Deposits	Evaluate seasonal GW fluctuations at topographic divide; data to support Aberdeen Effects Assessment.	3 m (10 ft) installed into colluvium/till above bedrock contact.

Notes:

1. UTM Easting and Northing estimated from handheld GPS; Elevations estimated from compiled DEM; Drillhole collars should be surveyed accurately by KGHM as soon as possible.
2. TSF=Tailings Storage Facility; EMRSF=East Mine Rock Storage Facility; SMRSF=South Mine Rock Storage Facility; GW=Groundwater; HSU=Hydrostratigraphic unit; ELFZ=Edith Lake Fault Zone; NA=Not Applicable.
3. Interpreted bedrock unit based on mapping by Massey et al., (2005) and previously existing drillholes nearby.

Table 2. Summary of 2014 Ajax South Monitoring Well Airlift Test Results.

Location	Hole ID	Depth to Bedrock (m bgs)	Surface Casing Depth (m bgs)	Hole Drill Depth at Time of Test (m bgs)	Approximate Yield (US gpm)
TSF	BGC14-001D	5.2	3.0	19.2	3.1
				29.0	3.0
	BGC14-001S	6.4	1.5	N/A	nm
	BGC14-002D	15.2	4.6	29.0	0.5
				29.9	0.8
	BGC14-002S	15.2	4.6	N/A	nm
	BGC14-003D	22.0	3.0	17.1	3-4
	BGC14-003I	20.1	11.3	N/A	nm
	BGC14-003S	-	30.4	N/A	nm
	BGC14-010	11.0	4.6	N/A	nm
	BGC14-011D	5.5	5.2	16.8	1.9
				29.6	1.8
	BGC14-011S	5.5	5.2	16.8	1.2
	BGC14-012D	5.2	5.2	29.6	1.0
	BGC14-012S	-	0.9	N/A	nm
	BGC14-016	1.8	5.2	29.6	0.2
	BGC14-017D	4.0	5.2	29.0	0.2
	BGC14-017S	5.2	1.5	N/A	nm
SMRSF	BGC14-007D	24.4	4.6	N/A	nm
	BGC14-007S	-	4.6	N/A	nm
	BGC14-008D	15.9	4.6	4.3	0.03
	BGC14-008S	-	0.9	N/A	nm
	BGC14-009	4.0	4.6	54.0	1.0
	BGC14-013	11.3	5.2	9.8	1.4
				18.3	2.8
				23.7	2.5
				30.5	2.7
	BGC14-014D	18.9	5.2	N/A	nm
	BGC14-014S	-	5.2	N/A	nm
	BGC14-015D	11.6	5.2	N/A	nm
	BGC14-015S	-	2.1	N/A	nm
EMRSF	BGC14-004	43.3	4.6	16.8	10
				29.0	80-100
				40.0	30
				54.0	50
				78.3	4.20
	BGC14-005	63.7	4.6	48.9	0.83
	BGC14-006D	14.0	4.6	26.6	0.04 [1]
	BGC14-006S	-	4.6	N/A	nm

Notes:
1. Inflow may be from unit above test zone.

Table 3. Summary of 2014 Ajax South Well Development Details.

Hole Name	Development Start Date	Development Complete Date	Total Gallons Purged	Turbidity of Final Well Volume (NTU)	pH of Final Well Volume	Approx. Number of Well Volumes Removed[1]	Visual Description of Final Well Volume	Logged Lithology	Comments	Development Completed by
BGC14-001D	12-Mar	12-Mar	75	56	8.85	9	Clear	Bedrock (Nicola Volcanics)		BGC
BGC14-001S	-	-	DRY	-	-	-	-	Silt, sand and gravel (Fluvial/Till)		N/A
BGC14-002D	6-Mar	8-Mar	110	143	9.23	12	Murky light Brown	Weathered Bedrock (Nicola Volcanics)		BGC
BGC14-002S	3-Mar	6-Mar	50	18	8.73	17	Clear	Silt with gravel, trace sand and clay (Till)		BGC
BGC14-003D	11-Mar	17-May	300	211	9.54	19	Murky	Bedrock (Nicola Volcanics)		BGC / KGHM
BGC14-003I	2-Mar	10-Mar	200	20	9.93	20	Clear	Gravel and sand (Fluvial/Glaciofluvial)		BGC
BGC14-003S	1-Mar	10-Mar	109	132	9.71	55	Murky Brown	Silt (Till)		BGC
BGC14-004	22-Mar	4-Jun	540	239	11.28	4	Cloudy	Bedrock	Well possibly affected by grout; Last reliable turbidity reading 5/26/2014	BGC / KGHM
BGC14-005	24-Mar	29-Mar	170	122	8.39	2	Light Brown	Bedrock (Iron Mask Hybrid)		BGC / KGHM
BGC14-006D	22-Mar	20-May	806	122	8.23	20	Light Brown	Weathered Bedrock (Iron Mask Hybrid)		BGC / KGHM
BGC14-006S	17-Mar	1-Jun	27	106	6.93	2	Clear	Silty sand (Till)	Development criteria revised due to well conditions[1]; Silt in well caused tubing blockages; Bailers used to overcome sediment load	BGC / KGHM
BGC14-007D	-	-	DRY	-	-	-	-	Bedrock (Nicola Volcanics)		N/A
BGC14-007S	-	-	DRY	-	-	-	-	Silt with gravel (Till)		N/A
BGC14-008D	25-Mar	30-May	45	272	13.46	4	Light Grey	Bedrock (Iron Mask Hybrid)	Development criteria revised due to well conditions[1]; Continuing development not practical due to slow recovery (i.e., over weeks); Well possibly affected by grout	BGC / KGHM
BGC14-008S	-	-	DRY	-		-		Sand and gravel (Glaciofluvial)		N/A
BGC14-009	26-Mar	29-Mar	190	37	8.12	9	Clear	Bedrock (Iron Mask Hybrid)		BGC
BGC14-010	11-Mar	13-Mar	270	102	7.15	13	Light Grey/Brown	Bedrock		KP
BGC14-011D	14-Mar	16-Mar	90	50	8.41	9	Cloudy	Bedrock		KP
BGC14-011S	14-Mar	14-Mar	90	92	9.38	11	Light Brown	Weathered Bedrock (Nicola Volcanics)		KP
BGC14-012D	17-Mar	17-Mar	110	29	8.93	7	Clear	Bedrock (Nicola Volcanics)		BGC / KGHM
BGC14-012S	15-Mar	17-Mar	130	27	9.29	65	Clear	Gravel and sand (Glaciofluvial)		BGC
BGC14-013	18-Mar	21-Mar	70	83	8.53	5	Clear	Weathered Bedrock		KGHM
BGC14-014D	23-Mar	28-May	29	708	6.73	7	Brown	Weathered Bedrock	Development criteria revised due to well conditions[2]; Final turbidity value >250 NTU but other physicochemical parameters stable.	BGC / KGHM
BGC14-014S	18-Mar	-	4	1495	8.66	-	Very Brown	Silt, sand and trace gravel (Till)	Dry on March 31, 2014; Water level close to well bottom throughout remainder of program	N/A
BGC14-015D	18-Mar	7-May	280	210	8.34	16	Slightly Milky	Bedrock (Nicola Volcanics)		BGC / KGHM

Table 3. Summary of 2014 Ajax South Well Development Details.

Hole Name	Development Start Date	Development Complete Date	Total Gallons Purged	Turbidity of Final Well Volume (NTU)	pH of Final Well Volume	Approx. Number of Well Volumes Removed[1]	Visual Description of Final Well Volume	Logged Lithology	Comments	Development Completed by
BGC14-015S	13-Mar	28-May	363	373	7.62	52	Grey	Sand with trace silt to silty (Glaciofluvial)	Development criteria revised due to well conditions[2]; Final turbidity value >250 NTU but other physicochemical parameters stable.	BGC / KGHM
BGC14-016	19-Mar	21-Mar	145	64	7.95	10	Clear	Bedrock		KGHM
BGC14-017D	21-Mar	29-May	168	135	8.21	10	Murky	Bedrock	Development criteria revised due to well conditions[2]; Final turbidity value >250 NTU but other physicochemical parameters stable.	BGC / KGHM
BGC14-017S	20-Mar	28-May	3	>800	7.59	1	Brown	Silt (Till)	Development criteria revised due to well conditions[2]; Continuing development not practical due to slow recovery (i.e., over weeks)	BGC / KGHM
KAX-14-114S	2-Jun	2-Jun	110	0	8.62	6	Clear	Sand and gravel	Well installed by KCB[3]; Added to development program at the request of KGHM Ajax on May 30, 2014.	BGC
KAX-14-128S	2-Jun	5-Jun	40	>800	7.74	13	Brown	Silt, clay, sand and gravel (Till)	Well installed by KCB[3]; Added to development program at the request of KGHM Ajax on May 30, 2014; Development criteria revised due to well conditions[1]; Silt in well caused tubing blockages; Bailers used to overcome sediment load	BGC

Notes:

1. Well volumes calculated based on water levels observed after drilling and may not represent static conditions.

2. Some wells would not meet the 250 NTU criteria as a result of slow water level recovery (i.e., several days to weeks) or excessive amounts of silt in the well screen. Development criteria were relaxed in these wells in order to keep with the water quality sampling schedule.

3. Drill hole logs for KAX-14-114S and 128S prepared by KCBL (2014).

4. N/A = Not Applicable.

Table 4. Summary of 2014 Ajax South Datalogger Deployment Details.

Groundwater Monitoring Wells

Location ID	UTM Easting	UTM Northing	Logger Serial Number	Water depth at installation (m bTOC)	Logger Deployment Depth (m bTOC)
BGC14-001D	682286	5608796	32031138	11.73	14.72
BGC14-001S	682286	5608796	32031137	DRY	5.94
BGC14-002D	682756	5608900	32031107	7.21	12.89
BGC14-002S	682756	5608900	32031106	7.40	12.34
BGC14-003D	683544	5608858	32031141	3.90	6.98
BGC14-003I	683544	5608858	32031125	4.45	9.34
BGC14-003S	683544	5608858	32031131	4.47	9.43
BGC14-004	687746	5609526	32031180	8.23	12.50
BGC14-005	687161	5609519	32031187	16.19	17.84
BGC14-006D	687288	5610779	2032062	8.69	11.50
BGC14-006S	687288	5610779	2031130	4.48	10.80
BGC14-007D	685324	5608722	32031184	DRY	30.83
BGC14-007S	685324	5608722	32031112	DRY	18.46
BGC14-008D	686107	5608923	32031097	DRY	26.71
BGC14-008S	686107	5608923	32030360	DRY	6.74
BGC14-009	686799	5608547	32031189	16.23	19.88
BGC14-010	681730	5607414	32030361	9.36	12.31
BGC14-011D	682796	5605945	32031105	5.26	7.56
BGC14-011S	682796	5605945	32032109	5.29	8.54
BGC14-012D	681950	5608373	32031110	1.21	5.37
BGC14-012S	681950	5608373	32032117	1.64	4.17
BGC14-013	686466	5606777	32030366	3.24	8.27
BGC14-014D	686672	5607810	32031188	21.92	29.16
BGC14-014S	686672	5607810	32031132	DRY	19.87
BGC14-015D	686773	5606920	32031104	0.87	2.97
BGC14-015S	686773	5606920	32017719	0.88	9.07
BGC14-016	685348	5607041	32031183	5.17	7.76
BGC14-017D	685540	5605928	32032511	3.48	10.48
BGC14-017S	685540	5605928	32030627	0.90	3.94

Surface Water Monitoring Stations

Location ID	UTM Easting	UTM Northing	Logger Serial Number	Water depth at installation (m)	Water depth on staffing gauge (m)
PETER	685667	5609299	32031095	0.11	0.19
JACSEEP	683266	5609103	32031186	0.17	0.17
JACLAKE	683124	5609098	32030359	0.38	0.08
JACINF	681084	5608693	32031102	0.09	0.12
KEYNES	682975	5608965	10434196	-	0.11

Notes:

1. m bTOC = metres below top of casing.
2. Barometric loggers located at KEYNES monitoring station and at previously existing monitoring well MW11-03S (678891E, 5611179N).

Table 5. Summary of 2014 Ajax South Snowpack Surveys.

Site	Date	UTM East (m)	UTM North (m)	Aspect	Snow Depth (mm)	SWE (mm)	Comments
Keynes Creek							
34	26-Feb-14	682525	5609114	310	130	10	Wind packed and sugary snow
35	26-Feb-14	682303	5608203	240	100	20	Wind packed and sugary. Top of slope has no snow, opposite side of the road has more snow
36	26-Feb-14	682231	5608146	11	210	100	Sugary, windpacked
37	26-Feb-14	682843	5607653	140	65	10	Small, local depression - average of the area
38	26-Feb-14	682826	5608116	84	80	10	Grassland location, snow is sublimating. Snow is compact and sugary
39	26-Feb-14	682949	5608136	84	180	80	Grassland. Bottom of small gully.
40	26-Feb-14	682848	5608791	240	210	90	Glades on hill, benched area
41	26-Feb-14	682358	5606425	33	310	110	Small conifers on grass slope. Loose snow (drift) with ice crystal texture. Wind packed snow nearby.
42	26-Feb-14	682353	5606380	320	100	40	Grassland. Top of hill. Sublimating.
43	26-Feb-14	682305	5606326	234	290	100	Bottom of hill next to the road. Within a stand of deciduous trees
44	26-Feb-14	684808	5606369	234	210	80	Location is approximately midslope. Slope is dry below
45	26-Feb-14	684800	5606352	234	250	110	Grassed slope with intermittent conifers. Wind crust and sugary below.
46	26-Feb-14	684649	5606407	n/a	320	100	Goose Lake. Wind slab - loose and hollow below.
47	26-Feb-14	684317	5605665	0	80	20	Under forest canopy, on the side of the road adjacent to the barbed wire fence
48	26-Feb-14	682887	5604518	290	300	100	Side of plateau, semi-treed area. Thicker snow on the plateau and thinner snow under trees
49	26-Feb-14	682061	5603807	0	260	90	heavily treed
50	27-Feb-14	681714	5604464	10	70	30	Treed area near the road at the top of a hill, fairly flat
51	27-Feb-14	681115	5605488	0	240	80	Edge of the open area, next to the trees
52	27-Feb-14	678994	5606146	60	260	80	Directly on the road
53	27-Feb-14	678992	5606136	40	160	70	In trees adjacent to the road
Peterson Creek							
681	18-Mar-14	680148	5603429	30	350	110	Under trees, slope forms the side of a swale.
682	18-Mar-14	678001	5602933	240	600	140	Sugary snow adjacent to trail edge.
683	18-Mar-14	676931	5603107	45	630	180	Adjacent to road, sugary, compact snow.
684	18-Mar-14	679306	5605013	50	380	120	Sugary snow adjacent to trail edge.
685	18-Mar-14	678726	5604780	20	580	90	Sugary snow, under trees adjacent to the trail edge.
686	18-Mar-14	677489	5603983	25	430	140	-
687	19-Mar-14	674532	5602500	45	910	160	Deep snow in cutblock adjacent to trees. Crust with unconsolidated snow bellow
688	19-Mar-14	674533	5603296	80	760	90	Windblown snow crust, onconsolidated and hollow beneath.
689	19-Mar-14	674580	5602844	0	540	130	Sugary snow crust over unconsolidated snow.

Table 6. Ajax South Monitoring Well Response Test Results.

Observation Point	Test No.	Type of Test	Best Fit to Slug Test Data[1]			Average Depth of Screened Interval (m bgs)	Logged Lithology	Interpreted HSU Based on Mapping and Log data
			Analysis Method	K (m/s)	S (m^{-1})			
BGC14-001D	1	FH	KGS [1994] Unconfined Aquifer	2 E-06	5 E-03	21.0	Bedrock (Nicola Volcanics)	Nicola Group
BGC14-001D	2	RH	KGS [1994] Unconfined Aquifer	3 E-06	4 E-03			
Representative Value =				**2 E-06**	**4 E-03**			
BGC14-002S	1	FH	KGS [1994] Unconfined Aquifer	1 E-07	-	12.1	Silt with gravel, trace sand and clay (Till)	Glacial Till Deposits
BGC14-002S	2	RH	KGS [1994] Unconfined Aquifer	1 E-07	-			
Representative Value =				**1 E-07**	**-**			
BGC14-002D	1	FH	Hvorslev [1951] Unconfined Aquifer	4 E-06	-	19.8	Weathered Bedrock (Nicola Volcanics)	Nicola Group
BGC14-002D	2	RH	Hvorslev [1951] Unconfined Aquifer	4 E-06	-			
BGC14-002D	3	FH	Hvorslev [1951] Unconfined Aquifer	4 E-06	-			
BGC14-002D	4	RH	Hvorslev [1951] Unconfined Aquifer	4 E-06	-			
Representative Value =				**4 E-06**	**-**			
BGC14-003S	1	FH	KGS [1994] Unconfined Aquifer	3 E-07	6 E-03	10.5	Silt (Till)	Glacial Till Deposits
BGC14-003S	2	RH	KGS [1994] Unconfined Aquifer	3 E-07	3 E-03			
Representative Value =				**3 E-07**	**5 E-03**			
BGC14-003I	1	FH	KGS [1994] Unconfined Aquifer	6 E-06	7 E-06	18.3	Gravel and sand (Fluvial/Glaciofluvial)	Fluvial and Glaciofluvial Sands
BGC14-003I	2	RH	KGS [1994] Unconfined Aquifer	7 E-06	4 E-05			
Representative Value =				**6 E-06**	**2 E-05**			
BGC14-003D	1	FH	KGS [1994] Unconfined Aquifer	2 E-08	1 E-03	29.9	Bedrock (Nicola Volcanics)	Nicola Group
BGC14-003D	2	RH	KGS [1994] Unconfined Aquifer	2 E-08	1 E-03			
Representative Value =				**2 E-08**	**1 E-03**			
BGC14-004	1	FH	KGS [1994] Unconfined Aquifer	2 E-07	8 E-04	75.3	Bedrock	Iron Mask Hybrid
BGC14-004	2	RH	KGS [1994] Unconfined Aquifer	8 E-07	1 E-05			
Representative Value =				**4 E-07**	**1 E-04**			
BGC14-005	1	FH	KGS [1994] Unconfined Aquifer	9 E-08	2 E-04	48.9	Bedrock (Iron Mask Hybrid)	Iron Mask Hybrid
BGC14-005	2	RH	KGS [1994] Unconfined Aquifer	5 E-08	3 E-03			
Representative Value =				**7 E-08**	**9 E-04**			
BGC14-006S	1	Single Rising Head	KGS [1994] Unconfined Aquifer	**1 E-08**	**6 E-04**	12.5	Silty sand (Till)	Glacial Till Deposits
BGC14-006D	1	FH	KGS [1994] Unconfined Aquifer	8 E-08	9 E-04	23.5	Weathered Bedrock (Iron Mask Hybrid)	Iron Mask Hybrid
BGC14-006D	2	RH	KGS [1994] Unconfined Aquifer	2 E-07	5 E-06			
Representative Value =				**1 E-07**	**7 E-05**			
BGC14-008D	1	Single Rising Head	Hvorslev [1951] Unconfined Aquifer	1 E-09	-	28.0	Bedrock (Iron Mask Hybrid)	Iron Mask Hybrid
BGC14-009	1	FH	KGS [1994] Unconfined Aquifer	2 E-07	8 E-06	50.9	Bedrock (Iron Mask Hybrid)	Iron Mask Hybrid
BGC14-009	2	RH	KGS [1994] Unconfined Aquifer	2 E-07	6 E-06			
Representative Value =				**2 E-07**	**7 E-06**			
BGC14-010	1	FH	KGS [1994] Unconfined Aquifer	6 E-08	7 E-04	52.1	Bedrock	Nicola Group
BGC14-010	2	RH	KGS [1994] Unconfined Aquifer	4 E-08	1 E-03			
Representative Value =				**5 E-08**	**1 E-03**			

Table 6. Ajax South Monitoring Well Response Test Results.

Observation Point	Test No.	Type of Test	Best Fit to Slug Test Data[1]			Average Depth of Screened Interval (m bgs)	Logged Lithology	Interpreted HSU Based on Mapping and Log data
			Analysis Method	K (m/s)	S (m^{-1})			
BGC14-011S	1	FH	KGS [1994] Unconfined Aquifer	1 E-06	4 E-03	16.8	Weathered Bedrock (Nicola Volcanics)	Nicola Group
BGC14-011S	2	RH	KGS [1994] Unconfined Aquifer	2 E-06	8 E-04			
			Representative Value =	**1 E-06**	**2 E-03**			
BGC14-011D	1	FH	KGS [1994] Unconfined Aquifer	3 E-07	1 E-03	26.5	Bedrock	Nicola Group
BGC14-011D	2	RH	KGS [1994] Unconfined Aquifer	4 E-07	2 E-04			
			Representative Value =	**3 E-07**	**5 E-04**			
BGC14-012S	1	FH	Hvorslev [1951] Unconfined Aquifer	6 E-04	-	3.0	Gravel and sand (Glaciofluvial)	Colluvium
BGC14-012S	2	RH	KGS [1994] Unconfined Aquifer	1 E-03	-			
BGC14-012S	3	FH	Hvorslev [1951] Unconfined Aquifer	9 E-04	-			
BGC14-012S	4	RH	KGS [1994] Unconfined Aquifer	1 E-03	-			
			Representative Value =	**9 E-04**	**-**			
BGC14-012D	1	FH	KGS [1994] Unconfined Aquifer	9 E-07	7 E-05	23.3	Bedrock (Nicola Volcanics)	Nicola Group
BGC14-012D	2	RH	KGS [1994] Unconfined Aquifer	6 E-07	3 E-04			
BGC14-012D	3	FH	KGS [1994] Unconfined Aquifer	1 E-06	3 E-05			
BGC14-012D	4	RH	KGS [1994] Unconfined Aquifer	1 E-06	3 E-05			
			Representative Value =	**8 E-07**	**6 E-05**			
BGC14-013	1	FH	KGS [1994] Unconfined Aquifer	1 E-08	4 E-03	29.0	Weathered Bedrock	Nicola Group
BGC14-013	2	RH	KGS [1994] Unconfined Aquifer	2 E-08	9 E-05			
			Representative Value =	**2 E-08**	**6 E-04**			
BGC14-014D	1	Single Rising Head	KGS [1994] Unconfined Aquifer	**1 E-09**	**-**	26.5	Bedrock (Nicola Volcanics)	Nicola Group
BGC14-015S	1	Single Rising Head	Cooper et al. [1967] Confined Aquifer	**1 E-07**	**-**	9.8	Sand with trace silt to silty (Glaciofluvial)	Glacial Till Deposits
BGC14-015D	1	FH	Cooper et al. [1967] Confined Aquifer	2 E-08	-	26.5	Bedrock (Nicola Volcanics)	Nicola Group
BGC14-015D	2	RH	Cooper et al. [1967] Confined Aquifer	4 E-09	1 E-05			
			Representative Value =	**9 E-09**	**1 E-05**			
BGC14-016	1	FH	KGS [1994] Unconfined Aquifer	6 E-08	-	26.5	Bedrock	Nicola Group
BGC14-016	2	RH	KGS [1994] Unconfined Aquifer	3 E-08	2 E-04			
			Representative Value =	**5 E-08**	**2 E-04**			
BGC14-017S	1	Single Rising Head	Cooper et al. [1967] Confined Aquifer	**2 E-07**	**2 E-02**	3.8	Silt (Till)	Glacial Till Deposits
BGC14-017D	1	Single Rising Head	KGS [1994] Confined Aquifer	**4 E-09**	**5 E-07**	26.5	Bedrock	Nicola Group
KAX-14-114S	1	FH	Hvorslev [1951] Unconfined Aquifer	1 E-06	-	26.5	Sand and gravel	Fluvial and Glaciofluvial Sands
KAX-14-114S	2	RH	Hvorslev [1951] Unconfined Aquifer	2 E-06	-			
			Representative Value =	**1 E-06**	**-**			
KAX-14-128S	1[3]	FH	Hvorslev [1951] Unconfined Aquifer	2 E-06	-	14.0	Gravel and Sand	Fluvial and Glaciofluvial Sands
KAX-14-128S	2[3]	RH	Hvorslev [1951] Unconfined Aquifer	2 E-06	-			
			Representative Value =	**2 E-06**	-			
KAX-14-128S	1A[3]	FH	Hvorslev [1951] Unconfined Aquifer	1 E-07	-	14.0	Silty Sands (Glaciolacustrine Till)	Lacustrine Deposits
KAX-14-128S	2A[3]	RH	Hvorslev [1951] Unconfined Aquifer	1 E-07	-			
			Representative Value =	**1 E-07**	-			

Notes:
1. At locations where multiple tests were conducted, representative hydraulic conductivity and storage paramaters have been calculated as the geometric mean value of individual analysis results.
2. Weathered bedrock indicated for materials logged as moderately to highly weathered.
3. Well screened across units with variable hydraulic conductivity. K estimated for early and late time response data.

Table 7. Summary of Ranges in Estimated Hydraulic Parameters in the Ajax South Monitoring Wells.

Interpreted HSU Based on Mapping and Log data	Hydraulic Conductivity (m/s)						Storage (m^{-1})			
	Ajax South Wells[1]			Previous Estimates[2]			Ajax South Wells[1]			Previous Estimates[3]
	Minimum	Maximum	Geomean	Minimum	Maximum	Geomean	Minimum	Maximum	Geomean	
Nicola Group	1E-09	4E-06	8E-08	2E-11	3E-05	1E-07	5E-07	4E-03	2E-04	1E-06
Iron Mask Hybrid	7E-08	4E-07	2E-07	2E-10	2E-05	6E-08	7E-06	9E-04	8E-05	1E-06
Glacial Till Deposits	1E-08	2E-02	1E-06	1E-10	1E-04	2E-07	6E-04	2E-02	3E-03	1E-05
Fluvial and Glaciofluvial Sands	1E-06	6E-06	3E-06	1E-09	1E-03	2E-05	2E-05			1 E -04
Colluvium[4]	9E-04			NA	NA	NA	NA	NA	NA	NA
Lacustrine Deposits[4]	1E-07			NA	NA	NA	NA	NA	NA	NA

Notes:
1. At locations where multiple tests were conducted, representative hydraulic conductivity and storage paramaters have been calculated as the geometric mean value of individual analysis results.
2. Previous estimates compiled in BGC (2013b).
3. Preliminary estimates, include assigned numerical model parameters and pumping test results compiled in BGC (2011).
4. Previous test data not available for colluvium or lacustrine deposits.

Table 8. Summary of Observations at Wells drilled near the mapped trace of the ELFZ.

Well ID	Location	Hanging Wall / Foot Wall[1]	Screened Material	Yield from Airlift Tests (US GPM)[2]	K (m/s)	Static Water Level (m bgs)[3]	Date and Time of Static Water Level Measurement	Notable Weathered Bedrock Zone(s) During Drilling	General Drilling Observations
BGC14-001D	TSF	FW	Bedrock (Nicola Volcanics)	3.2	2E-06	10.39	17-Jun-04 11:14	None	Water encountered at 19.2 m
BGC14-001S	TSF	FW	Silt, sand and gravel (Fluvial/Till)	3.0	Not Tested	>15.2	17-Jun-04 11:38	None	Dry during drilling
BGC14-002D	TSF	HW	Weathered Bedrock (Nicola Volcanics)	0.8	4E-06	5.79	17-Jun-04 12:37	Bedrock moderately weathered with distinct yellowish brown returns at 20.1 m bgs	Softer drilling at 20.1 m
BGC14-002S	TSF	HW	Silt with gravel, trace sand and clay (Till)	nm	1E-07	5.89	17-Jun-04 12:10	Bedrock slightly to moderately weathered	-
BGC14-013	SWRSF	FW	Weathered Bedrock	2.4	2E-08	2.09	07-Jul-14 15:26	Bedrock moderately weathered with distinct yellowish brown returns at 28.7 m bgs	-
BGC14-015D	SWRSF	HW	Bedrock (Nicola Volcanics)	nm	9E-09	> 0.94	03-Jul-14 13:12	None	Dry during drilling
BGC14-015S	SWRSF	HW	Sand with trace silt to silty (Glaciofluvial)	nm	1E-07	0.43	26-Jul-14 16:22	None	-

Notes:
1. Location of borehole in relation to the mapped fault by Logan and Mihalynuk (2005).
2. nm = not measurable.
3. BGC14-001S dry at time of measurement; BCG14-015D water level at top of PVC at time of measurement; Levels for BGC14-015S and 015D reported in metres above ground surface.

PHOTOGRAPHS

Photo 1.
JacInf Gauging Station

May 29, 2014

Photo 2.
JacLake Gauging Station

May 29, 2014

Photo 3.
JacSeep Gauging Station

June 1, 2014

Photo 4.
Keynes Creek Gauging Station

June 1, 2014

Photo 5.
Peterson Creek Gauging Station

June 1, 2014

APPENDIX A
BOREHOLE LOGS AND MONITORING WELL COMPLETION DETAILS

LEGEND FOR WELL LOGS

The various parameters depicted on the well logs are described below according to the select headings found on the form.

Location

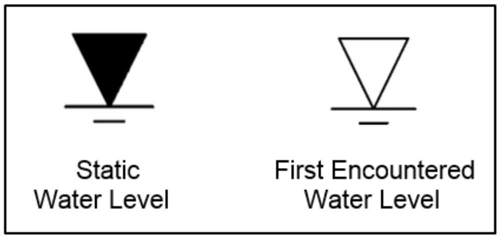
TSF – Tailings Storage Facility
EMRSF – East Mine Rock Storage Facility
SMRSF – South Mine Rock Storage Facility

Depth

Depth below ground surface is measured in metres.

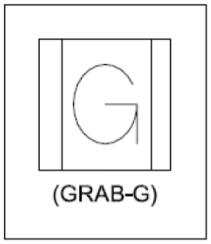
Water Levels

Groundwater levels are represented by the symbols shown below. First encountered water levels were obtained during drilling progress, static water levels were measured after drilling and piezometer installation is complete.



Sample Type and Sample Number

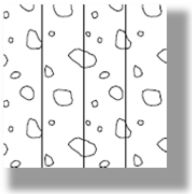
Samples were collected to permit cross-checking of logged geology by the KGHM Ajax site geologist and were limited to grab samples collected from the Dual Rotary drill cuttings. Samples are numbered and represented graphically by the symbol shown below. All samples collected from test holes are shown on the logs; however, will not be tested, as they are considered to be “disturbed” due to aggressive drilling methods.



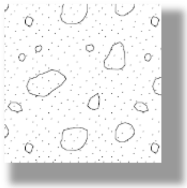
Symbol

Sediment types and rock are represented graphically by the following symbols:

GRAVEL



Silt/Gravel
(GM)

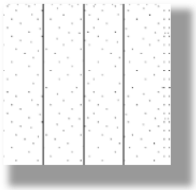


Sand/Gravel
(GSP)

Poorly-graded
Gravel
(GP)

Well-graded Gravel
(GW)

SAND

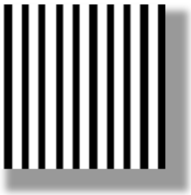


Silt/Sand
(SM)

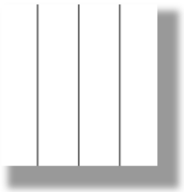
Poorly-graded
Sand
(SP)

Well-graded Sand
(SW)

SILT

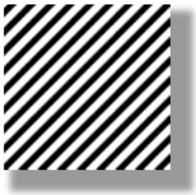


High Plastic Silt
(MH)

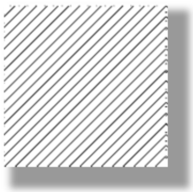


Low Plastic Silt
(ML)

CLAY

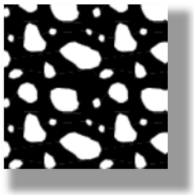


High Plastic Clay
(CH)



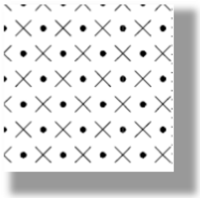
Low Plastic Clay
(CI/CL)

OTHER



Boulders and Cobbles
(BLDRCBBL)

BEDROCK



Ironmask Hybrid

Nicola Group

Undifferentiated Bedrock

Lithologic Description

Due to the aggressive nature of Dual Rotary drilling, sediments and lithology are considered to be of disturbed nature, and are described using simplified observations, where possible.

Disturbed sediments are classified according to the Unified Soil Classification System (USCS), and are described typically by the following features: primary constituent; particle size range; secondary constituents; gradation; colour; particle shape and angularity; maximum particle size; moisture content; presence of foreign materials.

Disturbed bedrock cuttings are described according to the International Society for Rock Mechanics (ISRM 1978). The following descriptions are typically listed for each main lithological unit on the logs: grain size; colour; alteration and weathering; vein and faulting characteristics.

Weathering Grade

Weathering and alteration of the rock mass is described according to Bieniawski 1976 parameters defined below.

Alteration and Weathering Rating (Bieniawski 1976)

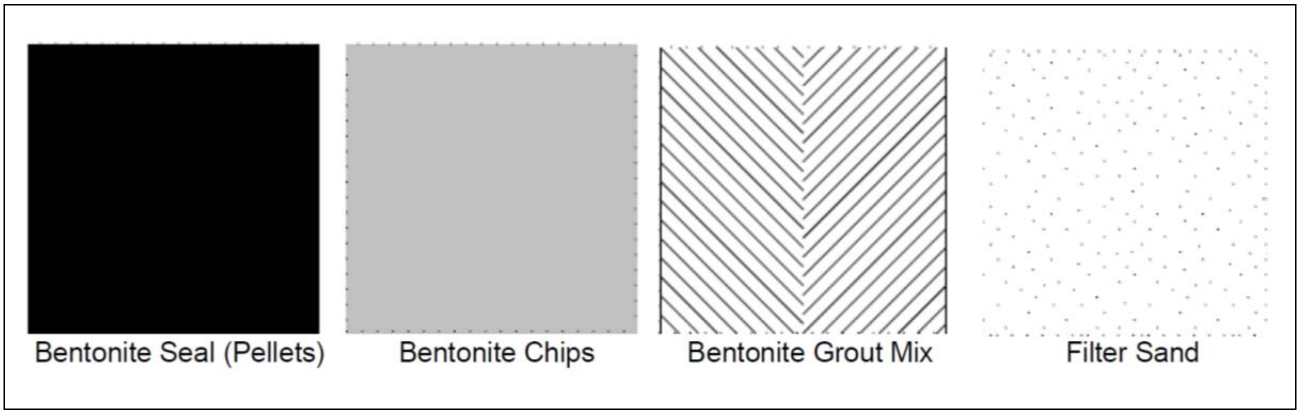
Degree of Alteration/Weathering	Description	Rating
Fresh	Alteration may result in an improvement in rock competency (e.g. silicification)	W1
Slightly Weathered/Altered	Rock strength unchanged; weathering on joints only	W2
Moderately Weathered/Altered	Rock is discoloured but rock strength only slightly affected; discontinuities are weathered	W3
Highly Weathered/Altered	Rock is discoloured and strength is significantly reduced by weathering	W4
Completely Weathered/Altered	Original fabric and relict structures remain but rock is decomposed and friable	W5
Residual Soil	Original fabric destroyed	W6

Note: If alteration/weathering is > W4 or UCS grade ≤R0, then RQD is 0% for that section. Also, if the UCS grade ≤R0, the number of discontinuities is recorded as the default 99.

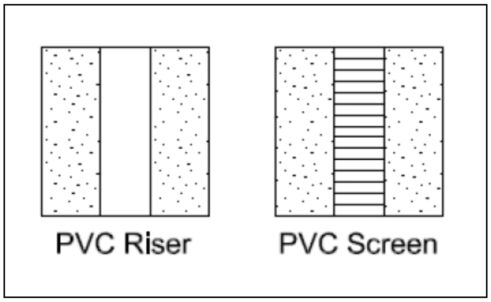
Instrument Details

Fill materials placed in the test holes are graphically represented by the symbols below. All test holes contain standpipe piezometers. These instruments are shown below in a default filter sand fill.

MATERIALS PLACED DOWN HOLE



INSTRUMENTATION SHOWN IN FILTER SAND



Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-001D

Location: Ajax Project Site

Coordinates (m): 682286E - 5608796N
Ground Elevation (m): 936
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.83

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 3.04

Start Date: 11 Feb 2014
Finish Date: 13 Feb 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 5.18
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
935	0				SAND AND GRAVEL (GM) Silty, sand is fine, well graded, light greyish brown, trace rootlets and organics. [TOPSOIL]	0	At grade, dry	11/02/2014 12:25	Logged from sump.
934 933	1 2				SAND (SM) Fine, some silt, uniformly graded, light brown.		Dry	11/02/2014 12:30	
932	3 4				SILT (ML) Some sand, some clay, trace gravel, well graded, dark brown with grey clasts. [TILL]		Dry	11/02/2014 12:30	
931	5				GRAVEL AND SAND (GM) Some silt, sand is medium, gravel is fine, well graded, dark brown with grey clasts. [FLUVIAL]		Dry	11/02/2014 12:40	Nearing bedrock?
930 929 928 927 926	6 7 8 9 10				BEDROCK Drill cuttings: fine to medium grained, angular to subrounded, dark to light grey, unweathered to slightly weathered. [NICOLA VOLCANICS]		Dry	11/02/2014 12:42	

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-001D

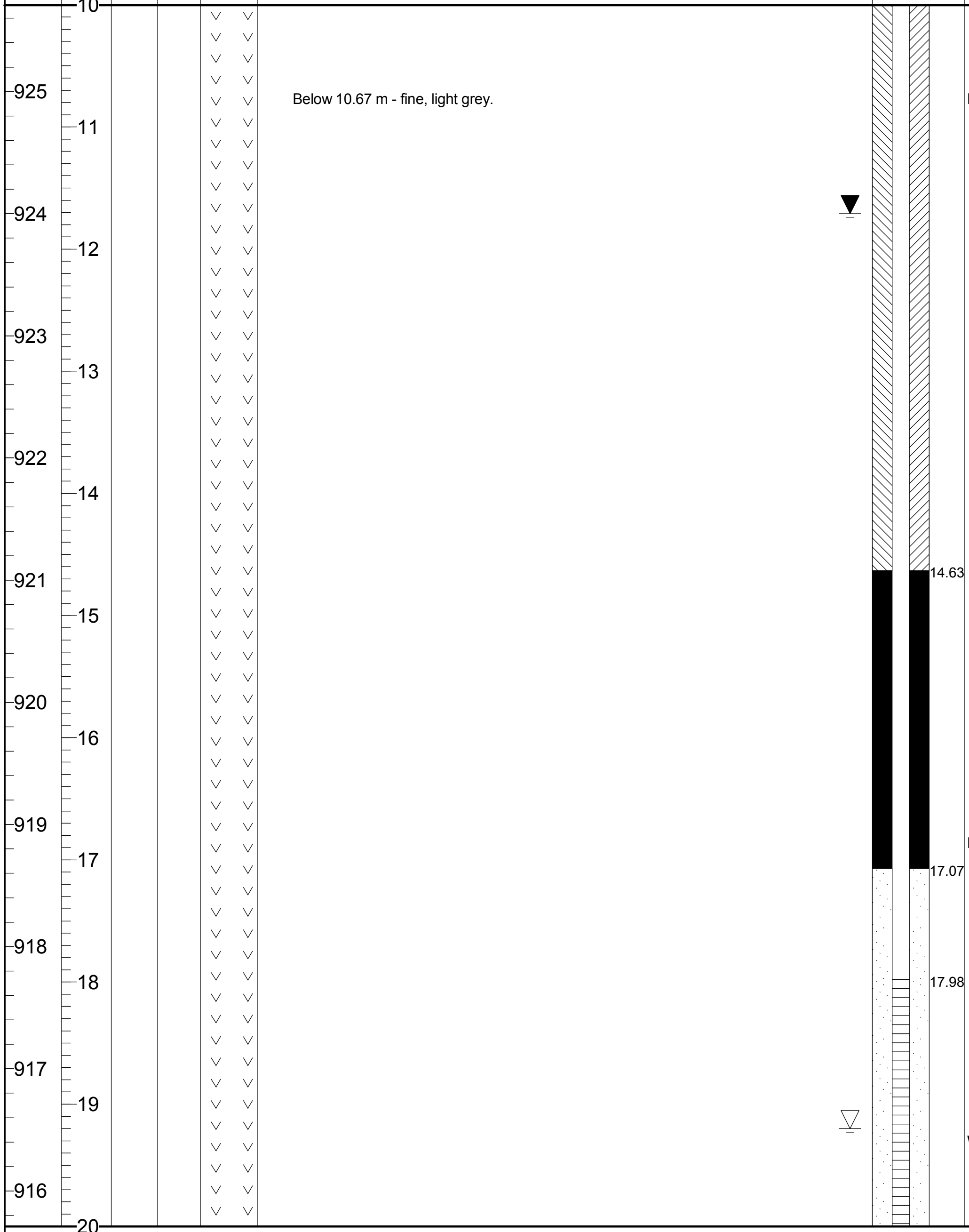
Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 682286E - 5608796N
Ground Elevation (m): 936
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.83

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 3.04

Start Date: 11 Feb 2014
Finish Date: 13 Feb 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 5.18
Logged By: SLP
Reviewed By: TWC



Depth (m)	Lithologic Description	Water Notes	Date + Time	Comments
10.67	Below 10.67 m - fine, light grey.	Dry	11/02/2014 12:53	
11.71				At 11.71 m - static water level, measured 3/12/2014 9:55.
17		Dry	11/02/2014 13:15	Drill returns are very dry, dusty.
19.20		Wet, light grey	11/02/2014 13:34	At 19.20 m -water encountered. AIRLIFT #1 2.6 US GPM 3.2 US GPM

(Continued on next page)

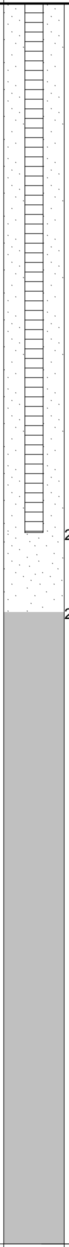
Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-001D

Location: Ajax Project Site

Coordinates (m): 682286E - 5608796N	Location: TSF	Start Date: 11 Feb 2014
Ground Elevation (m): 936	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 13 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 5.18
Stick-up (m): 0.83	Fluid: Air	Logged By: SLP
	Cased To (m): 3.04	Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20			∨ ∨					3.4 US GPM Average 3.1 US GPM
913	23			∨ ∨	Below 22.86 m - fine, smaller clast size than above, dark green.		Wet, green	11/02/2014 13:42	Possible chloritization.
	24			∨ ∨		24.08			
911				∨ ∨		24.69			
	26			∨ ∨	At 25.90 m - colour change to brownish red.		Wet	11/02/2014 13:50	
909				∨ ∨	At 26.52 m - colour change to grey.		Wet	11/02/2014 13:53	
	29			∨ ∨			Wet	11/02/2014 14:00	AIRLIFT #2 3.4 US GPM 2.9 US GPM 2.6 US GPM Average 3.0 US GPM
906					END OF HOLE AT 29.56 m				
	30								

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-001D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 682286E - 5608796N
Ground Elevation (m): 936
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.83

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 3.04

Start Date: 11 Feb 2014
Finish Date: 13 Feb 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 5.18
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30				NOTES: 1. 2" PVC standpipe piezometer installed with screen from 17.98 to 24.08 metres. 2. Filter sand placed from 17.07 to 24.69 metres. 3. Bentonite seal placed from 14.63 to 17.07 metres. 4. Hole backfilled from 24.69 m to 29.56 m with bentonite chips.				
905									
	31								
904									
	32								
903									
	33								
902									
	34								
901									
	35								
900									
	36								
899									
	37								
898									
	38								
897									
	39								
896									
	40								

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Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-001S

***Page** 1 **of** 1*

Location: Ajax Project Site

Coordinates (m): 682286E - 5608796N	Location: TSF	Start Date: 12 Feb 2014
Ground Elevation (m): 934	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 12 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 6.40
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 5.49
Stick-up (m): 0.84	Fluid: Air	Logged By: SLP
	Cased To (m): 1.52	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
934	0				SAND AND GRAVEL (GM) Silty, well graded, light greyish brown. [TOPSOIL]	0	Dry	12/02/2014 10:30	
933 932	1 2				SAND (SM) Fine, trace silt, uniformly graded, light brown, no odour. [TILL]	1.83	Dry	12/02/2014 10:33	
931 930	3 4				SILT (ML) Some sand, some gravel, trace clay, gap graded, dark brown, no odour. [TILL]	3.66 3.96	Dry	12/02/2014 10:35	
929	5				SAND AND GRAVEL (GM) Some silt, well graded, light brown with grey clasts. [FLUVIAL]		Dry	12/02/2014 10:40	
	6	G	G1		BEDROCK Drill cuttings: fine to medium grained, angular to subrounded, light grey to light brown. [NICOLA VOLCANICS]	5.49	Dry	12/02/2014 10:43	
928 927 926 925	7 8 9 10				END OF HOLE AT 6.40 m NOTES: 1. 2" PVC standpipe piezometer installed with screen from 3.96 to 5.49 metres. 2. Filter sand placed from 3.66 to 6.40 metres. 3. Bentonite seal placed from 1.83 to 3.66 metres.		Dry	12/02/2014 10:45	

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Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-002D

Location: Ajax Project Site

Coordinates (m): 682756E - 5608900N
Ground Elevation (m): 925
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.73

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 12 Feb 2014
Finish Date: 13 Feb 2014
Final Depth (m): 29.87
Depth to Top of Rock (m): 15.24
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
925	0				SAND (SW) Fine to medium, some gravel, trace silt, well graded, dark brown with grey clasts. [FILL]	0	Dry	12/02/2014 13:00	Logged from road cut.
924	1				SAND AND GRAVEL (GW) Silty, sand is fine to medium, gravel is fine to coarse, well graded, light brown with grey clasts, gravel size range from 3 mm to 20 mm. [FLUVIAL]		Dry	12/02/2014 13:06	
923	2	G	G1				Dry	12/02/2014 13:12	
922 921	3 4	G	G2		SILT (ML) Gravelly, some fine sand, gravel is multilithic, well graded, angular to subrounded, grey, light greyish brown matrix. [TILL]		Dry	12/02/2014 13:18	
920	5	G	G3		GRAVEL (GM) Silty, some fine sand, trace clay, gravel is multilithic, angular to subrounded, grey to purple, gravel size range from 2 mm to 15 mm. [FLUVIAL]		Dry	12/02/2014 13:25	Welding time 13:30 to 13:42.
919 918	6 7				SILT (ML) Some sand, some gravel, trace clay, uniformly graded, low plasticity, light brown with grey clasts. [TILL]		Moist	12/02/2014 13:47	
917	8						Moist	12/02/2014 13:50	
916	9				▼				At 8.53 m - static water level, measured 2/13/2014 8:55.
	10				Below 9.14 m - increase in clay content to some, colour change to dark grey.		Moist	12/02/2014 13:54	Slight increase in moisture.

(Continued on next page)

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Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

DRILL HOLE # BGC14-002D

Coordinates (m): 682756E - 5608900N
Ground Elevation (m): 925
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.73

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 12 Feb 2014
Finish Date: 13 Feb 2014
Final Depth (m): 29.87
Depth to Top of Rock (m): 15.24
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
915	10								
							Moist	12/02/2014 13:57	
914	11								
							Moist	12/02/2014 14:00	Welding time 14:00 to 14:11.
913	12								
		G	G4		Below 12.19 m - decrease in gravel content, dark greyish brown.		Moist	12/02/2014 14:15	
912	13								
		G	G5				Moist	12/02/2014 14:17	
						14.02			
911	14								
910	15								
		G	G6	∨ ∨	BEDROCK Drill cuttings: fine to coarse grained, light reddish brown to organish brown, slightly to moderately weathered, some oxidation. [NICOLA VOLCANICS]		Dry	12/02/2014 14:22	
						15.85			
909	16			∨ ∨					
				∨ ∨	Below 16.76 m - fine, dark grey.	16.76		12/02/2014 14:40	At 16.76 m - potential groundwater.
908	17			∨ ∨					
907	18			∨ ∨					
				∨ ∨	Below 18.29 m - colour change to dark bluish grey.			12/02/2014 14:47	
906	19			∨ ∨					
	20								

(Continued on next page)

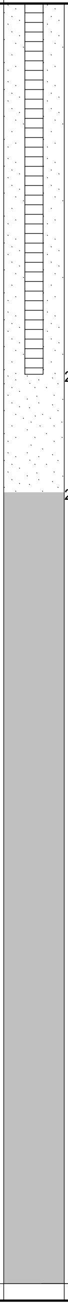
Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-002D

Location: Ajax Project Site

Coordinates (m): 682756E - 5608900N	Location: TSF	Start Date: 12 Feb 2014
Ground Elevation (m): 925	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 13 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.87
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 15.24
Stick-up (m): 0.73	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
905	20								
					At 20.12 m - significant colour change to light yellowish brown.			12/02/2014 14:50	Slightly softer drilling.
					At 20.42 m - colour change to dark grey.				
							Moist	12/02/2014 14:53	
904	21								
903	22								
					At 22.56 m - colour change to dark brown.			12/02/2014 14:55	
					At 22.86 m - colour change to dark bluish grey.	22.86		12/02/2014 14:57	
902	23								
						23.77			
901	24								
		G	G7						
900	25								
899	26	G	G8						
					At 26.21 m - colour change to orangish brown.		Dry	12/02/2014 15:07	Possible oxidation.
					At 26.52 m - colour change to grey.		Dry	12/02/2014 15:09	
898	27								
		G	G9				Moist		
897	28								
896	29	G	G10				Wet	12/02/2014 15:15	AIRLIFT #1 0.6 US GPM 0.5 US GPM 0.5 US GPM Average 0.5 US GPM
	30								

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-002D

Page 4 **of** 4

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 682756E - 5608900N	Location: TSF	Start Date: 12 Feb 2014
Ground Elevation (m): 925	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 13 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.87
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 15.24
Stick-up (m): 0.73	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
895	30				END OF HOLE AT 29.87 m NOTES: 1. 2" PVC standpipe piezometer installed with screen from 16.76 to 22.86 metres. 2. Filter sand placed from 15.85 to 23.77 metres. 3. Bentonite seal placed from 14.02 to 15.85 metres. 4. Hole backfilled from 23.77 m to 29.87 m with bentonite chips.			12/02/2014 16:30	AIRLIFT #2 0.8 US GPM 0.9 US GPM 0.8 US GPM Average 0.8 US GPM
894	31								
893	32								
892	33								
891	34								
890	35								
889	36								
888	37								
887	38								
886	39								
	40								

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AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

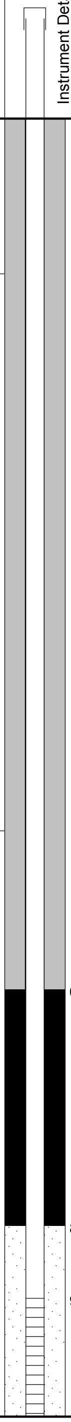
DRILL HOLE # BGC14-002S

Location: Ajax Project Site

Coordinates (m): 682756E - 5608900N
Ground Elevation (m): 925
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.85

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 13 Feb 2014
Finish Date: 13 Feb 2014
Final Depth (m): 15.70
Depth to Top of Rock (m): 15.24
Logged By: SLP
Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
925	0				SAND (SW) Fine to medium, some fine gravel, some silt, light brown. [FILL]	0	At grade, dry	13/02/2014 14:00	
924	1								
					GRAVEL (GP) Fine, some medium to coarse sand, trace silt, poorly graded, light brown with grey clasts, maximum particle size is 10 mm. [FLUVIAL]		Dry	13/02/2014 14:05	
923	2								
922	3						Dry	13/02/2014 14:07	
921	4								
							Dry	13/02/2014 14:11	Welding time 14:13 to 14:30.
920	5								
					SILT (ML) Some gravel, trace fine sand, trace clay, well graded, low plasticity, dark brown with dark grey clasts. [TILL]		Moist	13/02/2014 14:33	
919	6								
						6.71			
918	7								
					Below 7.62 m - increase in gravel content to gravelly, clasts are dark to light grey. ▼		Moist	13/02/2014 14:35	
									At 7.87 m - static water level, measured 3/3/2014 15:11.
917	8								
						8.53			
916	9					9.09			
					Below 9.14 m - significant decrease in gravel content to trace, increase in clay content to some, increase in moisture content.		Moist	13/02/2014 14:38	
	10								

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-002S

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 682756E - 5608900N
Ground Elevation (m): 925
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.85

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 13 Feb 2014
Finish Date: 13 Feb 2014
Final Depth (m): 15.70
Depth to Top of Rock (m): 15.24
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
915	10								
					Below 10.67 m - colour change of matrix from dark brown to dark grey.		Moist	13/02/2014 14:40	Welding time 14:41 to 14:55.
914	11								
913	12								
							Moist	13/02/2014 14:58	
912	13								
							Moist	13/02/2014 15:01	
911	14								
					Below 14.78 m - slight increase in moisture content.		Moist	13/02/2014 15:03	
910	15								
						15.19			
					BEDROCK Drill cuttings: fine to coarse grained, light reddish brown to organish brown, slightly to moderately weathered, some oxidation. [NICOLA VOLCANICS]		Dry	13/02/2014 15:05	
					END OF HOLE AT 15.70 m NOTES: 1. 2" PVC standpipe piezometer installed with screen from 9.09 to 15.19 metres. 2. Filter sand placed from 8.53 to 15.70 metres. 3. Bentonite seal placed from 6.71 to 8.53 metres.				
909	16								
908	17								
907	18								
906	19								
	20								

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Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-003D

Page 1 ***of*** 4

Location: Ajax Project Site

Coordinates (m): 683544E - 5608858N
Ground Elevation (m): 897
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 1.2

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 3.04

Start Date: 14 Feb 2014
Finish Date: 14 Feb 2014
Final Depth (m): 32.34
Depth to Top of Rock (m): 21.95
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND (SW) Gravelly, silty, well graded, light brown with grey clasts, trace organics (rootlets 1 mm diameter). [TOPSOIL]	0	Dry	14/02/2014 08:17	Logged from sump.
896									
	1								
		G	G1				Dry	14/02/2014 08:22	
895									
	2								
894					SILT (ML) Some gravel, some fine sand, trace to some clay, low plasticity, dark brown matrix with grey pockets and grey clasts. [TILL]		Dry	14/02/2014 08:24	
	3								
		G	G2				Dry	14/02/2014 08:25	
893									
	4								
					▼				
		G	G3		Below 4.57 m - decrease in clay content.		Moist	14/02/2014 08:27	At 4.43 m - static water level, measured 5/7/2014 9:16. Welding time 8:28 to 8:48.
892									
	5								
891									
					Below 5.79 m - colour change to dark greyish brown.				
	6								
		G	G4				Moist	14/02/2014 08:50	
890									
	7								
							Moist	14/02/2014 08:52	
889									
	8								
888									
	9								
		G	G5				Dry to moist	14/02/2014 08:57	
887									
	10								

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-003D

Location: Ajax Project Site

Coordinates (m): 683544E - 5608858N	Location: TSF	Start Date: 14 Feb 2014
Ground Elevation (m): 897	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 14 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 32.34
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 21.95
Stick-up (m): 1.2	Fluid: Air	Logged By: SLP
	Cased To (m): 3.04	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								
					Below 10.36 m - decrease in gravel content to trace, colour change to dark brown.				
886							Moist	14/02/2014 09:03	Welding time 9:04 to 9:20.
	11								
					SAND (SM) Coarse, some silt, trace gravel, dark greyish brown. [TILL]				
885									
	12								
							Moist	14/02/2014 09:23	
884									
	13								
883					Below 13.72 m - sand is medium, increase in silt content to silty, medium plasticity.		Moist	14/02/2014 09:25	
	14								
882									
	15				SILT (ML) Clayey, some fine sand, dark grey, low plasticity. [TILL]		Moist	14/02/2014 09:35	
		G	G6						
881									
	16								
880		G	G7		Below 16.76 m - trace gravel, decrese in clay content to some. ▽		Moist	14/02/2014 09:37	Welding time 9:48 to 10:00.
	17								
					GRAVEL AND SAND (GM) Silty, sand is coarse, gravel is coarse to fine, dark grey. [FLUVIAL]		Wet-water encountered at 17.07 m bgs.	14/02/2014 10:02	Estimated inflow 3-4 US GPM.
879									
	18								
		G	G8				Wet	14/02/2014 10:06	
878									
	19								
877									
		G			Below 19.81 m - increase in clay content to trace, sand is coarse, slight colour		Wet	14/02/2014 10:12	
	20								

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-003D

Location: Ajax Project Site

Coordinates (m): 683544E - 5608858N	Location: TSF	Start Date: 14 Feb 2014
Ground Elevation (m): 897	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 14 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 32.34
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 21.95
Stick-up (m): 1.2	Fluid: Air	Logged By: SLP
	Cased To (m): 3.04	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20	G	G9	change to lighter greyish brown.				
876	21							
875		G	G10	SILT (ML) Gravelly, sandy, sand is fine to medium, grey with pockets of brown silt. [TILL]		Dry to moist	14/02/2014 10:17	
	22			WEATHERED BEDROCK Drill cuttings: sandy, sand is fine to medium, some coarse gravel, uniform light greyish green. [NICOLA VOLCANICS]		Dry	14/02/2014 10:21	Qualities of soil, logged as a soil.
874	23	G	G11					
873	24							
		G	G12		24.38	Dry	14/02/2014 10:30	Highly chloritized bedrock?
872	25							
871	26	G	G13		26.21	Dry	14/02/2014 10:39	
870	27							
		G	G14	BEDROCK Drill cuttings: fine grained, angular to subrounded, light grey, maximum particle size is 10 mm, fresh and unweathered. [NICOLA VOLCANICS]		Dry	14/02/2014 10:40	Competent bedrock surface.
869	28				28.35			
868	29	G	G15			Dry	14/02/2014 10:45	
867	30							

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-003D

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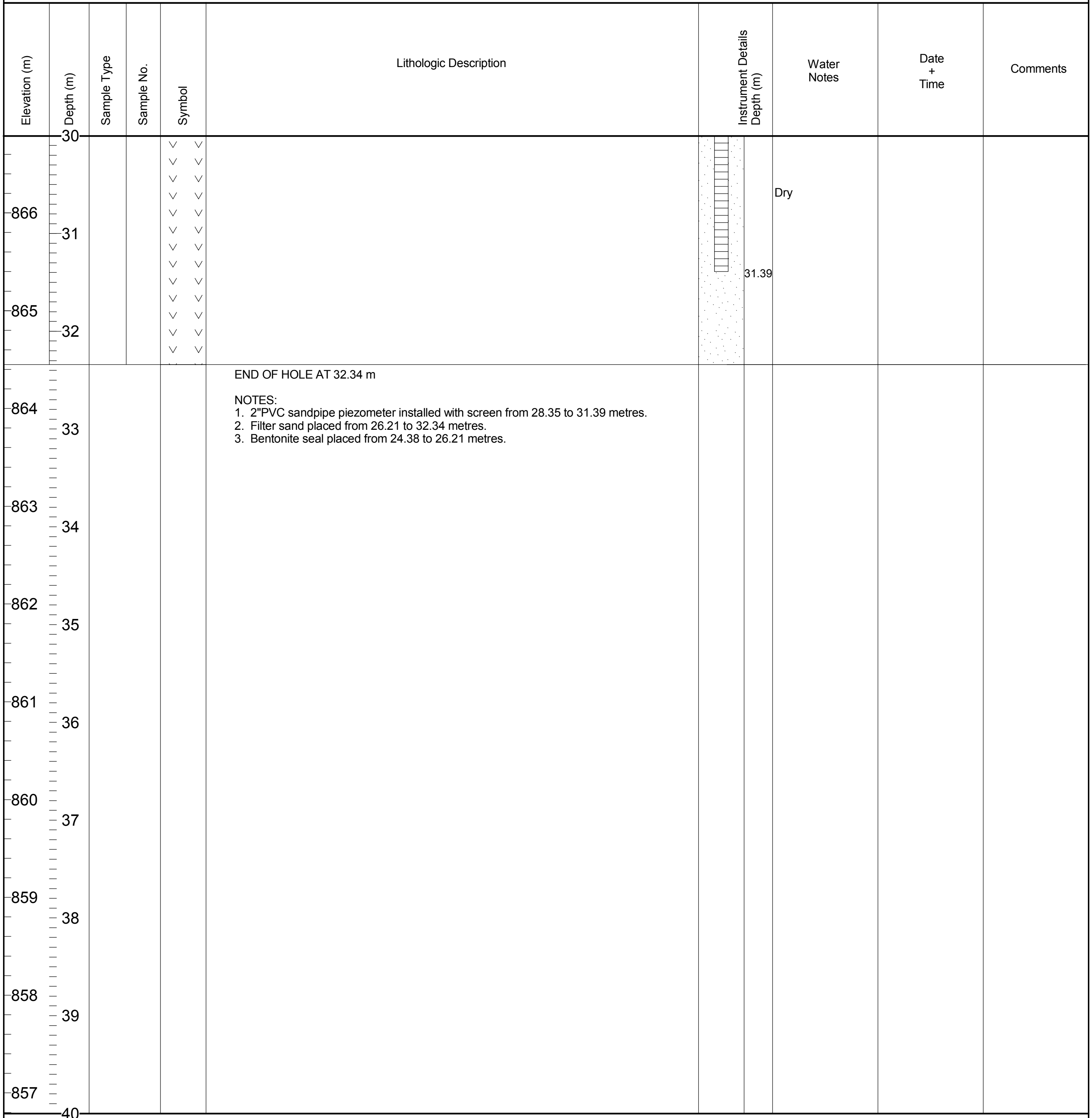
Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 683544E - 5608858N
Ground Elevation (m): 897
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 1.2

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 3.04

Start Date: 14 Feb 2014
Finish Date: 14 Feb 2014
Final Depth (m): 32.34
Depth to Top of Rock (m): 21.95
Logged By: SLP
Reviewed By: TWC



END OF HOLE AT 32.34 m

NOTES:
1. 2"PVC sandpipe piezometer installed with screen from 28.35 to 31.39 metres.
2. Filter sand placed from 26.21 to 32.34 metres.
3. Bentonite seal placed from 24.38 to 26.21 metres.

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Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

AJAX (HYDROGEO) AJAX_SOIL_HYDROGEO.GDL BGC.GDT 5/28/15

Project No.: 1125-007
Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-003I

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Location: Ajax Project Site

Coordinates (m): 683544E - 5608858N
Ground Elevation (m): 897
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.82

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 11.28

Start Date: 17 Feb 2014
Finish Date: 17 Feb 2014
Final Depth (m): 21.95
Depth to Top of Rock (m): 20.11
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND (SW) Gravelly, silty, well graded, light brown with grey clasts, trace organics (rootlets 1 mm diameter). [TOPSOIL]	0	Dry	17/02/2014 08:11	Logged from sump.
896									
	1								
							Dry	17/02/2014 08:15	
895									
	2								
894					SILT (ML) Some gravel, some fine sand, trace clay, low plasticity, dark brown with grey clasts. [TILL]		Dry	17/02/2014 08:17	
	3								
							Dry	17/02/2014 08:18	
893									
	4								
					▼				
							Dry	17/02/2014 08:21	At 4.43 m - static water level, measured 3/2/2014 8:00. Welding time 8:23 to 8:52.
892									
	5								
891									
	6								
					Below 6.10 m - decrease in sand content to trace, colour change of matrix to dark grey.		Moist	17/02/2014 08:54	
890									
	7								
							Moist	17/02/2014 08:56	
889									
	8								
888									
	9								
							Slightly moist	17/02/2014 08:59	
887									
	10								

(Continued on next page)

DRILL HOLE # BGC14-003I

Coordinates (m): 683544E - 5608858N
Ground Elevation (m): 897
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.82

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 11.28

Start Date: 17 Feb 2014
Finish Date: 17 Feb 2014
Final Depth (m): 21.95
Depth to Top of Rock (m): 20.11
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								
					Below 10.36 m - decrease in gravel content to trace, colour change of matrix to light brown.		Slightly moist	17/02/2014 09:01	
886									
	11								
					SAND (SM) Fine to coarse, some silt, trace clay, dark greyish brown. [TILL]		Moist	17/02/2014 09:02	Welding time 9:03 to 9:25.
885									
	12								
							Moist	17/02/2014 09:27	
884									
	13								
883							Moist	17/02/2014 09:28	
	14					14.02			
882									
	15				SILT Sandy, some clay to clayey, sand is fine, medium plasticity, dark grey. [TILL]		Moist	17/02/2014 09:34	
							Moist	17/02/2014 09:35	
						15.54			
881									
	16								
880					Below 16.76 m - gravelly, some clay.	16.76	Moist	17/02/2014 09:38	
	17								
					▽				
879					GRAVEL AND SAND (GM) Silty, sand is coarse, dark grey. [FLUVIAL/GLACIOFLUVIAL]		Wet		At 16.67 m - water encountered at unit change.
	18								
					Below 18.29 m - increase in clay content to trace.		Wet	17/02/2014 10:10	Welding time 9:41 to 10:06.
878									
	19								
877									
						19.81			
					Below 19.81 m - decrease in silt content to trace, sand is coarse, gravel is fine,		Wet	17/02/2014 10:16	
	20								

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-003I

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 683544E - 5608858N
Ground Elevation (m): 897
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.82

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 11.28

Start Date: 17 Feb 2014
Finish Date: 17 Feb 2014
Final Depth (m): 21.95
Depth to Top of Rock (m): 20.11
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20				maximum particle size is 5 mm.				
876 875	21				BEDROCK Drill cuttings: fine grained, light grey, fresh and unweathered. [NICOLA VOLCANICS]	20.42	Dry	17/02/2014 10:18	Cuttings are dry, dusty.
874 873 872 871 870 869 868 867	22 23 24 25 26 27 28 29 30				END OF HOLE AT 21.95 m NOTES: 1. 2" PVC standpipe piezometer installed with screen from 16.76 to 19.81 metres. 2. Filter sand placed from 15.54 to 20.42 metres. 3. Bentonite seal placed from 14.02 to 15.54 metres. 4. Hole backfilled from 20.42 m to 21.95 m with bentonite chips.		Dry	17/02/2014 10:20	

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-003S

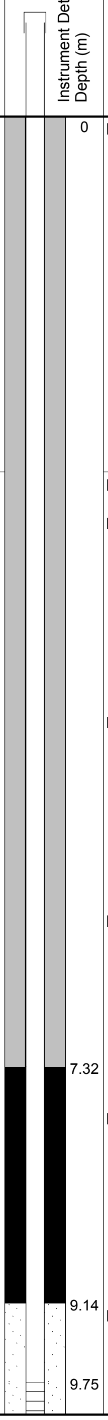
Location: Ajax Project Site

Coordinates (m): 683544E - 5608858N
Ground Elevation (m): 897
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.8

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 3.04

Start Date: 14 Feb 2014
Finish Date: 14 Feb 2014
Final Depth (m): 11.28
Depth to Top of Rock (m): N/A
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND (SW) Gravelly, some silt, well graded, light brown with grey clasts, trace organics (rootlets <2 mm diameter). [TOPSOIL]	0	Dry	14/02/2014 14:54	
					SILT Some gravel, some fine sand, trace clay, dark brown with grey clasts. [TILL]		Dry Moist	14/02/2014 14:56 14/02/2014 14:59	
					▼				
					Below 4.57 m - increase in sand content to sandy, light brown with grey clasts.		Dry	14/02/2014 15:04	At 4.43 m - static water level, measured 3/11/2014 9:20. Welding time 15:05 to 15:25.
					Below 6.10 m - decrease in sand content, dark brown with grey clasts.		Dry	14/02/2014 15:29	
						7.32			
					Below 7.62 m - decrease in sand content to trace.		Dry to moist	14/02/2014 15:32	
						9.14	Dry to moist	14/02/2014 15:35	
						9.75			
	10				Below 9.75 m - decrease in gravel content to trace.				



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Project No.: 1125-007

Project: Ajax Project Environmental Assessment

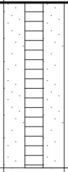
DRILL HOLE # BGC14-003S

Location: Ajax Project Site

Coordinates (m): 683544E - 5608858N
Ground Elevation (m): 897
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.8

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 3.04

Start Date: 14 Feb 2014
Finish Date: 14 Feb 2014
Final Depth (m): 11.28
Depth to Top of Rock (m): N/A
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
886	10 11						Moist	14/02/2014 15:39	
885 884 883 882 881 880 879 878 877	12 13 14 15 16 17 18 19 20				END OF HOLE AT 11.28 m NOTES: 1. 2" PVC standpipe piezometer installed with screen from 9.75 to 11.28 metres. 2. Filter sand placed from 9.14 to 11.28 metres. 3. Bentonite seal placed from 7.32 to 9.14 metres.		Moist	14/02/2014 15:40	

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-004

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Location: Ajax Project Site

Coordinates (m): 687746E - 5609526N	Location: EMRSF	Start Date: 18 Feb 2014
Ground Elevation (m): 871	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 19 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 78.33
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 63.70
Stick-up (m): 0.86	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
871	0				SAND (SW) Medium, some silt, some gravel, well graded, light brown, trace organics (rootlets). [TILL]	0	Dry	19/02/2014 19:49	Logged from pad fill.
870	1								
		G	G1		Below 1.52 m - organics no longer present.		Dry	19/02/2014 07:51	
869	2								
868	3				Below 3.04 m - increase in silt content, trace gravel, slightly darker brown matrix.		Dry	19/02/2014 07:52	
867	4								
		G	G2		Below 4.57 m - decrease in silt content, decrease in gravel content, sand is fine, uniform.		Dry	19/02/2014 07:54	Welding time 7:56 to 8:18.
866	5								
865	6				SILT (MH) Sandy, some gravel, sand is coarse, gravel is fine, well graded, dark brown matrix with grey clasts. [TILL]		Moist	19/02/2014 08:20	
864	7				Below 7.67 m - sand is medium to coarse, gravel is fine to coarse, increase in moisture.				
		G	G3				Moist	19/02/2014 08:21	
863	8				▼				At 8.23 m - static water level, measured 5/13/2014 14:44.
862	9								
					Below 9.14 m - clayey, sand is fine, low plasticity.		Moist	19/02/2014 08:22	
	10								

(Continued on next page)

Coordinates (m): 687746E - 5609526N	Location: EMRSF	Start Date: 18 Feb 2014
Ground Elevation (m): 871	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 19 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 78.33
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 63.70
Stick-up (m): 0.86	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
861	10								
							Moist	19/02/2014 08:23	Welding time 8:24 to 8:43.
860	11								
859	12								
					Below 12.19 m - decrease in sand content.		Moist	19/02/2014 08:45	
858	13								
		G	G4		Below 13.72 m - increase in gravel content to gravelly.		Moist	19/02/2014 08:47	
857	14								
856	15								
		G	G5		At 15.24 m - sand is medium, colour change to dark greyish brown.		Dry to moist	19/02/2014 08:51	
855	16								
854	17	G	G6		GRAVEL (GP) Sandy, sand is medium to coarse, poorly graded, subrounded to subangular, dark brown. [FLUVIAL]		Dry	19/02/2014 08:53	Welding time 8:54 to 9:20.
					▽				At 17.37 m - water encountered. AIRLIFT #1 10 US GPM 10 US GPM 11 US GPM Average 10 US GPM
853	18								
		G	G7		Below 18.29 m - sand no longer present, gravel is multilithic.		Wet	19/02/2014 09:23	
852	19								
	20				Below 19.81 m - coarse sand present in cuttings.		Wet, brown silty	19/02/2014 09:25	

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-004

Location: Ajax Project Site

Coordinates (m): 687746E - 5609526N	Location: EMRSF	Start Date: 18 Feb 2014
Ground Elevation (m): 871	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 19 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 78.33
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 63.70
Stick-up (m): 0.86	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
851	20								
850	21								
		G	G8		At 21.34 m - gravel size range from 4 to 20 mm.		Wet, brown silty	19/02/2014 09:27	
849	22								
848	23	G	G9		At 22.86 m - maximum particle size is 30 mm.		Wet, clean	19/02/2014 09:29	Welding time 9:30 to 9:45.
847	24								
					Below 24.38 m - sand no longer present.		Wet, clean	19/02/2014 09:48	
846	25								
845	26				At 25.91 m - trace silt.		Wet, dark grey	19/02/2014 09:51	
844	27								
		G	G10		Below 27.43 m - silt no longer present, gravel is dark grey to black, multilithic.		Wet, brown, silty	19/02/2014 09:54	
843	28								
842	29	G	G11		Below 28.96 m - sandy, coarse.		Wet, brown, silty/clayey	19/02/2014 09:56	Welding time 9:57 to 10:22. AIRLIFT #2 80-100 US GPM
	30								

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-004

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Location: Ajax Project Site

Coordinates (m): 687746E - 5609526N	Location: EMRSF	Start Date: 18 Feb 2014
Ground Elevation (m): 871	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 19 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 78.33
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 63.70
Stick-up (m): 0.86	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
841	30								
							Wet	19/02/2014 10:26	
840	31								
839	32						Wet, clean	19/02/2014 10:29	
838	33								
							Wet, clean	19/02/2014 10:30	Welding time 10:31 to 10:49.
837	34								
836	35	G	G12				Wet, clean	19/02/2014 10:50	
835	36								
					At 36.58 m - sandy, coarse.		Wet, dark grey	19/02/2014 10:51	
834	37								
833	38						Wet, clean	19/02/2014 11:04	
832	39								
		G	G13				Wet, clean	19/02/2014 11:09	Welding time 11:10 to 11:40.
	40								

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-004

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Location: Ajax Project Site

Coordinates (m): 687746E - 5609526N	Location: EMRSF	Start Date: 18 Feb 2014
Ground Elevation (m): 871	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 19 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 78.33
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 63.70
Stick-up (m): 0.86	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
831	40								AIRLIFT #3 33 US GPM 30 US GPM 27 US GPM Average 30 US GPM
830	41								
							Wet, clean	19/02/2014 11:41	
829	42								
							Wet	19/02/2014 11:43	
828	43								
827	44								
							Wet, clean	19/02/2014 11:50	
826	45								
							Wet	19/02/2014 11:55	
825	46								
824	47								
							Wet, clean	19/02/2014 11:57	Welding time 11:58 to 12:16.
823	48								
822	49	G	G14				Wet, light grey	19/02/2014 12:20	
	50								

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-004

Location: Ajax Project Site

Coordinates (m): 687746E - 5609526N	Location: EMRSF	Start Date: 18 Feb 2014
Ground Elevation (m): 871	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 19 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 78.33
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 63.70
Stick-up (m): 0.86	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
821	50								
							Wet, clean	19/02/2014 12:23	
820	51								
819	52						Wet, clean	19/02/2014 12:26	
818	53								
							Wet, dark grey	19/02/2014 12:29	Welding time 12:36 to 12:55.
817	54						Wet, clean	19/02/2014 12:30	AIRLIFT #4 50 US GPM 60 US GPM 43 US GPM Average 50 US GPM
816	55						Wet	19/02/2014 12:57	
815	56								
					At 56.39 m - driller described as tough, cohesive drilling, resembled compacted gravel.		Wet	19/02/2014 13:01	
814	57								
813	58						Wet, clean	19/02/2014 13:05	
812	59								
							Wet, clean	19/02/2014 13:08	Welding time 13:09 to 13:32.
	60								

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-004

Location: Ajax Project Site

Coordinates (m): 687746E - 5609526N
Ground Elevation (m): 871
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.86

Location: EMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 18 Feb 2014
Finish Date: 19 Feb 2014
Final Depth (m): 78.33
Depth to Top of Rock (m): 63.70
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
811	60								
810	61						Wet	19/02/2014 13:43	
809	62								
					At 62.48 m - maximum particle size is 40 mm.		Wet	19/02/2014 13:48	
808	63								
					BEDROCK Drill cuttings: fine to medium grained, angular to subrounded, dark grey, fresh and unweathered.		Wet, clean water	19/02/2014 13:51	Changing drill bit 13:53 to 14:30.
807	64								
806	65								
		G	G15		Below 65.53 m - green with orangish speckling, slightly weathered to unweathered.		Wet, light grey, silty	19/02/2014 14:34	
805	66								
						66.9			
804	67								
		G	G16		Below 67.06 m - orangish brown mineralization (not iron staining), angular.		Wet, light grey	19/02/2014 14:37	
803	68								
						68.28			
		G	G17		Below 68.58 - grey.		Wet, cleaner than above	19/02/2014 14:40	
802	69								
	70								

(Continued on next page)

Coordinates (m): 687746E - 5609526N
Ground Elevation (m): 871
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.86

Location: EMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 18 Feb 2014
Finish Date: 19 Feb 2014
Final Depth (m): 78.33
Depth to Top of Rock (m): 63.70
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
801	70								
		G	G18				Wet, light grey	19/02/2014 14:49	
800	71								
		G	G19				Wet, light grey	19/02/2014 14:47	
799	72								
						72.24			
798	73								
		G	G20		Below 73.15 m - dark green.		Wet	19/02/2014 14:50	
797	74								
		G	G21		Below 74.68 m - grey to dark grey.		Wet, grey	19/02/2014 14:55	
796	75								
795	76								
		G	G22				Wet, light grey	19/02/2014 15:03	
794	77								
		G	G23				Wet	19/02/2014 15:08	
793	78								
					END OF HOLE AT 78.33 m NOTES: 1. 4" PVC standpipe piezometer installed with screen from 72.24 to 78.33 metres. 2. Filter sand placed from 68.28 to 78.33 metres. 3. Bentonite seal placed from 66.90 to 68.28 metres.		Wet	19/02/2014 15:10	AIRLIFT #5 4 US GPM 4.4 US GPM 4.2 US GPM Average US 4.2 GPM
792	79								
	80								

Project No.: 1125-007

DRILL HOLE # BGC14-005

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Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 687161E - 5609519N
Ground Elevation (m): 878
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.86

Location: EMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 19 Feb 2014
Finish Date: 20 Feb 2014
Final Depth (m): 50.46
Depth to Top of Rock (m): 43.28
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0			▥	SILT (ML) Sandy, some gravel, sand is fine, well graded, nonplastic, gravel is rounded, light brown with grey clasts. [TILL]	0	Dry	19/02/2014 15:22	
876		G	G1	▥			Dry	19/02/2014 15:24	
				▥			Dry	19/02/2014 15:26	
	4			▨	CLAY (CI) Silty, some fine sand, trace gravel, medium plasticity, light greyish brown. [TILL]				
873		G	G2	▨			Dry to moist	19/02/2014 15:28	Welding time 15:30 to 15:50.
				▨			Dry	19/02/2014 15:52	
870		G	G3	▥	SILT (ML) Sandy, some clay, trace gravel, sand is fine, light brown with grey clasts. [TILL]		Dry	19/02/2014 15:55	
		G	G4	⁙	SAND (SW) Fine, silty, some gravel, well graded, light brown. [TILL]		Dry	19/02/2014 15:59	
	10								

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Coordinates (m): 687161E - 5609519N
Ground Elevation (m): 878
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.86

Location: EMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 19 Feb 2014
Finish Date: 20 Feb 2014
Final Depth (m): 50.46
Depth to Top of Rock (m): 43.28
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Lithologic Description	Water Notes	Date + Time	Comments
				Below 10.67 m - decrease in silt.	Dry	19/02/2014 16:02	Welding time 16:05 to 16:28.
					Dry	19/02/2014 16:31	
864		G	G5	SAND (SP) Trace gravel, trace silt, uniformly graded, light brown. [GLACIOFLUVIAL]	Dry	19/02/2014 16:35	
				Below 15.24 m - increase in gravel content.	Dry	19/02/2014 16:38	
				▼			At 16.08 m - static water level, measured 3/24/2014 15:50.
				Below 16.76 m - slight increase in silt content.	Dry	19/02/2014 16:42	
				Below 18.29 m - silty, dark greyish brown.	Dry to moist	20/02/2014 07:33	
	20				Dry	20/02/2014 07:37	

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-005

Location: Ajax Project Site

Coordinates (m): 687161E - 5609519N
Ground Elevation (m): 878
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.86

Location: EMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 19 Feb 2014
Finish Date: 20 Feb 2014
Final Depth (m): 50.46
Depth to Top of Rock (m): 43.28
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20								
857									
	21								
		G	G6		SAND (SM) Fine, some silt, uniformly graded, light brown. [GLACIOFLUVIAL]		Dry	20/02/2014 07:40	
856									
	22								
855									
	23				Below 27.86 m - colour change to grey.		Dry to moist	20/02/2014 07:43	Colour change. Welding time 7:45 to 8:05.
854									
	24								
							Dry	20/02/2014 08:07	
853									
	25								
852									
	26						Dry	20/02/2014 08:11	
851									
	27								
							Dry	20/02/2014 08:13	
850									
	28								
849									
	29	G	G7		SILT (ML) Sandy, sand is fine, uniformly graded, low plasticity, grey to dark grey. [TILL]		Dry	20/02/2014 08:15	Welding time 8:19 to 8:36.
848									
	30								

(Continued on next page)

Coordinates (m): 687161E - 5609519N	Location: EMRSF	Start Date: 19 Feb 2014
Ground Elevation (m): 878	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 20 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 50.46
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 43.28
Stick-up (m): 0.86	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30								
847					Below 30.48 m - trace to some clay, increase in moisture content.		Moist	20/02/2014 08:39	
	31								
846									
	32	G	G8		Below 32.00 m - slight increase in clay to some.		Moist	20/02/2014 08:43	
845									
	33								
844					Below 33.53 m - slight increase in moisture content.		Moist	20/02/2014 08:47	Slightly more moist than above.
	34								
843									
	35								
							Moist	20/02/2014 08:52	
842					∇		Wet	20/02/2014 08:54	Welding time 8:54 to 9:14. At 35.66 m - water encountered. Inadequate quantity of water to complete Airlift test.
	36								
841							Wet, dark grey, silty	20/02/2014 09:18	
	37								
840									
	38								
							Wet, dark grey, silty	20/02/2014 09:24	
839									
	39								
838		G	G9				Wet, dark grey, silty	20/02/2014 09:28	
	40								

(Continued on next page)

Coordinates (m): 687161E - 5609519N
Ground Elevation (m): 878
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.86

Location: EMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 19 Feb 2014
Finish Date: 20 Feb 2014
Final Depth (m): 50.46
Depth to Top of Rock (m): 43.28
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
					Below 41.15 m - decrease in moisture content.		Moist	20/02/2014 09:32	Welding time 9:33 to 10:00.
							Wet, dark grey, silty	20/02/2014 10:05	
					BEDROCK Drill cuttings: fine to medium grained, angular to subrounded, dark grey, slightly weathered. [IRONMASK HYBRID]		Wet	20/02/2014 10:10	
		G	G10				Wet	20/02/2014 10:11	Changing drill bit 10:15 to 10:45.
						44.5			
		G	G11		Below 45.72 m - fine to coarse, dark grey to orangish brown, multilithic.		Wet, light grey	20/02/2014 10:49	
						46.02			
		G	G12		Below 47.24 m - light greenish grey.	47.24	Wet, light grey	20/02/2014 10:51	
		G	G13				Wet, light greenish grey	20/02/2014 10:53	AIRLIFT #1 0.7 US GPM 1.0 US GPM 0.8 US GPM Average 0.8 US GPM

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Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-005

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Location: Ajax Project Site

Coordinates (m): 687161E - 5609519N	Location: EMRSF	Start Date: 19 Feb 2014
Ground Elevation (m): 878	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 20 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 50.46
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 43.28
Stick-up (m): 0.86	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	50								
827	51				END OF HOLE AT 50.46 m NOTES: 1. 4" PVC standpipe piezometer installed with screen from 47.24 to 50.46 metres. 2. Filter sand placed from 46.02 to 50.46 metres. 3. Bentonite seal placed from 44.50 to 46.02 metres.				
826	52								
825	53								
824	54								
823	55								
822	56								
821	57								
820	58								
819	59								
818	60								

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-006D

Location: Ajax Project Site

Coordinates (m): 687288E - 5610779N
Ground Elevation (m): 940
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.76

Location: EMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 21 Feb 2014
Finish Date: 22 Feb 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 14.02
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
940	0				SAND (SW) Fine, silty, some fine to coarse gravel, well graded, light brown with grey and brown clasts. [TOPSOIL]	0	Dry	22/02/2014 09:08	
939	1	G	G1				Dry	22/02/2014 09:12	
938	2				SILT (ML) Sandy, trace to some clay, trace gravel, sand is fine, well graded, low plasticity, light brown with grey clasts. [TILL]		Dry to slightly moist	22/02/2014 09:14	
937	3	G	G2				Dry to slightly moist	22/02/2014 09:16	
936	4								
935	5	G	G3		SAND (SP) Fine, gravelly, gravel is fine to coarse, trace silt, uniformly graded, light brown with grey clasts. [TILL]		Dry	22/02/2014 09:20	Welding time 9:22 to 9:44.
934	6				GRAVEL (GP) Fine to coarse, trace fine sand, trace silt, uniformly graded, light brown and grey clasts. [GLACIOFLUVIAL]		Dry	22/02/2014 09:47	
933	7								
932	8	G	G4				Dry	22/02/2014 09:19	
					▼				At 8.64 m - static water level, measured 5/24/2014 12:01.
931	9	G	G5		SAND AND GRAVEL (GM) Some silt, trace clay, sand is fine to medium, gravel is fine to coarse, well graded, light brown. [TILL]		Dry	22/02/2014 09:52	
	10				SAND (SM)		Dry	22/02/2014 09:53	

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-006D

Location: Ajax Project Site

Coordinates (m): 687288E - 5610779N
Ground Elevation (m): 940
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.76

Location: EMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 21 Feb 2014
Finish Date: 22 Feb 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 14.02
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10				Fine, silty, some fine to coarse gravel, well graded, light grey [TILL]				
		G	G6				Dry	22/02/2014 09:55	
							Dry	22/02/2014 10:17	
					▽		Moist	22/02/2014 10:19	At 13.1 m - water encountered.
		G	G7						
	14				BEDROCK Drill cuttings: fine to medium grained, greyish green and reddish brown, slightly to moderately weathered. [IRONMASK HYBRID]		Moist	22/02/2014 10:21	Changing drill bit 10:25 to 10:45.
							Wet, brown, silty	22/02/2014 10:47	AIRLIFT #1 1 drop/sec
		G	G8		Below 15.24 m - fine, angular, light grey, fresh and unweathered.		Dry	22/02/2014 10:50	
							Dry	22/02/2014 10:52	
						17.37			
		G	G9				Dry	22/02/2014 10:56	
					From 19.20 m to 27.43 m - brown fine sand and silt present in cuttings, gravel is subangular to rounded, moderately weathered.	19.2	Dry	22/02/2014 10:57	Possible fault.
	20	G					Dry	22/02/2014 10:58	

(Continued on next page)

Coordinates (m): 687288E - 5610779N	Location: EMRSF	Start Date: 21 Feb 2014
Ground Elevation (m): 940	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 22 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 14.02
Stick-up (m): 0.76	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20	G	G10						
920									
						20.42			
	21								
919									
		G	G11		Below 21.34 m - slight decrease in sand content.		Dry	22/02/2014 11:01	Weathered zone.
	22								
918									
	23	G	G12		Below 22.86 m - colour change to reddish purple.		Dry	22/02/2014 11:03	Weathered zone.
917									
	24								
916									
		G	G13		Below 22.86 m - reddish brown, silt and fine sand present in cuttings, clasts are subrounded, slight increase in moisture, indicated by darker colour.		Dry to moist	22/02/2014 11:09	Weathered zone.
	25								
915									
	26	G	G14				Dry to moist	22/02/2014 11:11	Weathered zone.
914									
						26.52			
	27								
913									
		G	G15		At 27.43 m - end of weathered zone, colour change back to light grey, angular, unweathered.		Dry	22/02/2014 11:16	End of weathered zone.
	28								
912									
	29	G	G16				Dry	22/02/2014 11:19	
911									
					END OF HOLE AT 29.56 m				AIRLIFT #2 0.04 US GPM Inflow possibly from
	30								

(Continued on next page)

DRILL HOLE # BGC14-006D

Coordinates (m): 687288E - 5610779N	Location: EMRSF	Start Date: 21 Feb 2014
Ground Elevation (m): 940	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 22 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 14.02
Stick-up (m): 0.76	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
910	30				NOTES: 1. 4" PVC standpipe piezometer installed with screen from 20.42 to 26.52 metres. 2. Filter sand placed from 19.20 to 29.56 metres. 3. Bentonite seal placed from 17.37 to 19.20 metres.				upper unit.
909	31								
908	32								
907	33								
906	34								
905	35								
904	36								
903	37								
902	38								
901	39								
	40								

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-006S

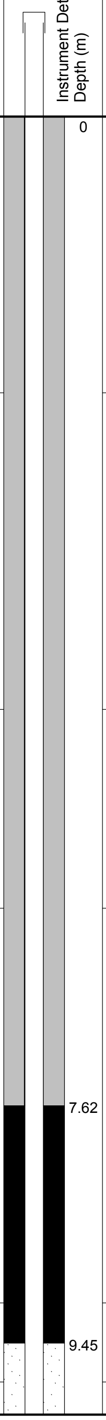
Location: Ajax Project Site

Coordinates (m): 687288E - 5610779N
Ground Elevation (m): 940
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.8

Location: EMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 22 Feb 2014
Finish Date: 22 Feb 2014
Final Depth (m): 14.33
Depth to Top of Rock (m): 14.02
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
940	0				SAND(SW) Fine, silty, some fine to coarse gravel, well graded, light brown with grey clasts. [TOPSOIL]	0	Dry	22/02/2014 11:09	
							Dry	22/02/2014 11:12	
938					SILT (ML) Sandy, trace clay, trace gravel, sand is fine, well graded, low plasticity, light brown to brown with grey clasts. [TILL]		Dry	22/02/2014 11:14	
							Dry	22/02/2014 11:17	
					SAND (SP) Fine, gravelly, trace silt, gravel is fine to coarse, uniformly graded, brown with grey clasts, clasts are subangular. [TILL]		Dry	22/02/2014 11:20	Welding time 11:21 to 11:43.
934					GRAVEL (GP) Fine to coarse, trace to some fine sand, trace silt, uniformly graded, light brown with grey clasts. [GLACIOFLUVIAL]		Dry	22/02/2014 11:45	
					▼	7.62	Dry	22/02/2014 11:50	
931					SAND AND GRAVEL (GM) Some silt, trace clay, sand is fine to medium, gravel is fine to coarse, well graded, light greyish brown. [TILL]	9.45	Dry	22/02/2014 11:53	At 9.15 m - static water level, measured 6/1/2014 11:15.
					SAND (SW)		Dry	22/02/2014 11:54	
	10								



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Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

DRILL HOLE # BGC14-006S

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

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Location: Ajax Project Site

Coordinates (m): 687288E - 5610779N
Ground Elevation (m): 940
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.8

Location: EMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 22 Feb 2014
Finish Date: 22 Feb 2014
Final Depth (m): 14.33
Depth to Top of Rock (m): 14.02
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
930	10				Fine, silty, some fine to coarse gravel, well graded, light grey. [TILL]				
							Dry	22/02/2014 11:55	Welding time 11:55 to 12:15.
929	11					10.97			
928	12				Below 12.19 m - increase in gravel content to gravelly.		Dry	22/02/2014 12:18	
927	13				Below 13.11 m - colour change to light greyish brown.				
							Dry	22/02/2014 12:21	
926	14				BEDROCK Drill cuttings: fine to medium grained, greyish green and reddish brown cuttings, slightly to moderately weathered. [IRONMASK HYBRID]	14.02	Dry	22/02/2014 12:23	
							Dry	22/02/2014 12:25	
					END OF HOLE AT 14.33 m				
925	15								
924	16								
923	17								
922	18								
921	19								
	20								

NOTES:
1. 4" PVC standpipe piezometer installed with screen from 10.97 to 14.02 metres.
2. Filter sand placed from 9.45 to 14.33 metres.
3. Bentonite seal placed from 7.62 to 9.45 metres.

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-007D

***Page** 1 **of** 4*

Location: Ajax Project Site

Coordinates (m): 685324E - 5608722N	Location: SMRSF	Start Date: 23 Feb 2014
Ground Elevation (m): 924	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 23 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 24.38
Stick-up (m): 0.76	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND (SW) Gravelly, silty, well graded, organics (rootlets, grasses) [TOPSOIL]	0	At grade, dry	23/02/2014 08:58	
					GRAVEL (GP) Some sand, uniformly graded, angular to subrounded, grey, multilithic gravel cuttings. [GLACIOFLUVIAL]				
		G	G1				Dry	23/02/2014 09:00	
					SILT (ML) Gravelly, some fine sand, gravel is fine to coarse, low plasticity, light brown to brown with grey clasts. [TILL]				
		G	G2				Dry	23/02/2014 09:03	
		G	G3		Below 4.27 m - decrease in gravel content, slightly darker brown.		Dry	23/02/2014 09:06	Welding time 9:07 to 9:48.
					Below 6.10 m - dark brown with grey clasts, increase in moisture content.		Dry to moist	23/02/2014 09:52	
		G	G4		Below 7.62 m - dark greyish brown.		Dry to moist	23/02/2014 09:54	
							Dry to moist	23/02/2014 09:57	
	10								

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-007D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 685324E - 5608722N
Ground Elevation (m): 924
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.76

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 23 Feb 2014
Finish Date: 23 Feb 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 24.38
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								
914									
		G	G5		Below 10.67 m - decrease in gravel content, dark grey.		Dry to moist	23/02/2014 10:00	Welding time 10:02 to 10:34.
	11								
913									
	12								
912					Below 12.19 m - decrease in gravel to trace.		Dry to moist	23/02/2014 10:39	
	13								
911									
		G	G6				Dry to moist	23/02/2014 10:42	
	14								
910									
	15								
909					Below 15.24 m - slight increase in gravel content.		Dry to moist	23/02/2014 10:48	
	16								
908									
		G	G7				Dry to moist	23/02/2014 10:54	Welding time 10:55 to 11:19.
	17								
907									
	18								
906		G	G8		BOULDER Drill cuttings: fine, unweathered, angular, dark grey.		Dry	23/02/2014 11:25	Changing drill bit 11:27 to 11:55.
	19				SILT (ML) Gravelly, gravel is fine to coarse, uniformly graded, light brown with brown and grey clasts. [TILL]				
905									
	20						Dry	23/02/2014 12:03	

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-007D

Location: Ajax Project Site

Coordinates (m): 685324E - 5608722N	Location: SMRSF	Start Date: 23 Feb 2014
Ground Elevation (m): 924	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 23 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 24.38
Stick-up (m): 0.76	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
							Dry	23/02/2014 12:14	Below 21.34 m - very little cuttings recovered, most cuttings blown away or blown out of basket.
							Dry	23/02/2014 12:22	
						24.03			
		G	G9		BEDROCK Drill cuttings: fine grained, angular, dark grey, fresh and unweathered. [NICOLA VOLCANICS]		Dry	23/02/2014 12:30	
		G	G10		Below 25.91 m - darker grey.	25.91	Dry	23/02/2014 12:36	Very little cuttings recovered.
						26.52			
					Below 27.43 m - light grey.		Dry	23/02/2014 12:42	
							Dry	23/02/2014 12:50	
					END OF HOLE AT 29.56 m				

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-007D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 685324E - 5608722N	Location: SMRSF	Start Date: 23 Feb 2014
Ground Elevation (m): 924	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 23 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 24.38
Stick-up (m): 0.76	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30				NOTES: 1. 4" PVC standpipe piezometer installed with screen from 26.52 to 29.56 metres. 2. Filter sand placed from 25.91 to 29.56 metres. 3. Bentonite seal placed from 24.03 to 25.91 metres.				
894									
	31								
893									
	32								
892									
	33								
891									
	34								
890									
	35								
889									
	36								
888									
	37								
887									
	38								
886									
	39								
885									
	40								

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-007S

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Location: Ajax Project Site

Coordinates (m): 685324E - 5608722N	Location: SMRSF	Start Date: 23 Feb 2014
Ground Elevation (m): 924	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 23 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 17.37
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): N/A
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND (SW) Gravelly, silty, well graded, organics. [TOPSOIL]	0			
924					GRAVEL (GP) Fine to coarse, some coarse sand, gravel is grey, angular, multilithic. [FLUVIAL]		Dry	23/02/2014 16:05	
923	1						Dry	23/02/2014 16:07	
921	3				SILT (ML) Gravelly, gravel is fine to coarse, uniformly graded, low plasticity, light brown with grey and brown clasts. [TILL]		Dry	23/02/2014 16:10	
920							Dry	23/02/2014 16:12	Welding time 16:13 to 16:30.
918	6				Below 6.10 m - decrease in gravel content, trace clay, darker brown.		Dry to moist	23/02/2014 16:33	
917							Dry to moist	23/02/2014 16:35	
915	9				Below 9.14 m - dark greyish brown.		Dry to moist	23/02/2014 16:37	
	10								

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-007S

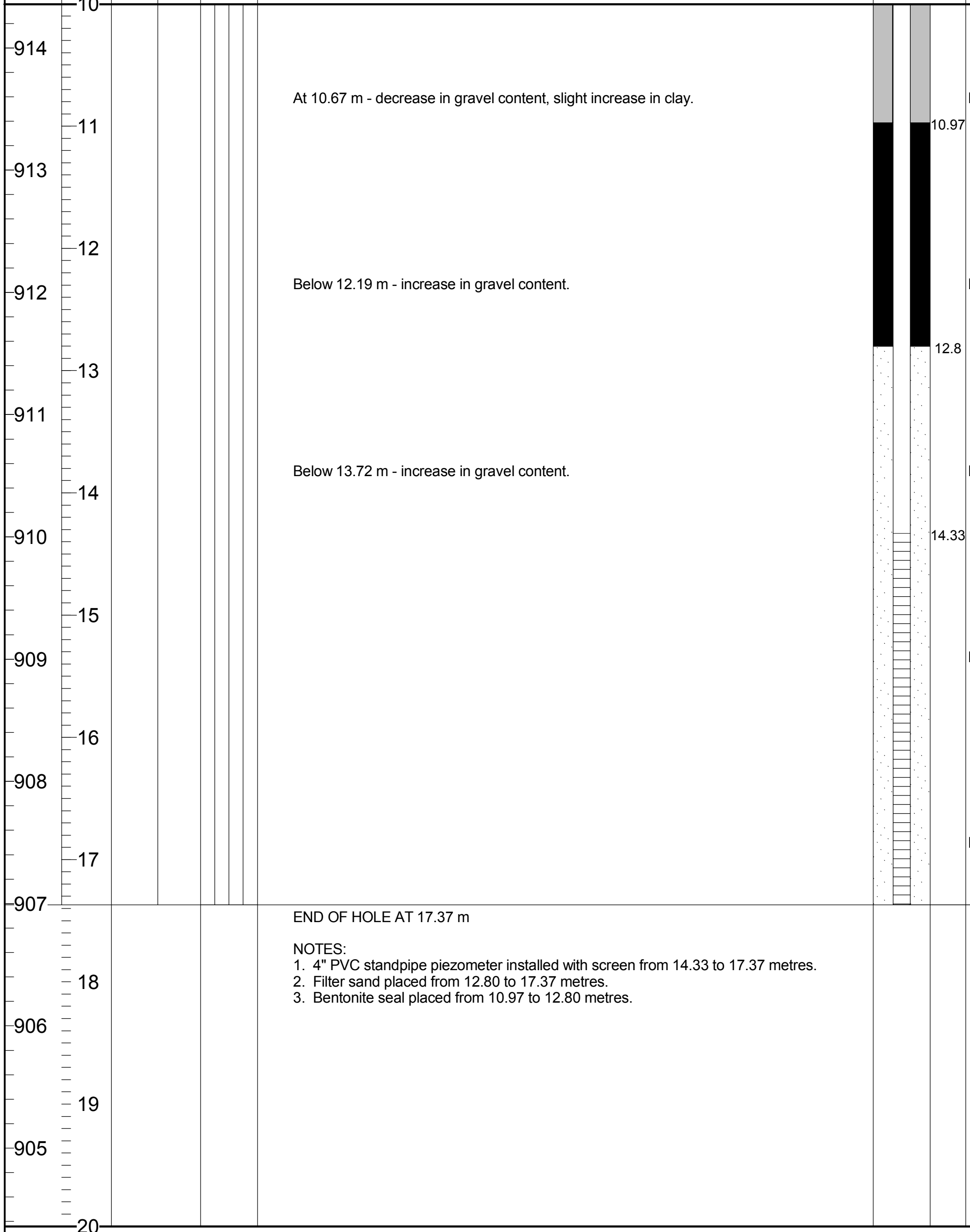
Page 2 **of** 2

Location: Ajax Project Site

Coordinates (m): 685324E - 5608722N
Ground Elevation (m): 924
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 23 Feb 2014
Finish Date: 23 Feb 2014
Final Depth (m): 17.37
Depth to Top of Rock (m): N/A
Logged By: SLP
Reviewed By: TWC



Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
At 10.67 m - decrease in gravel content, slight increase in clay.		Moist	23/02/2014 16:42	Welding time 16:43 to 17:09.
	10.97			
Below 12.19 m - increase in gravel content.		Moist	23/02/2014 17:12	
	12.8			
Below 13.72 m - increase in gravel content.		Moist	23/02/2014 17:15	
	14.33			
		Moist	23/02/2014 17:18	
		Moist	23/02/2014 17:22	

END OF HOLE AT 17.37 m

NOTES:
1. 4" PVC standpipe piezometer installed with screen from 14.33 to 17.37 metres.
2. Filter sand placed from 12.80 to 17.37 metres.
3. Bentonite seal placed from 10.97 to 12.80 metres.

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

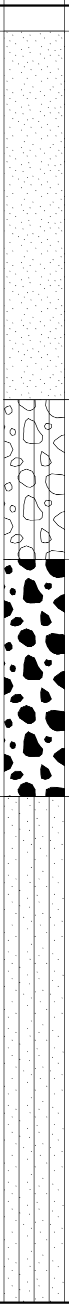
DRILL HOLE # BGC14-008D

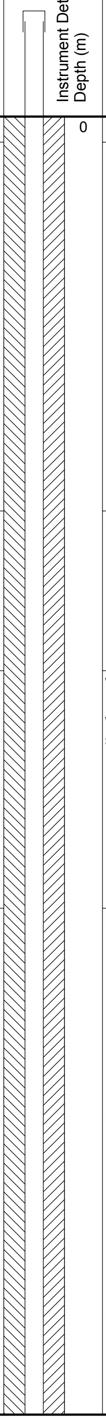
Location: Ajax Project Site

Coordinates (m): 686107E - 5608923N
Ground Elevation (m): 878
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.81

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 24 Feb 2014
Finish Date: 25 Feb 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 15.85
Logged By: SLP
Reviewed By: TWC





Elevation (m)	Depth (m)	Sample Type	Sample No.	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0			SAND Gravelly, dark brown, grasses, rootlets. [TOPSOIL]	0	Moist	25/02/2014 12:30	Moist from snow.
				SAND (SP) Fine to medium, some silt, trace coarse gravel, uniformly graded, light brown. [GLACIOFLUVIAL]		Dry	25/02/2014 12:31	
		G	G1			Dry	25/02/2014 12:32	
		G	G2	GRAVEL (GM) Coarse to fine, silty, some fine sand, well graded, angular, brown with brown and grey clasts. [GLACIOFLUVIAL]		Dry	25/02/2014 12:35	
				GRAVEL AND SAND (GW) Gravel is coarse, sand is coarse, trace silt, well graded, subangular, dark brown with brown and grey clasts. ∇ [GLACIOFLUVIAL]		Wet	25/02/2014 12:36	
		G	G3			Wet, dark grey, sandy	25/02/2014 12:37	At 4.57 - water encountered. AIRLIFT #1 0.03 US GPM Welding time 12:38 PM to 12:59 PM.
		G	G4	SAND (SM) Fine to medium, silty, some fine to coarse gravel, well graded, greyish brown with grey clasts. [TILL]		Moist	25/02/2014 13:05	
		G	G5	At 7.62 m - decrease in gravel content.		Moist	25/02/2014 13:07	
						Moist	25/02/2014 13:10	

Elevation (m): 877, 876, 875, 874, 873, 872, 871, 870, 869, 868
Depth (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

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BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-008D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 686107E - 5608923N	Location: SMRSF	Start Date: 24 Feb 2014
Ground Elevation (m): 878	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 25 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 15.85
Stick-up (m): 0.81	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								
867									
		G	G6		At 10.67 m - increase in gravel content.		Moist	25/02/2014 13:13	Welding time 13:15 to 13:35.
	11								
866									
	12								
		G	G7		SILT (ML) Sandy (fine), trace to some fine to coarse gravel, well graded, greyish brown. [TILL]		Moist	25/02/2014 13:39	
865									
	13								
864									
							Moist	25/02/2014 13:42	
	14								
863									
	15								
					At 15.24 m - sand is coarse, increase in gravel content, increase in moisture.		Moist	25/02/2014 13:47	
862									
	16				WEATHERED BEDROCK Drill cuttings: fine gravel, subrounded to subangular, light green, moderately to highly weathered. [IRONMASK HYBRID]		Dry	25/02/2014 13:50	Soft drilling, powdery.
861									
	17	G	G8				Dry	25/02/2014 13:52	Possibily chloritized Welding time 13:53 to 14:15.
860									
	18								
859		G	G9		Below 18.29 m - dark greenish grey.		Dry	25/02/2014 14:17	Powdery cuttings.
	19								
858									
	20	G			Below 19.81 m - dark grey.		Dry	25/02/2014 14:18	Powdery cuttings.

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-008D

Project: Ajax Project Environmental Assessment

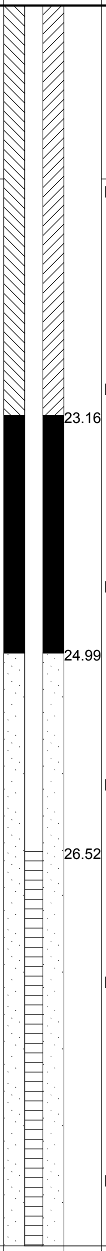
Location: Ajax Project Site

Coordinates (m): 686107E - 5608923N
Ground Elevation (m): 878
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.81

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 24 Feb 2014
Finish Date: 25 Feb 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 15.85
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20	G	G10						
857									
	21								
856		G	G11		BEDROCK Drill cuttings: fine to medium grained, dark grey to light green, fresh and unweathered to slightly weathered. [IRONMASK HYBRID]		Dry	25/02/2014 14:21	Hard drilling.
	22				▼				At 21.96 m - static water level, measured 5/7/2014 11:54.
855									
	23				Below 22.86 m - fine, angular, dark grey.	23.16	Dry	25/02/2014 14:24	
854									
	24								
853		G	G12		Below 24.38 m - slightly lighter grey than above.		Dry	25/02/2014 14:28	
	25					24.99			
852									
	26	G	G13				Dry	25/02/2014 14:32	
851						26.52			
	27								
850		G	G14				Dry	25/02/2014 14:36	
	28								
849									
	29						Dry	25/02/2014 14:40	
848					END OF HOLE AT 29.56 m		Dry	25/02/2014 14:42	
	30								



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BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-008D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 686107E - 5608923N
Ground Elevation (m): 878
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.81

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 24 Feb 2014
Finish Date: 25 Feb 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 15.85
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30				NOTES: 1. 4" PVC standpipe piezometer installed with screen from 26.52 to 29.56 metres. 2. Filter sand placed from 24.99 to 29.56 metres. 3. Bentonite seal placed from 23.16 to 24.99 metres.				
847									
	31								
846									
	32								
845									
	33								
844									
	34								
843									
	35								
842									
	36								
841									
	37								
840									
	38								
839									
	39								
838									
	40								

AJAX (HYDROGEO) AJAX_SOIL_HYDROGEO.GDL BGC.GDT 5/28/15

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

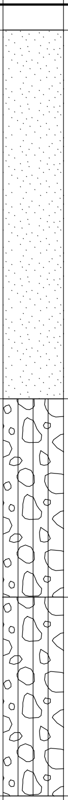
DRILL HOLE # BGC14-008S

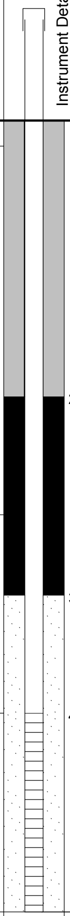
Page 1 **of** 1

Location: Ajax Project Site

Coordinates (m): 686107E - 5608923N	Location: SMRSF	Start Date: 25 Feb 2014
Ground Elevation (m): 878	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 25 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 6.10
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): N/A
Stick-up (m): 0.86	Fluid: Air	Logged By: SLP
	Cased To (m): 0.91	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND Gravelly, some silt, light brown, grasses and rootlets. [TOPSOIL]	0	Dry	25/02/2014 15:42	
					SAND (SP) Fine to medium, some silt, trace coarse gravel, uniformly graded, light brown. [TILL]	2.13	Dry	25/02/2014 15:44	
	3				GRAVEL (GM) Fine to coarse, sandy, silty, sand is coarse, well graded, grey and brown clasts. [GLACIOFLUVIAL]	3.66	Dry	25/02/2014 15:46	
873					SAND AND GRAVEL (GM) Silty, sand is fine to coarse, gravel is fine to coarse, well graded, brown with grey clasts. [GLACIOFLUVIAL]	4.57	Moist	25/02/2014 15:48	Welding time 15:49 to 16:11.
	6				END OF HOLE AT 6.10 m		Moist	25/02/2014 16:16	





NOTES:
1. 4" PVC standpipe piezometer installed with screen from 4.57 to 6.10 metres.
2. Filter sand placed from 3.66 to 6.10 metres.
3. Bentonite seal placed from 2.13 to 3.66 metres.

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-009

Location: Ajax Project Site

Coordinates (m): 686799E - 5608547N
Ground Elevation (m): 919
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 26 Feb 2014
Finish Date: 27 Feb 2014
Final Depth (m): 53.95
Depth to Top of Rock (m): 3.96
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
919	0				SAND (SW) Fine to coarse, some fine to coarse gravel, trace silt, well graded, light brown with grey clasts, light brown with grey clasts. [TILL]	0	Dry	26/02/2014 09:02	
		G	G1				Dry	26/02/2014 09:04	
		G	G2		Below 3.04 m - increase in silt content.		Dry	26/02/2014 09:06	
	4				WEATHERED BEDROCK Drill cuttings: fine to coarse, sandy, trace silt, sand is medium to coarse, well graded, ubangular to subrounded, greyish brown, moderately to highly weathered. [IRONMASK HYBRID]				
		G	G3				Dry	26/02/2014 09:10	Welding time 9:11 to 9:52.
	6				BEDROCK Drill cuttings: fine grained, angular to subangular, dark to light grey, fresh and unweathered. [IRONMASK HYBRID]		Dry	26/02/2014 09:54	Changing drill bit 9:56 to 10:16.
		G	G4				Dry	26/02/2014 10:18	Consistently hard drilling.
							Dry	26/02/2014 10:20	
909	10								

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Coordinates (m): 686799E - 5608547N	Location: SMRSF	Start Date: 26 Feb 2014
Ground Elevation (m): 919	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 27 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 53.95
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 3.96
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								
908							Dry	26/02/2014 10:24	Hard drilling.
	11								
907	12								
		G	G5				Moist	26/02/2014 10:30	At 12.19 m - moisture encountered, unmeasurable quantity. Zone of moisture.
906	13								
905		G	G6		From 13.72 m to 16.76 m - fine sand, light greenish grey, moderately weathered.	▼	Dry to moist	26/02/2014 10:35	Pulverized rock, resembles sand. At 14.06 m - static water level, measured 3/26/2014 10:53.
	14								
904	15								
		G	G7				Dry to moist	26/02/2014 10:37	
903	16								
902		G	G8		Below 16.76 - fine, angular, dark grey, fresh and unweathered.		Dry to moist	26/02/2014 10:39	
	17								
901	18								
		G	G9				Dry	26/02/2014 10:45	
900	19								
899							Dry	26/02/2014 10:48	
	20								

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-009

Location: Ajax Project Site

Coordinates (m): 686799E - 5608547N	Location: SMRSF	Start Date: 26 Feb 2014
Ground Elevation (m): 919	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 27 Feb 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 53.95
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 3.96
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20								
898									
	21								
		G	G10				Dry	26/02/2014 10:50	
897									
	22								
896									
	23				Below 22.86 m - subangular to rounded.		Dry	26/02/2014 10:52	
895									
	24								
		G	G11				Dry	26/02/2014 10:58	
894									
	25								
893									
	26						Dry	26/02/2014 11:00	
892									
	27								
		G	G12				Dry	26/02/2014 11:03	
891									
	28								
890									
	29						Dry	26/02/2014 11:06	
889									
	30								

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-009

Location: Ajax Project Site

Coordinates (m): 686799E - 5608547N
Ground Elevation (m): 919
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 26 Feb 2014
Finish Date: 27 Feb 2014
Final Depth (m): 53.95
Depth to Top of Rock (m): 3.96
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30								
		G	G13				Dry	26/02/2014 11:10	
888	31								
887	32						Dry	26/02/2014 11:14	
886	33								
		G	G14				Dry	26/02/2014 11:17	
885	34								
884	35								
		G	G15				Dry	26/02/2014 11:19	
883	36								
882	37								
881	38								
		G	G16				Dry	26/02/2014 13:15	
880	39								
879	40								

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-009

Location: Ajax Project Site

Coordinates (m): 686799E - 5608547N
Ground Elevation (m): 919
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 26 Feb 2014
Finish Date: 27 Feb 2014
Final Depth (m): 53.95
Depth to Top of Rock (m): 3.96
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	40								
878									
	41								
		G	G17				Dry	26/02/2014 13:19	
877									
	42								
876									
	43								
875									
	44								
		G	G18		Below 44.20 m - rounded to subangular, dark greenish grey, slightly softer than previous.		Dry to slightly moist	26/02/2014 13:37	
874									
	45								
						45.11			
873							Dry	26/02/2014 13:31	
	46								
872									
						46.94			
	47								
		G	G19				Dry	26/02/2014 13:33	
871					At 47.80 m - possible fault.	47.85	Moist	26/02/2014 13:34	Driller described a moist fracture.
	48								
870					At 47.77 m - subrounded to rounded, dark grey.		Moist	26/02/2014 13:35	Slowing increasing moisture.
	49								
869									
	50								

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-009

Location: Ajax Project Site

Coordinates (m): 686799E - 5608547N
Ground Elevation (m): 919
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 26 Feb 2014
Finish Date: 27 Feb 2014
Final Depth (m): 53.95
Depth to Top of Rock (m): 3.96
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
		G	G20		At 50.46 m - increase in moisture content.		Moist	26/02/2014 13:48	
					At 51.82 m - subangular, dark greenish grey, cuttings are uniform in size.		Moist	26/02/2014 13:53	
		G	G21		At 53.34 m - increase in moisture content. ▽		Wet	26/02/2014 13:58	At 53.34 m - water encountered.
					END OF HOLE AT 53.95 m NOTES: 1. 2" PVC standpipe piezometer installed with screen from 47.85 to 53.95 metres. 2. Filter sand placed from 46.94 to 53.95 metres. 3. Bentonite seal placed from 45.11 to 46.94 metres.		Wet, grey, silty	26/02/2014 13:58	AIRLIFT #1 0.9 US GPM 1 US GPM 1 US GPM AVG 1 US GPM

AJAX (HYDROGEO) AJAX_SOIL_HYDROGEO.GDL BGC.GDT 5/28/15

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-010

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 681730E - 5607414N
Ground Elevation (m): 979
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 27 Feb 2014
Finish Date: 02 Mar 2014
Final Depth (m): 78.33
Depth to Top of Rock (m): 10.97
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				GRAVEL (GP) Fine to coarse, some coarse sand, subangular to rounded, brown and grey clasts. [TOPSOIL/FILL]	0	Dry	27/02/2014 13:28	
978	1								
							Dry	27/02/2014 13:31	
977	2								
					GRAVEL AND SILT (GM) Some fine to coarse sand, gravel is fine to coarse, well graded, subangular to subrounded, brown with grey and brown clasts. [TILL]		Dry to slightly moist	27/02/2014 13:34	
976	3								
		G	G1						
975	4								
		G	G2		SILT (ML) Some fine sand to sandy, trace fine to coarse gravel, uniformly graded, brown with grey clasts, clasts are angular to subrounded. [TILL]		Moist	27/02/2014 13:37	Welding time 13:39 to 14:02.
974	5								
973	6								
		G	G3		Below 6.10 m - decrease in gravel content, decrease in sand content, trace clay.		Dry	27/02/2014 14:03	
972	7								
971		G	G4		Below 7.62 m - clayey.		Moist	27/02/2014 14:05	Sticky, cohesive drilling.
	8								
970	9								
					Below 9.14 m - trace to no gravel.		Dry to moist	27/02/2014 14:06	
					▼				
969									At 9.59 m - static water level, measured
	10								

(Continued on next page)

Coordinates (m): 681730E - 5607414N	Location: TSF	Start Date: 27 Feb 2014
Ground Elevation (m): 979	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 02 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 78.33
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 10.97
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								3/12/2014 10:02.
968		G	G5		Below 10.67 m - trace to some fine gravel.		Dry	27/02/2014 14:07	Changing dril bit 14:08 to 14:24.
967	11 12				BEDROCK Drill cuttings: fine to medium grained, angular to subrounded, brown and grey clasts, moderately weathered.				
966	13	G	G6		Below 12.19 m - fine, dark grey, angular.		Dry	27/02/2014 14:32	
965	14				Below 13.72 m - slightly lighter grey than above.		Dry	27/02/2014 14:39	
964 963	15 16	G	G7		Below 15.24m - dark grey.		Dry	27/02/2014 14:45	
962	17	G	G8		Below 16.76 m - subrounded, light grey, average clast size is 4 mm.		Dry	27/02/2014 14:49	
961 960	18 19	G	G9		Below 18.29 m - subrounded, whitish grey.		Dry	27/02/2014 14:55	
959	20	G			Below 19.81 m - angular to subangular, grey.		Dry	27/02/2014 15:00	

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-010

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 681730E - 5607414N	Location: TSF	Start Date: 27 Feb 2014
Ground Elevation (m): 979	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 02 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 78.33
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 10.97
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20	G	G10						
958									
	21								
		G	G11		Below 21.34 - angular, dark grey.		Dry	27/02/2014 15:05	
957									
	22								
956									
	23	G	G12				Dry	27/02/2014 15:10	
955									
	24								
		G	G13		Below 24.38 m - fine, angular to rounded, foliated, grey, flat and elongated.		Dry	27/02/2014 15:15	
954									
	25								
953									
	26	G	G14		Below 25.91 m - light grey, shape as above.		Dry	27/02/2014 15:20	
952									
	27								
					Below 27.43 m - long, flat, rounded.		Dry	27/02/2014 15:23	Powdery cuttings.
951									
	28								
950									
	29	G	G15		Below 28.96 m - angular, grey, average clast size 2 mm.		Dry	27/02/2014 15:25	Powdery cuttings.
949									
	30								

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-010

Location: Ajax Project Site

Coordinates (m): 681730E - 5607414N
Ground Elevation (m): 979
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 27 Feb 2014
Finish Date: 02 Mar 2014
Final Depth (m): 78.33
Depth to Top of Rock (m): 10.97
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30								
948		G	G16		Below 30.48 m - drill cuttings described as soil: fine sand, uniformly graded, whitish grey, no dry strength, pulverized, powdery.				
	31						Dry	28/02/2014 10:51	Very dusty discharge.
947									
	32				Below 32.00 m - fine, flat, elongated, dark to light grey, foliated, unweathered.		Dry	28/02/2014 10:54	
946									
	33								
945		G	G17				Dry	28/02/2014 10:57	
	34								
944									
	35				Below 35.05 m - average clast size is 2 mm.		Dry	28/02/2014 11:01	
943									
	36								
942		G	G18				Dry	28/02/2014 11:05	
	37								
941									
	38						Dry	28/02/2014 11:12	
940									
	39								
939		G	G19				Dry	28/02/2014 11:18	
	40								

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

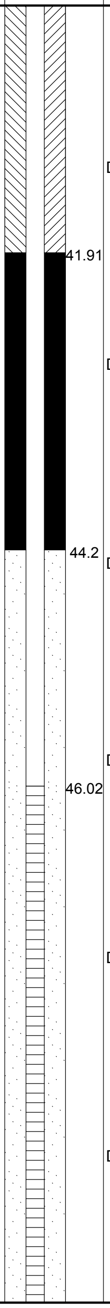
Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-010

Location: Ajax Project Site

Coordinates (m): 681730E - 5607414N	Location: TSF	Start Date: 27 Feb 2014
Ground Elevation (m): 979	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 02 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 78.33
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 10.97
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 4.57	Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
938	41				Below 41.45 m - average clast size 5 mm.		Dry	28/02/2014 11:21	
937	42					41.91			
936	43	G	G20				Dry	28/02/2014 11:30	
935	44					44.2	Dry	28/02/2014 11:36	
933	46	G	G21				Dry	28/02/2014 11:40	
						46.02			
932	47				▽			28/02/2014 11:45	At 46.63 m - moisture encountered. Unmeasurable amount of water. Driller described "break in dust".
							Dry	28/02/2014 11:47	
930	49	G	G22				Dry	28/02/2014 11:54	

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Coordinates (m): 681730E - 5607414N
Ground Elevation (m): 979
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 27 Feb 2014
Finish Date: 02 Mar 2014
Final Depth (m): 78.33
Depth to Top of Rock (m): 10.97
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	50								
							Dry	28/02/2014 12:00	
928									
	51								
927									
	52	G	G23		Below 51.82 m - angular, elongated, flat, dark grey.		Dry	28/02/2014 12:08	
926									
	53								
							Dry	28/02/2014 12:16	
925									
	54								
924									
	55	G	G24				Dry	28/02/2014 12:20	
923									
	56								
							Dry	28/02/2014 12:25	
922									
	57								
921									
	58	G	G25		Below 57.91 m - rounded to subangular, light greyish white, average clast size is 2 mm.		Dry	28/02/2014 12:30	
						58.22			
920									
	59								
							Dry	28/02/2014 12:37	
919						59.74			
	60								

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-010

Location: Ajax Project Site

Coordinates (m): 681730E - 5607414N
Ground Elevation (m): 979
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 27 Feb 2014
Finish Date: 02 Mar 2014
Final Depth (m): 78.33
Depth to Top of Rock (m): 10.97
Logged By: SLP
Reviewed By: TWC

Elevation (m): 918, 917, 916, 915, 914, 913, 912, 911, 910, 909

Depth (m): 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	61	G	G26				Dry	28/02/2014 12:42	
					Below 62.48 m - subangular, light grey, average clast size is 4 mm.		Dry	28/02/2014 12:47	
	64	G	G27		Below 64.00 m - angular to subangular, dark grey, average clast size is 5 mm.		Dry	28/02/2014 12:52	
							Dry	28/02/2014 12:55	
	67	G	G28		Below 67.06 m - average clast size is 3 mm.		Dry	28/02/2014 13:01	
					Below 68.58 m - angular.		Dry	28/02/2014 13:04	

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-010

Location: Ajax Project Site

Coordinates (m): 681730E - 5607414N
Ground Elevation (m): 979
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 4.57

Start Date: 27 Feb 2014
Finish Date: 02 Mar 2014
Final Depth (m): 78.33
Depth to Top of Rock (m): 10.97
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	70								
		G	G29				Dry	28/02/2014 13:08	
908	71								
907	72						Dry	28/02/2014 13:12	
906	73								
		G	G30				Dry	28/02/2014 13:15	
905	74								
904	75				Below 74.68 m - equant, subrounded clasts.		Dry	28/02/2014 13:18	
903	76								
		G	G31		Below 76.20 m - rounded, average clast size is 4 mm.		Dry	28/02/2014 13:25	
902	77								
901	78	G	G32				Dry	28/02/2014 13:32	
					END OF HOLE AT 78.33 m		Dry	28/02/2014 13:37	
900	79								
899	80								

NOTES:
1. 2" PVC standpipe piezometer installed with screen from 46.02 to 58.22 metres.
2. Filter sand placed from 44.20 to 59.74 metres.
3. Bentonite seal placed from 41.91 to 44.20 metres.
4. Hole backfilled from 59.74 m to 78.33 m with bentonite chips.

Project No.: 1125-007

DRILL HOLE # BGC14-011D

Page 1 **of** 4

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 682796E - 5605945N
Ground Elevation (m): 1,029
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.88

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 01 Mar 2014
Finish Date: 02 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 5.49
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
1029	0				SAND (SW) Fine, some fine to coarse gravel, some silt, well graded, light brown with grey clasts. [TOPSOIL/FILL]	0	Dry	01/03/2014 10:03	
1028	1								
		G	G1				Dry	01/03/2014 10:05	
1027	2								
1026	3	G	G2		SILT (ML) Sandy, trace to some gravel, sand is fine, gravel is fine to coarse, well graded, low plasticity, brown with brown and grey clasts. [TILL]		Moist	01/03/2014 10:08	
1025	4								
		G	G3		Below 4.57 m - trace clay.		Moist	01/03/2014 10:11	Welding time 10:12 to 10:38.
1024	5								
					WEATHERED BEDROCK Drill cuttings: sandy, some gravel, sand is fine, gravel is fine, uniformly graded, light green, highly weathered. [NICOLA VOLCANICS]				
1023	6						Dry	01/03/2014 10:42	Cutting casing, changing drill bit 10:43 to 10:59.
1022	7								
		G	G4				Dry	01/03/2014 11:03	
1021	8								
					▼				At 8.62 m - static water level, measured 3/16/2014 12:35.
1020	9	G	G5				Dry	01/03/2014 11:06	
					From 9.75 m to 10.36 m - sandy, silty, green.		Moist	01/03/2014 11:10	Possible fault.
	10								

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-011D

Location: Ajax Project Site

Coordinates (m): 682796E - 5605945N
Ground Elevation (m): 1,029
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.88

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 01 Mar 2014
Finish Date: 02 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 5.49
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
1019	10								
		G	G6		BEDROCK Drill cuttings: fine grained, angular, dark grey, fresh and unweathered to slightly weathered.		Dry to moist	01/03/2014 11:14	
1018	11								
1017	12								
		G	G7		Below 12.19 m - angular to subrounded, average clast size is 6 mm.		Dry	01/03/2014 11:33	
1016	13								
					Below 13.72 m - average clast size is 3 mm.		Dry	01/03/2014 11:33	Hard drilling.
1015	14								
1014	15								
		G	G8		Below 15.24 m - rounded to subangular.		Dry	01/03/2014 11:37	
					▽		Moist		At 15.85 m - moisture encountered.
1013	16								
					Below 16.76 m - subrounded to angular, dark greenish grey.		Wet	01/03/2014 11:44	AIRLIFT #1 1.9 US GPM 1.7 US GPM 2.0 US GPM Average 1.9 US GPM
1012	17								
1011	18								
					Below 18.29 m - subangular to subrounded.		Wet	01/03/2014 11:55	
1010	19								
		G			WEATHERED BEDROCK	19.81	Moist	01/03/2014 12:09	
	20								

(Continued on next page)

Project No.: 1125-007

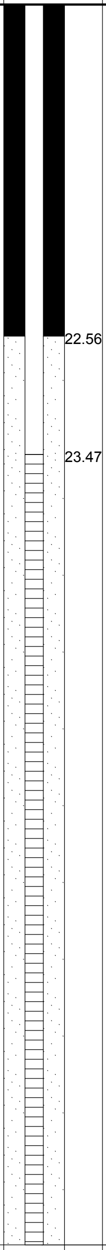
Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-011D

***Page** 3 **of** 4*

Location: Ajax Project Site

Coordinates (m): 682796E - 5605945N	Location: TSF	Start Date: 01 Mar 2014
Ground Elevation (m): 1,029	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 02 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 5.49
Stick-up (m): 0.88	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
1009	20	G	G9		Drill cuttings: sandy, sand is fine, uniformly graded, dark green, highly weathered.				
1008	21								
		G	G10				Moist	01/03/2014 12:21	
1007	22								
						22.56			
1006	23						Moist	01/03/2014 12:26	
						23.47			
1005	24								
		G	G11		Below 24.38 m - trace gravel, subangular.		Moist	01/03/2014 12:31	
1004	25								
1003	26						Moist	01/03/2014 12:38	
1002	27								
		G	G12				Moist	01/03/2014 12:45	
1001	28								
1000	29						Moist	01/03/2014 12:52	AIRLIFT #2 1.5 US GPM 2 US GPM 1.8 US GPM Average 1.8 US GPM
					END OF HOLE AT 29.56 m				
	30								

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-011D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 682796E - 5605945N
Ground Elevation (m): 1,029
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.88

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 01 Mar 2014
Finish Date: 02 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 5.49
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
999	30				NOTES: 1. 2" PVC standpipe piezometer installed with screen from 23.47 to 29.56 metres. 2. Filter sand placed from 22.56 to 29.56 metres. 3. Bentonite seal placed from 19.81 to 22.56 metres.				
998	31								
997	32								
996	33								
995	34								
994	35								
993	36								
992	37								
991	38								
990	39								
	40								

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Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-011S

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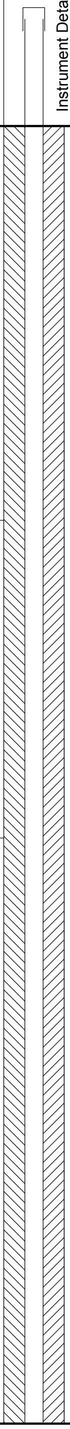
Location: Ajax Project Site

Coordinates (m): 682796E - 5605945N	Location: TSF	Start Date: 01 Mar 2014
Ground Elevation (m): 1,029	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 02 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 18.29
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 5.49
Stick-up (m): 0.91	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
1029	0				SAND (SW) Fine, some fine to coarse gravel, some silt, well graded, light brown with grey clasts. [TOPSOIL/FILL]	0	Dry	01/03/2014 15:03	
1028	1								
							Dry	01/03/2014 15:06	
1027	2								
1026	3				SILT (ML) Some sand to sandy, trace to some gravel, sand is fine, gravel is fine to coarse, well graded, low plasticity, light brown to brown with grey and brown clasts. [TILL]		Moist	01/03/2014 15:09	
1025	4								
					Below 4.57 m - trace clay.		Moist	01/03/2014 15:12	Welding time 15:13 to 15:30.
1024	5								
					BEDROCK Drill cuttings: fine grained, angular, dark grey, average clast size is 3 mm, fresh and unweathered to slightly weathered. [NICOLA VOLCANICS] ▼				At 5.65 m - static water level, measured 3/14/2014 9:28. Cutting casing 15:35 PM to 15:43.
1023	6						Dry	01/03/2014 15:46	
1022	7								
							Dry	01/03/2014 15:54	
1021	8								
1020	9				Below 9.14 m - subrounded, light grey.		Dry	01/03/2014 16:00	
	10								

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

AJAX (HYDROGEO) AJAX_SOIL_HYDROGEO.GDL BGC.GDT 5/28/15

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-011S

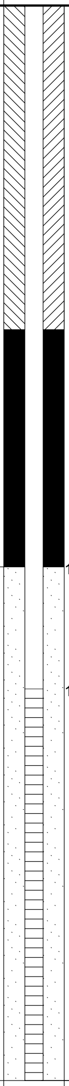
Page 2 **of** 2

Location: Ajax Project Site

Coordinates (m): 682796E - 5605945N
Ground Elevation (m): 1,029
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.91

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 01 Mar 2014
Finish Date: 02 Mar 2014
Final Depth (m): 18.29
Depth to Top of Rock (m): 5.49
Logged By: SLP
Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
1019	10								
					Below 10.67 m - subangular to subrounded, average particle size is 4 mm.		Dry	01/03/2014 16:08	
1018	11								
1017	12								
							Dry	01/03/2014 16:11	
						12.5			
1016	13								
					Below 13.72 m - clasts are flat and angular, average clast size is 3 mm.			01/03/2014 16:14	
1015	14								
					WEATHERED BEDROCK Drill cuttings: sand , trace gravel, sand is fine, gravel is fine to coarse, uniformly graded, dark green. [NICOLA VOLCANICS]	14.33	Moist	01/03/2014 16:16	
1014	15								
						15.27			
1013	16				▽				At 15.85 m - water encountered.
							Moist	01/03/2014 16:18	AIRLIFT #1 1.5 US GPM 1 US GPM 1 US GPM Average 1.2 US GPM
1012	17								
1011	18								
					END OF HOLE AT 18.29 m NOTES: 1. 2" PVC standpipe piezometer installed with screen from 15.24 to 18.29 metres. 2. Filter sand placed from 14.33 to 18.29 metres. 3. Bentonite seal placed from 12.50 to 14.33 metres.		Moist	01/03/2014 16:20	
1010	19								
	20								

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Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-012D

Page 1 **of** 4

Location: Ajax Project Site

Coordinates (m): 681950E - 5608373N
Ground Elevation (m): 924
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.91

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 02 Mar 2014
Finish Date: 03 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 5.18
Logged By: SLP
Reviewed By: TWC

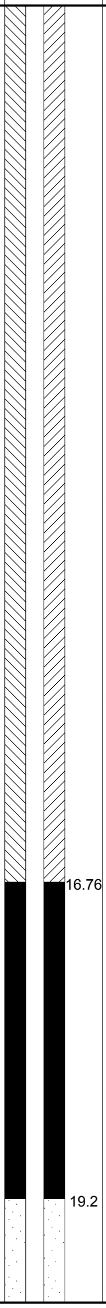
Elevation (m)	Depth (m)
	0
923	1
922	2
921	3
920	4
919	5
918	6
917	7
916	8
915	9
914	10

Sample Type	Sample No.	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
		SAND (SW) Coarse, silty, gravelly, gravel is fine to coarse, well graded, angular to subrounded, dark brown with multilithic clasts. [TOPSOIL]	0	Dry	02/03/2014 14:41	
G	G1	▼		Moist	02/03/2014 14:44	At 1.34 m - static water level, measured 3/17/2014 10:58.
		▽				
		GRAVEL AND SAND (GP/SP) Gravel is fine to coarse, sand is coarse, uniformly graded, angular, dark brown, multilithic. [GLACIOFLUVIAL]		Wet	02/03/2014 14:45	At 2.13 m - water encountered.
G	G2					
		SILT (ML) Sandy, trace gravel, trace clay, sand is fine, gravel is fine, uniformly graded, low plasticity, very dark grey. [TILL]		Wet	02/03/2014 14:46	
G	G3			Moist	02/03/2014 14:47	Welding time 14:48 to 15:10.
		BEDROCK Drill cuttings: fine grained, angular to subangular, dark grey, average clast size is 3 mm, fresh and unweathered to slightly weathered. [NICOLA VOLCANICS]				
G	G4			Dry	02/03/2014 15:13	Hard drilling.
G	G5	Below 7.62 m - average clast size is 5 mm.		Dry	02/03/2014 15:25	
G	G6	Below 9.14 m - average clast size is 4 mm. From 9.44 m to 10.36 m - fine sand and fine gravel, sand is uniformly graded, gravel is rounded.		Dry	02/03/2014 15:32	

(Continued on next page)

DRILL HOLE # BGC14-012D

Coordinates (m): 681950E - 5608373N	Location: TSF	Start Date: 02 Mar 2014
Ground Elevation (m): 924	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 03 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 5.18
Stick-up (m): 0.91	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								
							Dry	02/03/2014 15:35	Soft drilling.
					Below 10.67 m - angular clasts.		Dry	02/03/2014 15:37	
913	11								
912	12								
		G	G7		Below 12.19 m - light grey, average clast size is 3 mm.		Dry	02/03/2014 15:47	
911	13								
							Dry	02/03/2014 15:53	
910	14								
909	15								
		G	G8		Below 15.24 m - greenish grey fine sand present in cuttings, gravel clasts as above.		Dry	02/03/2014 16:00	
908	16								
						16.76	Dry	02/03/2014 16:04	
907	17								
906	18								
		G	G9		Below 18.29 m - green sand no longer present in cuttings.		Dry	02/03/2014 16:08	
905	19								
						19.2			
					Below 19.81 m - average clast size is 4 mm.		Dry	02/03/2014 16:16	
904	20								

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

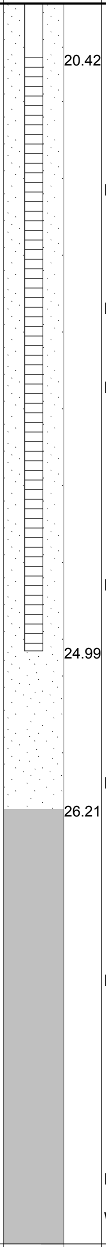
DRILL HOLE # BGC14-012D

Location: Ajax Project Site

Coordinates (m): 681950E - 5608373N
Ground Elevation (m): 924
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.91

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 02 Mar 2014
Finish Date: 03 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 5.18
Logged By: SLP
Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20								
903	21								
		G	G10				Moist	02/03/2014 16:20	At 21.34 m - water encountered.
902	22								
					From 22.25 m to 25.91 m - fine sand, gravelly, rounded cuttings, dark reddish brown, highly weathered, oxidized.		Moist	02/03/2014 16:23	Possible fault. Soft drilling.
901	23	G	G11				Moist	02/03/2014 16:25	
900	24								
		G	G12		Below 24.38 m - dark purplish red.		Moist	02/03/2014 16:27	
899	25								
898	26	G	G13		Below 25.91 m - angular, grey, end of weathered zone.		Moist	02/03/2014 16:29	
897	27								
		G	G14		Below 27.43 m - angular, uniformly graded, dark grey.		Moist	02/03/2014 16:40	
896	28								
895	29	G	G15		Below 28.96 m - subrounded, moderately weathered.		Moist	02/03/2014 16:45	
					At 29.26 m - increase in moisture content.		Wet	02/03/2014 16:50	
					END OF HOLE AT 29.56 m			02/03/2014 16:50	AIRLIFT #1 1 US GPM 0.8 US GPM
894	30								

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-012D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 681950E - 5608373N	Location: TSF	Start Date: 02 Mar 2014
Ground Elevation (m): 924	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 03 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 5.18
Stick-up (m): 0.91	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30				NOTES: 1. 2" PVC standpipe piezometer installed with screen from 20.42 to 24.99 metres. 2. Filter sand placed from 19.20 to 26.21 metres. 3. Bentonite seal placed from 16.76 to 19.20 metres. 4. Hole backfilled from 26.21 m to 29.56 with bentonite chips.				1 US GPM Average 1 US GPM
893	31								
892	32								
891	33								
890	34								
889	35								
888	36								
887	37								
886	38								
885	39								
884	40								

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Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-012S

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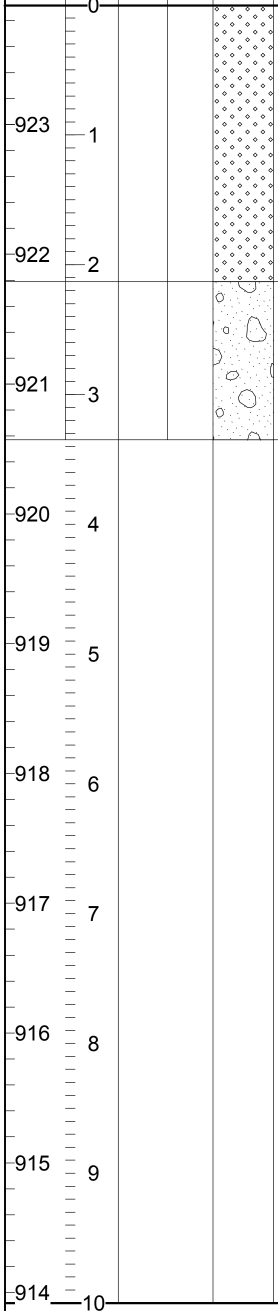
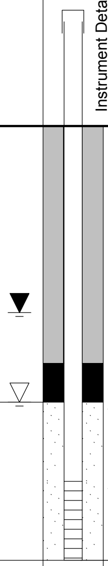
Location: Ajax Project Site

Coordinates (m): 681950E - 5608373N	Location: TSF	Start Date: 03 Mar 2014
Ground Elevation (m): 924	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 03 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 3.35
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): N/A
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 0.91	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND (SW) Coarse, silty, gravelly, gravel is fine to coarse, well graded, angular to subrounded, dark brown with multilithic clasts. [TILL]	0	Dry	03/03/2014 10:22	
						1.83	Dry	03/03/2014 10:23	At 1.44 m - static water level, measured 3/17/2014 8:55.
					GRAVEL AND SAND (GP/SP) Gravel is fine to coarse, sand is coarse, uniformly graded, angular, dark brown, mulitlithic. [GLACIOFLUVIAL]	2.13 2.74			At 2.13 m - water encountered.
					END OF HOLE AT 3.35 m NOTES: 1. 2" PVC standpipe piezometer installed with screen from 2.74 to 3.35 metres. 2. Filter sand placed from 2.13 to 3.35 metres. 3. Bentonite seal placed from 1.83 to 2.13 metres.		Wet	03/03/2014 10:25	





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Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007
Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-013

Page 1 ***of*** 4
Location: Ajax Project Site

Coordinates (m): 686466E - 5606777N
Ground Elevation (m): 987
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.75

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 03 Mar 2014
Finish Date: 04 Mar 2014
Final Depth (m): 30.48
Depth to Top of Rock (m): 11.28
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SILT (ML) Sandy, some clay, trace fine gravel, sand is fine, well graded, low plasticity, light greyish brown. [TILL]	0	Moist	03/03/2014 15:51	Soapy feeling.
986	1								
		G	G1				Moist	03/03/2014 15:52	
985	2								
					SAND AND SILT (SM) Sand is fine, trace clay, uniformly graded, low plasticity, brown. [TILL]				
984	3								
		G	G2		▼		Moist	03/03/2014 15:34	At 3.16 m - static water level, measured 3/18/2014 8:48.
983	4								
		G	G3		Below 4.57 m - trace to some clay.		Moist	03/03/2014 15:56	Welding time 15:57 to 16:18.
982	5								
981	6								
							Moist	03/03/2014 16:20	
980	7								
		G	G4		Below 7.62 m - slight increase in silt content.		Moist	03/03/2014 16:25	
979	8								
978	9								
		G	G5		Below 9.14 m - increase in silt content.		Moist	03/03/2014 16:28	
					▽				
977					GRAVEL (GP)				At 9.75 m - water
	10								

(Continued on next page)

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Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-013

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 686466E - 5606777N	Location: SMRSF	Start Date: 03 Mar 2014
Ground Elevation (m): 987	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 04 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 30.48
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 11.28
Stick-up (m): 0.75	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10				Fine to coarse, sandy, trace clay, sand is coarse, uniformly graded, subangular to subrounded, multilithic. [GLACIOFLUVIAL]				encountered at start of unit.
976	11	G	G6				Wet	03/03/2014 16:30	AIRLIFT #1 1.5 US GPM 1.3 US GPM 1.3 US GPM Average 1.4 US GPM
					BEDROCK Drill cuttings: fine to coarse grained, uniformly graded, angular, multilithic, moderately weathered, oxidized.		Wet	03/03/2014 16:31	Changing drill bit 16:31 to 16:50.
975	12								
		G	G7				Wet, dark grey	03/03/2014 16:55	
974	13								
973	14				Below 13.72 m - angular, dark grey, slightly weathered, faintly oxidized.		Wet, dark grey	03/03/2014 16:57	
972	15								
		G	G8				Wet, dark grey	03/03/2014 17:01	
971	16								
970	17						Wet, light grey	03/03/2014 17:07	
969	18								
		G	G9		Below 18.29 m - subangular, dark grey to light grey, average particle size is 4 mm.		Wet, light grey to clear	04/03/2014 07:18	AIRLIFT #2 2.9 US GPM 2.8 US GPM 2.7 US GPM Average 2.8 US GPM
968	19								
967	20				Below 19.81 m - uniformly graded, angular to subangular, dark bluish grey, average		Wet, clean to light	04/03/2014 07:25	

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-013

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 686466E - 5606777N
Ground Elevation (m): 987
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.75

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 03 Mar 2014
Finish Date: 04 Mar 2014
Final Depth (m): 30.48
Depth to Top of Rock (m): 11.28
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20				particle size is 2 mm.		grey		
966	21								
		G	G10				Wet, silty	04/03/2014 07:29	From 21.64 to 22.56 m - softer drilling, silty discharge water.
965	22								
964	23	G	G11		Below 22.86 m - trace silt, average clast size is 5 mm.		Wet, silty	04/03/2014 07:33	
								04/03/2014 07:33	AIRLIFT #3 2.5 US GPM 2.5 US GPM 2.4 US GPM Average 2.5 US GPM
963	24					24.08			
		G	G12		Below 24.38 m - angular, flat, grey, average clast size is 4 mm.		Wet, clean to light grey	04/03/2014 07:46	
962	25								
961	26				Below 25.91 m - average clast size is 2 mm.		Wet, clean to light grey	04/03/2014 07:50	
						26.52			
960	27								
		G	G13			27.43	Wet, clean to light grey	04/03/2014 07:55	
959	28								
		G	G14						
958					From 28.04 m to 28.65 m - yellowish brown, clayey, silty discharge, cuttings are angular, dark grey and brown. At 28.91 m - angular, dark grey, as above.		Wet, yellowish brown	04/03/2014 07:56	
	29	G	G15						
		G	G16				Wet, yellowish brown	04/03/2014 08:03	
957	30								

(Continued on next page)

DRILL HOLE # BGC14-013

Coordinates (m): 686466E - 5606777N	Location: SMRSF	Start Date: 03 Mar 2014
Ground Elevation (m): 987	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 04 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 30.48
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 11.28
Stick-up (m): 0.75	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30	G	G17		From 29.56 m to 29.87 m - silty, yellowish brown, multilithic cuttings. Below 29.87 m - fine, angular, dark grey.				
					END OF HOLE AT 30.48 m NOTES: 1. 2" PVC standpipe piezometer installed with screen from 27.43 to 30.48 metres. 2. Filter sand placed from 26.52 to 30.48 metres. 3. Bentonite seal placed from 24.08 to 26.52 metres.		Wet, clean to light grey	04/03/2014 08:09	AIRLIFT #4 2.6 US GPM 2.7 US GPM 2.7 US GPM Average 2.7 US GPM
956	31								
955	32								
954	33								
953	34								
952	35								
951	36								
950	37								
949	38								
948	39								
947	40								

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-014D

Location: Ajax Project Site

Coordinates (m): 686672E - 5607810N
Ground Elevation (m): 986
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 04 Mar 2014
Finish Date: 05 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 18.90
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND (SW) Fine, silty, gravelly, gravel is fine to coarse, well graded, dark brown with grey clasts. [TOPSOIL/FILL]	0	Moist	04/03/2014 14:00	Moist from snow.
		G	G1		GRAVEL (GP) Fine to coarse, sandy, sand is coarse, uniformly graded, angular to subrounded, brown and grey. [GLACIOFLUVIAL]		Dry	04/03/2014 14:02	
	3	G	G2		SAND [SM] Fine, silty, some gravel, gravel is fine to coarse, light brown with grey clasts. [TILL]		Dry to moist	04/03/2014 14:04	
							Dry to moist	04/03/2014 14:07	Welding time 14:08 PM to 14:32.
	6				SILT [ML] Sandy, trace to some gravel, sand is fine, uniformly graded, low plasticity, grey with grey and brown clasts. [TILL]		Dry to moist	04/03/2014 14:37	
		G	G3		Below 7.62 m - gravel is angular to subrounded, grey.		Dry to moist	04/03/2014 14:40	
							Dry to moist	04/03/2014 14:43	
	10								

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-014D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 686672E - 5607810N	Location: SMRSF	Start Date: 04 Mar 2014
Ground Elevation (m): 986	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 05 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 18.90
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								
975									
		G	G4		Below 10.67 m - trace clay, light brownish grey.		Dry to moist	04/03/2014 14:46	Welding time 14:48 to 15:04.
	11								
974									
	12								
							Dry to moist	04/03/2014 15:08	
973									
					▼				
	13								At 12.91 m - static water level, measured 5/28/2014 8:15.
972									
		G	G5		Below 13.72 m - trace gravel, multilithic.		Dry to moist	04/03/2014 15:09	
	14								
971									
	15								
					Below 15.24 m - decrease in gravel content.		Dry to moist	04/03/2014 15:14	
970									
	16								
969									
		G	G6				Dry to moist	04/03/2014 15:16	Welding time 15:17 to 15:35.
	17								
968									
	18								
							Dry to moist	04/03/2014 15:39	
967									
	19				BEDROCK Drill cuttings: sand and gravel, sand is medium to coarse, gravel is coarse, sand is rounded, gravel is angular to subrounded, brownish grey, mulitlithic, moderately weathered.				
966									
	20	G					Dry	04/03/2014 15:42	Changing drill bit

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-014D

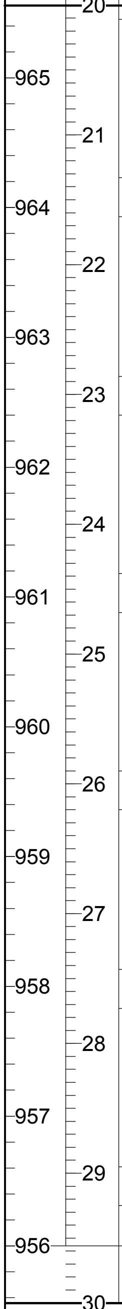
Project: Ajax Project Environmental Assessment

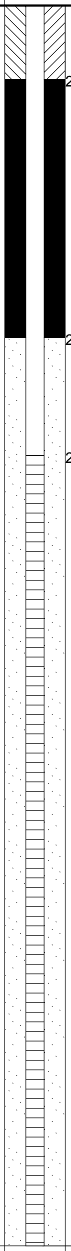
Location: Ajax Project Site

Coordinates (m): 686672E - 5607810N
Ground Elevation (m): 986
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 04 Mar 2014
Finish Date: 05 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 18.90
Logged By: SLP
Reviewed By: TWC





Sample Type	Sample No.	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
G	G7					15:43 to 16:00.
			20.57			
G	G8	Below 21.34 m - rounded clasts, light greenish grey, fine sand present in cuttings, moderately weathered.		Dry	04/03/2014 16:05	
			22.56			
G	G9	Below 22.86 m - gravelly sand, sand is fine, light greyish green, gravel is rounded, moderately weathered.		Dry	04/03/2014 16:09	
			23.47			
G	G10	Below 24.38 m - sandy gravel, gravel is dark grey, angular to subrounded, sand is coarse, grey, moderately weathered. ∇		Dry	04/03/2014 16:17	
					04/03/2014 16:17	At 24.69 m - moisture encountered, driller described "break in dust".
					04/03/2014 16:17	At 25.30 m - moisture encountered, driller described "break in dust".
G	G11	Below 25.91 m - fine sand, light greenish grey, uniform, trace gravel, gravel is dark grey, angular, moderately weathered.		Dry	04/03/2014 16:21	
G	G12	Below 27.43 m - gravel, fine to coarse, some sand (fine), gravel is grey, subrounded, sand is greenish grey, moderately weathered.		Dry	04/03/2014 16:28	
G	G13					
		END OF HOLE AT 29.56 m				

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-014D

Location: Ajax Project Site

Coordinates (m): 686672E - 5607810N
Ground Elevation (m): 986
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 04 Mar 2014
Finish Date: 05 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 18.90
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30				NOTES: 1. 2" PVC standpipe piezometer installed with screen from 23.47 to 29.56 metres. 2. Filter sand placed from 22.56 to 29.56 metres. 3. Bentonite seal placed from 20.57 to 22.56 metres.				
955									
	31								
954									
	32								
953									
	33								
952									
	34								
951									
	35								
950									
	36								
949									
	37								
948									
	38								
947									
	39								
946									
	40								

BGC ENGINEERING INC.
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Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-014S

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Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 686672E - 5607810N	Location: SMRSF	Start Date: 05 Mar 2014
Ground Elevation (m): 986	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 05 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 18.90
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): N/A
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND (SW) Fine to coarse, gravelly, silty, well graded, dark brown with grey clasts. [TOPSOIL]	0	Moist from snow melt	05/03/2014 11:28	
					GRAVEL (GW) Fine to coarse, silty, some fine to coarse sand, well graded, angular to subrounded, greyish brown. [GLACIOFLUVIAL]		Dry	05/03/2014 11:31	
	3				SILT (ML) Some fine sand, trace to some gravel, low plasticity, uniformly graded, brown with grey clasts, clasts are angular. [TILL]		Dry	05/03/2014 11:35	
					Below 4.57 m - sandy, fine.		Dry to moist	05/03/2014 11:39	Welding time 11:40 to 12:04.
					Below 6.10 m - decrease in gravel, light greyish brown with grey and brown clasts.		Dry to moist	05/03/2014 12:06	
							Dry to moist	05/03/2014 12:10	
							Dry to moist	05/03/2014 12:13	
	10					9.75			

(Continued on next page)

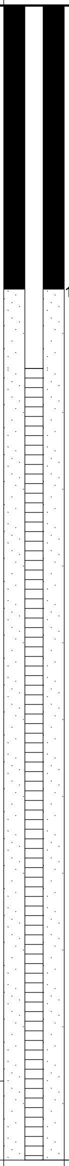
BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

DRILL HOLE # BGC14-014S

Coordinates (m): 686672E - 5607810N	Location: SMRSF	Start Date: 05 Mar 2014
Ground Elevation (m): 986	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 05 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 18.90
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): N/A
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
					Below 10.67 m - trace clay.		Dry to moist	05/03/2014 12:15	Welding time 12:16 to 12:40.
						12.19	Dry to moist	05/03/2014 12:42	
						12.8			
							Dry to moist	05/03/2014 12:46	
					Below 15.24 m - increase in gravel content, angular to subrounded.		Dry to moist	05/03/2014 12:50	
					Below 16.76 m - decrease in gravel content.		Dry to moist	05/03/2014 12:59	Welding time 13:00 to 13:20.
					Below 18.29 m - gravel is angular.		Dry to moist	05/03/2014 13:22	

END OF HOLE AT 18.90 m

NOTES:
1. 2" PVC standpipe peizometer installed with screen from 12.80 to 18.90 metres.
2. Filter sand placed from 12.19 to 18.90 metres.
3. Bentonite seal placed from 9.75 to 12.19 metres.

AJAX (HYDROGEO) AJAX_SOIL_HYDROGEO.GDL BGC.GDT 5/28/15

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-015D

Location: Ajax Project Site

Coordinates (m): 686773E - 5606920N	Location: SMRSF	Start Date: 06 Mar 2014
Ground Elevation (m): 977	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 06 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 11.28
Stick-up (m): 0.94	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SILT (ML) Sandy, some gravel, trace clay, sand is fine, gravel is fine, well graded, low plasticity, dark brown with grey clasts. [TILL]	0	Moist	06/03/2014 07:50	Drill bit plugged with soil 7:51 to 8:43.
976									
	1								At 0.95 m - static water level, measured 5/7/2014 2:02.
975							Dry to moist	06/03/2014 08:45	
	2								
974									
	3	G	G1		Below 3.04 m - some fine sand, trace to some clay.		Dry to moist	06/03/2014 08:47	
973									
	4								
972		G	G2		SAND (SP) Fine, some fine gravel, trace silt, uniformly graded, brown with brown and grey clasts. [TILL]		Dry	06/03/2014 08:57	Welding time 8:58 to 9:20.
	5								
971									
	6	G	G3		Below 6.10 m - some silt, trace gravel, slight increase in moisture content.		Dry	06/03/2014 09:23	
970									
	7				At 7.01 m - boulder.			06/03/2014 09:25	Changing drill bit 9:25 to 9:33.
969		G	G4		Below 7.62 m - increase in silt, gravel no longer present.		Dry to moist	06/03/2014 00:00	
	8								
968					GRAVEL AND SAND (SP/GP) Gravel is fine to coarse, sand is medium to coarse, trace silt, uniformly graded, subrounded, dark grey. [GLACIOFLUVIAL]		Wet	06/03/2014 09:36	At 8.53 m - water encountered.
	9	G	G5		Below 9.14 m - trace to some silt, subangular to subrounded.		Wet	06/03/2014 09:40	
967									
	10								

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-015D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 686773E - 5606920N
Ground Elevation (m): 977
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.94

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 06 Mar 2014
Finish Date: 06 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 11.28
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								
966					Below 10.67 - trace to some clay, driller described as cohesive drilling.		Wet	06/03/2014 09:47	Welding time and had to case through boulder 9:49 to 10:30. At 11.25 m - attempted to airlift, no water expelled.
	11								
965					WEATHERED BEDROCK Drill cuttings: gravel and sand, gravel is coarse, sand is coarse, subangular, brownish grey, moderately to extremely weathered. [NICOLA VOLCANICS]				
	12								
		G	G6				Wet	06/03/2014 10:30	
964									
	13								
963									
		G	G7		Below 13.72 m - fine sand, uniformly graded, brownish grey.			06/03/2014 10:45	
	14								
962					BEDROCK Drill cuttings: fine grained, angular, grey, fresh and unweathered. [NICOLA VOLCANICS]		Dry	06/03/2014 10:48	Hard drilling.
	15								
		G	G8				Dry	06/03/2014 10:50	Tripping out rods to switch drill bits 10:55 to 11:08.
961									
	16								
960									
					Below 16.76 m - average particle size is 4 mm.		Dry	06/03/2014 11:10	Welding time 11:15 to 11:40.
	17								
959									
	18								
		G	G9		Below 18.29 m - average particle size is 5 mm.		Dry	06/03/2014 11:54	
958									
	19								
957									
	20						Dry	06/03/2014 11:55	

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

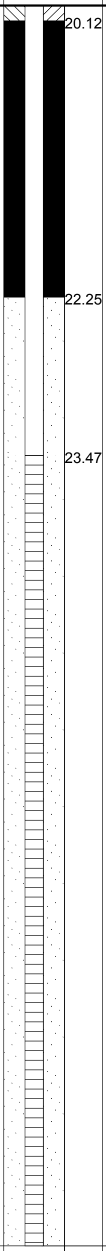
DRILL HOLE # BGC14-015D

Location: Ajax Project Site

Coordinates (m): 686773E - 5606920N
Ground Elevation (m): 977
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.94

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 06 Mar 2014
Finish Date: 06 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 11.28
Logged By: SLP
Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20					20.12			
956	21	G	G10				Dry	06/03/2014 11:56	
955	22					22.25			
954	23							06/03/2014 11:57	
953	24					23.47			
952	25	G	G11		Below 24.38 m - average clast size is 3 mm.		Dry	06/03/2014 11:58	
951	26				Below 25.91 m - average particle size is 2 - 3 mm.		Dry	06/03/2014 11:59	
950	27								
949	28	G	G12		Below 27.43 m - fine sand present in cuttings, increase in weathering.		Dry	06/03/2014 12:00	
948	29	G	G13		At 28.96 m - average particle size is 4 mm.		Dry	06/03/2014 12:02	Driller described "break in dust". From 29.26 m to 29.56 m - moisture detected, not enough for airlift.
947	30				END OF HOLE AT 29.56 m				

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-015D

Location: Ajax Project Site

Coordinates (m): 686773E - 5606920N	Location: SMRSF	Start Date: 06 Mar 2014
Ground Elevation (m): 977	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 06 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 11.28
Stick-up (m): 0.94	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30				NOTES: 1. 2" PVC standpipe piezometer installed with screen from 23.47 to 29.56 metres. 2. Filter sand placed from 22.25 to 29.56 metres. 3. Bentonite seal placed from 20.17 to 22.25 metres.				
946	31								
945	32								
944	33								
943	34								
942	35								
941	36								
940	37								
939	38								
938	39								
937	40								

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AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

DRILL HOLE # BGC14-015S

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 686773E - 5606920N
Ground Elevation (m): 977
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 2.13

Start Date: 06 Mar 2014
Finish Date: 06 Mar 2014
Final Depth (m): 11.28
Depth to Top of Rock (m): N/A
Logged By: SLP
Reviewed By: TWC

Depth (m)	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
0	SILT (ML) Sandy, trace gravel, trace clay, sand is fine, well graded, low plasticity, brown with grey and brown clasts. [TILL]	0	Moist	06/03/2014 15:10	
					At 0.88 m - static water level, measured 5/28/2014 10:27.
			Dry to moist	06/03/2014 15:13	
	Below 3.04 m - some sand increase in clay.		Dry to moist	06/03/2014 15:16	
	SAND (SW) Fine, gravelly, silty, gravel is fine to coarse, well graded, angular, dark grey with grey clasts. [TILL]		Dry	06/03/2014 15:19	Welding time 15:20 to 15:46.
		5.49			
	Below 6.10 m - decrease in silt content.		Dry	06/03/2014 15:51	
	Below 7.62 m - increase in silt content, dark greyish brown.	7.62	Dry	06/03/2014 15:54	
		8.23			
	SAND (SP) Fine, trace silt, some gravel to gravelly, gravel is fine, uniformly graded, greyish brown. [GLACIOFLUVIAL]			06/03/2014 15:55	At 9.14 m - moisture encountered.

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-015S

Location: Ajax Project Site

Coordinates (m): 686773E - 5606920N	Location: SMRSF	Start Date: 06 Mar 2014
Ground Elevation (m): 977	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 06 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 11.28
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): N/A
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 2.13	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
966	10 11				Below 10.67 m - gravelly, fine to coarse.		Moist	06/03/2014 15:58	
965	12				END OF HOLE AT 11.28 m NOTES: 1. 2" PVC standpipe piezometer installed with screen from 8.23 to 11.28 metres. 2. Filter sand placed from 7.62 to 11.28 metres. 3. Bentonite seal placed from 5.49 to 7.62 metres.				
964	13								
963	14								
962	15								
961	16								
960	17								
959	18								
958	19								
957	20								

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AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-016

Location: Ajax Project Site

Coordinates (m): 685348E - 5607041N	Location: SMRSF	Start Date: 07 Mar 2014
Ground Elevation (m): 1,039	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 07 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 1.83
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND AND GRAVEL (SP/GP) Sand is fine, gravel is fine to coarse, gap graded, light brown with brown and grey clasts. [TOPSOIL]	0	Dry	07/03/2014 09:52	
1038	1								
		G	G1				Dry	07/03/2014 09:55	Cutting casing, switching drill bits 9:56 to 10:08.
1037	2				BEDROCK Drill cuttings: fine to medium grained, angular, light grey, slightly weathered, average clast size is 5 mm.				
1036	3								
		G	G2				Dry	07/03/2014 10:10	Hard drilling.
1035	4								
					Below 4.57 m - grey, average clast size is 4 mm, slight decrease in weathering grade.		Dry	07/03/2014 10:13	
1034	5								
					▼				At 5.46 m - static water level, measured 3/21/2014 7:48.
1033	6								
		G	G3		Below 6.10 m - average clast size is 2 - 3 mm, fresh and unweathered.		Dry	07/03/2014 10:20	
1032	7								
					Below 7.62 m - darker grey.				
1031	8								
1030	9								
		G	G4		Below 9.14 m - average clast size is 3 mm.		Dry	07/03/2014 10:31	
1029	10								

(Continued on next page)

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-016

Location: Ajax Project Site

Coordinates (m): 685348E - 5607041N
Ground Elevation (m): 1,039
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 07 Mar 2014
Finish Date: 07 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 1.83
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								
1028	11						Dry	07/03/2014 10:37	
1027	12								
		G	G5		Below 12.19 m - subangular to angular, light grey to white, slightly weathered.				
1026	13								
1025	14				Below 13.72 m - slightly darker grey.		Dry	07/03/2014 10:47	Environmental inspection 10:48 to 11:09.
1024	15								
		G	G6		Below 15.24 m - angular to subrounded, grey, average clast size is 4 mm.		Dry	07/03/2014 11:13	
1023	16								
1022	17				Below 16.76 m - angular, dark grey.		Dry	07/03/2014 11:17	
1021	18								
		G	G7		Below 18.29 m - angular to subangular, grey, average clast size is 5 mm.		Dry	07/03/2014 11:26	
1020	19								
1019	20						Dry	07/03/2014 11:32	Very hard drilling.

(Continued on next page)

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-016

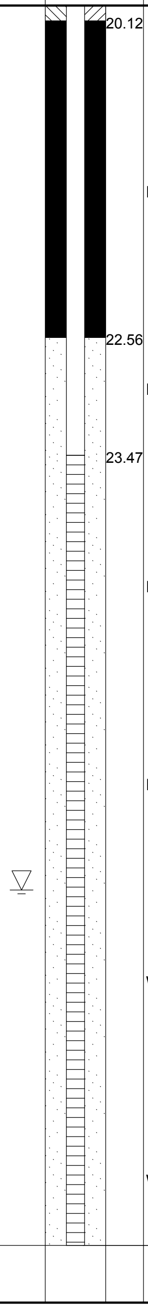
Location: Ajax Project Site

Coordinates (m): 685348E - 5607041N
Ground Elevation (m): 1,039
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.89

Location: SMRSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 07 Mar 2014
Finish Date: 07 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 1.83
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
					20.12			
		G	G8	Below 21.34 m - angular, average clast size is 2 - 3 mm.		Dry	07/03/2014 11:39	
					22.56			
						Dry	07/03/2014 11:44	
					23.47			
		G	G9			Dry	07/03/2014 11:49	
		G	G10	Below 25.91 m - subangular, whitish grey.		Dry	07/03/2014 11:56	
							07/03/2014 11:57	At 26.82 m - water encountered.
		G	G11	Below 27.43 m - subrounded to subangular, dark grey, slightly weathered.		Wet	07/03/2014 12:03	Softer drilling.
		G	G12			Wet	07/03/2014 12:08	
				END OF HOLE AT 29.56 m			07/03/2014 12:08	AIRLIFT #1 0.2 US GPM (estimated from



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DRILL HOLE # BGC14-016

Coordinates (m): 685348E - 5607041N	Location: SMRSF	Start Date: 07 Mar 2014
Ground Elevation (m): 1,039	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 07 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 1.83
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30				NOTES: 1. 2" PVC standpipe peizometer installed with screen from 23.47 to 29.56 metres. 2. Filter sand placed from 23.47 to 29.56 metres. 3. Bentonite seal placed from 20.12 to 22.56 metres.				buildup).
1008	31								
1007	32								
1006	33								
1005	34								
1004	35								
1003	36								
1002	37								
1001	38								
1000	39								
999	40								

Project No.: 1125-007

Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-017D

Location: Ajax Project Site

Coordinates (m): 685540E - 5605928N	Location: TSF	Start Date: 10 Mar 2014
Ground Elevation (m): 1,040	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 10 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 3.96
Stick-up (m): 0.91	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0			SAND (SW) Fine, silty, some fine to coarse gravel, well graded, dark brown, trace organics (roots, 5 - 10 mm diameter). [TOPSOIL] ▼	0	Moist	10/03/2014 10:41	Artesian, noted 5/13/2014 9:36:00.
1040								
	1							
1039								
		G	G1					
	2							
1038				SILT (ML) Sandy, trace to some fine to coarse gravel, trace clay, sand is fine, well graded, light brown, low plasticity, clasts are angular. [TILL]		Moist	10/03/2014 10:42	
	3							
		G	G2			Moist	10/03/2014 10:44	
1037								
	4			BEDROCK Drill cuttings: fine to medium grained, angular, grey, fresh and unweathered to slightly weathered.				
1036								
						Dry	10/03/2014 10:47	Changing drill bit 10:49 to 11:04.
	5							
1035				▽				
								At 5.49 m - moisture encountered.
	6							
1034		G	G3	Below 6.10 m - fine, grey, slightly green, fresh and unweathered, average clast size is 7 mm.		Dry	10/03/2014 11:06	
	7							
1033								
				Below 7.62 m - bluish grey, average clast size is 4 mm.		Dry	10/03/2014 11:10	
	8							
1032								At 8.23 m - moisture encountered.
	9							
1031		G	G4			Dry	10/03/2014 11:14	
	10							

(Continued on next page)

Coordinates (m): 685540E - 5605928N
Ground Elevation (m): 1,040
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.91

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 10 Mar 2014
Finish Date: 10 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 3.96
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	10								
1030									
					Below 10.67 m - angular to subangular, average clast size is 3 mm.		Dry	10/03/2014 11:17	
1029	11								At 10.97 m - moisure encountered.
	12								
1028		G	G5				Dry	10/03/2014 11:21	
	13								
1027									
		G	G6		Below 13.72 m - greenish grey sand present in cuttings, slightly weathered.		Dry	10/03/2014 11:25	
	14								
1026									
	15								
1025		G	G7		Below 15.24 m - average clast size is 2 mm, slightly weathered.		Dry	10/03/2014 11:29	
	16								
1024									
							Dry	10/03/2014 11:32	
	17								
1023									
	18								
1022		G	G8		At 18.29 m - lumps of clayey silt present in cuttings with slight oxidation, gravel cuttings are subrounded, slightly purplish red to grey, modereately weathered.		Dry to slightly moist	10/03/2014 11:36	
	19								
1021									
	20	G			Below 19.81 m - grey clasts with some greenish grey sand present, angular to		Dry	10/03/2014 11:39	

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-017D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 685540E - 5605928N	Location: TSF	Start Date: 10 Mar 2014
Ground Elevation (m): 1,040	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 10 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 29.56
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 3.96
Stick-up (m): 0.91	Fluid: Air	Logged By: SLP
	Cased To (m): 5.18	Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	20	G	G9		subrounded.	20.12			
1020									
	21								
1019									
		G	G10		Below 21.34 m - purplish grey, mostly fine sand, moderately weathered.		Dry	10/03/2014 11:43	
	22								
1018									
						22.56			
	23	G	G11		Below 22.86 m - only some sand present, gravel cuttings are greyish green, angular, slightly weathered.		Dry	10/03/2014 11:48	
1017									
						23.47	Dry to slightly moist	10/03/2014 11:54	At 23.47 m - moisture encountered.
	24								
1016									
		G	G12						
	25								
1015									
	26	G	G13					10/03/2014 11:59	At 25.91 m - sand is dry to slightly moist.
1014									
	27								At 26.82 m - moisture encountered.
1013									
		G	G14		Below 27.43 m - moderately weathered, faint oxidation, moisture encountered.		Dry to slightly moist	10/03/2014 12:04	
	28								
1012									
	29	G	G15		Below 28.96 m - slightly weathered.		Dry	10/03/2014 12:09	AIRLIFT #1 0.2 US GPM
1011									
					END OF HOLE AT 29.56 m				
	30								

(Continued on next page)

Project No.: 1125-007

DRILL HOLE # BGC14-017D

Project: Ajax Project Environmental Assessment

Location: Ajax Project Site

Coordinates (m): 685540E - 5605928N
Ground Elevation (m): 1,040
Survey Method: Handheld GPS
Datum: NAD83 UTM ZONE 10U
Stick-up (m): 0.91

Location: TSF
Drilling Contractor: JR Drilling Central Ltd.
Drill Method: Dual Rotary
Diameter (m): 0.15
Fluid: Air
Cased To (m): 5.18

Start Date: 10 Mar 2014
Finish Date: 10 Mar 2014
Final Depth (m): 29.56
Depth to Top of Rock (m): 3.96
Logged By: SLP
Reviewed By: TWC

Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	30				NOTES: 1. 2" PVC standpipe piezometer installed with screen from 23.47 to 29.56 metres. 2. Filter sand placed from 22.56 to 29.56 metres. 3. Bentonite seal placed from 20.12 to 22.56 metres.				
1010									
	31								
1009									
	32								
1008									
	33								
1007									
	34								
1006									
	35								
1005									
	36								
1004									
	37								
1003									
	38								
1002									
	39								
1001									
	40								

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

Project No.: 1125-007

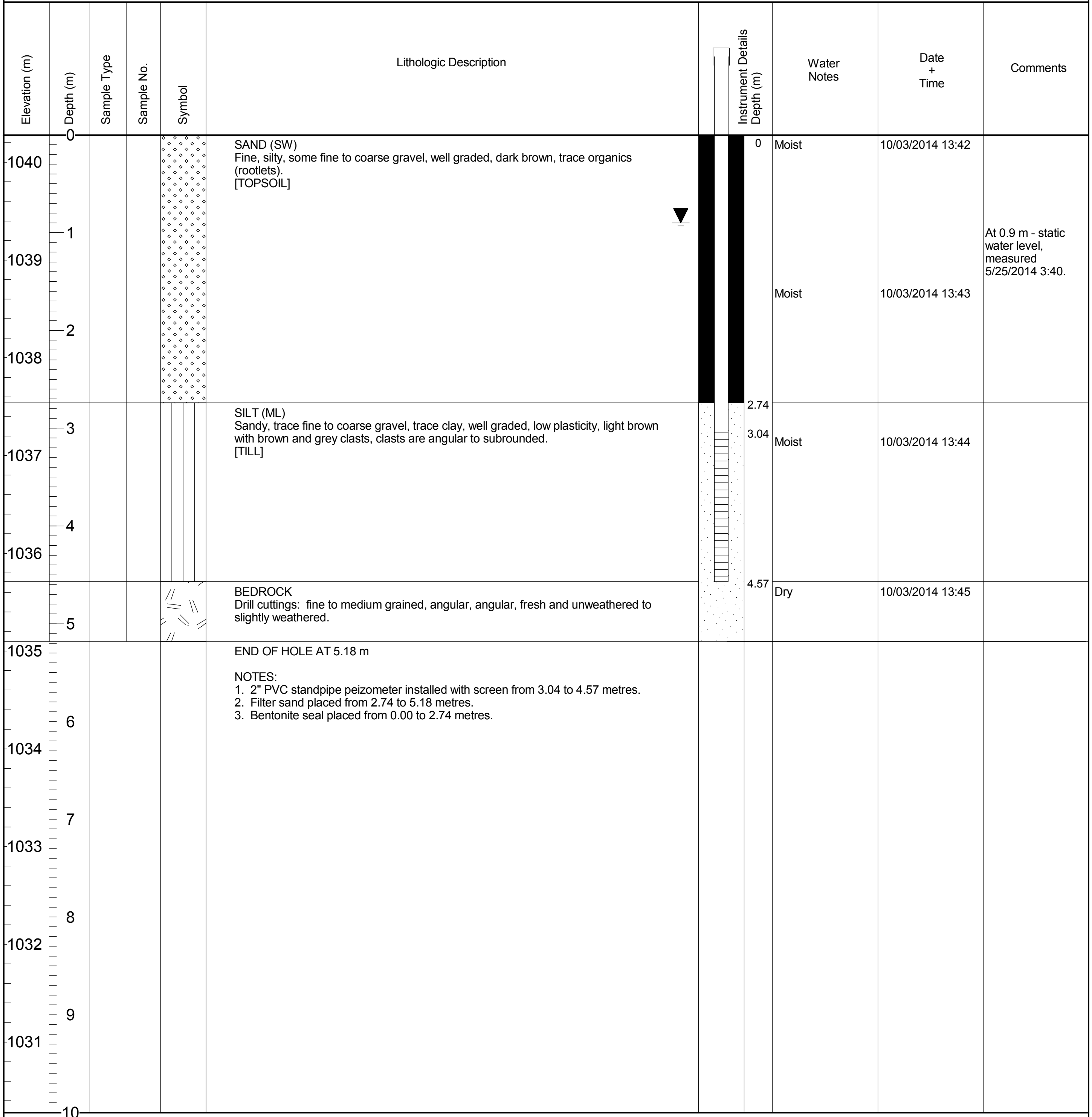
Project: Ajax Project Environmental Assessment

DRILL HOLE # BGC14-017S

***Page** 1 **of** 1*

Location: Ajax Project Site

Coordinates (m): 685540E - 5605928N	Location: TSF	Start Date: 10 Mar 2014
Ground Elevation (m): 1,040	Drilling Contractor: JR Drilling Central Ltd.	Finish Date: 10 Mar 2014
Survey Method: Handheld GPS	Drill Method: Dual Rotary	Final Depth (m): 5.18
Datum: NAD83 UTM ZONE 10U	Diameter (m): 0.15	Depth to Top of Rock (m): 4.57
Stick-up (m): 0.89	Fluid: Air	Logged By: SLP
	Cased To (m): 1.52	Reviewed By: TWC



Elevation (m)	Depth (m)	Sample Type	Sample No.	Symbol	Lithologic Description	Instrument Details Depth (m)	Water Notes	Date + Time	Comments
	0				SAND (SW) Fine, silty, some fine to coarse gravel, well graded, dark brown, trace organics (rootlets). [TOPSOIL]	0	Moist	10/03/2014 13:42	
									At 0.9 m - static water level, measured 5/25/2014 3:40.
							Moist	10/03/2014 13:43	
					SILT (ML) Sandy, trace fine to coarse gravel, trace clay, well graded, low plasticity, light brown with brown and grey clasts, clasts are angular to subrounded. [TILL]	2.74 3.04	Moist	10/03/2014 13:44	
					BEDROCK Drill cuttings: fine to medium grained, angular, angular, fresh and unweathered to slightly weathered.	4.57	Dry	10/03/2014 13:45	
					END OF HOLE AT 5.18 m NOTES: 1. 2" PVC standpipe peizometer installed with screen from 3.04 to 4.57 metres. 2. Filter sand placed from 2.74 to 5.18 metres. 3. Bentonite seal placed from 0.00 to 2.74 metres.				

AJAX (HYDROGEO) AJAX_SOIL_HYDROGEO.GDL BGC.GDT 5/28/15

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: KGHM Ajax Mining Inc.

Print Date: 5/28/2015

APPENDIX B
AS-BUILT MONITORING WELL DIAGRAMS

DRILL HOLE #: BGC14-001D

PROJECT NAME: AJax

PROJECT NUMBER: 1125006

INSTALLATION START DATE: FEB 12/2014 **INSTALLATION LOGGED BY:** SLP

INSTALLATION FINISH DATE: FEB 12/2014 **PERMANENT CASING INSTALLED TO:** 10' bgs.

PVC DETAILS

DIAMETER: 2" mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☐ SLIP
☑ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET FILTER SAND.

SIZE: 10-20

BENTONITE

TYPE:
☑ CHIPS
☑ PELLETS

SIZE:
☑ 3/8" Both
☐ 5/8"

GROUT

TYPE/BRAND: QUIK-GEL/LAFARGE

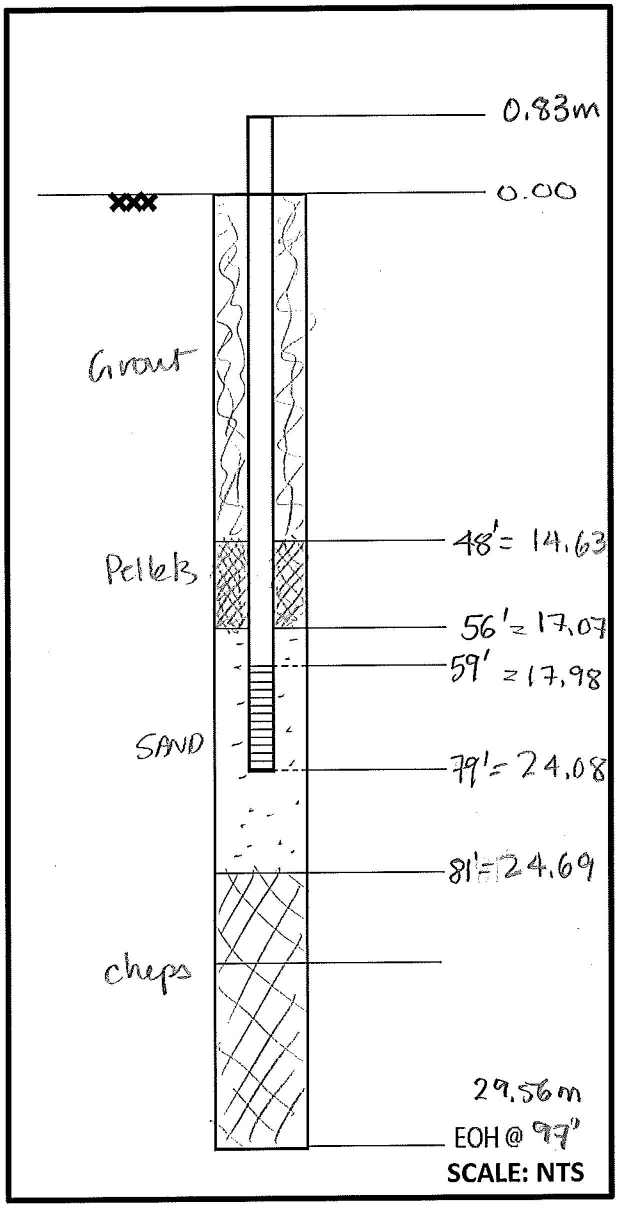
MIX:
2 BAGS CEMENT TYPE GU
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
☑ YES: Padlock
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: 19.20m mbgl/mbtpvc

MEASURED ON: FEB 11/2014 date/time 1:30pm

NOTES:

WL measured FEB 12/2014 @ 4:00pm : 11.72m

REV 20120503

DRILL HOLE #: BGC14-001S

PROJECT NAME: AJAX

PROJECT NUMBER: 1125006

INSTALLATION START DATE: FEB 12/2014
INSTALLATION FINISH DATE: 〃
INSTALLATION LOGGED BY: SLP
PERMANENT CASING INSTALLED TO: 5' bgs

PVC DETAILS
DIAMETER: 2" mm/cm
SCREEN SLOT SIZE: 010
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☐ SLIP
☑ J-PLUG
☐ OTHER: ________

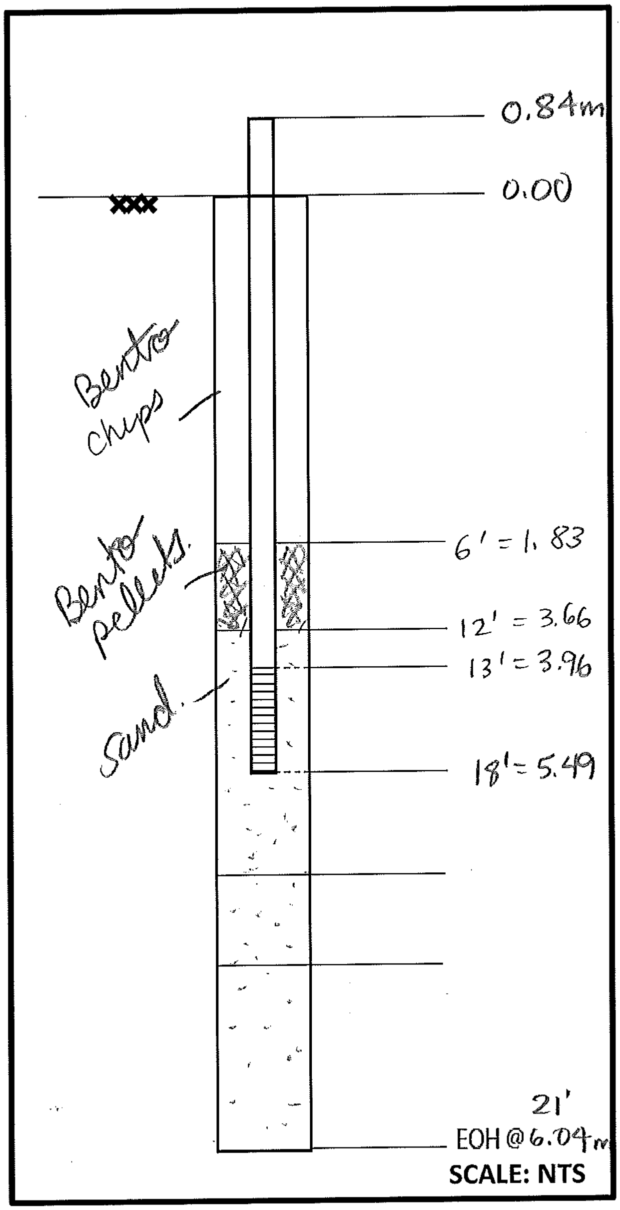
FILTER SAND
TYPE\BRAND: TARGET
SIZE: 10-20

BENTONITE
TYPE:
☑ CHIPS
☑ PELLETS
SIZE:
☑ 3/8" Both
☐ 5/8"

~~**GROUT**~~
~~TYPE/BRAND: QUIK-GEL~~
~~MIX:~~
~~___ BAGS CEMENT~~
~~___ BAGS BENTONITE~~
~~___ GALLONS OF WATER~~
Backfilled with chips

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: Padlock
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: dry mbgl/mbtpvc
MEASURED ON: – date/time

NOTES:

REV 20120503

DRILL HOLE #: BGC14-002D

PROJECT NAME: AJAX

PROJECT NUMBER: 1125006

INSTALLATION START DATE: FEB 13/14 **INSTALLATION LOGGED BY:** SLP

INSTALLATION FINISH DATE: FEB 13/14 **PERMANENT CASING INSTALLED TO:** 15' bgs.

PVC DETAILS

DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☑ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: QUIK-GEL/LAFARG TYPE GU

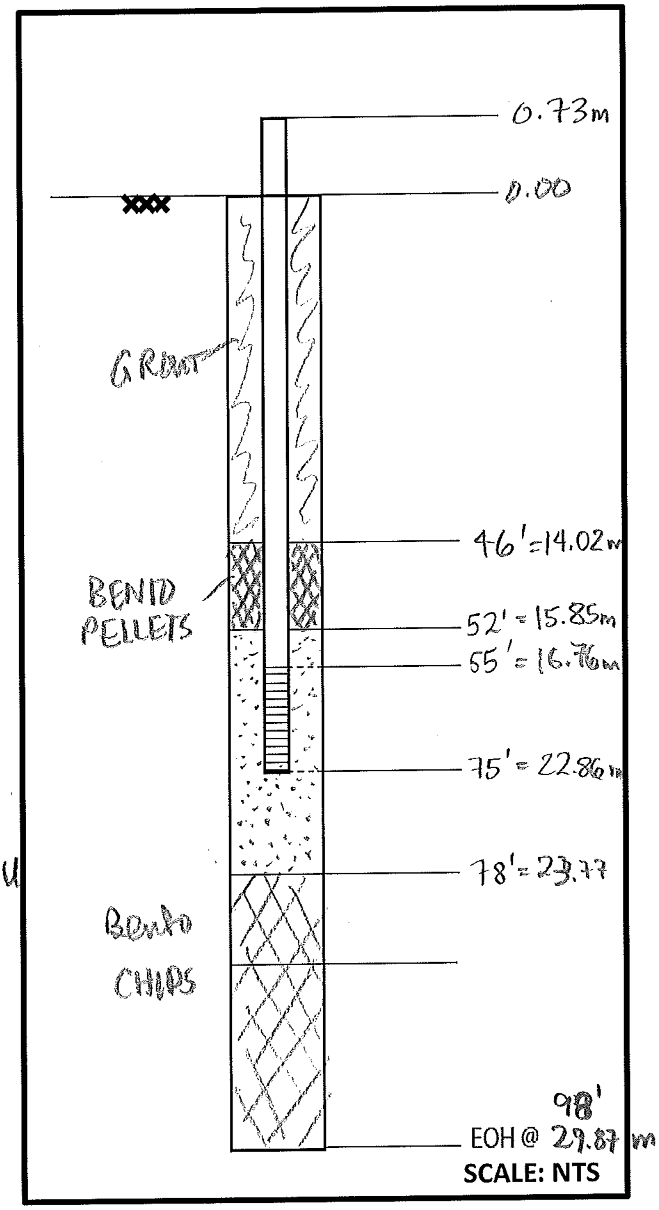
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: 28' bgs. mbgl/mbtpvc

MEASURED ON: 8:45am FEB 13, 2014 date/time

NOTES:

REV 20120503

DRILL HOLE #: BGC14-0025

PROJECT NAME: AJAX

PROJECT NUMBER: 1125006

INSTALLATION START DATE: FEB 13/14
INSTALLATION FINISH DATE: FEB13/14
INSTALLATION LOGGED BY: SLP
PERMANENT CASING INSTALLED TO: 15' bgs.

PVC DETAILS
DIAMETER: 2" PVC mm/cm
SCREEN SLOT SIZE: 010
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

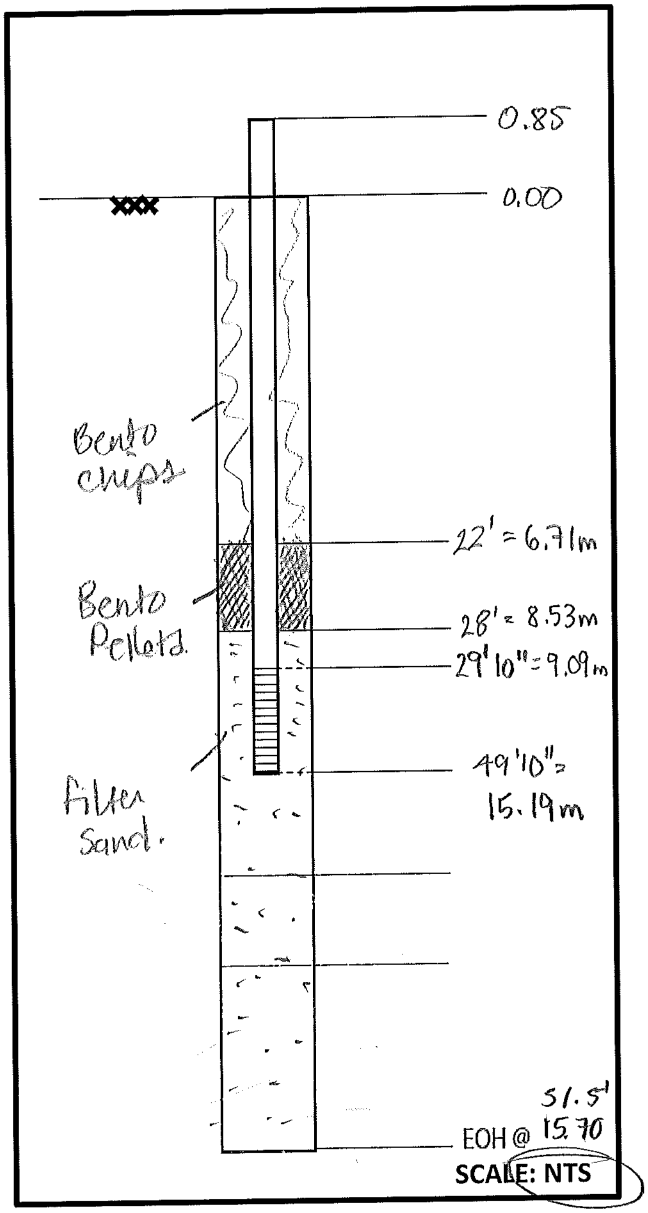
FILTER SAND
TYPE\BRAND: TARGET
SIZE: 10-20

BENTONITE
TYPE:
☑ CHIPS
☑ PELLETS
SIZE:
☑ 3/8"
☐ 5/8"

GROUT
TYPE/BRAND: ________
MIX:
____ BAGS CEMENT
____ BAGS BENTONITE
____ GALLONS OF WATER
CHIPPED TO SURFACE

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: 28' bgs mbgl/mbtpvc
MEASURED ON: 8:45 am FEB 13, 2014 date/time

NOTES:
static WL measured in morning for deep installation.

DRILL HOLE #: BGC14-003D

PROJECT NAME: AJAX

PROJECT NUMBER: 1125006

INSTALLATION START DATE: FEB 14/14

INSTALLATION FINISH DATE: FEB 14/14

INSTALLATION LOGGED BY: SLP

PERMANENT CASING INSTALLED TO: 10' bgs

PVC DETAILS

DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☐ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: QUIK-GEL/LAFARGE TYPE GU

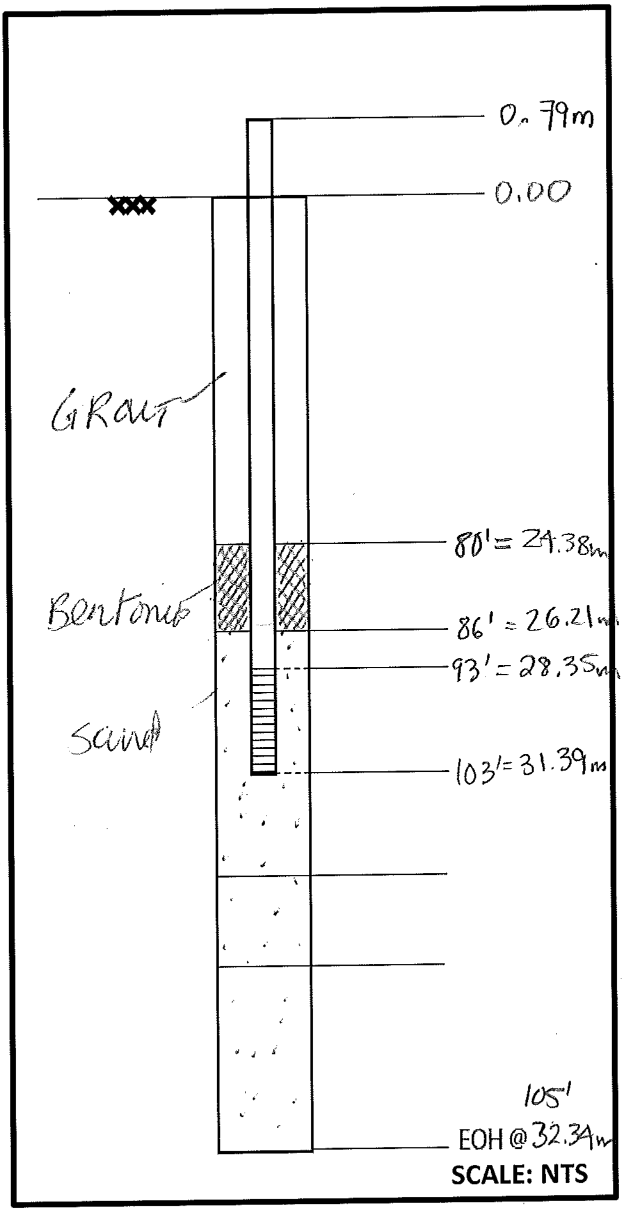
MIX:
2 BAGS CEMENT
6.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: dry mbgl/mbtpvc

MEASURED ON: — date/time

NOTES:
driller overpoured sand far past the screen. sand still in green sandy "bedrock"
Bedrock was dry @ time of Installation. No water table seen in bedrock.

REV 20120503

DRILL HOLE #: BGC14-003I

PROJECT NAME: AJAX
PROJECT NUMBER: 1125006

INSTALLATION START DATE: FEB 17, 2014
INSTALLATION LOGGED BY: SLP
INSTALLATION FINISH DATE: FEB 17, 2014
PERMANENT CASING INSTALLED TO: 37' bgs.

PVC DETAILS
DIAMETER: 2" PVC mm/cm
SCREEN SLOT SIZE: 010
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

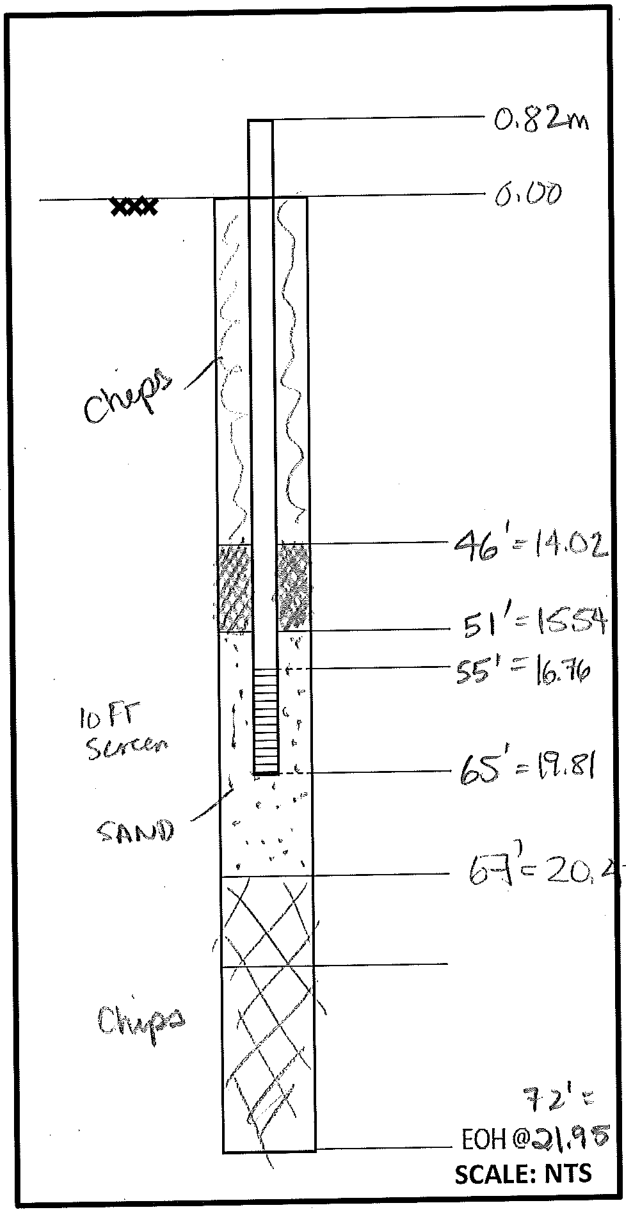
FILTER SAND
TYPE\BRAND: TARGET
SIZE: 10-20

BENTONITE
TYPE:
☑ CHIPS
☑ PELLETS
SIZE:
☑ 3/8"
☐ 5/8"

GROUT
TYPE/BRAND: 0
MIX:
____ BAGS CEMENT
____ BAGS BENTONITE
____ GALLONS OF WATER

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: ____________ mbgl/mbtpvc
MEASURED ON: ____________ date/time

NOTES:
Bentonite seal was installed successfully, bento pellet bridge formed at top of seal, inside casing, in shoe. left casing in ground to preserve well.

REV 20120503

DRILL HOLE #: BGC14-003S

PROJECT NAME: Ajax

PROJECT NUMBER: 1125008

INSTALLATION START DATE: FEB14/14 **INSTALLATION LOGGED BY:** SLP

INSTALLATION FINISH DATE: FEB14/14 **PERMANENT CASING INSTALLED TO:** 10' bgs.

PVC DETAILS

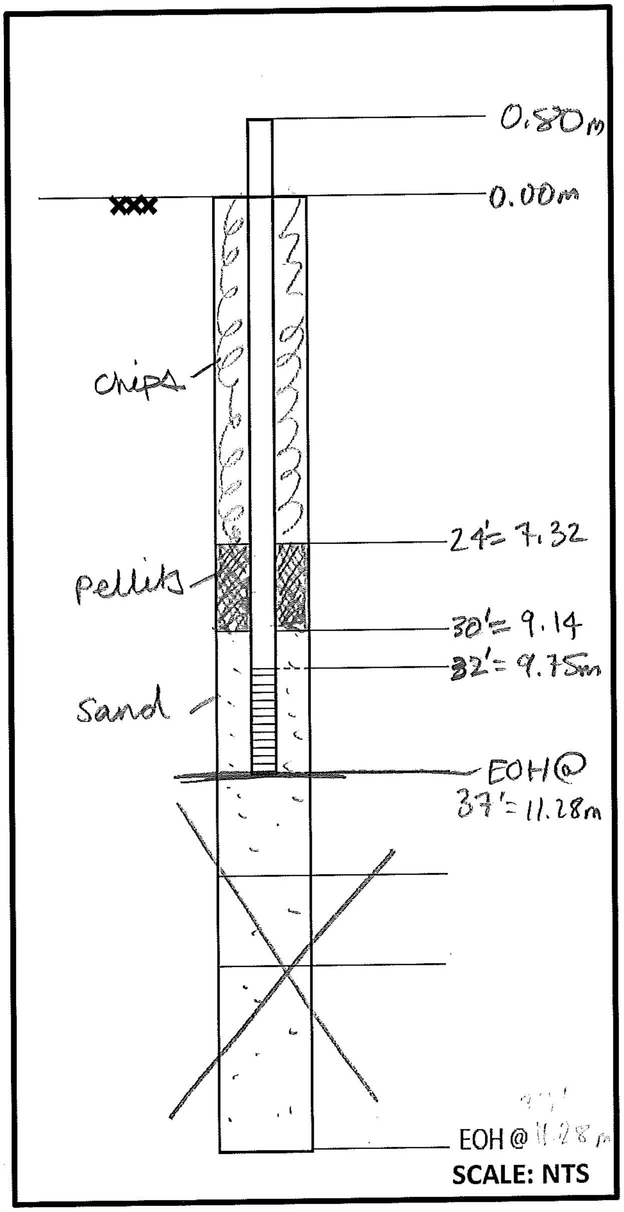
DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________



FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☑ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

~~**GROUT**~~

~~TYPE/BRAND: QUIK-GEL~~

~~MIX:~~
~~____ BAGS CEMENT~~
~~____ BAGS BENTONITE~~
~~____ GALLONS OF WATER~~

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO

WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: dry mbgl/mbtpvc

MEASURED ON: — date/time

NOTES:

Well seated at EOH. on couple cm's of sand.

DRILL HOLE #: BGC14-004

PROJECT NAME: AJAX

PROJECT NUMBER: 1125006

INSTALLATION START DATE: FEB 19/14

INSTALLATION FINISH DATE: FEB 19/14

INSTALLATION LOGGED BY: SLP

PERMANENT CASING INSTALLED TO: 15' bgo.

PVC DETAILS

DIAMETER: 4" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☑ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: QUIK-GEL / LAFARGE TYPE GU

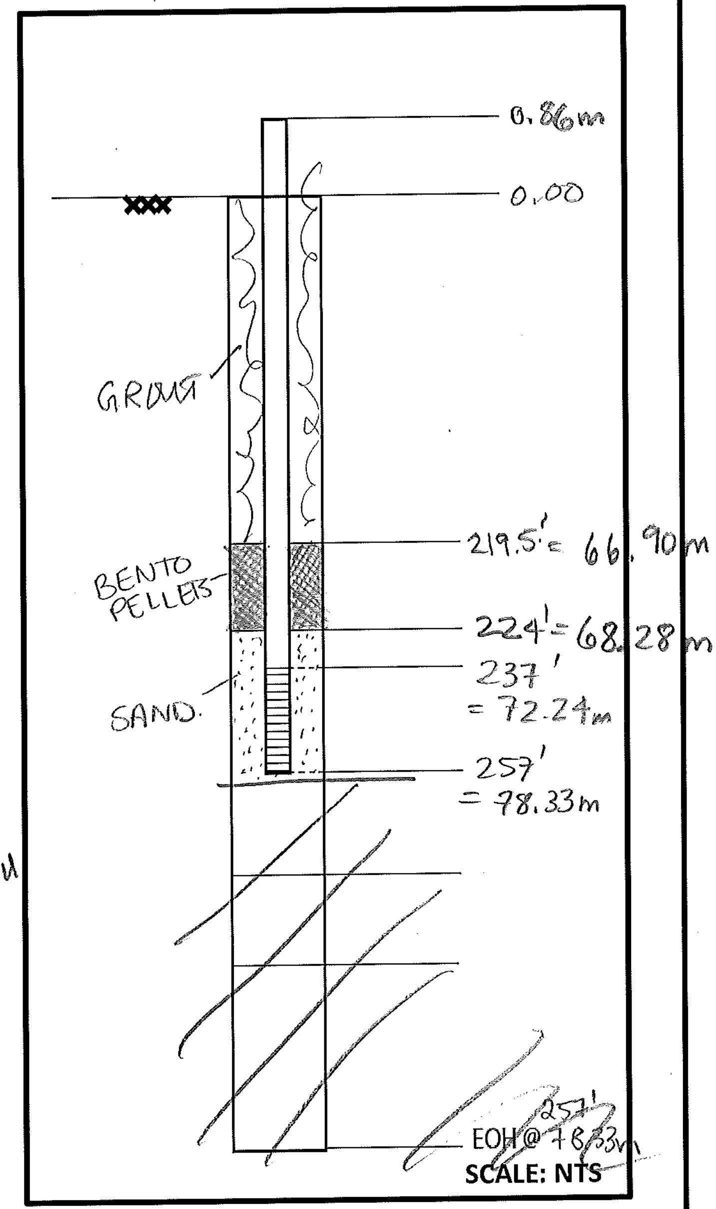
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: 24' bgo mbgl/mbtpvc

MEASURED ON: FEB 19, 2014 @ 1:00 pm. date/time

NOTES:

Grouted until return, with rods at 210', pulled 100' of rods and grouted into gravel formation, pulled remaining rods (except top rod) and grouted in silt

DRILL HOLE #: BGC14-005

PROJECT NAME: AJAX

PROJECT NUMBER: 1125006

INSTALLATION START DATE: FEB 20/14

INSTALLATION FINISH DATE: FEB 20/14

INSTALLATION LOGGED BY: SLP

PERMANENT CASING INSTALLED TO: 15' bgs.

PVC DETAILS

DIAMETER: 4" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☑ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☐ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: QUIK-GEL/LAFARGE TYPE GU

MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

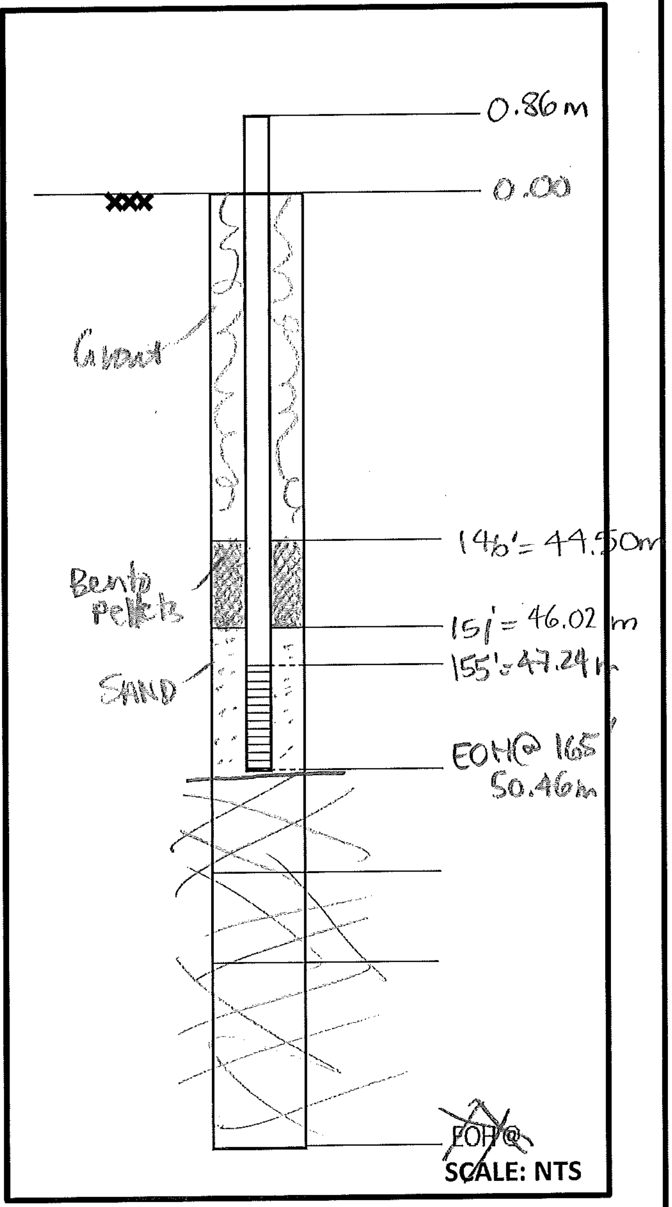
HEAT TRACE:
☐ YES
☐ NO

WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: ____________ mbgl/mbtpvc

MEASURED ON: ____________ date/time

NOTES:



DRILL HOLE #: BGC14-006D

PROJECT NAME: AjAx

PROJECT NUMBER: 1125006

INSTALLATION START DATE: FEB 21/14 **INSTALLATION LOGGED BY:** SLP.

INSTALLATION FINISH DATE: FEB 22/14 **PERMANENT CASING INSTALLED TO:** 15' bgp.

PVC DETAILS

DIAMETER: 4" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☑ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: QUIK-GEL/LAFARGE TYPE GU

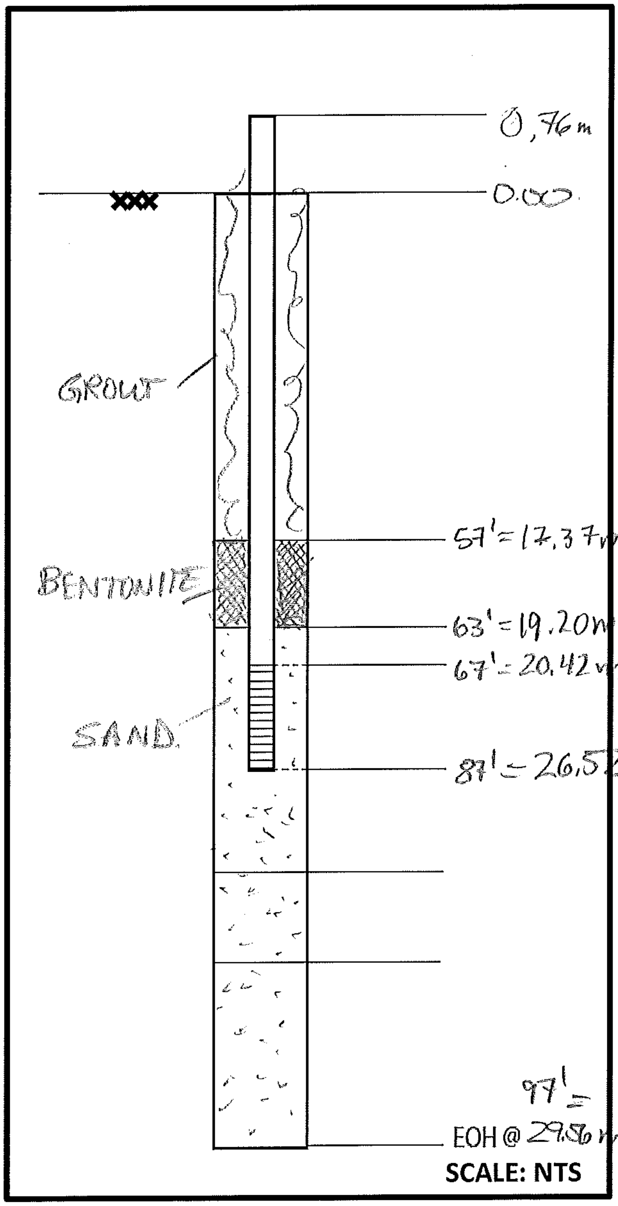
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP.

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



SCALE: NTS

WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: 9.74 [✓ mbgl]/mbtpvc

MEASURED ON: 11:00 am on Feb 22, 2014 date/time

NOTES:

WL measured after well installed → 10.23m from Stickup.

~~9.4~~

DRILL HOLE #: BGC14-006S

PROJECT NAME: Ajax

PROJECT NUMBER: 1128006

INSTALLATION START DATE: Feb 22/2014
INSTALLATION FINISH DATE: Feb 22/2014

INSTALLATION LOGGED BY: SLP
PERMANENT CASING INSTALLED TO: 15' bgs

PVC DETAILS
DIAMETER: 4" PVC mm/cm
SCREEN SLOT SIZE: 010
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND
TYPE\BRAND: TARGET
SIZE: 10-20

BENTONITE
TYPE:
☑ CHIPS
☑ PELLETS
SIZE:
☑ 3/8"
☐ 5/8"

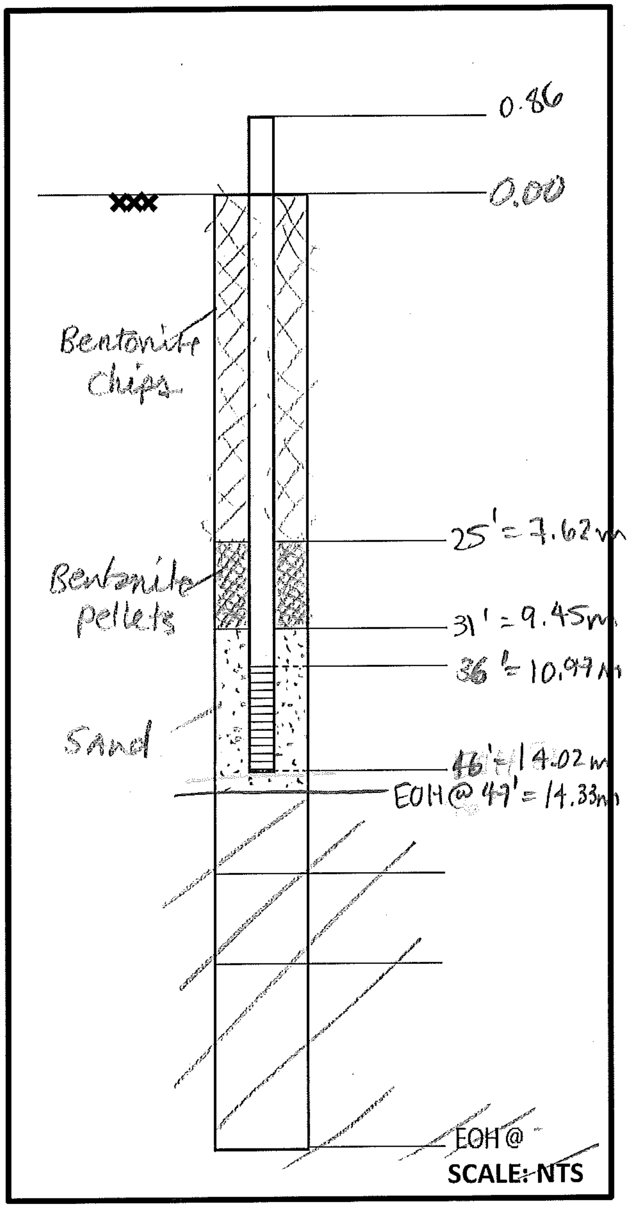
GROUT
TYPE/BRAND: ________
MIX:
____ BAGS CEMENT
____ BAGS BENTONITE
____ GALLONS OF WATER

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO

WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: ____________ mbgl/mbtpvc
MEASURED ON: ____________ date/time

NOTES:



DRILL HOLE #: BGC14-007D

PROJECT NAME: AJAX

PROJECT NUMBER: 1125006

INSTALLATION START DATE: FEB23/14

INSTALLATION FINISH DATE: FEB23/14

INSTALLATION LOGGED BY: SLP

PERMANENT CASING INSTALLED TO: 15' bgs

PVC DETAILS

DIAMETER: 4" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☑ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

~~**GROUT**~~

~~TYPE/BRAND: [illegible]~~

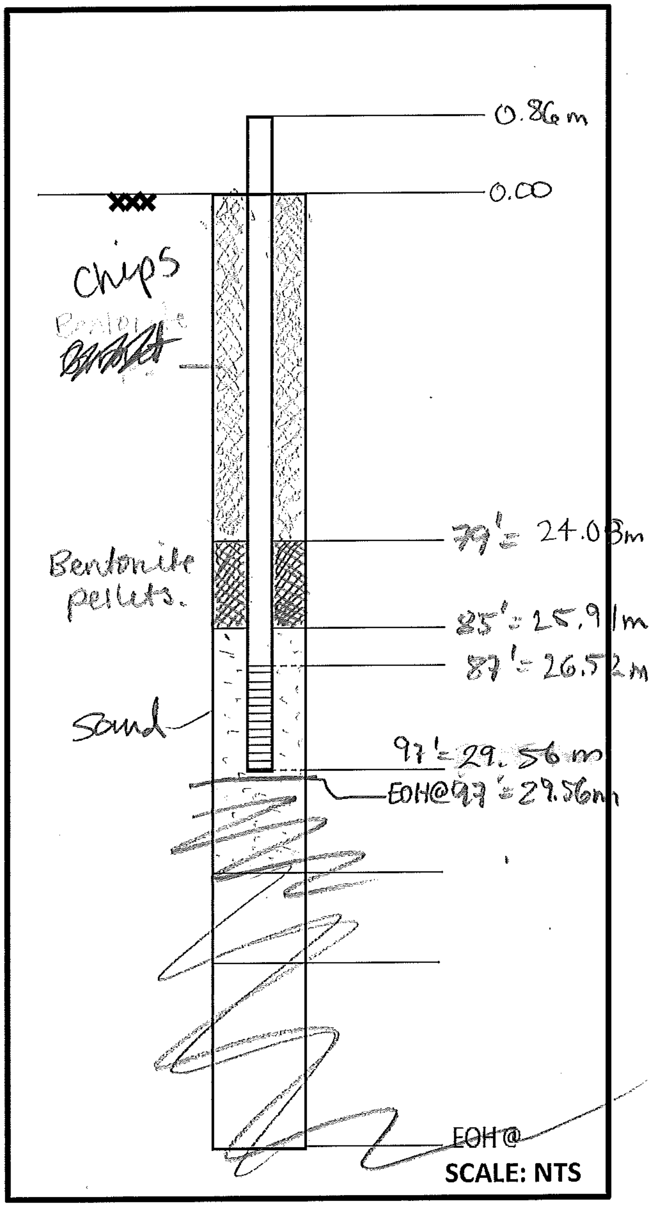
~~MIX:~~
~~___ BAGS CEMENT~~
~~0.5 BAGS BENTONITE~~
~~10 GALLONS OF WATER~~

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: dry mbgl/mbtpvc

MEASURED ON: Feb 23, 2014 date/time

NOTES:

WL measured again on Feb 24, 2014 @ 7:30 am → dry.

DRILL HOLE #: BGC14-007S

PROJECT NAME: AJAX

PROJECT NUMBER: 1125006.

INSTALLATION START DATE: Feb 24/14

INSTALLATION LOGGED BY: SLP

INSTALLATION FINISH DATE: Feb24/14

PERMANENT CASING INSTALLED TO: 15' bgs.

PVC DETAILS

DIAMETER: 4" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☑ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: ________

MIX:
____ BAGS CEMENT
____ BAGS BENTONITE
____ GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

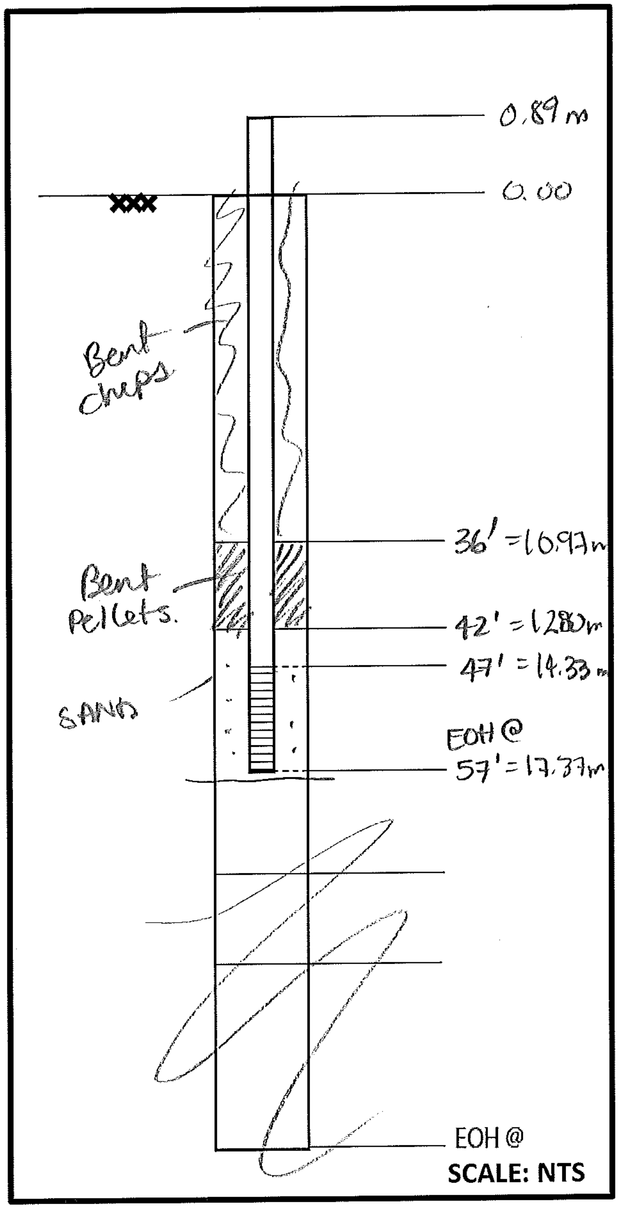
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO

WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: Dry. mbgl/mbtpvc

MEASURED ON: Feb 24/14 date/time



NOTES:

REV 20120503

DRILL HOLE #: BGC14-008D

PROJECT NAME: Ajax

PROJECT NUMBER: 1125006.

INSTALLATION START DATE: FEB 24,14

INSTALLATION FINISH DATE: FEB 25,14

INSTALLATION LOGGED BY: SLP

PERMANENT CASING INSTALLED TO: 15' bgs.

PVC DETAILS

DIAMETER: 4" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☑ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: QUIK-GEL

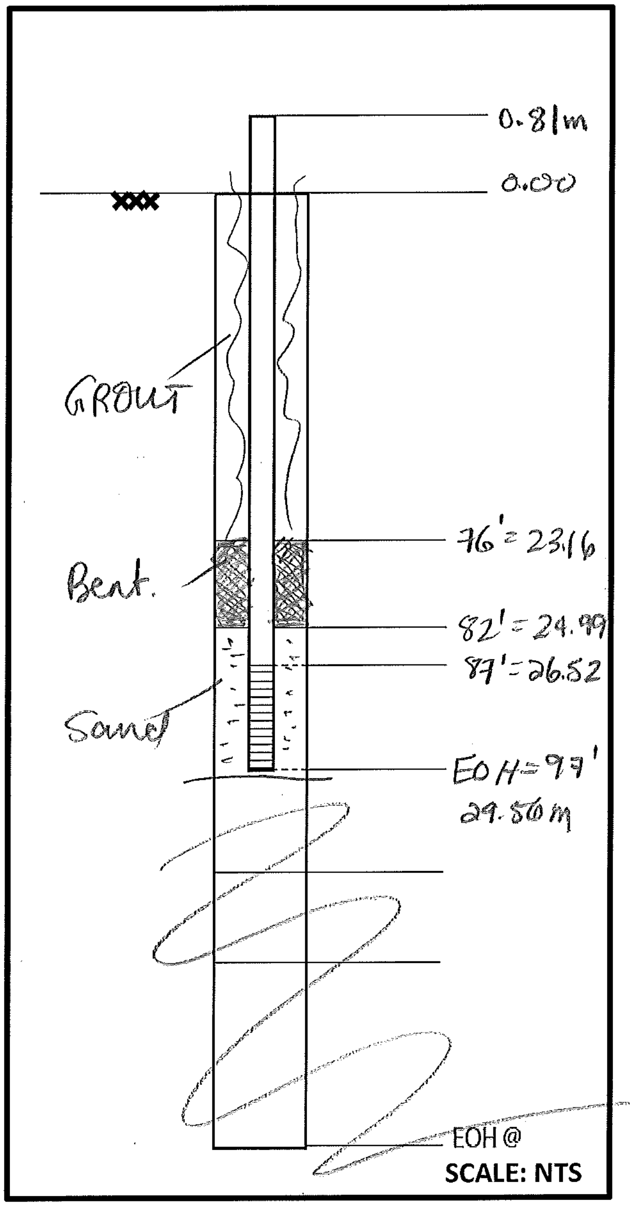
MIX:
2 BAGS CEMENT
1 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
☑ YES: PADLOCK.
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: ____________ mbgl/mbtpvc

MEASURED ON: ____________ date/time

NOTES:

DRILL HOLE #: BGRC14-0085

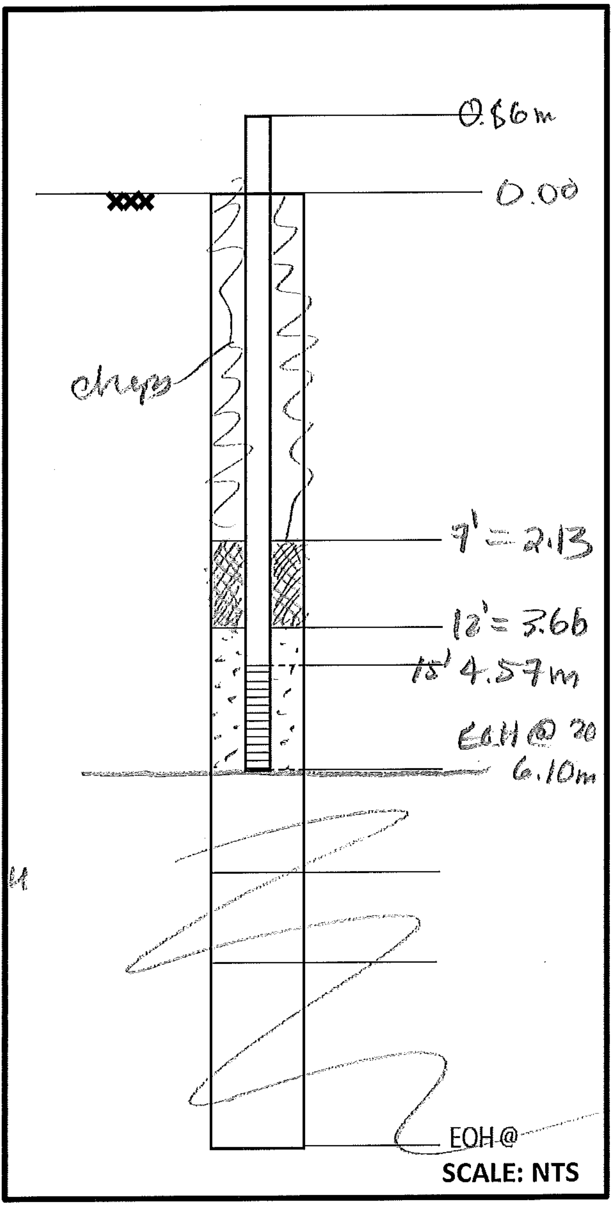
PROJECT NAME: Ajax **PROJECT NUMBER:** 1125006

INSTALLATION START DATE: FEB 25/14 **INSTALLATION LOGGED BY:** SLP
INSTALLATION FINISH DATE: Feb25/14 **PERMANENT CASING INSTALLED TO:** ______

PVC DETAILS
DIAMETER: 4" PVC mm/cm
SCREEN SLOT SIZE: 010
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ______

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ______



FILTER SAND
TYPE\BRAND: TARGET
SIZE: 10-20

BENTONITE
TYPE:
☐ CHIPS
☑ PELLETS
SIZE:
☑ 3/8"
☐ 5/8"

GROUT
TYPE/BRAND: QUICGET / LAFARGE TYPEGU
MIX:
2 BAGS CEMENT
___ BAGS BENTONITE
___ GALLONS OF WATER

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO

WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: ______ mbgl/mbtpvc
MEASURED ON: ______ date/time

NOTES:

DRILL HOLE #: BGC14-009

PROJECT NAME: Ajax

PROJECT NUMBER: 1125006

INSTALLATION START DATE: Feb 27/14
INSTALLATION FINISH DATE: Feb 27/14
INSTALLATION LOGGED BY: SLP.
PERMANENT CASING INSTALLED TO: 15' bgs.

PVC DETAILS
DIAMETER: 2" PVC mm/cm
SCREEN SLOT SIZE: 010
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

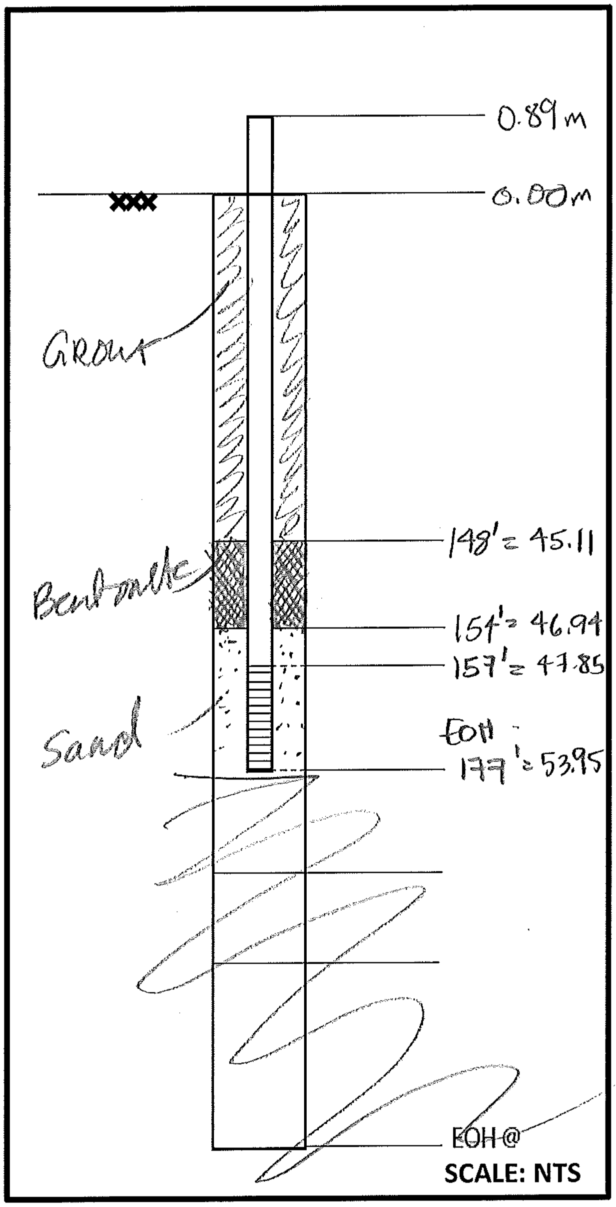
FILTER SAND
TYPE\BRAND: TARGET
SIZE: ________

BENTONITE
TYPE:
☐ CHIPS
☑ PELLETS
SIZE:
☑ 3/8"
☐ 5/8"

GROUT
TYPE/BRAND: QUIK GEL / LAFARGE TYPE GU
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: ________ mbgl/mbtpvc
MEASURED ON: ________ date/time

NOTES:

DRILL HOLE #: BGC14-010

PROJECT NAME: AJAX **PROJECT NUMBER:** 1125006

INSTALLATION START DATE: FEB 28, 14 **INSTALLATION LOGGED BY:** SLP.

INSTALLATION FINISH DATE: MAR 2, 14 **PERMANENT CASING INSTALLED TO:** 15' bgs.

PVC DETAILS

DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☐ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: QUIKGEL / LAFARGE TYPE GU

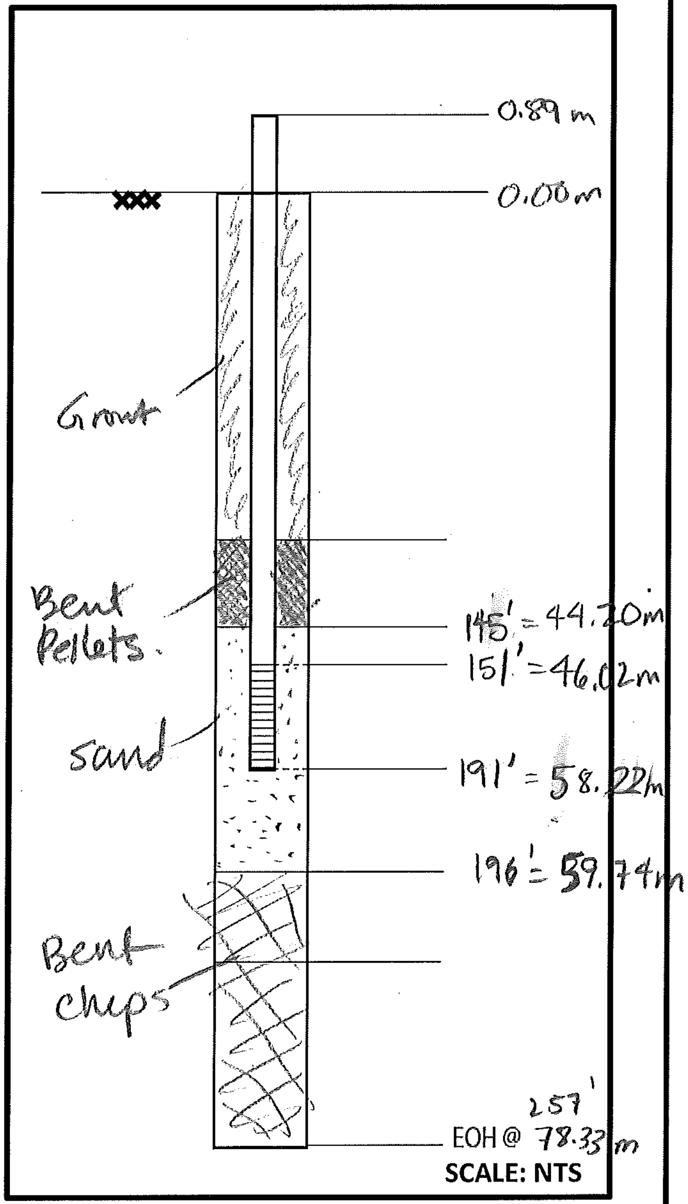
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP.

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: 60.96 [✓ mbgl]/mbtpvc

MEASURED ON: Feb 28, 2014 16:00 h date/time

NOTES:

REV 20120503

DRILL HOLE #: BGC14-011D

PROJECT NAME: Ajax

PROJECT NUMBER: 1126007

INSTALLATION START DATE: MAR 1/2014

INSTALLATION LOGGED BY: SLP

INSTALLATION FINISH DATE: MAR

PERMANENT CASING INSTALLED TO: 17' bgs.

PVC DETAILS

DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
- ☐ SCHED. 80
- ☐ SCHED. 60
- ☑ SCHED. 40

END CAP TYPE:
- ☑ THREADED
- ☐ SLIP
- ☐ OTHER: ________

TOP CAP TYPE:
- ☐ THREADED
- ☑ SLIP
- ☐ J-PLUG
- ☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
- ☐ CHIPS
- ☑ PELLETS

SIZE:
- ☑ 3/8"
- ☐ 5/8"

GROUT

TYPE/BRAND: QUIK-GEL / LAFARGE TYPE GU

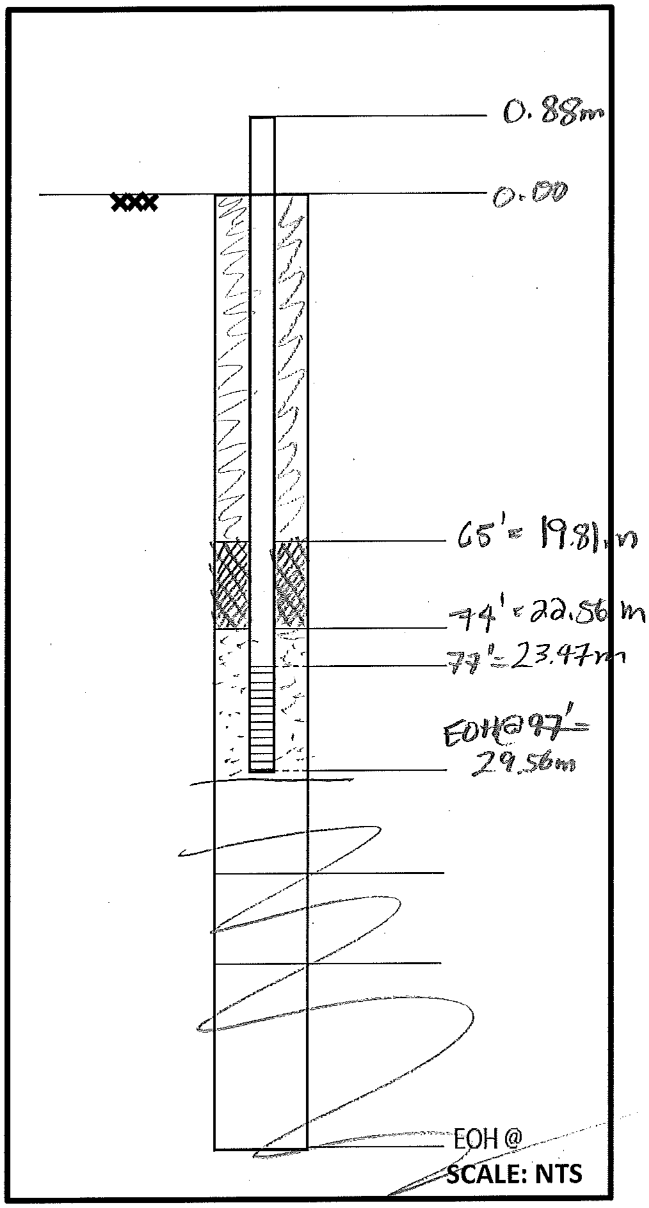
MIX:
- 2 BAGS CEMENT
- .05 BAGS BENTONITE
- 30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
- ☑ YES: PADLOCK
- ☐ NO

HEAT TRACE:
- ☐ YES
- ☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: 12.95 [✓ mbgl] mbtpvc

MEASURED ON: MARCH 1, 2014 @ 14:45 date/time

NOTES:

Water level encountered during drilling @ 52' bgs.

SWL measured next day, before grouting, 6.71 mbgs. (Mar 2, 2014 11:00am)

DRILL HOLE #: BGC14-011S

PROJECT NAME: & Ajax

PROJECT NUMBER: 1125007

INSTALLATION START DATE: MAR 1, 2014

INSTALLATION FINISH DATE: MAR

INSTALLATION LOGGED BY: SLP

PERMANENT CASING INSTALLED TO: 17' BGS

PVC DETAILS

DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☐ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: QUIK-GEL / LAFARGE

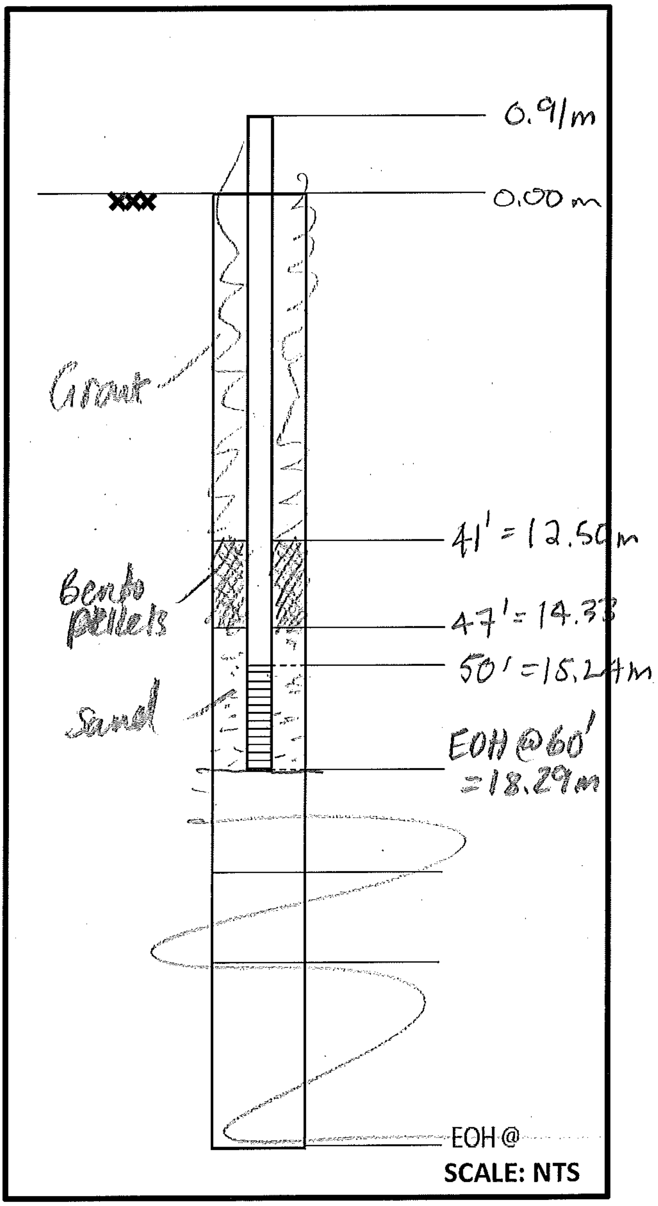
MIX:
2 BAGS CEMENT TYPE GU
0.5 BAGS BENTONITE
20 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: 8.59 [✓ mbgl]/mbtpvc

MEASURED ON: March 2, 2014 11:00am date/time

NOTES:

water level measured outside PVC the next day, after installing PVC.

REV 20120503

DRILL HOLE #: BGC14-012

PROJECT NAME: Ajax

PROJECT NUMBER: 1125 007

INSTALLATION START DATE: MAR 3, 2014

INSTALLATION FINISH DATE: MAR 3, 2014

INSTALLATION LOGGED BY: SLP

PERMANENT CASING INSTALLED TO: 17' bgs

PVC DETAILS

DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☑ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: QUIKGEL / LAFARGE TYPE GU

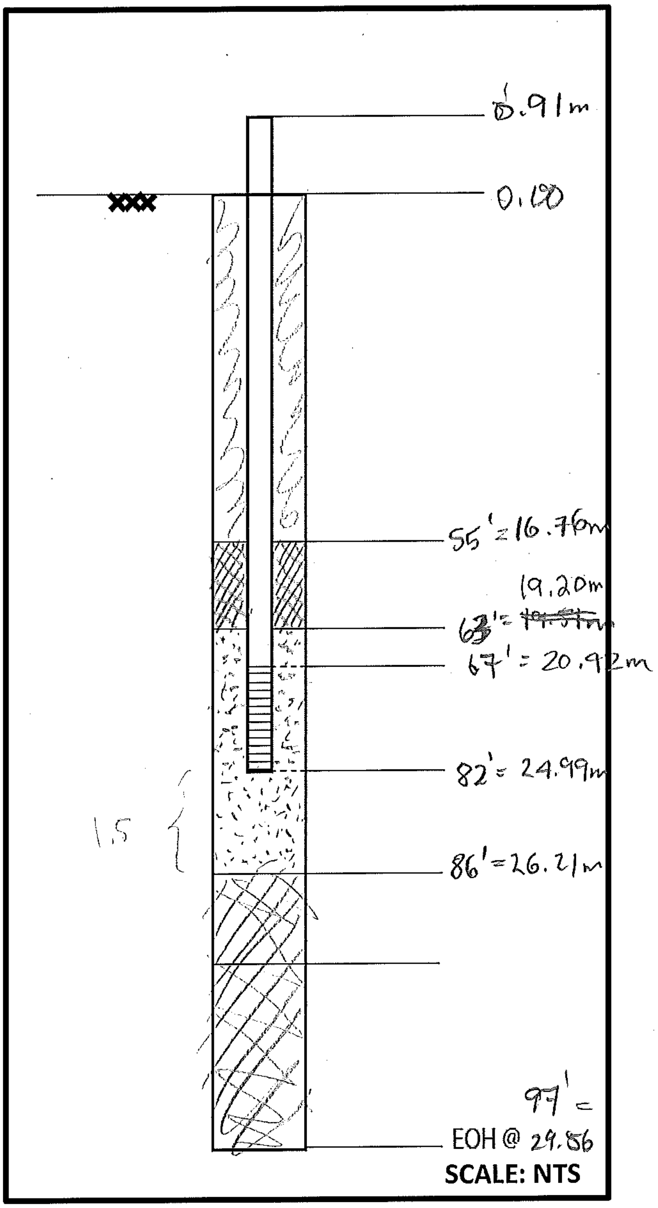
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: ____________ mbgl/mbtpvc

MEASURED ON: ____________ date/time

NOTES:

REV 20120503

DRILL HOLE #: BGC14-012S

PROJECT NAME: Ajax

PROJECT NUMBER: 1125007

INSTALLATION START DATE: MAR 3, 2014

INSTALLATION FINISH DATE: MAR 3, 2014

INSTALLATION LOGGED BY: SLP

PERMANENT CASING INSTALLED TO: 3' bgs.

PVC DETAILS

DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
- ☐ SCHED. 80
- ☐ SCHED. 60
- ☑ SCHED. 40

END CAP TYPE:
- ☑ THREADED
- ☐ SLIP
- ☐ OTHER: ________

TOP CAP TYPE:
- ☐ THREADED
- ☑ SLIP
- ☐ J-PLUG
- ☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
- ☑ CHIPS
- ☑ PELLETS

SIZE:
- ☑ 3/8"
- ☐ 5/8"

GROUT

TYPE/BRAND: ________

MIX:
- ____ BAGS CEMENT
- ____ BAGS BENTONITE
- ____ GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
- ☑ YES: PADLOCK
- ☐ NO

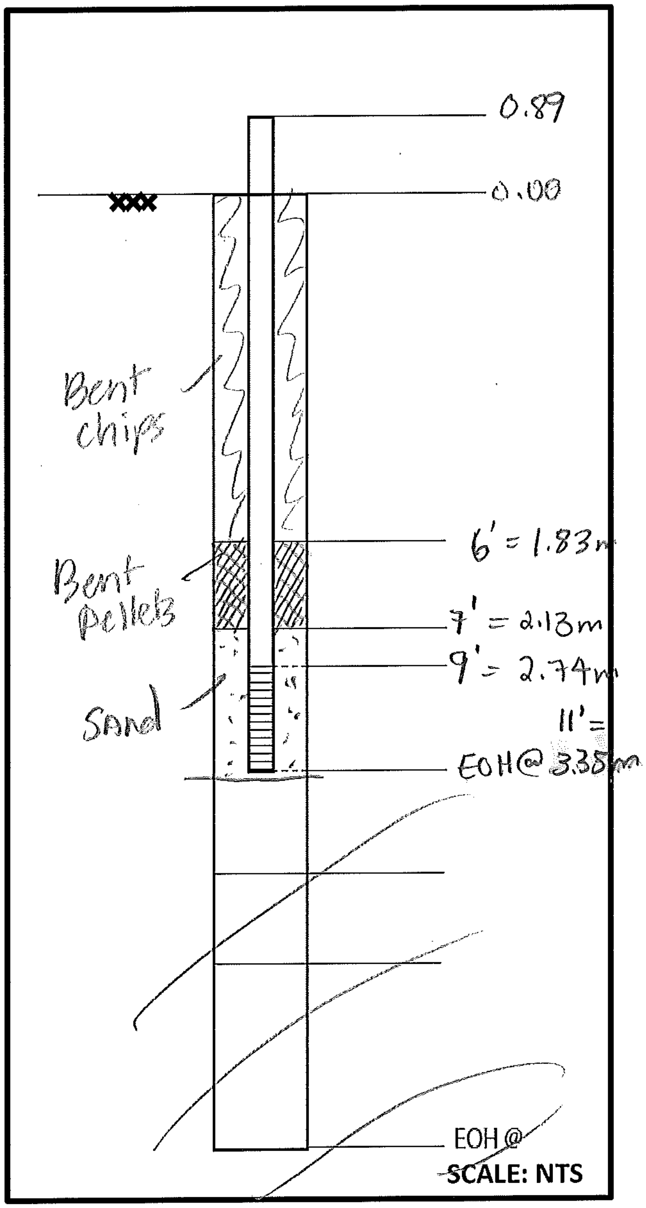
HEAT TRACE:
- ☐ YES
- ☐ NO

WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: ____________ mbgl/mbtpvc

MEASURED ON: ____________ date/time

NOTES:



DRILL HOLE #: BGC14-013

PROJECT NAME: Ajax

PROJECT NUMBER: 1125-007

INSTALLATION START DATE: MAR 4, 14 **INSTALLATION LOGGED BY:** SLP
INSTALLATION FINISH DATE: MAR 4, 14 **PERMANENT CASING INSTALLED TO:** 17' bgs.

PVC DETAILS
DIAMETER: 2" PVC mm/cm
SCREEN SLOT SIZE: 010
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40
END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________
TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

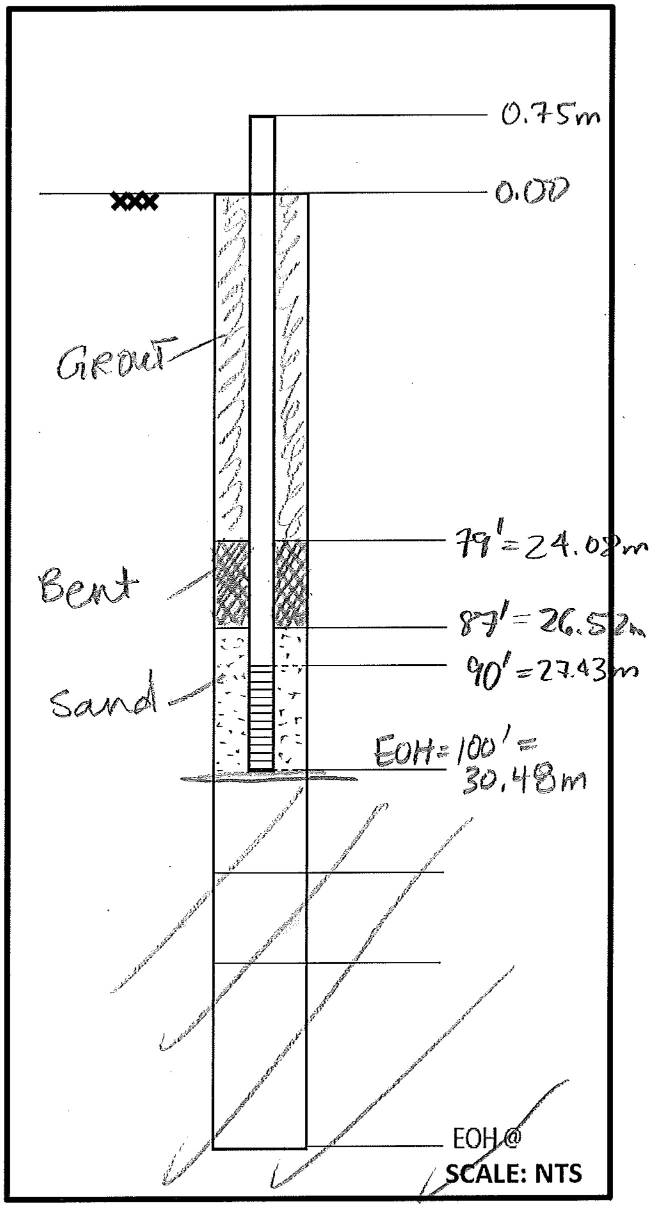
FILTER SAND
TYPE\BRAND: TARGET
SIZE: 10-20

BENTONITE
TYPE:
☑ CHIPS
☑ PELLETS
SIZE:
☑ 3/8"
☐ 5/8"

GROUT
TYPE/BRAND: QUIKGEL / LAFARGE TYPE GU
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: +0.75 m above gs. (TOP OF PVC) mbgl/mbtpvc
MEASURED ON: March 4, 2014 date/time
11:30am → RIGHT after installation.

NOTES:

REV 20120503

DRILL HOLE #: BGC14-014D

PROJECT NAME: Ajax **PROJECT NUMBER:** 1125007

INSTALLATION START DATE: Mar 5/14 **INSTALLATION LOGGED BY:** SLP
INSTALLATION FINISH DATE: Mar 5/14 **PERMANENT CASING INSTALLED TO:** 17' bgs.

PVC DETAILS
DIAMETER: 2" PVC mm/cm
SCREEN SLOT SIZE: 010
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

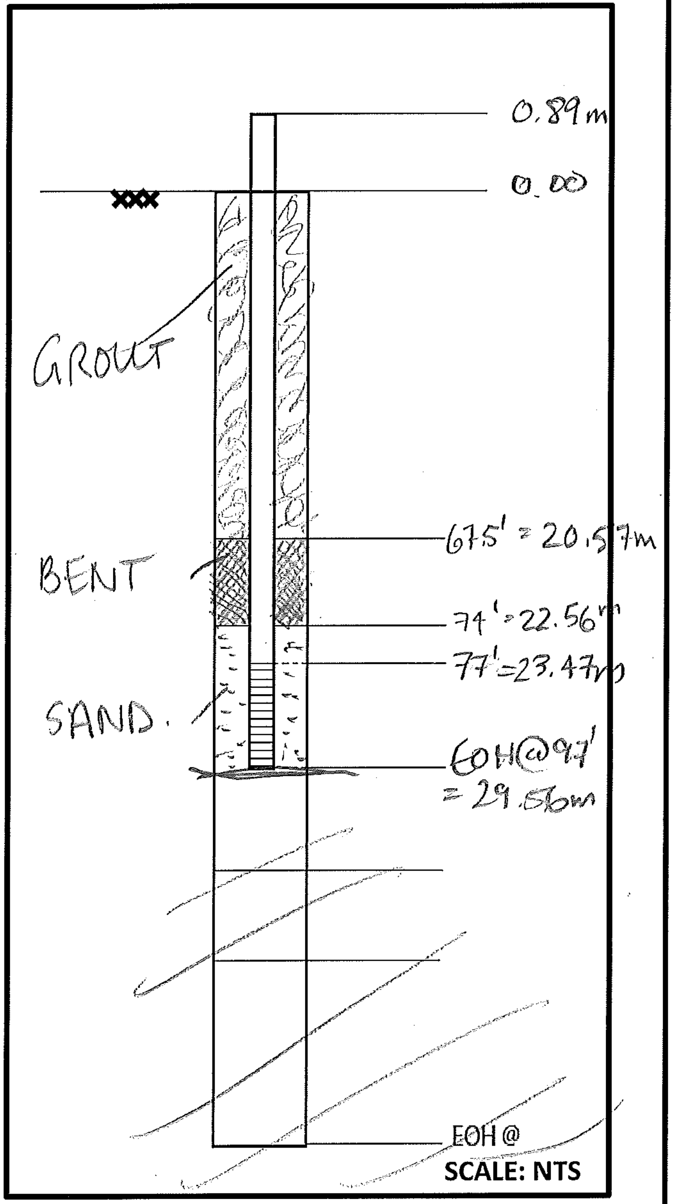
FILTER SAND
TYPE\BRAND: TARGET
SIZE: 10-20

BENTONITE
TYPE:
☑ CHIPS
☑ PELLETS
SIZE:
☑ 3/8"
☐ 5/8"

GROUT
TYPE/BRAND: QUIKGEL / LAFARGE TYPE GU
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: dry mbgl/mbtpvc
MEASURED ON: March 5, 2014 7:30am date/time

NOTES:

REV 20120503

DRILL HOLE #: BGC14-014S

PROJECT NAME: AJAX

PROJECT NUMBER: 1125007

INSTALLATION START DATE: MARCH 5,14

INSTALLATION FINISH DATE: MARCH 5,14

INSTALLATION LOGGED BY: SLP

PERMANENT CASING INSTALLED TO: 17' bgs.

PVC DETAILS

DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
- ☐ SCHED. 80
- ☐ SCHED. 60
- ☑ SCHED. 40

END CAP TYPE:
- ☑ THREADED
- ☐ SLIP
- ☐ OTHER: ________

TOP CAP TYPE:
- ☐ THREADED
- ☑ SLIP
- ☐ J-PLUG
- ☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
- ☑ CHIPS
- ☑ PELLETS

SIZE:
- ☑ 3/8"
- ☐ 5/8"

GROUT

TYPE/BRAND: TARGET/LAFARGE TYPE GU

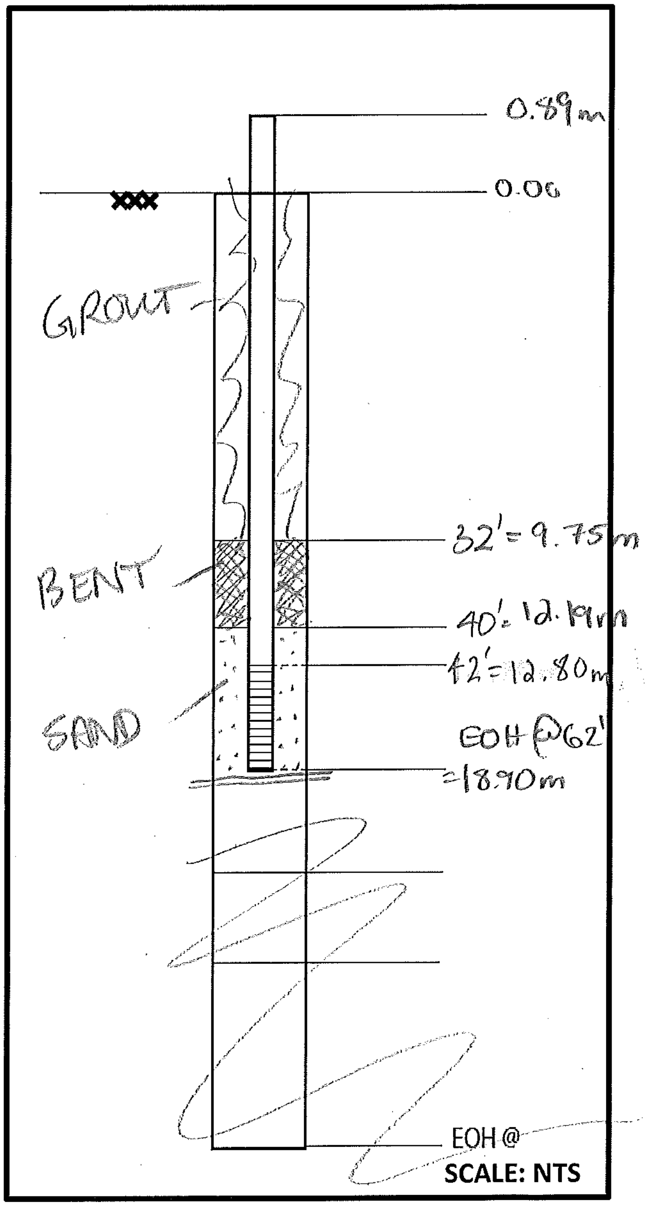
MIX:
- 2 BAGS CEMENT
- 0.5 BAGS BENTONITE
- 30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: ~~PAD~~ CASING CAP

LOCKING MECHANISM:
- ☑ YES: PADLOCK
- ☐ NO

HEAT TRACE:
- ☐ YES
- ☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: dry. mbgl/mbtpvc

MEASURED ON: ____________ date/time

NOTES:

REV 20120503

DRILL HOLE #: BGC14-01SD

PROJECT NAME: Ajax **PROJECT NUMBER:** 1125007

INSTALLATION START DATE: MAR 6/14 **INSTALLATION LOGGED BY:** SLP
INSTALLATION FINISH DATE: MAR. 6/14 **PERMANENT CASING INSTALLED TO:** 17'690

PVC DETAILS
DIAMETER: 2" PVC mm/cm
SCREEN SLOT SIZE: ____
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ____

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ____

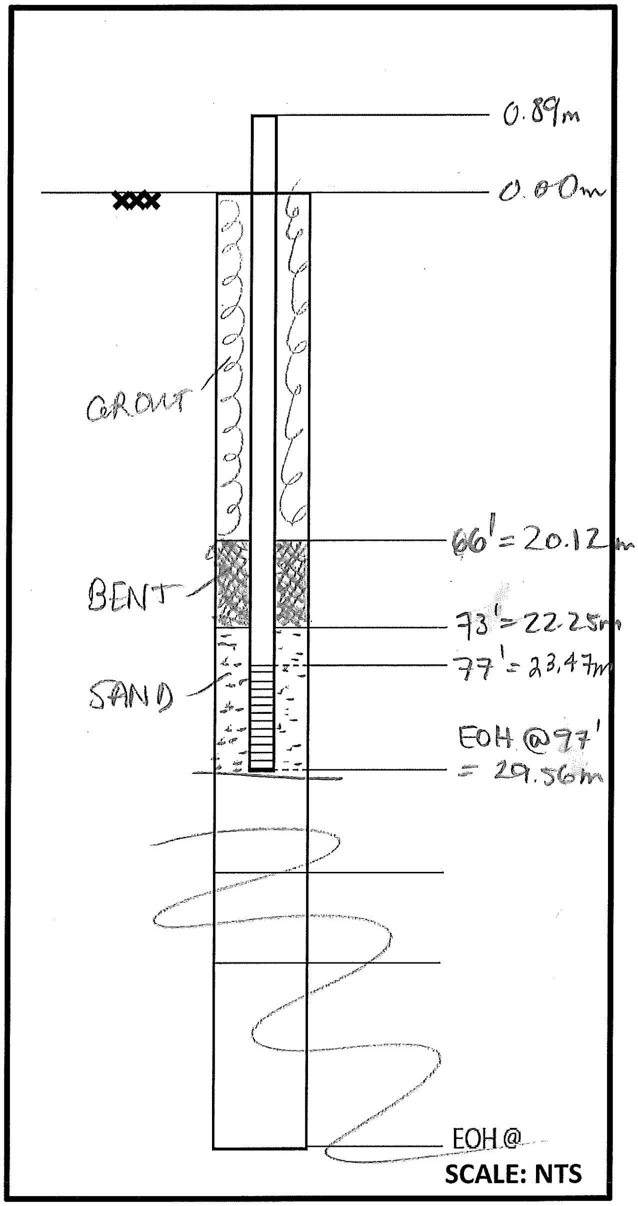
FILTER SAND
TYPE\BRAND: TARGET
SIZE: 10-20

BENTONITE
TYPE:
☑ CHIPS
☑ PELLETS
SIZE:
☑ 3/8"
☐ 5/8"

GROUT
TYPE/BRAND: QUIKGEL / LAFARGE TYPE GU
MIX:
2 BAGS CEMENT
.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: dry mbgl/mbtpvc
MEASURED ON: March 6, 14 @ 1:30pm date/time

NOTES:
WL measured March 7, 2014 @ 7:30 am - 5.60m from stickup.

DRILL HOLE #: BaC14-015S

PROJECT NAME: Ajax

PROJECT NUMBER: 1625007

INSTALLATION START DATE: MAR 6/14 **INSTALLATION LOGGED BY:** SLP

INSTALLATION FINISH DATE: MAR 6/14 **PERMANENT CASING INSTALLED TO:** 7' bgs.

PVC DETAILS

DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
☑ CHIPS
☑ PELLETS

SIZE:
☑ 3/8"
☐ 5/8"

GROUT

TYPE/BRAND: QUIKGEL / LAFARGE TYPE GU

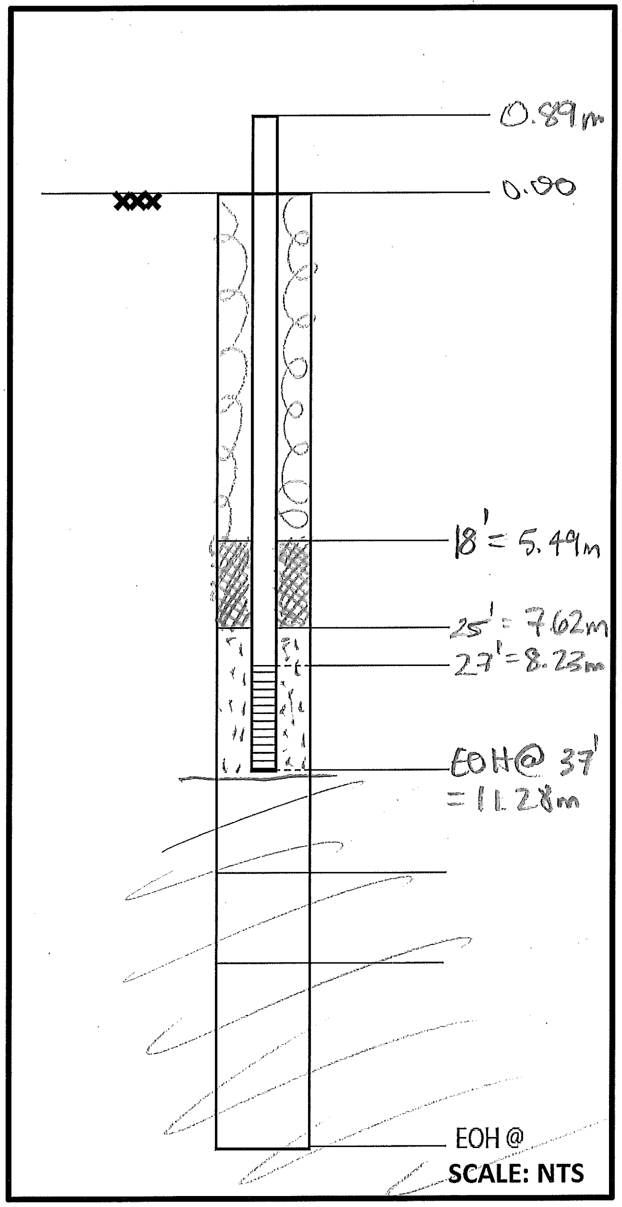
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: dry mbgl/mbtpvc

MEASURED ON: MARCH 6, 2014 4:00 pm date/time

NOTES:

WL measured on March 7, 2014, @ 9:30 am, 6.03 meters from s.u.

DRILL HOLE #: 3GC14-016

PROJECT NAME: Ajax **PROJECT NUMBER:** 1125007

INSTALLATION START DATE: Mar. 7/14 **INSTALLATION LOGGED BY:** SLP
INSTALLATION FINISH DATE: Mar 7/14 **PERMANENT CASING INSTALLED TO:** 17' bgs.

PVC DETAILS
DIAMETER: 2" PVC mm/cm
SCREEN SLOT SIZE: 010
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

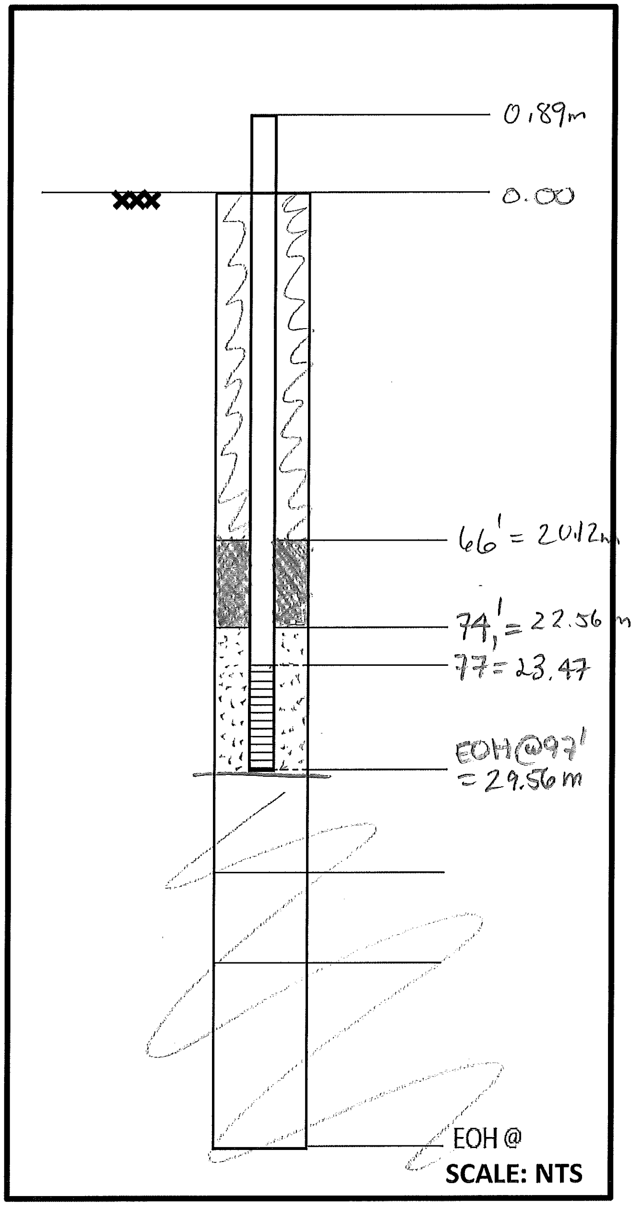
FILTER SAND
TYPE\BRAND: TARGET
SIZE: 10-20

BENTONITE
TYPE:
☑ CHIPS
☑ PELLETS
SIZE:
☑ 3/8"
☐ 5/8"

GROUT
TYPE/BRAND: QUIKGEL / LAFARGE TYPE GU
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: 28.55 [✓ mbgl]/mbtpvc
MEASURED ON: MARCH 7, 2014 1:19pm. date/time

NOTES:

REV 20120503

DRILL HOLE #: BGC14-017D

PROJECT NAME: Ajax

PROJECT NUMBER: 1125007

INSTALLATION START DATE: Mar 10/2014
INSTALLATION LOGGED BY: SLP
INSTALLATION FINISH DATE: Mar 10/2014
PERMANENT CASING INSTALLED TO: 17' bgs.

PVC DETAILS
DIAMETER: 2" PVC mm/cm
SCREEN SLOT SIZE: 010
WALL THICKNESS:
☐ SCHED. 80
☐ SCHED. 60
☑ SCHED. 40

END CAP TYPE:
☑ THREADED
☐ SLIP
☐ OTHER: ________

TOP CAP TYPE:
☐ THREADED
☑ SLIP
☐ J-PLUG
☐ OTHER: ________

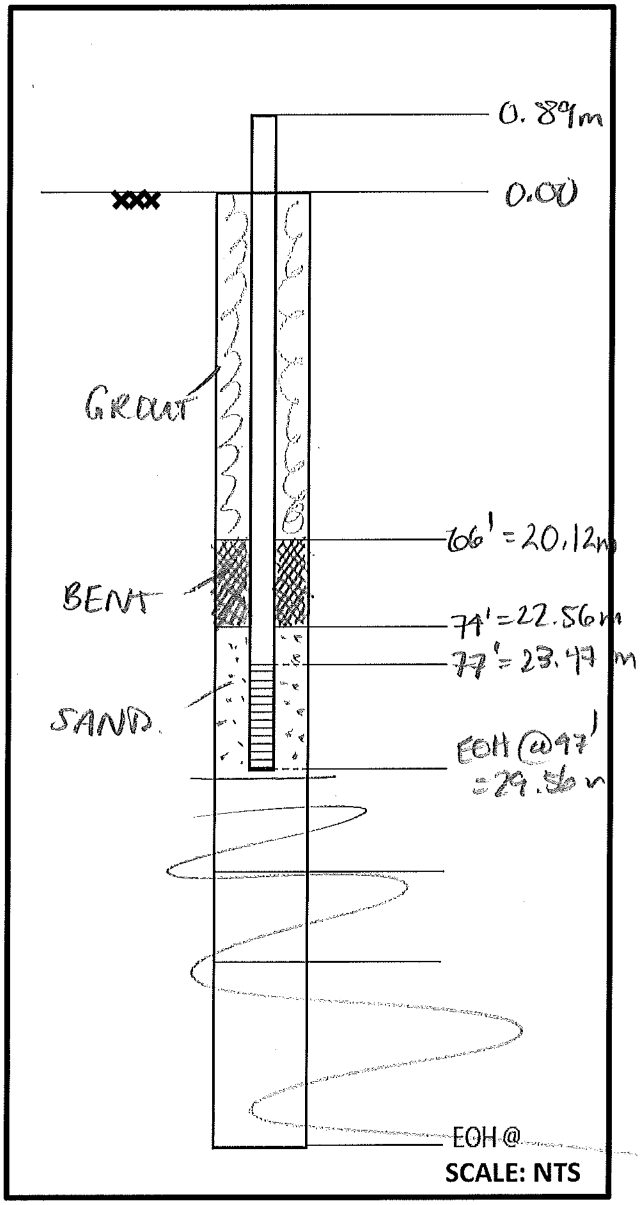
FILTER SAND
TYPE\BRAND: TARGET
SIZE: 10-20

BENTONITE
TYPE:
☑ CHIPS
☑ PELLETS
SIZE:
☑ 3/8"
☐ 5/8"

GROUT
TYPE/BRAND: QUIKGEL/LAFARGE TYPE GU
MIX:
2 BAGS CEMENT
0.5 BAGS BENTONITE
30 GALLONS OF WATER

SURFACE COMPLETION
TYPE: CASING CAP
LOCKING MECHANISM:
☑ YES: PADLOCK
☐ NO

HEAT TRACE:
☐ YES
☐ NO



WATER LEVEL
WATER LEVEL AT TIME OF INSTALLATION: ____________ mbgl/mbtpvc
MEASURED ON: ______________ date/time

NOTES:

REV 20120503

DRILL HOLE #: BGC14-0178

PROJECT NAME: AJAX

PROJECT NUMBER: 1125007

INSTALLATION START DATE: MAR10/14

INSTALLATION FINISH DATE: MAR10/14

INSTALLATION LOGGED BY: SLP

PERMANENT CASING INSTALLED TO: 5' bgs.

PVC DETAILS

DIAMETER: 2" PVC mm/cm

SCREEN SLOT SIZE: 010

WALL THICKNESS:
- ☐ SCHED. 80
- ☐ SCHED. 60
- ☑ SCHED. 40

END CAP TYPE:
- ☐ THREADED
- ☑ SLIP
- ☐ OTHER: ________

TOP CAP TYPE:
- ☐ THREADED
- ☑ SLIP
- ☐ J-PLUG
- ☐ OTHER: ________

FILTER SAND

TYPE\BRAND: TARGET

SIZE: 10-20

BENTONITE

TYPE:
- ☑ CHIPS
- ☑ PELLETS

SIZE:
- ☑ 3/8"
- ☐ 5/8"

~~**GROUT**~~

~~TYPE/BRAND:~~

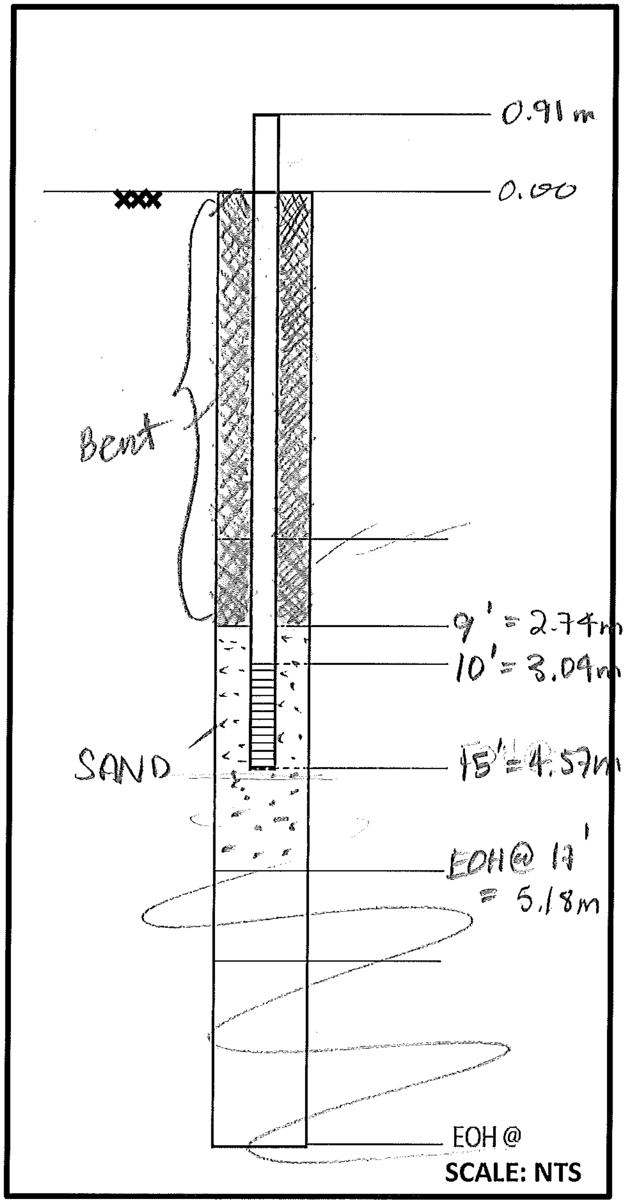
~~MIX:~~
- ~~____ BAGS CEMENT~~
- ~~____ BAGS BENTONITE~~
- ~~____ GALLONS OF WATER~~

SURFACE COMPLETION

TYPE: CASING CAP

LOCKING MECHANISM:
- ☑ YES: PADLOCK
- ☐ NO

HEAT TRACE:
- ☐ YES
- ☐ NO



WATER LEVEL

WATER LEVEL AT TIME OF INSTALLATION: __________ mbgl/mbtpvc

MEASURED ON: __________ date/time

NOTES:

REV 20120503

APPENDIX C
SOLINST LEVELOGGER MANUAL

User Guide

Levelogger Series - Software Version 4

November 5, 2013

Solinst®

Levelogger®
Model 3001

1 Introduction

This User Guide focuses on the current Levelogger Series, which includes:

- Levelogger Edge
- Barologger Edge
- Levelogger Junior Edge
- LTC Levelogger Junior
- Rainlogger Edge

Software Version 4.1 is also compatible with Levelogger Gold, Barologger Gold, Levelogger Junior and Rainlogger dataloggers. For details on setting up these dataloggers, see Section 5.9. Software Version 4.1 is also compatible with the Leveloader Gold data transfer device, which has a separate User Guide.

This Windows based software provides many convenient features. You can view and program datalogger settings, begin logging sessions, monitor real-time readings, download data, manage data files, perform data compensations, and save and export data files. Depending on the type of datalogger, there will be differences in programming options. See below for a summary of the differences:

NOTE

This version of software is not compatible with older models of the Levelogger (Made before Dec. 2005). To program and use the old versions, Levelogger 3.1.1 Software and User Guides can still be accessed at: www.solinst.com/Downloads/
For Software version 2.0.3, contact Solinst.

Datalogger Programming Options

Datalogger Type	Sampling Options	Memory Capacity	Battery Life
Levelogger Edge 	Linear (0.125 second to 99 hours), Compressed Linear, Event Based, Schedule, Repeat Schedule, Real Time View, Future Start/Stop	40,000 sets of readings or up to 120,000 Compressed. Slate or Continuous Mode (see note)	10 years based on 1 reading per minute
Barologger Edge 	Linear (0.125 second to 99 hours), Compressed Linear, Event Based, Schedule, Repeat Schedule, Real Time View, Future Start/Stop	40,000 sets of readings or up to 120,000 Compressed. Slate or Continuous Mode (see note)	10 years based on 1 reading per minute
Levelogger Junior Edge 	Linear (0.5 second to 99 hours), Real Time View	40,000 sets of readings in Slate Mode	5 years based on 1 reading per minute
LTC Levelogger Junior 	Linear (5 seconds to 99 hours), Real Time View	16,000 sets of readings in Slate Mode	5 years based on 1 reading every 5 minutes
Rainlogger Edge & Rainlogger 	Event Based (records tips from tipping-bucket rain gauge), Real Time View	Up to 60,000 tip time logs in Slate Mode	10 years based on 2 parameters logged every 10 minutes
Levelogger Gold 	Linear (0.5 second to 99 hours), Event Based, Schedule, Real Time View, Future Start/Stop	40,000 sets of readings, Slate or Continuous Mode	10 years based on 1 reading per minute
Barologger Gold 	Linear (0.5 second to 99 hours), Event Based, Schedule, Real Time View, Future Start/Stop	40,000 sets of readings, Slate or Continuous Mode	10 years based on 1 reading per minute
Levelogger Junior 	Linear (0.5 second to 99 hours), Real Time View	32,000 sets of readings in Slate Mode	5 years based on 1 reading per minute

NOTE

Let Solinst keep you up-to-date with each new software and firmware release.
Register your software at: www.solinst.com/Registration/ to receive these updates automatically.

NOTE

To use the new compression algorithm, which enables up to 120,000 data points, the Levelogger Edge or Barologger Edge must be in linear sampling mode and slate memory mode.

1.1 Levelogger Series

1.1.1 Levelogger Edge

The Levelogger Edge is an absolute (non-vented) datalogger, which measures groundwater and surface water levels and temperature. Water levels are displayed as temperature compensated pressure readings, and can be barometrically compensated with the aid of a Barologger Edge.

Levelogger Edge Technical Specifications	
Level Sensor:	Piezoresistive Silicon with Hastelloy Sensor
Ranges:	6,15, 30, 65, 100, 300, 600 ft. (2, 5, 10, 20, 30, 100, 200 m)
Accuracy	± 0.05% FS
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Temp. Sensor Accuracy:	± 0.05ºC
Temp. Sensor Resolution:	0.003ºC
Temp. Comp. Range:	0ºC to 50ºC
Battery Life:	10 years (based on 1 reading/minute)
Clock Accuracy:	± 1 minute/year (-20ºC to 80ºC)
Operating Temperature:	-20ºC to 80ºC
Maximum # Readings:	40,000 (up to 120,000 using data compression)
Memory:	FRAM, Continuous or Slate mode
Communication Speed:	9600 bps, 38,400 bps with USB optical reader
Com Interface:	Optical Infra-red: USB, RS-232, SDI-12
Size:	7/8" x 6.25" (22 mm x 159 mm)
Weight:	129 grams (4.5 oz.)
Corrosion Resistance:	Titanium based PVD coated body and superior corrosion resistant Hastelloy sensor
Other Wetted Materials:	Delrin®, Viton®, 316L Stainless Steel
Sampling Modes:	Linear, Event & User-Selectable Schedule with Repeat Mode, Future Start, Future Stop, Real Time View
Measurement Rates:	0.125 second to 99 hours
Barometric Compensation:	High accuracy, air-only, Barologger Edge

! NOTE

Solinst recommends using the most recent firmware, Version 3.003, when using a Levelogger Edge with Software Version 4.1.

LT Edge Models	Full Scale	Accuracy
F6, M2	6.6 ft, 2 m	± 0.05% FS
F15, M5	16.4 ft., 5 m	± 0.05% FS
F30, M10	32.8 ft., 10 m	± 0.05% FS
F65, M20	65.6 ft., 20 m	± 0.05% FS
F100, M30	98.4 ft., 30 m	± 0.05% FS
F300, M100	328.1 ft., 100 m	± 0.05% FS
F600, M200	656.2 ft, 200 m	± 0.05% FS

! NOTE

The Model number refers to the depth of submergence below water level that the pressure sensor can withstand. i.e.: The Levelogger Edge, which is available in F6 (M2), F15 (M5), F30 (M10), F65 (M20), F100 (M30), F300 (M100), and F600 (M200) ranges has actual water level ranges of 6.6 ft (2 m), 16.40 ft (5 m), 32.80 ft (10 m), 65.60 ft (20 m), 98.40 ft (30 m), 328.0 ft (100 m), and 656.2 ft (200 m), respectively.

NOTE

Solinst recommends using the most recent firmware, Version 3.003, when using a Barologger Edge with Software Version 4.1.

1.1.2 Barologger Edge

The Barologger Edge uses algorithms based on air pressure only. It measures and logs changes in atmospheric pressure, which are then used to compensate water level readings recorded by a Levelogger Edge, Levelogger Junior Edge, or LTC Levelogger Junior.

Barologger Edge Technical Specifications	
Level Sensor:	Piezoresistive Silicon with Hastelloy Sensor
Accuracy	± 0.05 kPa
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Temp. Sensor Accuracy:	± 0.05ºC
Temp. Sensor Resolution:	0.003ºC
Temp. Comp. Range:	-10ºC to 50ºC
Battery Life:	10 years (based on 1 reading/minute)
Clock Accuracy:	±1 minute/year (-20ºC to 80ºC)
Operating Temperature:	-20ºC to 80ºC
Maximum # Readings:	40,000 (120,000 using data compression)
Memory:	FRAM, Continuous or Slate mode
Communication Speed:	9600 bps, 38,400 bps with USB optical reader
Com Interface:	Optical Infra-red: USB, RS-232, SDI-12
Size:	7/8" x 6.25" (22 mm x 159 mm)
Weight:	129 grams (4.5 oz.)
Corrosion Resistance:	Titanium based PVD coated body and superior corrosion resistant Hastelloy sensor
Other Wetted Materials:	Delrin®, Viton®, 316L Stainless Steel
Sampling Modes:	Linear, Event & User-Selectable Schedule with Repeat Mode, Future Start, Future Stop, Real Time View
Measurement Rates:	0.125 second to 99 hours

LT Edge Models	Full Scale (FS)	Accuracy
Barologger	Air Only	±0.05 kPa

1.1.3 Levelogger Junior Edge

The Levelogger Junior Edge provides an inexpensive alternative for measuring groundwater and surface water levels and temperature.

NOTE

Solinst recommends using the most recent firmware, Version 3.003, when using a Levelogger Junior Edge with Software Version 4.1.

NOTE

The Levelogger Junior Edge looks very similar to the previous Levelogger Junior. To determine the difference, look at the serial number on the body of the Levelogger. If the fourth number in the serial number is 1, it is a Levelogger Junior. If the fourth number is a 2, it is a Levelogger Junior Edge.

Levelogger Junior Edge Technical Specifications

Level Sensor:	Piezoresistive Silicon with Hastelloy Sensor
Ranges:	15, 30 ft. (5, 10 m)
Accuracy	± 0.1% FS
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Accuracy:	± 0.1ºC
Resolution:	0.1ºC
Temp Compensation Range:	0ºC to 40ºC
Battery life:	5 years (based on 1 reading/minute)
Clock Accuracy:	± 1 minute / year (-20ºC to 80ºC)
Operating Temperature:	-20ºC to 80ºC
Memory:	FRAM, Slate mode
Maximum # Readings	40,000 (no data compression)
Com Interface:	Optical Infra-red: USB, RS-232, SDI-12
Communication Speed:	9600 bps
Size:	7/8" x 5.6" (22 mm x 142 mm)
Weight:	4.2 oz (119 grams)
Wetted Materials:	Delrin®, Viton®, 316L Stainless Steel, Hastelloy
Sampling Mode:	Linear, Future Start, Real Time View
Measurement Rates:	0.5 seconds to 99 hours
Barometric Compensation:	High accuracy, air-only, Barologger Edge

LT Models	Full Scale (FS)	Accuracy
F15, M5	16.4 ft., 5 m	± 0.1% FS
F30, M10	32.8 ft., 10 m	± 0.1% FS

1.1.4 LTC Levelogger Junior

The LTC Levelogger Junior provides an inexpensive and convenient method to measure level, temperature and conductivity all in one probe.

NOTE

Solinst recommends using the most recent firmware, Version 2.005, when using a LTC Levelogger Junior with Software Version 4.1.

LTC Levelogger Junior Technical Specifications	
Level Sensor:	Piezoresistive Silicon with Hastelloy Sensor
Ranges:	30, 100 ft. (10, 30 m)
Accuracy	± 0.1% FS
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Accuracy:	± 0.1ºC
Resolution:	0.1ºC
Temp Compensation Range:	10ºC to 40ºC
Conductivity Sensor:	4-Electrode Platinum
Full Range:	0 to 80,000 µS/cm
Calibrated Range:	500 to 50,000 µS/cm
Accuracy:	± 2% of reading or 20 µS/cm
Resolution:	1 µS
Normalization:	Specific Conductance normalized to 25ºC for full range
User Calibration Points:	1413, 5000, 12,880 µS
Battery Life:	5 years (based on 1 reading/ 5 minutes)
Clock Accuracy:	± 1 minute / year
Operating Temperature:	-20ºC to 80ºC
Memory:	Non-volatile EEPROM, FRAM back-up, Slate mode only
Maximum Readings:	16,000
Communication Speed:	9600 bps
Com Interface:	Optical Infrared: USB, RS-232, SDI-12
Size:	7/8" x 7.5" (22 mm x 190 mm)
Weight:	200 g (7.05 oz.)
Wetted Materials:	Hastelloy, Delrin®, Viton®, 316L Stainless Steel, Platinum
Sampling Mode:	Linear, Future Start, Real Time View
Measurement Rates:	5 seconds to 99 hours
Altitude Input:	-980 to 16,400 ft. (-300 to 5,000 m)
Barometric Compensation:	High accuracy, air-only, Barologger

LTC Models	Full Scale (FS)	Accuracy
F30, M10	32.8 ft., 10 m	± 0.032 ft., 1.0 cm
F100, M30	98.4 ft., 30 m	± 0.098 ft., 3 cm

1.1.5 Rainlogger Edge

The Rainlogger Edge is designed for use with most standard tipping-bucket rain gauges with a reed switch output. It records each tip time from the tipping-bucket, and outputs the amount of rainfall per programmed time period (based on rainfall calibration constant).

Rainlogger Edge Technical Specifications	
Battery Life:	10 years (logging 2 parameters/10 minutes)
Clock Accuracy:	± 1 minute/year
Operating Temperature:	-20˚C to 80˚C
Maximum # Readings:	Up to 60,000 tip times
Memory:	Non-volatile EEPROM, Slate mode only
Communication:	Optical infra-red: USB, RS-232, SDI-12
Measurement:	Records each tip by the tipping-bucket rain gauge and outputs the amount of rainfall
Sampling Mode:	Event Based, Future Start, Real TIme View
Size:	7/8" x 5.5" (22 mm x 140 mm)
Weight:	1.6 oz (44 grams)
Materials:	ABS, Delrin®, Viton®

! NOTE

Solinst recommends using the most recent firmware, Version 3.000, when using a Rainlogger Edge with Software Version 4.1.

1.1.6 Leveloader Gold

The Leveloader Gold is a data transfer device for use with all versions of Leveloggers. It can be used to download, store, and transfer data from Levelogger to PC, as well as, save settings files for transfer to a Levelogger. Also allows real time viewing of Levelogger readings. The Leveloader is used with Levelogger Software, see separate Leveloader Gold User Guide.

! NOTE

Solinst recommends using the most recent firmware, Version 2.001, when using a Leveloader Gold with Software Version 4.1.

! NOTE

To use the Levelogger Gold with Software Version 4.1, ensure you are using version 2.007 firmware.

Contact Solinst if you need to upgrade your firmware from version 1.016 or lower.

1.1.7 Levelogger Gold

The Levelogger Gold is an absolute (non-vented) datalogger, which measures groundwater and surface water levels and temperature. Water levels are displayed as temperature compensated pressure readings, and can be barometrically compensated with the aid of a Barologger.

Levelogger Gold Technical Specifications	
Level Sensor:	Piezoresistive Silicon in 316L Stainless Steel
Accuracy	0.05% FS
Ranges:	15, 30, 65, 100, 300 ft. (5, 10, 20, 30, 100 m)
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Temp. Sensor Accuracy:	± 0.05°C
Temp. Sensor Resolution:	0.003°C
Temp. Comp. Range:	10ºC to 40°C
Battery Life:	10 Years - based on one reading/min
Clock Accuracy:	± 1 minute/year
Operating Temperature:	-20°C to 80°C
Maximum # Readings:	40,000 of level and temperature
Memory:	EEPROM Slate, Continuous, and redundant backup of last 1200 readings
Communication:	Optical Infra-red: USB, RS-232, SDI-12
Communication Speed:	9600 bps
Size:	7/8" x 6" (22 mm x 154 mm)
Weight:	6.3 oz (179 grams)
Corrosion Resistance:	Zirconium Nitride (ZrN) Coating
Other Wetted Materials:	316L Stainless Steel, Delrin®, Viton®
Sampling Modes:	Linear, Event & User-Selectable with 30 separate line items
Measurement Rates:	0.5 sec to 99 hrs
Barometric Compensation:	High accuracy, air-only, Barologger Gold

LT Models	Full Scale (FS)	Accuracy
F15, M5	16.4 ft., 5 m	± 0.010 ft., 0.3 cm
F30, M10	32.8 ft., 10 m	± 0.016 ft., 0.5 cm
F65, M20	65.6 ft., 20 m	± 0.032 ft., 1 cm
F100, M30	98.4 ft., 30 m	± 0.064 ft., 1.5 cm
F300, M100	328.1 ft., 100 m	± 0.164 ft., 5 cm

NOTE

To use the Barologger Gold with Software Version 4.1, ensure you are using version 2.007 firmware.

1.1.8 Barologger Gold

The Barologger Gold uses algorithms based on air pressure only. It measures and logs changes in atmospheric pressure, which are then used to compensate water level readings recorded by a Levelogger.

Barologger Gold Technical Specifications	
Level Sensor:	Piezoresistive Silicon in 316L Stainless Steel
Accuracy	0.05% FS
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Temp. Sensor Accuracy:	± 0.05°C
Temp. Sensor Resolution:	0.003°C
Temp. Comp. Range:	0ºC to 40°C
Battery Life:	10 Years - based on one reading/min
Clock Accuracy:	± 1 minute/year
Operating Temperature:	-20°C to 80°C
Maximum # Readings:	40,000 of pressure and temperature
Memory:	EEPROM Slate, Continuous, and redundant backup of last 1200 readings
Communication:	Optical Infra-red: USB, RS-232, SDI-12
Communication Speed:	9600 bps
Size:	7/8" x 6" (22 mm x 154 mm)
Weight:	6.3 oz (179 grams)
Corrosion Resistance:	Zirconium Nitride (ZrN) Coating
Other Wetted Materials:	316L Stainless Steel, Delrin®, Viton®
Sampling Modes:	Linear, Event & User-Selectable with 30 separate line items
Measurement Rates:	0.5 sec to 99 hrs

LT Models	Full Scale (FS)	Accuracy
Barologger	Air Only	± 0.003 ft., 0.1 cm

1.1.9 Levelogger Junior

The Levelogger Junior functions like the Levelogger Gold; provides an inexpensive alternative for measuring groundwater and surface water levels and temperature.

NOTE

To use the Levelogger Junior with Software Version 4.1, ensure you are using version 2.007 firmware.

NOTE

The Levelogger Junior looks very similar to the newer Levelogger Junior Edge. To determine the difference, look at the serial number on the body of the Levelogger. If the fourth number in the serial number is 1, it is a Levelogger Junior. If the fourth number is a 2, it is a Levelogger Junior Edge.

Levelogger Junior Technical Specifications	
Level Sensor:	Piezoresistive Silicon in 316L Stainless Steel
Ranges:	15, 30 ft. (5, 10 m)
Accuracy	± 0.1% FS
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Accuracy:	± 0.1ºC
Resolution:	0.1ºC
Temp Compensation Range:	10ºC to 40ºC
Battery life:	5 years (based on 1 reading/minute)
Clock Accuracy:	± 1 minute / year
Operating Temperature:	-20ºC to 80ºC
Memory:	Non-volatile EEPROM, FRAM back-up, Slate mode only
Maximum # Readings	32,000 (no data compression)
Com Interface:	Optical Infra-red: USB, RS-232, SDI-12
Communication Speed:	9600 bps
Size:	7/8" x 5.5 " (22 mm x 140 mm)
Weight:	154 g (5.4 oz)
Wetted Materials:	Delrin®, Viton®, 316L Stainless Steel
Sampling Mode:	Linear, Future Start, Real Time View
Measurement Rates:	0.5 seconds to 99 hours
Altitude Input:	-980 to 16,400 ft. (-300 to 5,000 m)
Barometric Compensation:	High accuracy, air-only, Barologger Gold

LT Models	Full Scale (FS)	Accuracy
F15, M5	16.4 ft., 5 m	± 0.020 ft., 0.6 cm
F30, M10	32.8 ft., 10 m	± 0.032 ft., 1.0 cm

1.1.10 Rainlogger

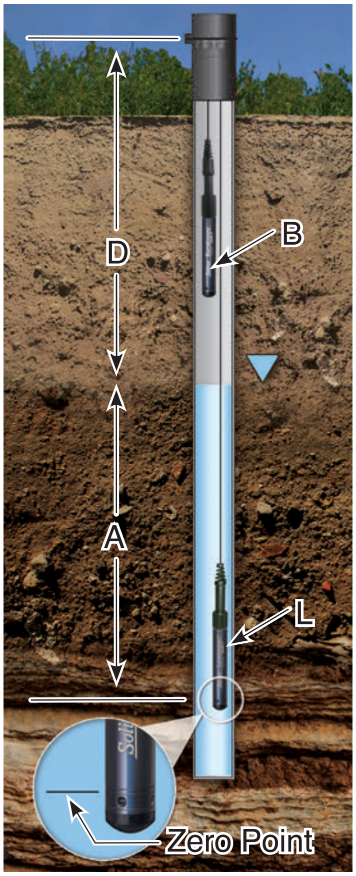
The Rainlogger is designed for use with most standard tipping-bucket rain gauges with a reed switch output. It records each tip time from the tipping-bucket, and outputs the amount of rainfall per programmed time period (based on rainfall calibration constant).

NOTE

Solinst recommends using the most recent firmware, Version 2.000, when using a Rainlogger with Software Version 4.1.

If using a firmware version prior to version 2.000, the Rainlogger will function differently (See previous Levelogger User Guide)

Rainlogger Technical Specifications	
Battery Life:	10 years (logging 2 parameters/10 minutes)
Clock Accuracy:	± 1 minute/year
Operating Temperature:	-20˚C to 80˚C
Maximum # Readings:	Up to 60,000 tip times
Memory:	Non-volatile EEPROM, Slate mode only
Communication:	Optical infra-red: USB, RS-232, SDI-12
Measurement:	Records each tip by the tipping-bucket rain gauge and outputs the amount of rainfall
Sampling Mode:	Event Based, Future Start, Real TIme View
Size:	7/8" x 7" (22 mm x 175 m)
Weight:	4.8 oz (135 grams)
Materials:	316L Stainless Steel, Delrin®, Viton®



A = L - B

Figure 1-1
Levelogger Measurement Fundamentals

> **NOTE**
>
> Leveloggers measure the pressure of air plus water column above their sensor (zero point). To adjust the level readings after data collection, for example to water level depths below top of casing (**D**), refer to the Advanced options within the software Data Wizard.

> **NOTE**
>
> The Levelogger Gold, Levelogger Junior and current LTC Levelogger Junior models convert pressure readings to the water level equivalent above the datalogger's pressure zero point of 950 cm (31.17 ft). The Levelogger Edge and Levelogger Junior Edge have no zero point offset. As such, water level data will appear different, although measuring the same amount of pressure. Barometric Compensation using the Data Wizard, automatically considers this zero point offset difference when compensating a mix of Models.

1.2 Measurement Parameters

1.2.1 Level

All Leveloggers measure total (absolute) pressure. When submerged, the Levelogger is recording the combination of barometric pressure and water pressure. The actual pressure of just water **(A)** above the sensor is obtained by subtracting barometric pressure **(B)** from the total pressure **(L)** (see Figure 1-1).

The best method to compensate for barometric pressure is to employ a Barologger above the water level, to obtain records of barometric pressure. The Levelogger Software includes a Data Wizard, which guides you through the automated process of barometric compensation. Manual methods can be employed to determine the absolute water level using barometric records collected on-site or available from a local weather station (i.e. airport). Water level readings from Leveloggers are automatically temperature-compensated.

A = Actual water column height
B = Barometric pressure
L = Levelogger total pressure readings
D = Depth to water level, below reference datum

Note: the Levelogger Gold, Levelogger Junior and current LTC Levelogger Junior models convert pressure readings to the water level equivalent above the datalogger's pressure zero point of 950 cm (31.17 ft). The Levelogger Edge and Levelogger Junior Edge have no zero point offset. As such, water level data will appear different, although measuring the same amount of pressure (i.e. Levelogger Edge data will appear to be reading 950 cm (31.17 ft) higher than a Levelogger Gold. Barometric Compensation using the Data Wizard, automatically considers this zero point offset difference when compensating a mix of Models.

1.2.1.1 Pressure Calibration

The Levelogger Edge is calibrated against a range of set reference points to an accuracy of 3 decimal places. During the calibration procedure, the Levelogger is fully submerged in a highly accurate water bath. The bath is set to 5°C and allowed to stabilize. The pressure is then calibrated to six separate pressure points covering the entire range of pressure for that particular Levelogger to check for any non-linearity. The process is repeated again at 35°C to check for temperature effects. Once done, the Levelogger is approved after all specifications for accuracy, precision, stability and hysteresis have been met. The Levelogger should be calibrated for the life-time of the instrument, as long as it is used within its specified range.

1.2.2 Barometric Pressure

The Barologger is designed for use in air only. It has a specific range and firmware algorithms based on air pressure rather than water pressure. This makes the Barologger less accurate if used in water, but more accurate if used as intended in air. Using a Barologger is the most accurate and convenient method of obtaining atmospheric pressure and air temperature measurements, which are then synchronized to the Levelogger. The Data Wizard in the Levelogger Software simplifies the adjustment of the level measurements for barometric pressure changes, by using the synchronized data from all Leveloggers on site and the site Barologger.

1.2.3 Temperature

Leveloggers record temperature compensated water levels. Groundwater and surface water temperature measurements are particularly important in situations where temperatures may fluctuate significantly, and when temperature is used in determining liquid level, viscosity and hydraulic conductivity. Temperature monitoring is vital in the calculation of certain temperature dependent contaminant reaction rates. A Platinum Resistance Temperature Detector is used to accurately compensate for temperature changes within the range of 0 to +50°C for the Levelogger Edge, -10°C to +50°C for the Barologger Edge, 0 to +40°C for the Levelogger Junior Edge, and +10 to +40 for the LTC Levelogger Junior. The Levelogger will record temperature in its thermal range of -20 to +80°C, but outside the range, compensation will be less accurate.

1.2.4 Conductivity

The LTC Levelogger Junior provides the added feature of electrical conductivity measurement. It measures the actual conductivity at the current temperature. Conductivity measurement is particularly useful in monitoring saltwater intrusion, surface water infiltration and mixing, as well as the monitoring of certain pollutants and contaminant parameters. Conductivity is measured via a platinum 4-electrode sensor, which produces highly stable and consistent readings. Conductivity calibration is performed by using a liquid solution, with a known conductivity value, and the Calibration Wizard in the Levelogger Windows Software. The Data Wizard allows you to convert conductivity readings to Specific Conductance (at 25°C), or Salinity expressed in Practical Salinity Units (PSU). A Practical Salinity Unit (PSU) is a dimensionless descriptor for the Practical Salinity Scale (PSS). The PSS defines salinity as the ratio of a water sample's conductivity to that of a standard KCL solution. The Data Wizard uses the equation given in the UNESCO Technical Paper "Algorithms for computation of fundamental properties of seawater", to convert Conductivity readings to Salinity. For more information, see: Fofonoff, N. P. and R.C. Millard, Jr. Algorithms for computation of fundamental properties of seawater, UNESCO, Tech. Pap. Mar. Sci.,44.

! NOTE

For every degree change in temperature, there is approximately a 2% change in conductivity. To convert raw conductivity measurements to Specific Conductance measurements, you can use the following equation:

Specific Conductance = Conductivity / (1 + 0.02 * (temp(C) - 25))

You can also perform this calculation automatically using the Data Wizard.

1.2.4.1 Calibration of the Conductivity Sensor

The conductivity sensor of the LTC Levelogger Junior is a highly sensitive device requiring regular calibration by the user. The conductivity calibration frequency is dependent on the water quality of the Levelogger's monitoring environment. To determine whether an LTC Levelogger Junior should be re-calibrated, test the unit in a solution with a known electrical conductivity value at a reference temperature. In Real Time View, observe current readings by using the Read Now function. If this reading varies from the known Specific Conductance of the solution by greater than 2% of the Full Scale of Conductivity measurement, the unit should be re-calibrated using the Conductivity Calibration Wizard procedure outlined in Section 6. As a minimum, calibrate your LTC Levelogger Junior at least twice a year. Ensure that a conductivity calibration is performed when the LTC Levelogger Junior is being set up for its initial use and after long periods of dry storage.

1.2.5 Total Rainfall

Solinst Rainloggers are designed to record the number of tips of an external tipping-bucket rain gauge, and output the amount of rainfall per tip.

NOTE

For software installation instructions, see Section 3.

1.3 Software Communication

Levelogger Software is Windows based, and is therefore used with a desktop or laptop PC. Dataloggers connect to a laptop or desktop PC with an Optical Reader cable. The Optical Reader cable uses an infrared data reader/port connected to the datalogger and a USB or RS-232 (Serial) Com Port to transfer information between the datalogger and computer.

If you are programming dataloggers in the office, or have deployed your datalogger using a wireline or cord, an Optical Reader is most commonly used for communication with a PC (see Figure 1-2).

If a datalogger is deployed in the field using a Direct Read Cable, a PC Interface Cable is used for communication with the PC, without removing it from the well (see Figure 1-3).

Figure 1-2 Levelogger Connected to a PC Using an Optical Reader

NOTE

Always plug in the USB device before starting the Software.

When you plug in a USB device for the first time, you will need to install the USB Driver on the PC. (See Section 4.1.3).

Figure 1-3
Levelogger and Direct Read Cable Connected to PC Using a PC Interface Cable

1.3.1 Backwards Compatibility

The Levelogger Edge is not backwards compatible with previous versions of Levelogger Software. Only Levelogger Software Version 4 and up can be used to program the Levelogger Edge and Barologger Edge. The Levelogger Junior Edge is only compatible with Levelogger Software Version 4.0.2 and up. The Rainlogger Edge is only compatible with Software Version 4.1 and up.

The Levelogger Junior, LTC Levelogger Junior, Rainlogger, and Leveloader are compatible with Levelogger Software Version 4.1. If used with previous software versions, they will not have some of the features gained with the release of Version 4.1 Software. The Levelogger Gold and Barologger Gold are also compatible with Version 4.1 Software, and previous versions.

To use your Leveloggers with Version 4.1 Software, ensure your firmware is upgraded to the following versions:

Datalogger	Firmware Version
Levelogger Edge	3.003
Barologger Edge	3.003
Levelogger Junior Edge	3.003
LTC Levelogger Junior	2.005
Rainlogger Edge	3.000
Leveloader Gold	2.001
Levelogger Gold	2.007
Barologger Gold	2.007
Levelogger Junior	2.007
Rainlogger	2.000

For more information on previous software and firmware versions, visit www.solinst.com to view **3001 Levelogger Series: Hardware Compatibility**, located on the Downloads page.

! NOTE

It is always recommended to use the most recent version of software and firmware.

! NOTE

For more information, visit www.solinst.com to view the 3001 Levelogger Series: Hardware Compatibility, which is located on the Downloads page.

2 System Requirements

The minimal hardware and software requirements for software installation and operation are:

Hardware	Software
Memory: 32 MB or more	OS: Windows XP or 7
Display: VGA: 800 x 600 pixels, 256 colour	
Ports: USB or RS-232 Serial Port	

Communication Port Setting for Levelogger Communications:

Bits per second	9600
Data bits	8
Stop bits	1
Flow control	None

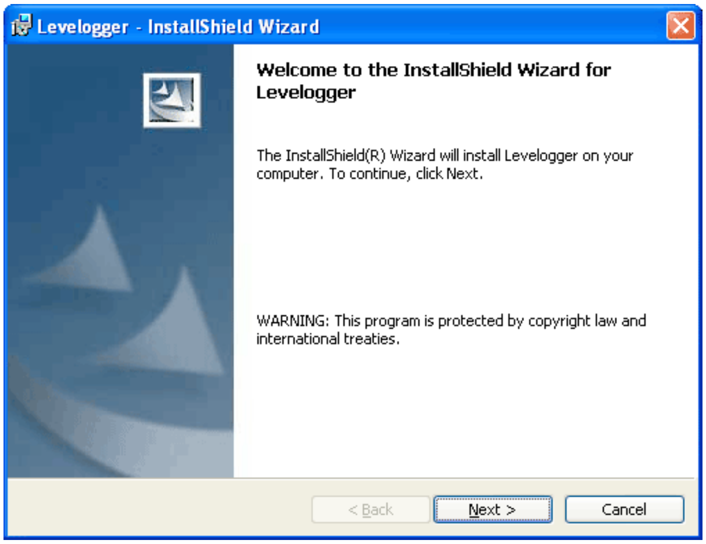
3 Software Installation

Web Download

Download the newest version of Levelogger Software by visiting www.solinst.com/Downloads/

CD Installation

1) Insert the software CD provided.
2) If the installer does not automatically start, to activate the software install click on the 'setup.exe' file located on the software CD.
3) The Software Installation Wizard will guide you through the remaining installation process. Figure 3-1 shows the Levelogger Installation Wizard.
4) Restart the computer after installation is completed. Default Directory is C:\Program Files\Solinst\Levelogger4_1



Welcome to the InstallShield Wizard for Levelogger

The InstallShield(R) Wizard will install Levelogger on your computer. To continue, click Next.

WARNING: This program is protected by copyright law and international treaties.

Figure 3-1 Software Installation Wizard

4 Startup, Configurations and Settings

4.1 Startup

If using a USB port, plug in the USB cable before starting the Levelogger Software. If plugging in the USB device for the first time, the driver for the device will have to be installed, see Section 4.1.3 for USB driver installation instructions.

To start the Levelogger Software, click , or click the Start button and select:

Programs > Solinst > Levelogger 4 > Levelogger 4.1

Once the program is started, you can set up the parameters for the Software.

4.1.1 Software/Firmware Update Checks

Each time the software is opened, it automatically checks for software updates. If there is an update, "Software Update Available" will appear in the top right of the menu bar. When you click the message, it will open a web page where you can download the software update.

The Software also checks for firmware updates once you have retrieved settings from a connected Levelogger (see Section 5)."Firmware Update Available" will appear in the top right menu bar. Clicking the message will open a web page where you can download the firmware update. See Section 12 for firmware update instructions.

! NOTE

Your PC must have an internet connection to check for software and firmware updates.

You can also check for updates using the Help menu.

4.1.2 Communicating with a USB Port

USB port communication requires the installation of USB driver software and the setting up of a virtual com port. If communicating via a USB port, the user will either:

1) Connect a Levelogger Optical Reader or PC Interface Cable to the USB port
2) Use a USB to RS-232 Adapter

If 1, during the installation of Levelogger Software, the **Virtual Com Port Driver** will be installed automatically. The Levelogger Software Installation Wizard also copies a folder to the Levelogger folder containing all the Solinst USB drivers. When you plug in the Solinst USB device, check the com port designation after installing the device (see Section 4.2.1).

If 2, Solinst strongly recommends the use of either Keyspan™ or IO Gear™ USB to RS-232 Serial Adapters. These adapters have a sufficiently large buffer to accommodate the size of data bundle and bit transfer rate of the Levelogger. Follow the manufacturer's USB Driver and Com port setup installations found on the CD accompanying the adapter.

If you have installed another brand-name adapter, but cannot communicate with the Levelogger, in most cases the problem is that the adapter does not have a large enough internal memory buffer. The minimum buffer size should be 96 bytes.

! NOTES

To check the Com port assigned to a USB device after installation, open the Device Manager. Expand "Ports (COM & LPT)" to show the Com Port that has been assigned. To change the assigned Port, see Section 4.2.1.

You may have to restart your computer after adding a new USB device, before that port will be detected by the Levelogger Software

4.1.3 Installing USB Drivers for Levelogger 4 Software

Levelogger Software Version 4.1, for use with Solinst USB Optical Reader, PC Interface Cable and Leveloader, comes equipped with USB drivers for: Windows XP and 7.

NOTE

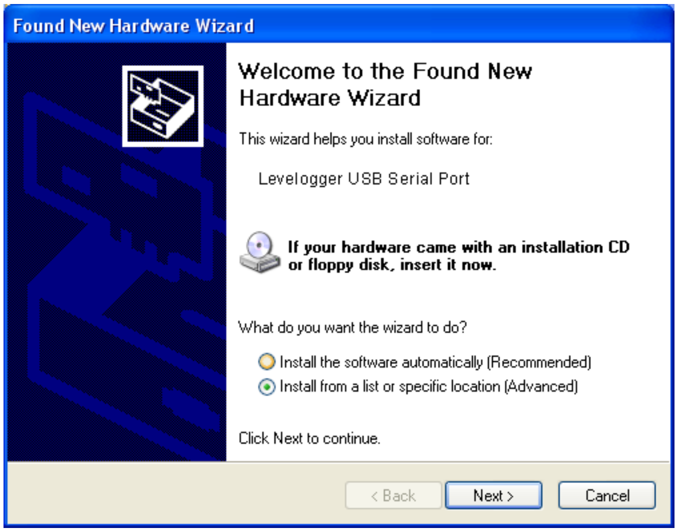
Do not install generic drivers that Windows will locate. Generic drivers are completely incompatible with Solinst USB devices.

4.1.3.1 USB Installation for Windows XP

1) Plug the USB device into the computer, and Windows will automatically detect the connected device. This will begin the 'Found New Hardware Wizard'.
2) The 'Wizard' will give the option to connect to Windows Update to search for software components, select: 'No, not at this time'.
3) Click 'Install from a list or specific location', then click the 'Next' Button. (Figure 4-1).

NOTE

After plugging in the USB device, if the 'Found New Hardware Wizard' does not automatically appear, proceed to the Manual USB Installation instructions in Section 4.1.3.2



Welcome to the Found New Hardware Wizard

This wizard helps you install software for:

Levelogger USB Serial Port

If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

○ Install the software automatically (Recommended)

● Install from a list or specific location (Advanced)

Click Next to continue.

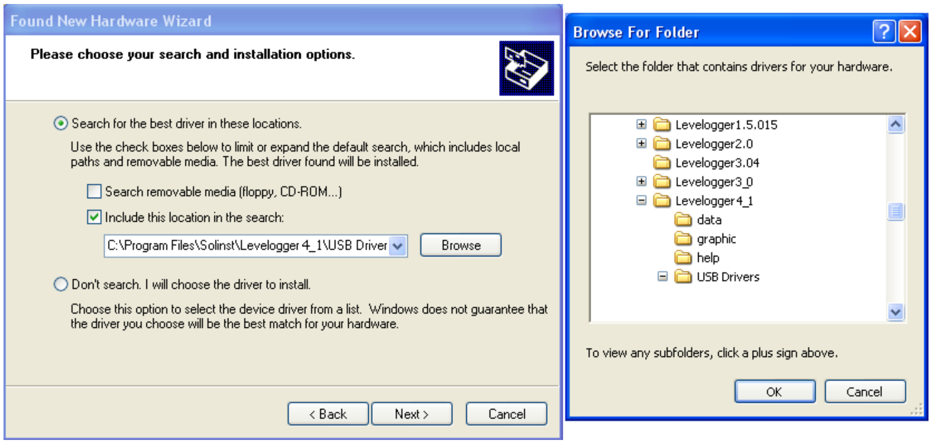
Figure 4-1 Found New Hardware Wizard Window

4) Select the installation option, 'Include this location in the search' (Figure 4-2), then click the 'Browse' button to search for the appropriate directory:

C:\Program Files\Solinst\Levelogger4_1\USB Drivers

NOTE

Make sure you only select the USB Drivers folder when browsing for the driver location. Do not choose a sub file from the folder.



Please choose your search and installation options.

● Search for the best driver in these locations.

Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.

☐ Search removable media (floppy, CD-ROM...)

☑ Include this location in the search:

C:\Program Files\Solinst\Levelogger 4_1\USB Driver

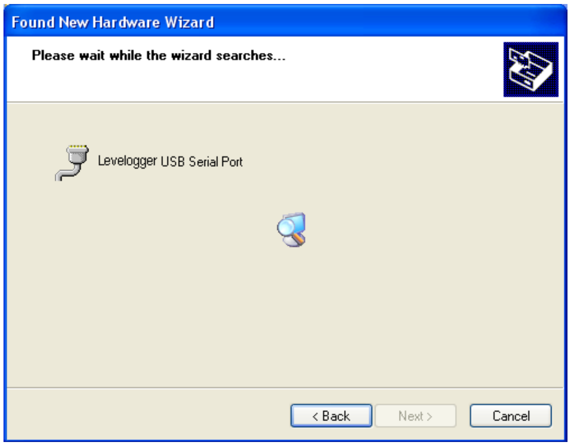
○ Don't search. I will choose the driver to install.

Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.

Select the folder that contains drivers for your hardware.

To view any subfolders, click a plus sign above.

Figure 4-2 Found New Hardware Window and Figure 4-3 Browse for Folder Window

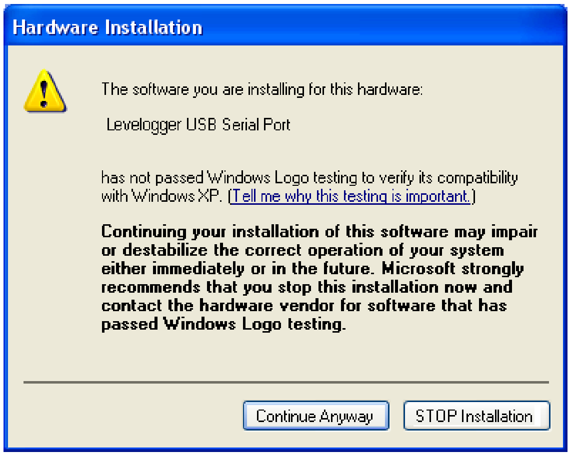

Found New Hardware Wizard

Please wait while the wizard searches...

Levelogger USB Serial Port

Figure 4-4 Found New Hardware Search Window

5) A warning message will then prompt that the software has not passed the Windows Logo Test. Select ‘Continue Anyway’ (Figure 4-5). This will complete the installation process. A system restart may be required. Repeat the steps if the installation fails the first time.


Hardware Installation

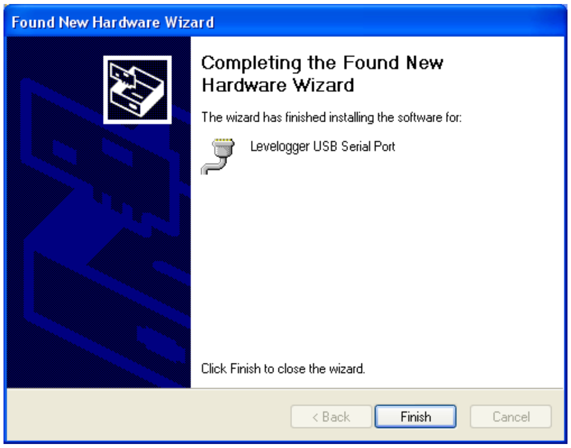
The software you are installing for this hardware:

Levelogger USB Serial Port

has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)

Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.

Figure 4-5 Hardware Installation Window


Found New Hardware Wizard

Completing the Found New Hardware Wizard

The wizard has finished installing the software for:

Levelogger USB Serial Port

Click Finish to close the wizard.

Figure 4-6 Found New Hardware Completed Window

4.1.3.2 Manual USB Installation

If your device is plugged in and the ‘Found New Hardware Wizard’ fails to start, then follow these steps:

1) Open the Device Manager. Typically this is found through the path:
   Start > Control Panel > System > Hardware > Device Manager

   Once the Device Manager is open, a version of the following list(s) will appear:

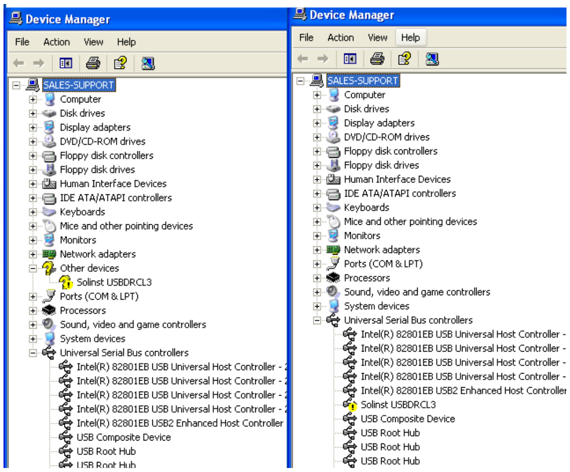


Figure 4-7 Device Manager

2) Identify the Solinst device from the list. The device will be categorized under ‘Other Devices’ or ‘Universal Serial Bus Controllers’.

3) Highlight the device in the list and right click. You will see an option to ‘Update the driver’. This will start the ‘Hardware Update Wizard’. Now follow the instructions for your specific Windows version.

NOTE

If you are unsure which is the correct device in the list, with the screen visible, safely remove the device and then reconnect it. The list should automatically refresh accordingly.

NOTE

If you do not know the correct Com Port that was assigned to your device, re-open the Device Manager. Expand “Ports (COM & LPT)” to show the Com Port that has been assigned. To change the assigned Port, see Section 4.2.1.

NOTE

USB driver installation should be automatic when connecting a PC Interface Cable or Optical Reader.

NOTE

The 'Found New Hardware Wizard' may start automatically, beginning at step 3 below.

NOTE

If the USB driver does not install the first time, repeat the steps a second time. It often takes more than once to install the driver for Windows 7 systems.

NOTE

If you are unsure which is the correct device in the list, with the screen visible, safely remove the device and then reconnect it. The list should automatically refresh accordingly.

4.1.3.3 USB Installation for Windows 7

Plug the USB Device into the PC. The system will automatically detect the connected unit. Windows 7 should automatically install the driver for the device.

If no driver is automatically found, and the 'Found New Hardware Wizard' fails to start, the following steps should be taken:

1) Press the Windows start button to bring up the start menu, select 'Control Panel', then 'Hardware and Sound', then 'Device Manager'.
2) Under 'Other Devices' there will be a Solinst device shown with a yellow warning symbol. Right click on this device, and select 'Update Driver Software'.

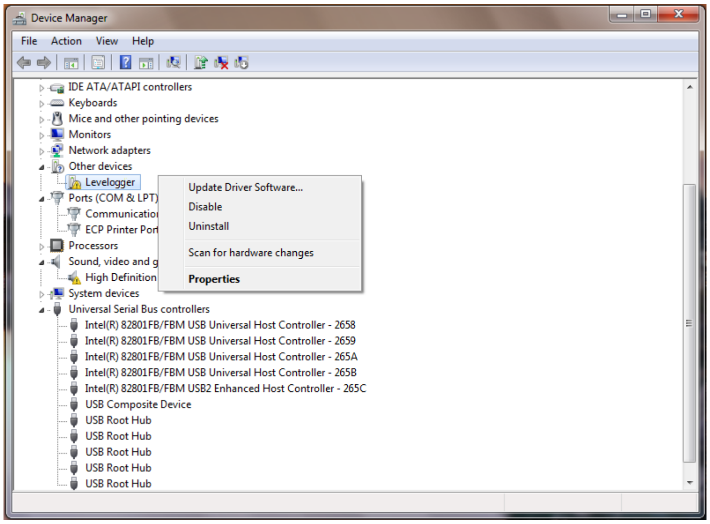
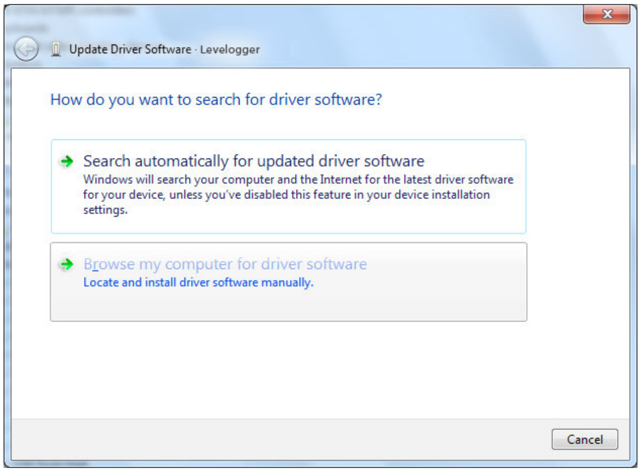


Figure 4-8 Windows 7 Device Manager

3) Select 'Browse my computer for driver software'.

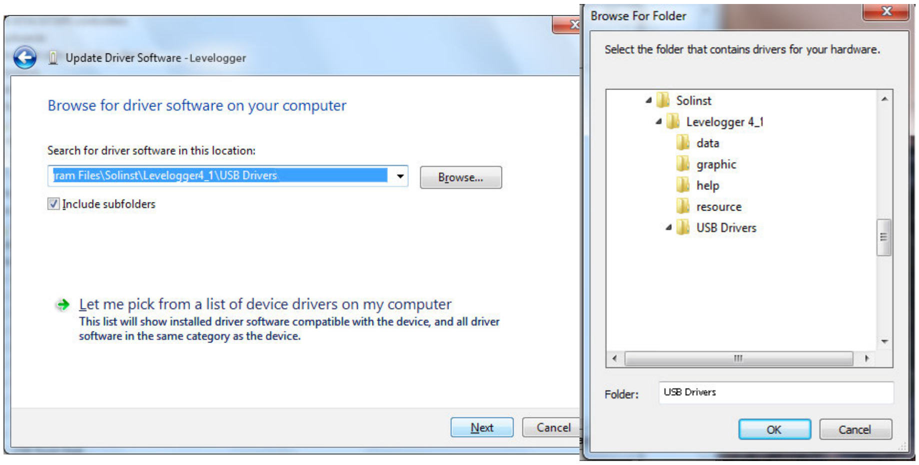

Update Driver Software - Levelogger

How do you want to search for driver software?

Search automatically for updated driver software
Windows will search your computer and the Internet for the latest driver software for your device, unless you've disabled this feature in your device installation settings.

Browse my computer for driver software
Locate and install driver software manually.

Figure 4-9 Update Driver Software



Browse for driver software on your computer

Search for driver software in this location: ram Files\Solinst\Levelogger4_1\USB Drivers

☑ Include subfolders

Let me pick from a list of device drivers on my computer
This list will show installed driver software compatible with the device, and all driver software in the same category as the device.

Select the folder that contains drivers for your hardware.

Folder: USB Drivers

Figure 4-10 Browse for Driver Software

NOTE

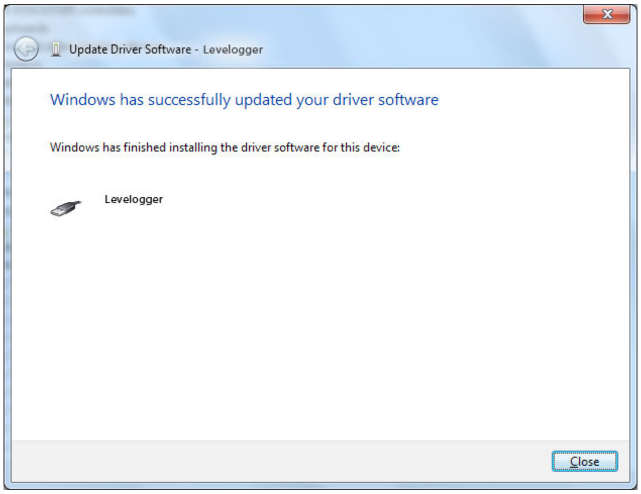
Make sure you only select the USB Drivers folder when browsing for the driver location. Do not choose a sub file from the folder.

4) Click the Browse button and point the navigation window to the provided USB drivers located within the Levelogger4_1 folder. Default destination is:

   C:\Program Files\Solinst\Levelogger4_1\USB Drivers

   Select the actual USB Drivers folder, not a sub file from the folder.

5) Select Next. A window may appear stating 'Windows can't verify the publisher of this driver software', select 'Install this driver software anyway'.



Windows has successfully updated your driver software

Windows has finished installing the driver software for this device:

Levelogger

Figure 4-11 Update Complete

6) Windows will confirm when the installation is complete. Press Close to close the window, then go back to the 'Device Manager'.

NOTE

If you are unsure which is the correct device in the list, with the screen visible, safely remove the device and then reconnect it. The list should automatically refresh accordingly.

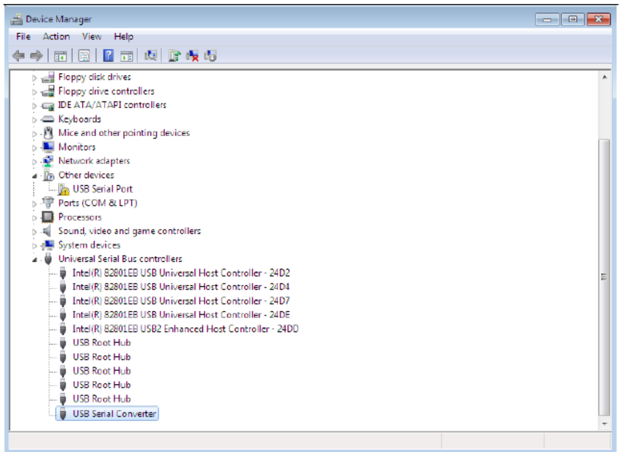


Figure 4-12 Update Serial Port

7) You may have to repeat steps 2-6 to update the USB Serial Port. This would be shown under ‘Other Devices’ with a yellow warning symbol.

8) Once installation is complete, a window will confirm the COM port assigned to the device.

4.2 Configuration and Settings

4.2.1 Com Port Designation Set Up

After installing a USB device, should the Com Port number assigned to the device conflict with your existing devices, it is possible to change the Com Port designation number:

1) Click Start > Settings > Control Panel
2) Click Systems to open the System Properties
3) Click the Hardware tab and click ‘Device Manager’
4) Double Click the Ports Icon and select the ‘USB Serial Port’
5) Right click and select Properties
6) Click the ‘Port Settings’ tab and click ‘Advanced’
7) Select the Com Port Number and click ‘OK’

Note: the path to the ‘Port Settings’ tab may be different for each Windows operating system. The above is just a guideline.

! NOTES

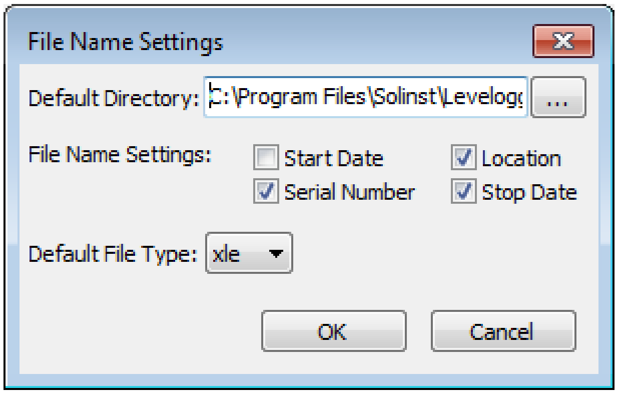
To check the Com port assigned to a USB device after installation, open the Device Manager. Expand 'Ports (COM & LPT)' to show the Com Port that has been assigned.

You may have to restart your computer after adding a new USB device, before that port will be detected by the Levelogger Software

4.2.2 Data Directory

The program will save data downloaded to the following default directory: <C:\Program Files\Solinst\Levelogger4_1\Data> unless otherwise specified in the Default Directory field of the Application Settings window (Figure 4-13).

Click the Configuration menu at the top of the program window, select Application Settings and input or navigate to a different folder destination. After completing the Application Settings, click the OK button to confirm and save the settings.



File Name Settings

Default Directory: C:\Program Files\Solinst\Levelog

File Name Settings: ☐ Start Date ☑ Location ☑ Serial Number ☑ Stop Date

Default File Type: xle

Figure 4-13 Application Setting Window

4.2.3 File Name Settings

From the Application Settings window in the Configuration menu, you can set what information will be included in your default file names of downloaded data (see Figure 4-13). You can include Start Date, Stop Date, Serial Number, and Location. Check-off the information you would like included.

After completing the Application Settings, click the OK button to confirm and save the settings.

4.2.4 Default File Type

From the Application Settings window in the Configuration menu, you can set what default file type you would like to use for downloaded, saved and exported data files. You can select between either *.xle (default) or *.lev file types (see Figure 4-13). For more information about the two file types, see Section 7.1.1.

After completing the Application Settings, click the OK button to confirm and save the settings.

NOTE

Depending on your Levelogger type, there will be different programming options.
See Table 1-1 for the major differences. See Section 5.9 for programming the Levelogger Gold, Barologger Gold, and Levelogger Junior.

NOTE

Click on ? icons to get an explanation of that software feature.

NOTE

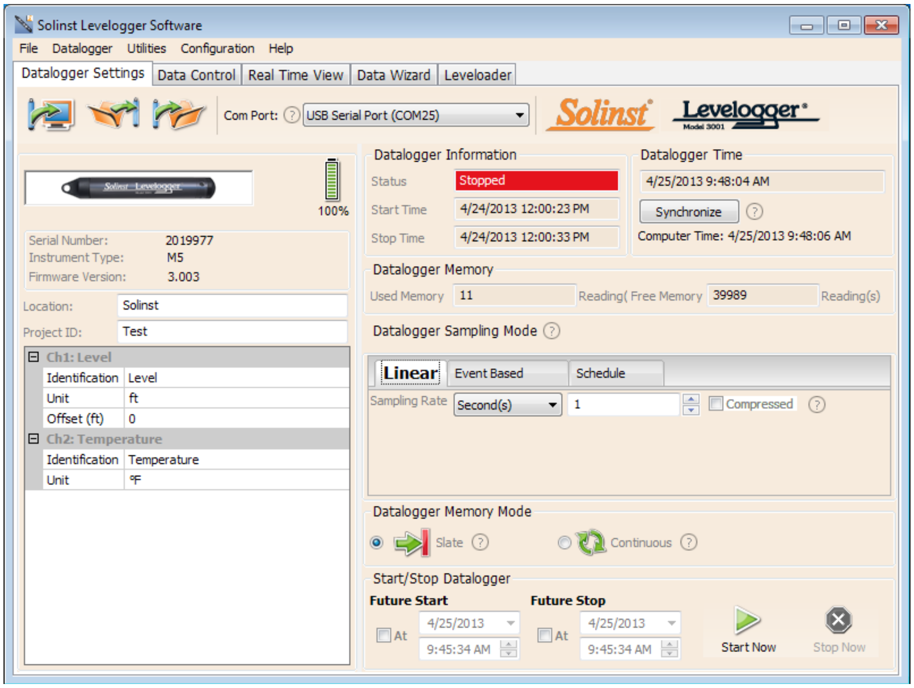
When first setting up a Barologger and Levelogger(s) that will be used for the same project, it is suggested to set them at the same sampling interval, and to use the Future Start and Stop options where possible. When the data sets have the same time stamps, and start and stop times, barometric compensation of the data will be most accurate. It is also useful to synchronize the clocks of the dataloggers. See Section 5.4.

NOTE

The Levelogger Edge, which is available in F6 (M2), F15 (M5), F30 (M10), F65 (M20), F100 (M30), F300 (M100), and F600 (M200) ranges has actual water level ranges of 6.6 ft (2 m), 16.40 ft (5 m), 32.80 ft (10 m), 65.60 ft (20 m), 98.40 ft (30 m), 328.0 ft (100 m), and 656.2 ft (200 m), respectively.

5 Levelogger Edge Series Setup

After you start the Levelogger Software, the main Levelogger Software window will appear, with the Datalogger Settings tab open.



Com Port: USB Serial Port (COM25)

100%

Serial Number: 2019977
Instrument Type: M5
Firmware Version: 3.003
Location: Solinst
Project ID: Test

⊟ Ch1: Level
Identification: Level
Unit: ft
Offset (ft): 0
⊟ Ch2: Temperature
Identification: Temperature
Unit: °F

Datalogger Information
Status: Stopped
Start Time: 4/24/2013 12:00:23 PM
Stop Time: 4/24/2013 12:00:33 PM

Datalogger Time
4/25/2013 9:48:04 AM
Computer Time: 4/25/2013 9:48:06 AM

Datalogger Memory
Used Memory: 11 Reading(Free Memory: 39989 Reading(s)

Datalogger Sampling Mode
Sampling Rate: Second(s) 1 ☐ Compressed

Datalogger Memory Mode
● Slate ○ Continuous

Start/Stop Datalogger
Future Start: ☐ At 4/25/2013 9:45:34 AM
Future Stop: ☐ At 4/25/2013 9:45:34 AM

Figure 5-1 Datalogger Settings Tab

Select the appropriate COM or USB Port for the connected communications device from the centre drop-down menu.

Click to retrieve the current settings from the connected datalogger.

5.1 Datalogger Settings

After you have retrieved the settings of the connected datalogger, the Datalogger Settings tab will identify the Instrument Type, Serial Number, Firmware Version, Project ID, Location, and the Channel Settings.

- **Instrument Type**: will display the model of the attached datalogger, i.e.: F100/M30, Barologger, Rainlogger.
- **Serial Number:** the unique serial number of the attached datalogger will be displayed.
- **Firmware Version**: shows the firmware version of the attached datalogger.
- **Project ID:** input your own identification system. The Project ID is limited to 32 characters.
- **Location**: input specific site / location information. The location is limited to 32 characters.

5.1.1 Setting Up Channel Information

In the lower left portion of the Datalogger Settings tab is the area for setting channel parameters (level, temperature, conductivity, rainfall). The software will detect the available channels when the datalogger settings are retrieved.

5.1.1.1 Level Channel (Ch1)

! NOTE

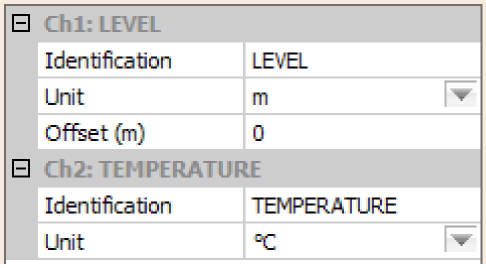
Readings can be converted to other units using the Data Wizard.

Readings can be corrected or offset with respect to a specific reference elevation or datum for a much wider spectrum of numeric offsets as part of the Data Wizard.

- **Identification** describes the measurement parameter of the channel and has already been configured as 'LEVEL'. The channel can be re-named to suit each project. The channel monitors water column equivalent pressure. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Unit** refers to the channel's unit of measurement. There are six options when using a Levelogger Edge or Levelogger Junior Edge, m (default), cm, ft, kPa, bar, and psi. When using a Barologger Edge, the options are kPa (default), mbar, and psi.
- **Offset** refers to an adjustment, such as the distance between the tip of the Levelogger and the monitoring well cap or static water level. It is recommended that the value of 0.00 be used, as this keeps all subsequent readings relative to the tip of the Levelogger. The reference range is -1000 to 16,400 ft or -300 m to 5000 m.

! NOTE

There is no Offset input option for the Barologger Edge.



Ch1: LEVEL

Identification	LEVEL
Unit	m
Offset (m)	0

Ch2: TEMPERATURE

Identification	TEMPERATURE
Unit	°C

Figure 5-2 Levelogger Edge Channel Setup

The LTC Levelogger Junior also has inputs for:

- **Altitude** in feet or meters above sea level, at which the logger is actually deployed, is input in the altitude field. You can enter an elevation between -1000 ft below sea level and 16,400 ft (or -300 m and 5000 m) above sea level. The readings will then be automatically compensated for elevation.
- **Density** is used to adjust the range of the Levelogger based on the sample fluid density. The range for the density adjustment is from 0.9 kg/L to 1.1 kg/L.

! NOTE

Levelogger Edge, Barologger Edge, and Levelogger Junior Edge data can be adjusted for altitude and density post data collection using the Data Wizard.

5.1.1.2 Temperature Channel (Ch2)

- **Identification** describes the measurement parameter of the channel and has already been configured as 'TEMPERATURE'. The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Unit** refers to the channel's unit of measurement. For the Levelogger Edge, Barologger Edge, and Levelogger Junior Edge, the temperature channel can be set to °C (default) or °F.

! NOTE

The LTC Levelogger Junior only measures in °C

NOTE

For every degree change in temperature, there is approximately a 2% change in conductivity. To convert raw conductivity measurements to Specific Conductance measurements, you can use the following equation:

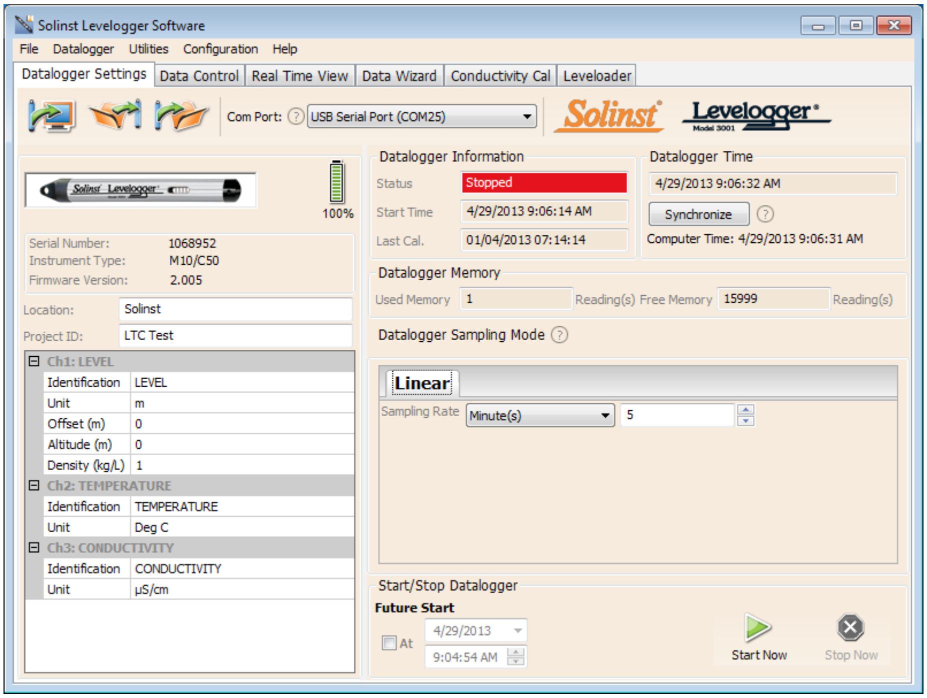
Specific Conductance = Conductivity / (1 + 0.02 * (temp(C) - 25))

You can also perform this calculation automatically using the Data Wizard.

You can also convert Conductivity readings to Salinity (expressed in Practical Salinity Units (PSU)) using the Data Wizard.

5.1.1.3 Conductivity Channel (Ch3)

- **Identification** describes the measurement parameter of the channel and has already been configured as 'CONDUCTIVITY'. The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Unit** refers to the channel's unit of measurement. There are two units of measure available for the user to select: mS/cm or µS/cm.



Com Port: USB Serial Port (COM25)

Serial Number: 1068952
Instrument Type: M10/C50
Firmware Version: 2.005
Location: Solinst
Project ID: LTC Test

Ch1: LEVEL
Identification LEVEL
Unit m
Offset (m) 0
Altitude (m) 0
Density (kg/L) 1
Ch2: TEMPERATURE
Identification TEMPERATURE
Unit Deg C
Ch3: CONDUCTIVITY
Identification CONDUCTIVITY
Unit µS/cm

Datalogger Information
Status Stopped
Start Time 4/29/2013 9:06:14 AM
Last Cal. 01/04/2013 07:14:14

Datalogger Time
4/29/2013 9:06:32 AM
Computer Time: 4/29/2013 9:06:31 AM

Datalogger Memory
Used Memory 1 Reading(s) Free Memory 15999 Reading(s)

Datalogger Sampling Mode
Linear
Sampling Rate Minute(s) 5

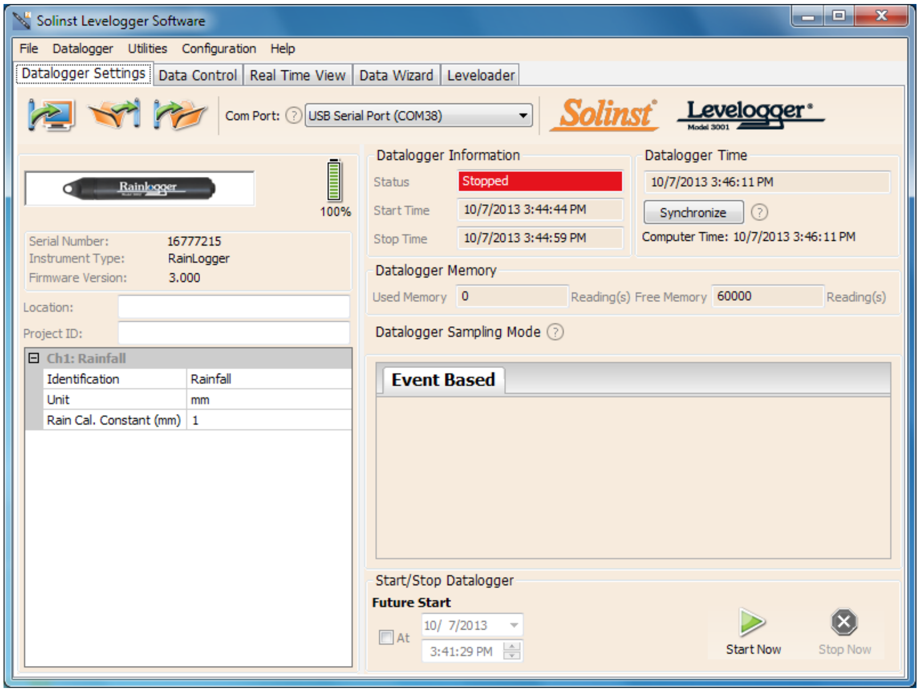
Start/Stop Datalogger
Future Start
☐ At 4/29/2013 9:04:54 AM

Figure 5-3 Conductivity Channel Setup

5.1.1.4 Rainloggers

There is one channel of measurement for the Rainlogger Edge and Rainlogger. The **RainFall** Channel records each tip time by the connected tipping-bucket and outputs the amount of rainfall per tip (input Rainfall Cal Constant).

- **Identification** describes the measurement parameter of the channel and has already been configured as 'RainFall'. The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Units** refers to the channel's unit of measurement. There are two units of measure available for the user to select: mm or in.
- **The Rainfall Cal Constant** field allows you to enter the calibration factor for the tipping-bucket you will be using. The calibration factor is the amount of rainfall depth (mm, in) per tip. The calibration factor should be indicated on a label on the tipping-bucket device or in the manufacturer's documentation. Input the calibration factor in mm or inches.



Com Port: USB Serial Port (COM38)

Serial Number: 16777215
Instrument Type: RainLogger
Firmware Version: 3.000
Location:
Project ID:

Ch1: Rainfall

Identification	Rainfall
Unit	mm
Rain Cal. Constant (mm)	1

Datalogger Information
Status: Stopped
Start Time: 10/7/2013 3:44:44 PM
Stop Time: 10/7/2013 3:44:59 PM

Datalogger Time
10/7/2013 3:46:11 PM
Computer Time: 10/7/2013 3:46:11 PM

Datalogger Memory
Used Memory: 0 Reading(s)
Free Memory: 60000 Reading(s)

Datalogger Sampling Mode
Event Based

Start/Stop Datalogger
Future Start
☐ At 10/ 7/2013 3:41:29 PM

Figure 5-4 Rainlogger Channel Setup

5.2 Datalogger Information

The Datalogger Information section shows the Status of the attached datalogger (i.e.: Started, Stopped, Future Start) and the Start Time and Stop Time of the datalogger. When a Future Start and/or Stop time is set (see Section 5.8), the Start Time and Stop Time fields will fill in. The fields will update each time the datalogger is stopped and started.

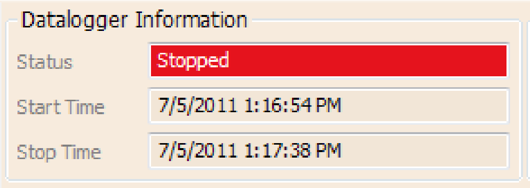

Datalogger Information
Status: Stopped
Start Time: 7/5/2011 1:16:54 PM
Stop Time: 7/5/2011 1:17:38 PM

Figure 5-5 Datalogger Information

5.3 Datalogger Memory

The Datalogger Memory section shows the amount of memory used, and the amount of memory remaining (number of readings).

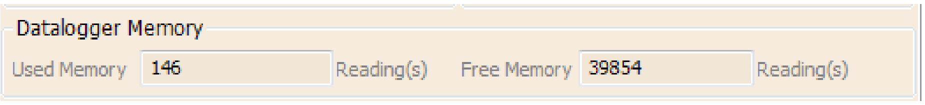

Datalogger Memory
Used Memory: 146 Reading(s)
Free Memory: 39854 Reading(s)

Figure 5-6 Datalogger Memory Remaining

If the Data Compression option is selected (see Section 5.5), the amount of free memory shown is approximated as a visual status bar.

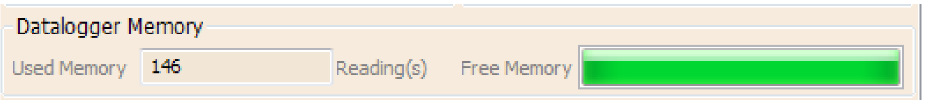

Datalogger Memory
Used Memory: 146 Reading(s)

Figure 5-7 Datalogger Compressed Memory

5.4 Datalogger Time

The Datalogger Time section provides the controls for setting the datalogger clock. If you want to synchronize the datalogger's clock to the computer clock, click Synchronize to set the time in the datalogger.

If you start the datalogger without synchronizing the clock and the time difference between the datalogger and the PC is more than 3 seconds, the software will give you a message asking 'Do you want to synchronize the logger time to system time?'. Click Yes to synchronize the clock.

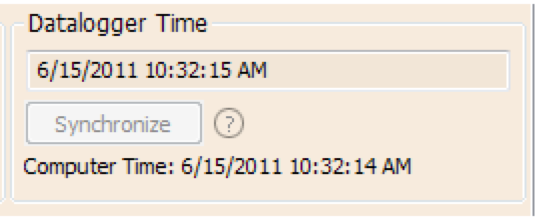
It can be very useful to synchronize the clocks of all the Leveloggers and Barologgers when it comes to Barometric Compensation.

NOTE

It is very useful to synchronize the clocks of all the Leveloggers and Barologgers for use on the same project.

NOTE

To synchronize to a different time/time zone you first must adjust the computer time using the Windows Operating System Date and Time Settings menu. Then re-start the Solinst Levelogger Software and synchronize your Dataloggers to the new time.


Datalogger Time
6/15/2011 10:32:15 AM

Computer Time: 6/15/2011 10:32:14 AM

Figure 5-8 Datalogger Time

NOTES

The battery life of the Levelogger Edge is 10 Years, based on 1 reading per minute. More rapid readings will reduce the battery life. For example, if a Levelogger Edge is setup in Continuous Mode at a sampling rate of 1 second, the battery will be depleted in approximately 4 months.

If a Levelogger Junior Edge or LTC Levelogger Junior are used at a sampling rate of 5 seconds, the battery will be depleted in approximately 2.5 months.

NOTE

The LTC Levelogger Junior and Levelogger Junior Edge record using Linear sampling mode only.

The Levelogger Junior Edge has a sample rate of 0.5 seconds to 99 hours. The LTC Levelogger Junior has a sample rate of 5 seconds to 99 hours.

NOTES

In Event Based sampling mode, the Levelogger Edge has a total memory of 25,000 readings of level and temperature.

In Event Based sampling mode, battery consumption is mainly a function of sampling rate. Therefore, with a smaller sampling interval, battery power will be used up quickly whether readings are stored or not.

NOTE

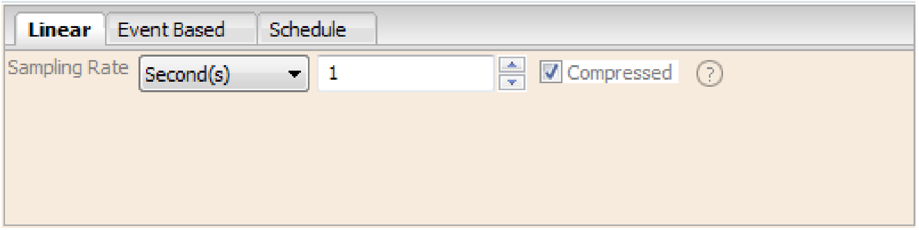
Rainloggers record in Event Based mode only. They record the tip times of a connected tipping-bucket.

5.5 Datalogger Sampling Mode

The Datalogger Sampling Mode section allows you to choose the sampling measurement type. Options for the Levelogger Edge are Linear, Event Based and Schedule.

Linear refers to a set time interval between collection of readings. Sample Rate can be any number from 0.125 seconds to 99 hours for the Levelogger Edge. There is a data compression option available for the Levelogger Edge. This increases the memory capacity of the Levelogger Edge from 40,000 readings to up to a maximum of 120,000. Check the Data Compression box to allow data compression.

Data Compression works by only saving data changes in memory. For example, if you have linear sampling set to record each second, and your water level varies a little for 60 seconds, the memory will only record incremental values for the 60 seconds. When your data is exported, it will display all 60 intervals with the corresponding level data.



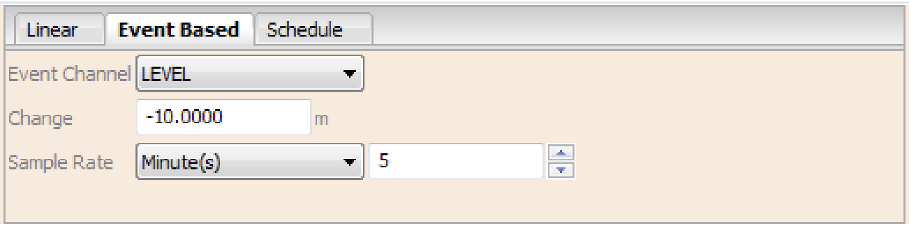
Sampling Rate: Second(s) 1 ☑ Compressed

Figure 5-9 Linear Sampling Setup

Event Based sample collection is the most memory efficient means of data collection. In Event mode, the Levelogger will be activated at every defined 'Sample Rate' to check if readings have changed by the selected 'Change' from the last recorded reading.

For the Levelogger Edge, 'LEVEL' or 'TEMPERATURE' is the selected parameter where change is monitored. The Levelogger will record a new reading only if the specified change in the parameter has occurred, at the specific point in time, as defined by the 'Sample Rate'.

A default reading will also be stored in the datalogger memory, every 24 hours from the last recording, if no 'Change' occurs.



Event Channel: LEVEL

Change: -10.0000 m

Sample Rate: Minute(s) 5

Figure 5-10 Event Based Sampling Setup

NOTE

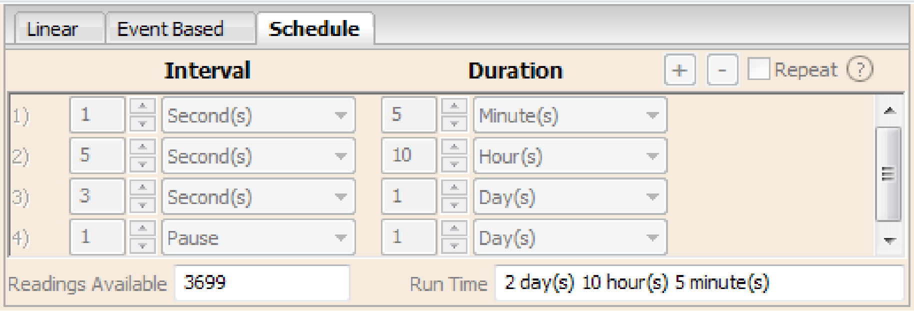
A schedule can be saved and applied to other Leveloggers, or a Leveloader, by saving the Levelogger Settings file (see Section 5.7).

Schedule Sampling allows you to select a logarithmic style sampling schedule adapted to the needs of each application.

Schedule Sampling is set by using the plus and minus buttons to add or subtract line items in the Schedule window. The maximum number of line items in a schedule is 30, each with its own sampling interval of seconds, minutes or hours and duration of seconds, minutes, hours, days or weeks. A 'Pause' interval can also be selected, which stops the Levelogger from recording for the specified duration.

Running totals of the number of readings still available, from the total possible 40,000 or 120,000, and the run time to date are shown. If the number of readings selected exceeds the Leveloggers memory capacity an error message appears.

By checking Repeat, the Levelogger will continue to run through the schedule until its memory is full, or it is stopped.



	Interval		Duration	
1)	1	Second(s)	5	Minute(s)
2)	5	Second(s)	10	Hour(s)
3)	3	Second(s)	1	Day(s)
4)	1	Pause	1	Day(s)

Readings Available 3699

Run Time 2 day(s) 10 hour(s) 5 minute(s)

Figure 5-11 Schedule Sampling Setup

NOTE

Datalogger Memory Mode is only available for Levelogger Edge and Levelogger Gold units using Linear Sampling.

Levelogger Junior Edge and LTC Levelogger Junior operate in Slate logging mode only.

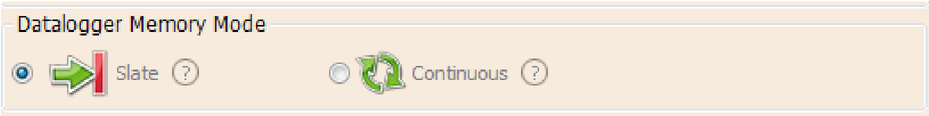
5.6 Datalogger Memory Mode

Datalogger Memory Mode selection will only appear when **Linear** sampling mode is selected. When using a Levelogger Edge in Linear Mode, there is a choice of **Continuous** Logging (wrap around) or **Slate** Logging .

Compressed Linear, Event Based and Schedule sampling modes can only use the Slate Mode option.

In Continuous Logging, the new log is started at the end of any previous log and continues logging, eventually recording over the first logged data. As one of the download options is to 'Append Data', Continuous Logging can be a preferred choice when logging long-term (see Section 7.1.2).

In Slate Logging, the new log is also started at the end of any previous log, but will stop recording after 40,000 readings (or up to 120,000 readings), so that the beginning of the current log will not be written over.



Datalogger Memory Mode

● Slate ○ Continuous

Figure 5-12 Datalogger Memory Mode

5.7 Saving and Retrieving Levelogger Settings Files

To store settings as defaults, click . It will store the settings of the Levelogger into an *.dtf file as a series of defaults. The *.dtf file will save the Project ID, Location, Sample Mode, Sample Rate, Channel ID, Unit, and Offset.

To retrieve settings from defaults, click from a selected *.dtf file. This is particularly useful if programming several Leveloggers with similar identical settings. Keep in mind that Project ID and Location identification information will be identical and should be distinguished from logger to logger or monitoring point to point.

NOTE

Settings files created in Levelogger Software Version 3 or earlier (.lls or .sci files) can not be opened by Software Version 4. These settings files will need to be re-created and saved in Levelogger Software Version 4.

5.8 Starting and Stopping the Datalogger

Starting the Datalogger

There are two ways to start logging: **Start Now** or by programming a **Future Start** time.

To start logging immediately, do not fill in a Future Start time and click, ▶ . It should say Start Now below the icon to indicate an immediate start. Any changed settings will automatically be applied to the datalogger, and it will start logging. Datalogger Status will change from Stopped to Started.

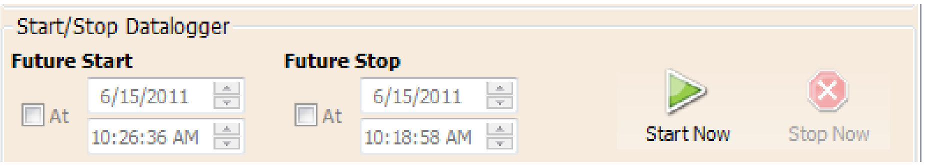
After the datalogger is started, and begins collecting readings, the Start icon will be greyed out, and only the Stop icon and Future Stop settings will be active.

NOTES

If a setting has been changed, it will be highlighted in yellow as a reminder before the datalogger is started.

If a setting has been entered incorrectly, it will be highlighted in red.

Changed settings are applied to the datalogger automatically when the Start icon is selected.



Start/Stop Datalogger

Future Start
☐ At 6/15/2011 10:26:36 AM

Future Stop
☐ At 6/15/2011 10:18:58 AM

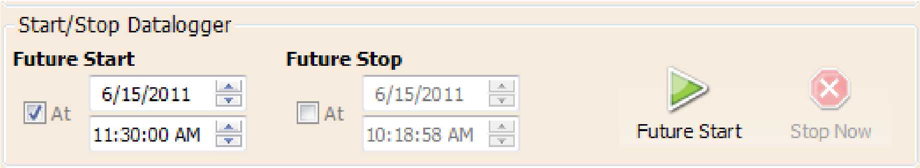
Figure 5-13 Starting the Datalogger Immediately

NOTE

Remember to download any data on the datalogger before starting a new session. When starting a new logging session, any data from previous recording sessions will be erased.

Check **Future Start** 'At' to set logging to start at a later date and/or time. This Start mode is referred to as Future Start in the Status field. Click ▶ to apply the Future Start time and any changes to the datalogger settings.

When the Future Start time is reached, the datalogger will start logging and the Status will change from Future Start to Started.



Start/Stop Datalogger

Future Start
☑ At 6/15/2011 11:30:00 AM

Future Stop
☐ At 6/15/2011 10:18:58 AM

Figure 5-14 Future Start Setting

NOTE

Retrieve the Levelogger settings in order to refresh the status (i.e. when the status changes from Future Start to Started).

NOTE

You can not set a Future Stop time for the Levelogger Junior Edge, LTC Levelogger Junior or a Rainlogger.

NOTE

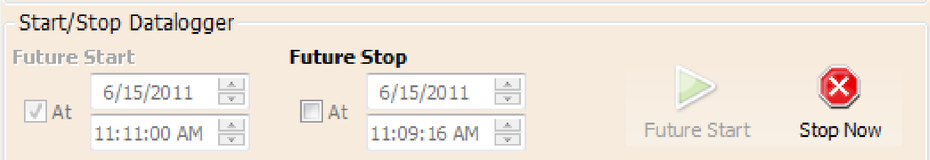
If you have set a Future Stop time, but wish to stop the datalogger immediately, uncheck the Future Stop 'At' box, and the Stop icon should say Stop Now. Click the icon to stop logging.

Stopping the Datalogger

There are two ways to stop logging: Stop Now or at a programmed Future Stop time for the Levelogger Edge and Barologger Edge.

To stop the datalogger immediately when it is logging, click ⊗ , (it should say Stop Now below the icon).

The Levelogger can be stopped at any time before it reaches the maximum reading capacity. **Starting again begins a new recording session and clears previously stored data readings.**



Start/Stop Datalogger

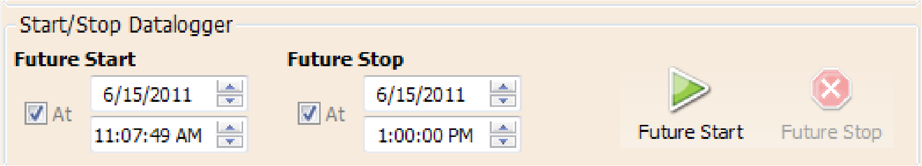
Future Start: ☑ At 6/15/2011 11:11:00 AM

Future Stop: ☐ At 6/15/2011 11:09:16 AM

Figure 5-15 Stopping the Datalogger Immediately

To program a **Future Stop** time for your datalogger, check Future Stop 'At' and fill in the desired stop time. The Future Stop time will be applied to the datalogger once ▶ is selected for an immediate or future start.

You can also program a Future Stop time after you have started the datalogger, by checking Future Stop 'At' and filling in the desired stop time. Select ⊗ to apply the Future Stop time (it should say Future Stop below the icon). The Stop Time should be shown in the Datalogger Status section.



Start/Stop Datalogger

Future Start: ☑ At 6/15/2011 11:07:49 AM

Future Stop: ☑ At 6/15/2011 1:00:00 PM

Figure 5-16 Future Stop Setting

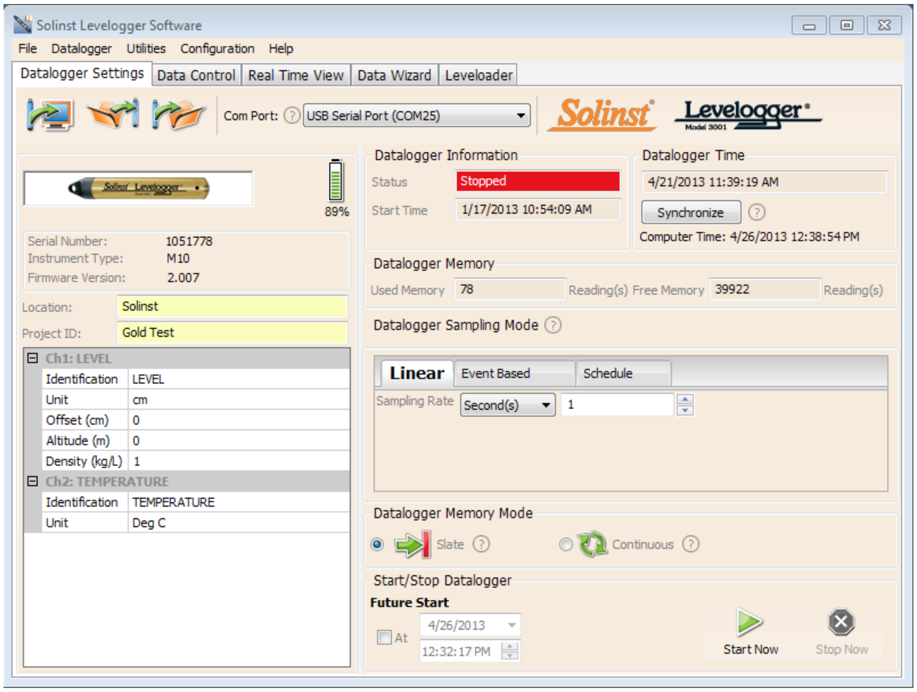
It is critical to note that when Leveloggers log data in Slate mode, it means they will record data until stopped or their memory is full. When the memory fills, the datalogger will stop recording. For this reason, it is important to determine, based on your start time and sampling rate, the date and time at which the memory will be full and the datalogger will stop recording. Levelogger Edge units record in Slate mode if Event, Schedule, or Compressed logging, but in standard Linear mode they can be set to Slate or to Continuous logging.

5.9 Levelogger Gold Series Setup

This section briefly describes the Levelogger Gold, Barologger Gold and Levelogger Junior setup.

NOTE

Click on ? icons to get an explanation of that software feature.



Com Port: USB Serial Port (COM25)

89%

Serial Number: 1051778
Instrument Type: M10
Firmware Version: 2.007

Location: Solinst
Project ID: Gold Test

Ch1: LEVEL	
Identification	LEVEL
Unit	cm
Offset (cm)	0
Altitude (m)	0
Density (kg/L)	1
Ch2: TEMPERATURE	
Identification	TEMPERATURE
Unit	Deg C

Datalogger Information
Status: Stopped
Start Time: 1/17/2013 10:54:09 AM

Datalogger Time
4/21/2013 11:39:19 AM
Computer Time: 4/26/2013 12:38:54 PM

Datalogger Memory
Used Memory 78 Reading(s) Free Memory 39922 Reading(s)

Datalogger Sampling Mode
Linear — Sampling Rate: Second(s) 1

Datalogger Memory Mode
● Slate ○ Continuous

Start/Stop Datalogger
Future Start
☐ At 4/26/2013 12:32:17 PM

Figure 5-17 Levelogger Gold Settings

Select the appropriate COM or USB Port for the connected communications device from the centre drop-down menu.

Click  to retrieve the current settings from the connected datalogger.

Channel Information

Level Channel (Ch1)

- **Identification** describes the measurement parameter of the channel and has already been configured as 'LEVEL'. The channel can be renamed to suit each project. The channel monitors water column equivalent pressure. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. The Identification is limited to 32 characters.
- **Units** refers to the channel's units of measurement. There are three units of measure available for the user to select: cm, m or ft. When the user changes the unit, the value of the range and altitude will change according to the Unit Conversion formula. Note that when a metric unit is used, the unit of altitude is meters. When feet are the level channel units, feet are the units of altitude.

- **Offset** refers to an offset correction, such as the distance between the tip of the Levelogger and the monitoring well cap or static water level. It is recommended that the value of 0.00 be used for offset as this keeps all subsequent readings relative to the tip of the Levelogger. The offset range for Levelogger Gold and Barologger Gold units is -1000 to 16400 ft or -300 m to 5000 m.
- **Altitude** in feet or meters above sea level, at which the logger is actually deployed, is input in the altitude field. Water column equivalent pressure decreases with altitude at a rate of approximately 1.2:1000 in the lower atmosphere below 5000 m. You can compensate for this by entering an elevation between -1000 ft below sea level and 16,400 ft (or -300 m and 5000 m) above sea level. The readings will then be automatically compensated for elevation.
- **Density Adjustment** is used to adjust the range of the Levelogger based on the sample fluid density. The range for the density adjustment is from 0.9 kg/L to 1.1 kg/L.

Temperature Channel (Ch2)

- **Identification** describes the measurement parameter of the channel and has already been configured as 'TEMPERATURE'. The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Unit** refers to the channel's unit of measurement. The Levelogger Gold and Barologger Gold measure in °C only.

Sample and Memory Modes

Sample Mode, allows you to choose the sampling measurement type. Options are Linear, Event Based and Schedule.

- **Linear** refers to a set time interval between collection of readings. Sample Rate can be any number from 0.5 seconds to 99 hours. The Levelogger Gold and Barologger Gold can store 40,000 readings of level and temperature.
- **Event Based** sample collection is the most memory efficient means of data collection. In Event mode, the Levelogger will activate every sampling interval defined and check if readings have changed by the selected threshold (Change) from the last recorded reading. For the Levelogger Gold, 'LEVEL' or 'TEMPERATURE' is the selected parameter where change is monitored. The Levelogger will record a new reading only if the specified change in the parameter has occurred.
- **Schedule Sampling** allows you to select a logarithmic style sampling schedule adapted to the needs of each application. Schedule Sampling is set by using the plus and minus buttons to add or subtract line items in the Schedule window. The maximum number of line items in a schedule is 30, each with its own sampling interval of seconds, minutes or hours and duration of seconds, minutes, hours, days or weeks.

NOTE

The Levelogger Junior records using Linear sampling mode only.

NOTE

In Event Based sampling mode, the Levelogger Gold has a total memory of 25,000 readings of level and temperature

NOTE

An important reminder for Event Based sampling is that, although actual memory usage in stable water level conditions may be relatively small, battery power consumption is partially a function of the sample reading rate. Therefore, a small sample reading interval will consume battery power at a higher rate whether readings are stored or not.

Memory Mode selection will be grayed-out if not in Linear Mode sampling. When using a Levelogger Gold in Linear Mode, there is a choice of **Continuous** logging (wrap around) or **Slate** logging. In Continuous logging the new log is started at the end of any previous log and continues logging, eventually recording over the first logged data. As one of the download options is to 'Append Data', Continuous logging can be a preferred choice when logging long-term. In Slate logging the new log is also started at the end of any previous log, but will stop recording after 40,000 readings, so that the beginning of the current log will not be written over.

Starting and Stopping the Levelogger

There are two ways to start logging: **Start Now** or by programming a **Future Start** time.

To start logging immediately, do not fill in a Future Start time and click, ▶ . It should say Start Now below the icon to indicate an immediate start. Any changed settings will automatically be applied to the datalogger, and it will start logging. Datalogger Status will change from Stopped to Started.

After the datalogger is started, and begins collecting readings, the Start icon will be greyed out, and only the Stop icon and Future Stop settings will be active.

Check **Future Start** 'At' to set logging to start at a later date and/or time. This Start mode is referred to as Future Start in the Status field. Click ▶ to apply the Future Start time and any changes to the datalogger settings.

When the Future Start time is reached, the datalogger will start logging and the Status will change from Future Start to Started.

To stop the datalogger immediately when it is logging, click ❌ , (it should say Stop Now below the icon).

The Levelogger can be stopped at any time before it reaches the maximum reading capacity. **Starting again begins a new recording session and clears previously stored data readings.**

It is critical to note that when Leveloggers log data in Slate mode, it means they will record data until stopped or their memory is full. When the memory fills, the datalogger will stop recording. For this reason, it is important to determine, based on your start time and sampling rate, the date and time at which the memory will be full and the datalogger will stop recording. Levelogger Gold units record in Slate mode if using Event, or Schedule sampling mode, but in standard Linear mode they can be set to Slate or to Continuous logging.

6 Conductivity Calibration

Figure 6-1
LTC Levelogger Junior

NOTE

If you know the approximate conductivity range of the water that you will be measuring, best accuracy when calibrating your unit is to select two calibration points - one above, and one below that range. A two point calibration provides a greater % accuracy than a three point calibration.

The LTC Levelogger Junior conductivity sensor must be calibrated for reliable conductivity measurements. Calibrate for conductivity at the start of each new monitoring project or at a minimum each new monitoring season (twice a year).

Calibrating the LTC Levelogger Junior directly after the monitoring project or season will provide information on the degree of conductivity deviation during the project or season. If necessary, readings can be corrected for any conductivity deviation in a spreadsheet program after the data has been exported.

The process of conductivity calibration is performed automatically by use of the Calibration Wizard. You place the LTC Levelogger Junior in a specified calibration solution and follow the steps provided by the wizard. Conductivity calibration solutions are available from Solinst or any laboratory supply outlet.

The LTC Levelogger Junior has an 80,000 µS/cm conductivity range and a calibrated range from 500 to 50,000 µS/cm. It can be calibrated to 3 calibration standard points:

- 1,413 µS/cm
- 5,000 µS/cm
- 12,880 µS/cm

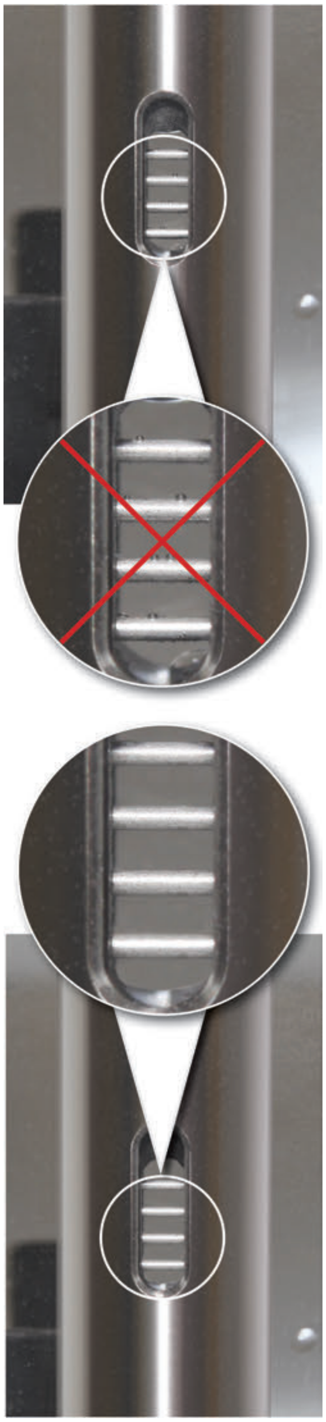
If you know the approximate conductivity range of the water that you will be measuring, best accuracy when calibrating your unit is to select two calibration points - one above, and one below that range. A two point calibration provides a greater % accuracy than a three point calibration.

The solution(s) must be between 10°C and 30°C during actual calibration. Temperature should remain stable during the 10 - 20 seconds it takes to perform each calibration.

For best accuracy, it is recommended you use calibration solutions that have a temperature error of ±2% or better. You should also keep the solution as close to the stated temperature on the bottle as possible (i.e. 25°C). The closer you get to the temperature extremes of 10°C and 30°C, the less accurate your calibrations may be.

NOTE

Ensure that the calibration solution covers the entire sensor cell and the logger is agitated to release entrapped air bubbles.

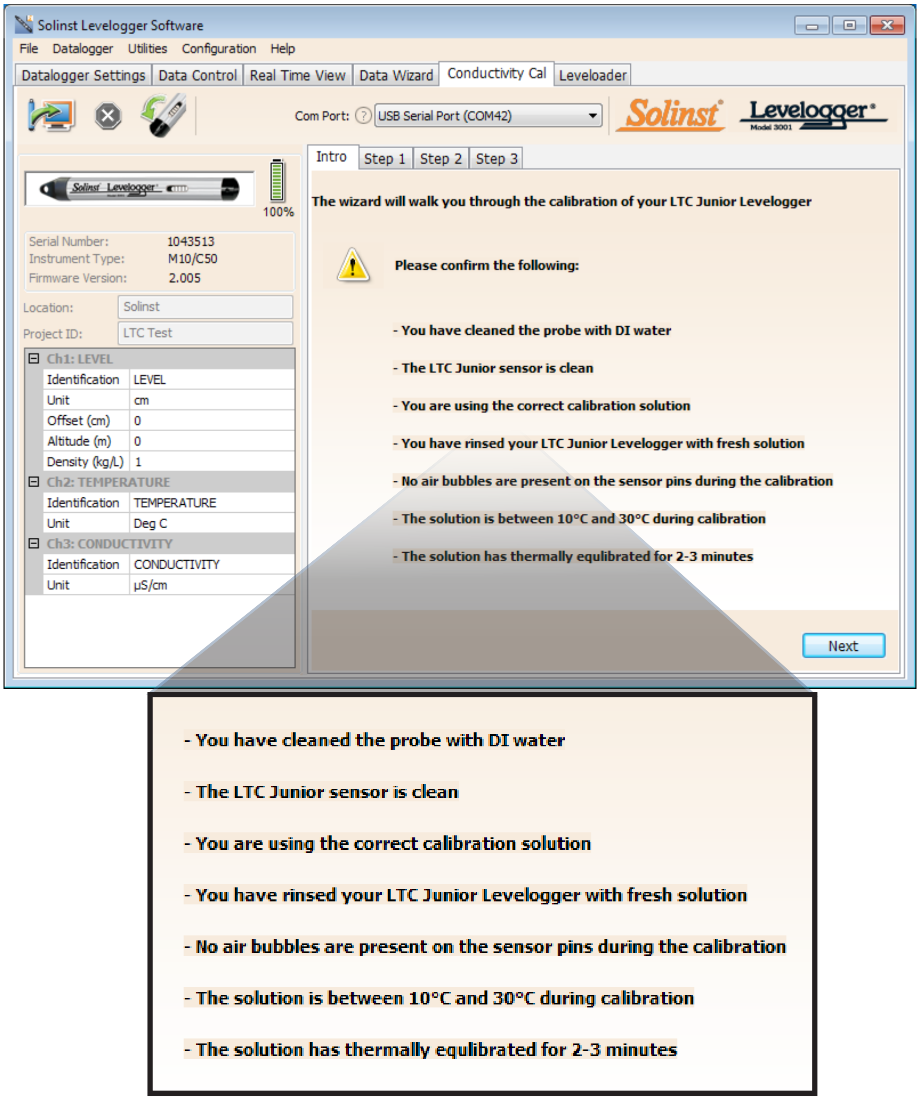


Retrieve the settings from the attached LTC Levelogger Junior by clicking .

Stop the LTC Levelogger Junior by clicking .

Start the Calibration Wizard by clicking the Conductivity Cal tab. The wizard will guide you through the calibration process. You can exit the wizard after any step to cancel the calibration session.

Introduction: The LTC Levelogger Junior must be connected to the computer with an Optical Reader during the entire calibration process and **must be in the stopped mode**. Ensure you use fresh calibration solution and allow thermal equilibration of the solution during the process. Also ensure no air bubbles are present on the sensor and that the pins are clean. See Section 10.2 for recommended methods to clean the sensor pins. See Section 10.1.5.3 for protection against biofouling conditions.



Com Port: USB Serial Port (COM42)

100%

Serial Number: 1043513
Instrument Type: M10/C50
Firmware Version: 2.005

Location: Solinst
Project ID: LTC Test

Ch1: LEVEL	
Identification	LEVEL
Unit	cm
Offset (cm)	0
Altitude (m)	0
Density (kg/L)	1
Ch2: TEMPERATURE	
Identification	TEMPERATURE
Unit	Deg C
Ch3: CONDUCTIVITY	
Identification	CONDUCTIVITY
Unit	µS/cm

The wizard will walk you through the calibration of your LTC Junior Levelogger

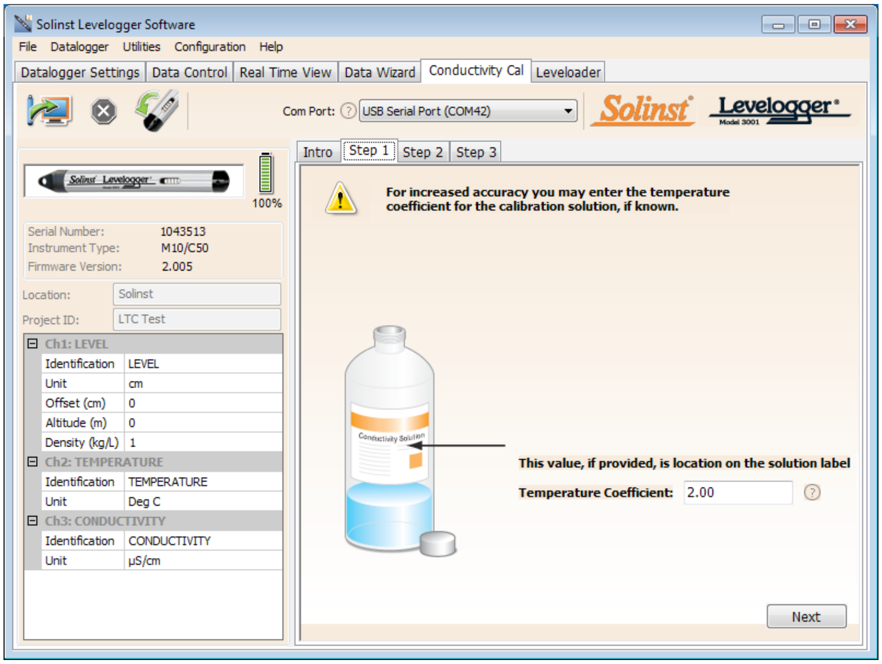
Please confirm the following:

- You have cleaned the probe with DI water
- The LTC Junior sensor is clean
- You are using the correct calibration solution
- You have rinsed your LTC Junior Levelogger with fresh solution
- No air bubbles are present on the sensor pins during the calibration
- The solution is between 10°C and 30°C during calibration
- The solution has thermally equlibrated for 2-3 minutes

- You have cleaned the probe with DI water
- The LTC Junior sensor is clean
- You are using the correct calibration solution
- You have rinsed your LTC Junior Levelogger with fresh solution
- No air bubbles are present on the sensor pins during the calibration
- The solution is between 10°C and 30°C during calibration
- The solution has thermally equlibrated for 2-3 minutes

Figure 6-2 LTC Levelogger Junior Calibration Wizard Introduction

1) **Setting the Temperature Coefficient:** The default setting for the Temperature Coefficient is 2.00. If the conductivity solution you are using to calibrate the LTC Levelogger Junior states a different temperature coefficient on the label, please input that number into the Temperature Coefficient field.



Serial Number: 1043513
Instrument Type: M10/C50
Firmware Version: 2.005
Location: Solinst
Project ID: LTC Test

Ch1: LEVEL	
Identification	LEVEL
Unit	cm
Offset (cm)	0
Altitude (m)	0
Density (kg/L)	1
Ch2: TEMPERATURE	
Identification	TEMPERATURE
Unit	Deg C
Ch3: CONDUCTIVITY	
Identification	CONDUCTIVITY
Unit	µS/cm

For increased accuracy you may enter the temperature coefficient for the calibration solution, if known.

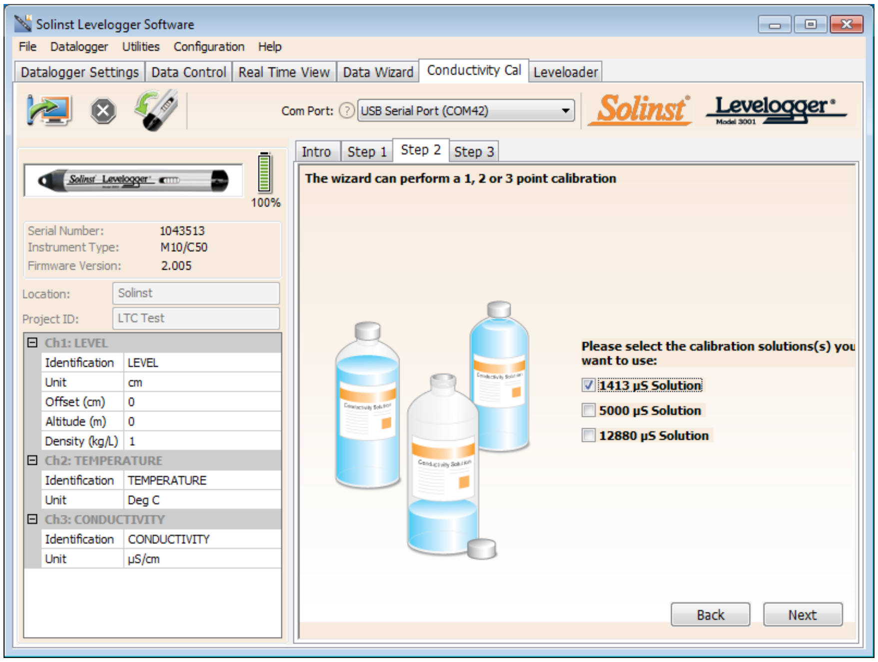
This value, if provided, is location on the solution label

Temperature Coefficient: 2.00

Figure 6-3 LTC Levelogger Junior Calibration Wizard Step 1

> **NOTE**
>
> By selecting more than one solution, you will be performing a multipoint calibration.

2) **Setup:** The Levelogger Software requires the user to choose the calibration solutions. You can choose up to three solutions for a multipoint calibration of the LTC Levelogger Junior. Ensure the solutions are ready in the calibration beaker or container. Start the calibration by selecting Next.



Serial Number: 1043513
Instrument Type: M10/C50
Firmware Version: 2.005
Location: Solinst
Project ID: LTC Test

Ch1: LEVEL	
Identification	LEVEL
Unit	cm
Offset (cm)	0
Altitude (m)	0
Density (kg/L)	1
Ch2: TEMPERATURE	
Identification	TEMPERATURE
Unit	Deg C
Ch3: CONDUCTIVITY	
Identification	CONDUCTIVITY
Unit	µS/cm

The wizard can perform a 1, 2 or 3 point calibration

Please select the calibration solutions(s) you want to use:

☑ 1413 µS Solution
☐ 5000 µS Solution
☐ 12880 µS Solution

Figure 6-4 LTC Levelogger Junior Calibration Wizard Step 2

3) **LTC Levelogger Junior Rinsing Process:** Use DI water to rinse the LTC Levelogger Junior first and then rinse the LTC Levelogger Junior with the displayed calibration solution. Use fresh solution for calibration, and immerse the LTC Levelogger Junior. Lightly tap the Levelogger to remove any bubbles from the sensor. Allow 2-3 minutes to stabilize, then select next to calibrate.

Serial Number: 1043513
Instrument Type: M10/C50
Firmware Version: 2.005
Location: Solinst
Project ID: LTC Test

Ch1: LEVEL	
Identification	LEVEL
Unit	cm
Offset (cm)	0
Altitude (m)	0
Density (kg/L)	1
Ch2: TEMPERATURE	
Identification	TEMPERATURE
Unit	Deg C
Ch3: CONDUCTIVITY	
Identification	CONDUCTIVITY
Unit	µS/cm

Calibration with 1413 micro-Siemens/cm

- Clean the probe with DI water
- Rinse your LTC Junior Levelogger with fresh solutio
- Immerse the LTC Junior Leveloger in the fresh solu

⚠ Allow the solution to thermally equilibrate and ensure that no air bubbles are present during the calibration process (this may take 2-3 minutes).

Figure 6-5 LTC Levelogger Junior Calibration Wizard Step 3
(example of window calibrating with 1413 µS/cm solution)

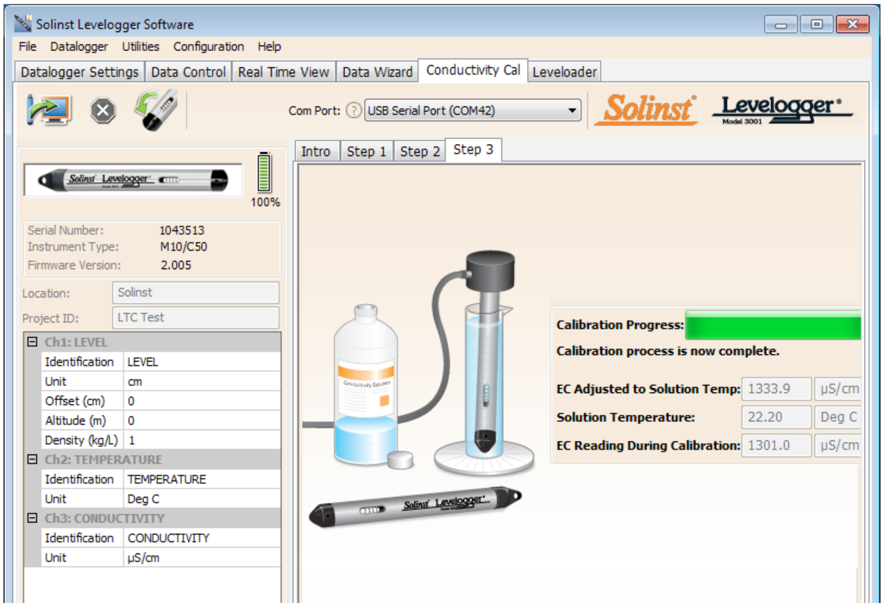
NOTE

Always remember to use fresh solution, remove all bubbles from the sensor pins, and allow for thermal equilibration of the sensor before proceeding.

Calibration: Since most standard calibration solutions state conductivity at a standard temperature of 25°C, the LTC Levelogger Junior can account for temperature differences between 10 to 30°C when you calibrate the unit. The LTC Levelogger Junior will compare the current temperature and conductivity readings against the temperature corrected standard solution.

NOTE

Once the calibration is complete for the first solution of a multipoint calibration, the Calibration Wizard will then go back to the beginning of Step 3 to start the rinsing process for the next solution selected.



Serial Number: 1043513
Instrument Type: M10/C50
Firmware Version: 2.005
Location: Solinst
Project ID: LTC Test

Ch1: LEVEL	
Identification	LEVEL
Unit	cm
Offset (cm)	0
Altitude (m)	0
Density (kg/L)	1
Ch2: TEMPERATURE	
Identification	TEMPERATURE
Unit	Deg C
Ch3: CONDUCTIVITY	
Identification	CONDUCTIVITY
Unit	µS/cm

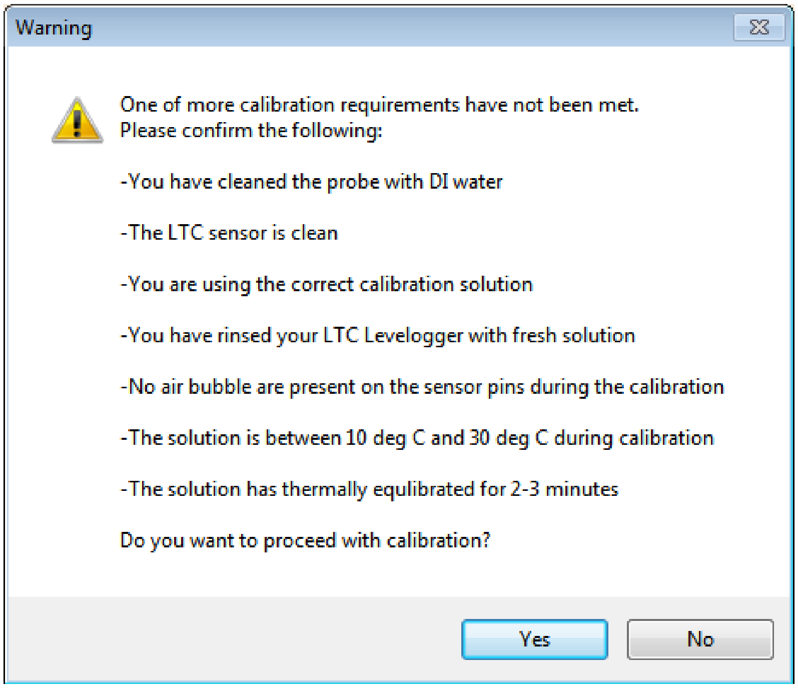
Calibration Progress:
Calibration process is now complete.

EC Adjusted to Solution Temp: 1333.9 µS/cm
Solution Temperature: 22.20 Deg C
EC Reading During Calibration: 1301.0 µS/cm

Figure 6-6 LTC Levelogger Junior Calibration Successful

When a single-point calibration is successful, the process is complete. Once the calibration is complete for the first solution of a multipoint calibration, a message will appear stating that the calibration was successful. When you select 'Okay', the Calibration Wizard will go back to the beginning of Step 3 to start the rinsing process for the next solution selected. The calibration process will proceed automatically until completed for all solutions.

If a failure occurs at any point during calibration, a message will appear asking you to clean and check your probe, then start the calibration process over for that current solution by selecting 'Yes' (Figure 6-7). If performing a multipoint calibration, any previous successful calibration points will remain.



One of more calibration requirements have not been met.
Please confirm the following:

-You have cleaned the probe with DI water

-The LTC sensor is clean

-You are using the correct calibration solution

-You have rinsed your LTC Levelogger with fresh solution

-No air bubble are present on the sensor pins during the calibration

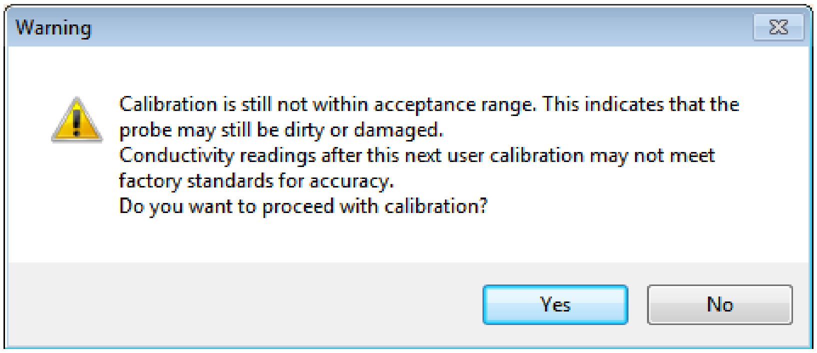
-The solution is between 10 deg C and 30 deg C during calibration

-The solution has thermally equlibrated for 2-3 minutes

Do you want to proceed with calibration?

Figure 6-7 LTC Levelogger Junior Calibration Warning 1

If a second failure occurs during calibration, a warning message will appear indicating that your probe may still be dirty, or damaged. This may occur if your LTC Levelogger Junior conductivity sensor has been affected by dirt, mineral build-up, etc., so it no longer responds like it did when it was first factory calibrated. This step allows your sensor to be calibrated within a wider range of the standard solution value.

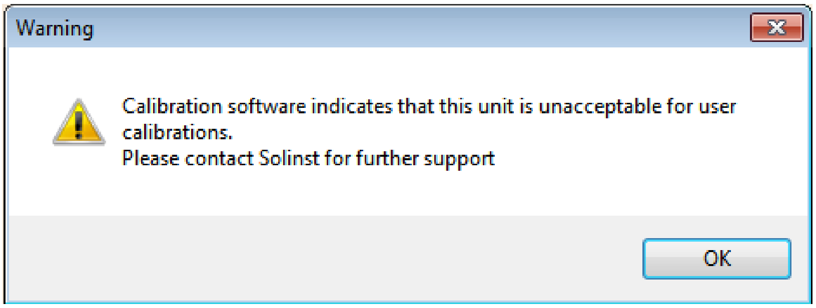


Calibration is still not within acceptance range. This indicates that the probe may still be dirty or damaged.
Conductivity readings after this next user calibration may not meet factory standards for accuracy.
Do you want to proceed with calibration?

Figure 6-8 LTC Levelogger Junior Calibration Warning 2

If you select 'Yes' to accept the larger tolerance, the calibration process will start over for that current solution (Figure 6-8). If performing a multipoint calibration, any previous successful calibration points will still remain. If you select 'No', the LTC Levelogger Junior will default back to the last pre-calibrated state. You can retry the calibration using the normal tolerance range.

If a third calibration error occurs, or the results of the calibration are outside the error tolerance range, a warning message will appear asking you to contact Solinst for more options (Figure 6-9).



Calibration software indicates that this unit is unacceptable for user calibrations.
Please contact Solinst for further support

Figure 6-9 LTC Levelogger Junior Calibration Warning 3

6.1 Restore Factory LTC Levelogger Junior Calibration

An LTC Levelogger Junior can be set back to original factory calibration settings for conductivity at any time, using this function. If you suspect that user calibrations are not working properly, you can restore the LTC Levelogger Junior to its original factory settings and then perform a "first-time" conductivity user calibration to maximize accuracy.

To execute this function, simply click the Restore Factory LTC Calibration button, with the LTC Levelogger Junior connected to the PC.

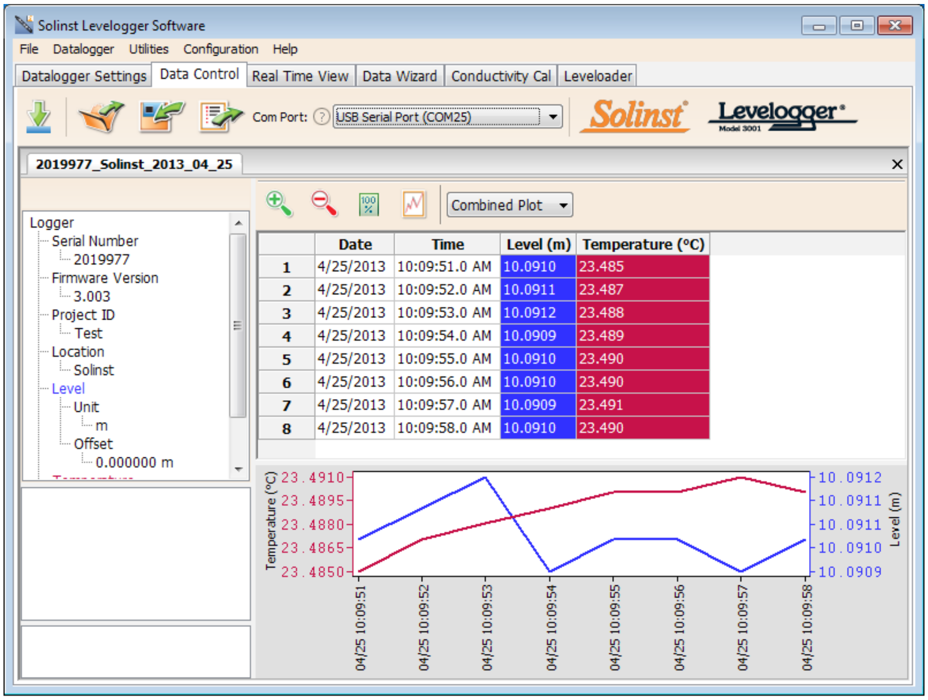
7 Data Control

(Downloading and Viewing Data)

Click the Data Control tab on the Main window. From the Data Control tab you can download data from a Levelogger, display data in tabular or graphic format, and save and export data files.

NOTE

When you click on a data point in the graph, the corresponding data point will be highlighted in the table. You can also highlight a section of data in the graph.



Logger
Serial Number
2019977
Firmware Version
3.003
Project ID
Test
Location
Solinst
Level
Unit
m
Offset
0.000000 m

	Date	Time	Level (m)	Temperature (°C)
1	4/25/2013	10:09:51.0 AM	10.0910	23.485
2	4/25/2013	10:09:52.0 AM	10.0911	23.487
3	4/25/2013	10:09:53.0 AM	10.0912	23.488
4	4/25/2013	10:09:54.0 AM	10.0909	23.489
5	4/25/2013	10:09:55.0 AM	10.0910	23.490
6	4/25/2013	10:09:56.0 AM	10.0910	23.490
7	4/25/2013	10:09:57.0 AM	10.0909	23.491
8	4/25/2013	10:09:58.0 AM	10.0910	23.490

Figure 7-1 Data Control Tab

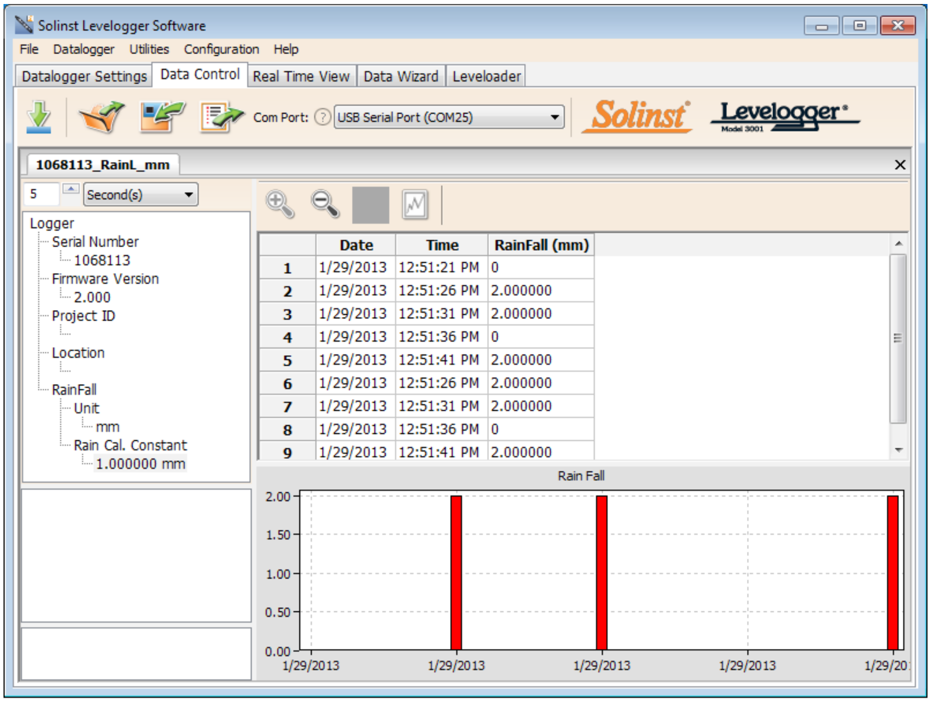
Click to open a *.xle or *.lev file. Multiple files can be opened at the same time and are available for viewing by clicking the File Name Tab on top of the data table.

All the Levelogger settings and the channel information effective during data collection are shown on the top left of the window.

The bottom left sections of the window are used to display information after a data compensation has been performed. The middle section displays information from a Barologger, if a barometric compensation is performed, and the bottom section includes information from other conversions, such as offsets or conductivity conversions (see Section 8).

NOTE

As there is only one channel of data for Rainloggers, there are no graphing options.



Logger
- Serial Number
  - 1068113
- Firmware Version
  - 2.000
- Project ID
- Location
- RainFall
  - Unit
    - mm
  - Rain Cal. Constant
    - 1.000000 mm

	Date	Time	RainFall (mm)
1	1/29/2013	12:51:21 PM	0
2	1/29/2013	12:51:26 PM	2.000000
3	1/29/2013	12:51:31 PM	2.000000
4	1/29/2013	12:51:36 PM	0
5	1/29/2013	12:51:41 PM	2.000000
6	1/29/2013	12:51:26 PM	2.000000
7	1/29/2013	12:51:31 PM	2.000000
8	1/29/2013	12:51:36 PM	0
9	1/29/2013	12:51:41 PM	2.000000

Figure 7-2 Rainlogger Data

When you view data downloaded from a Rainlogger, the RainFall data will be shown in a table and in a bar graph. A drop-down menu appears that allows you to select the time interval at which you would like the data shown, from 1 to 99 seconds, minutes, hours, days, or weeks (this acts like a zoom function). Figure 7-2 shows the data every 5 seconds from the start date and time.

7.1 Downloading Options and Saving Data Files

7.1.1 Default File Format

NOTE

The default file type is *.xle, unless changed in the Application Settings (see Section 4.2.4).

The default file type for Levelogger Software Version 4 and up is *.xle, unless changed to *.lev in the Application Settings (see Section 4.2.4). Previous Levelogger Software used *.lev files as the default. The *.xle file type is a *.xml format, which allows for enhanced functionality. The *.xle files can be exported as *.xml files, which can be integrated into external database programs.

The *.lev files of previous Levelogger downloads are compatible with Levelogger Software Version 4 and up, however, *.xle files are not compatible with previous software versions. To ensure compatibility, all Levelogger Software versions allow data to be exported as *.csv files for use in external spreadsheet programs. See Section 7.3 for Export options.

NOTE

Before downloading data you must select the COM Port that the datalogger is connected to and retrieve the settings from the attached datalogger by clicking in Datalogger Settings tab.

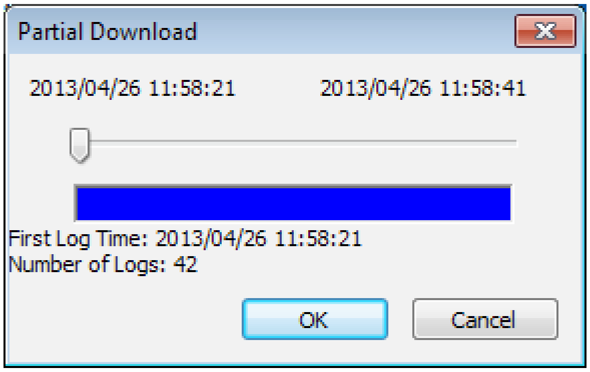
7.1.2 Downloading Data

Click from the Data Control tab to download data from a connected datalogger. There are four options for downloading data. They are: **All Data, Append Download, Partial Download and Recover Previous Log**.

If you select **All Data**, the program will download all the data from the current logging session of a datalogger into a *.xle file.

The default directory for saved data is in the 'Data' folder: <C:\Program\Files\Solinst\Levelogger4_1\Data>.

If you select **Append Download**, the program will append the data in an opened *.xle file from the datalogger. The opened *.xle file and the attached datalogger should have the same serial number and start time, otherwise an error will occur.



2013/04/26 11:58:21 2013/04/26 11:58:41

First Log Time: 2013/04/26 11:58:21
Number of Logs: 42

Figure 7-3 Partial Download Window

If you select **Partial Download**, a Partial Download Selection Window will open. The window shows the time stamp of the first and last reading in the logging session. Use the slider to select the time interval you would like data from. Once you click OK, all the data within that time will be downloaded to a *.xle file.

If you select **Recover Previous Log**, the software will try to recover the data from the previous log session and download the data to a *.xle file.

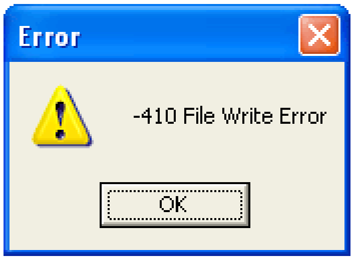
Once the data is downloaded from a Levelogger, it is automatically saved in a temporary file.

7.1.3 Saving Data

Click to save the data in a specific *.xle file.

The default directory for saved data is in the 'Data' folder:
<C:\Program\Files\Solinst\Levelogger4_1\Data>.

However, the default directory for saved files can be changed by clicking the Configuration menu at the top of the program window, selecting 'Application Settings' and inputting or navigating to a different folder destination. If an error is experienced in saving your first data file such as depicted in Figure 7-4, you may not have file writing privileges to the default directory. It this case, create and set as the default file save folder, a new Levelogger data folder within the My Documents folder and attempt the file save procedure again.



-410 File Write Error

Figure 7-4 File Write Error Message

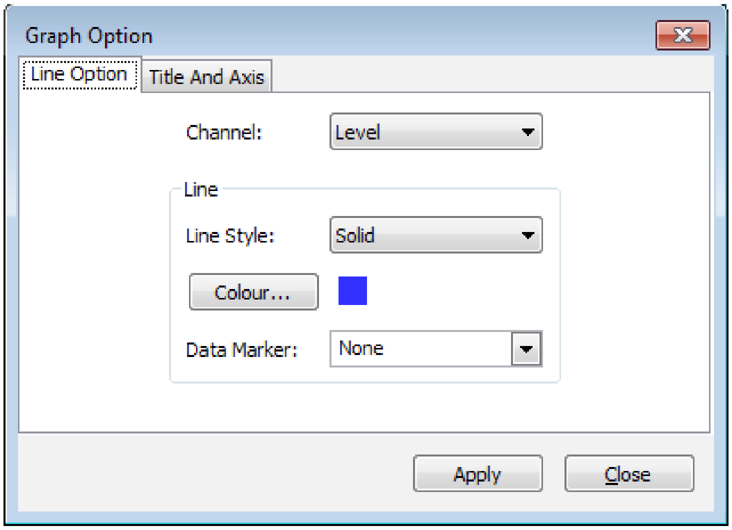
7.2 Graph Manipulation and Zoom Function

To perform the Zoom In function on the graph, click .

To perform a Zoom Out function on the graph click . Click to undo all the zoom functions.

The Zoom functions can also be used for data selections in the graph.

Click to open the Graph Option Dialog. The Graph Dialog is shown in Figure 7-5.



Channel: Level

Line Style: Solid

Data Marker: None

Figure 7-5 Line Option Window

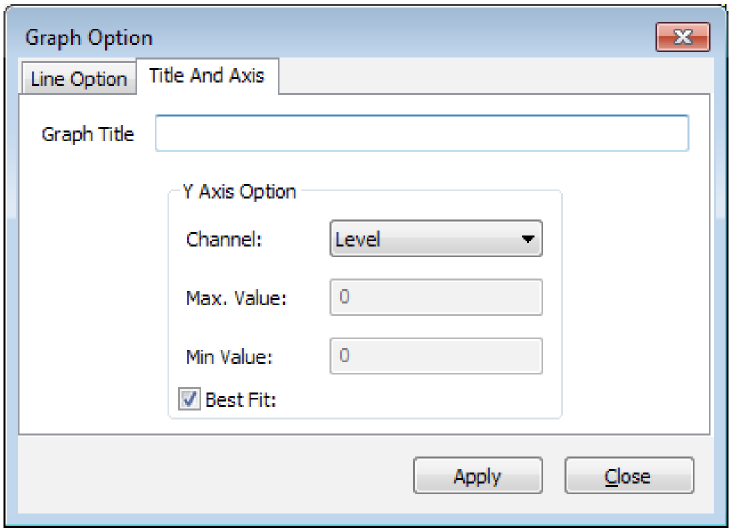
The Line Option is used to adjust the style and colour of the line in the graph for each channel. The user can also select the shape of the data marker or remove the data marker.

! NOTE

As there is only one channel of data for Rainloggers, there are no graphing options.

! NOTE

Right click, and drag the mouse to scan the data graph.



Graph Title:

Y Axis Option

Channel: Level

Max. Value: 0

Min Value: 0

☑ Best Fit:

Figure 7-6 Title and Axis Option Window

The Title and Axis Option is used to enter the title of the graph and change the Y axis label or user selected scale. Check the Best Fit box to enable the software to determine the best fit scale. If the Best Fit box is not checked, the user has to enter a maximum and minimum value of the selected channel. The X axis is logging time.

There is the option to show Combined Plot graphs or Separated Plot graphs of the data. Choosing a Combined Plot will show the data from each of the channels in one graph. The Separated Plot option will show a separate graph for each data channel.

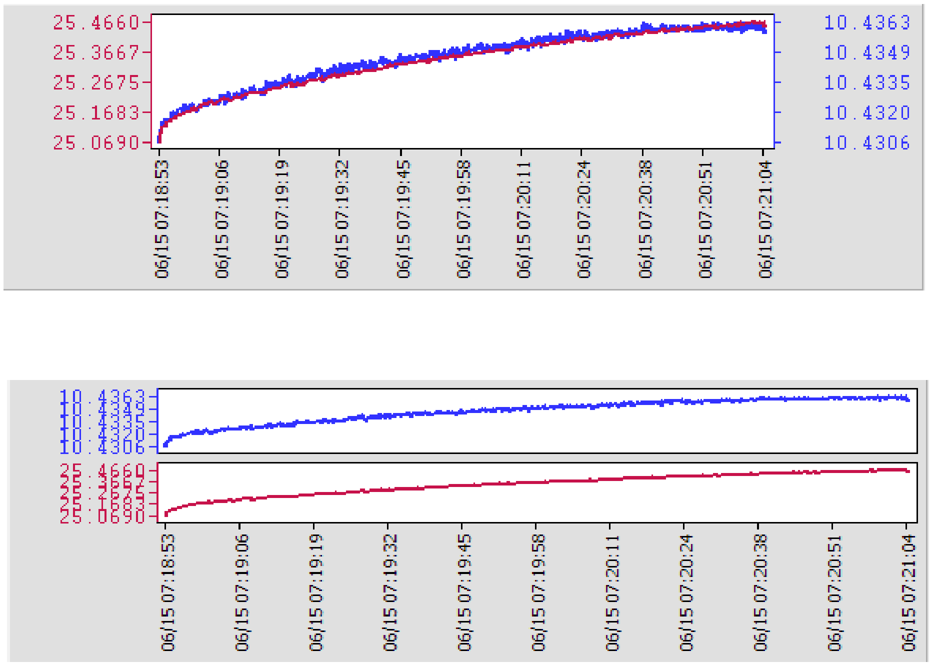
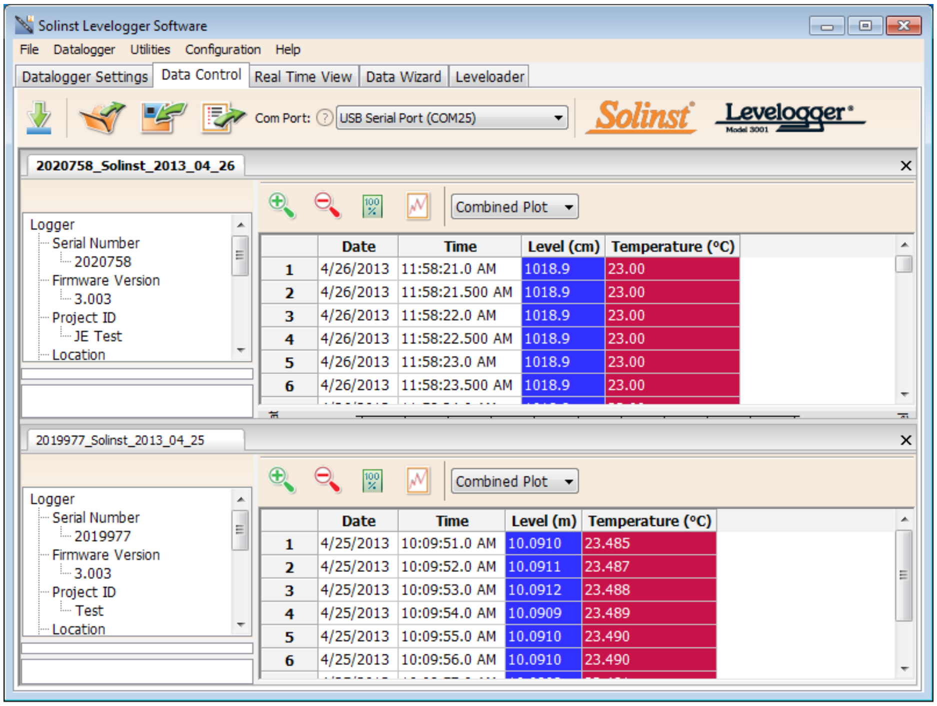


Figure 7-7 Combined and Separated Plot Graphs

There is also the option to view more than one graph at a time. Click and drag a File Name Tab and drop it when you see a shaded area on the window to open a separate graph of that data file. You can view any number of graphs at one time by re-sizing your window as required.



Com Port: USB Serial Port (COM25)

2020758_Solinst_2013_04_26

Logger
- Serial Number
  - 2020758
- Firmware Version
  - 3.003
- Project ID
  - JE Test
- Location

	Date	Time	Level (cm)	Temperature (°C)
1	4/26/2013	11:58:21.0 AM	1018.9	23.00
2	4/26/2013	11:58:21.500 AM	1018.9	23.00
3	4/26/2013	11:58:22.0 AM	1018.9	23.00
4	4/26/2013	11:58:22.500 AM	1018.9	23.00
5	4/26/2013	11:58:23.0 AM	1018.9	23.00
6	4/26/2013	11:58:23.500 AM	1018.9	23.00

2019977_Solinst_2013_04_25

Logger
- Serial Number
  - 2019977
- Firmware Version
  - 3.003
- Project ID
  - Test
- Location

	Date	Time	Level (m)	Temperature (°C)
1	4/25/2013	10:09:51.0 AM	10.0910	23.485
2	4/25/2013	10:09:52.0 AM	10.0911	23.487
3	4/25/2013	10:09:53.0 AM	10.0912	23.488
4	4/25/2013	10:09:54.0 AM	10.0909	23.489
5	4/25/2013	10:09:55.0 AM	10.0910	23.490
6	4/25/2013	10:09:56.0 AM	10.0910	23.490

Figure 7-8 Viewing Two Graphs

7.3 File Export and Print Function

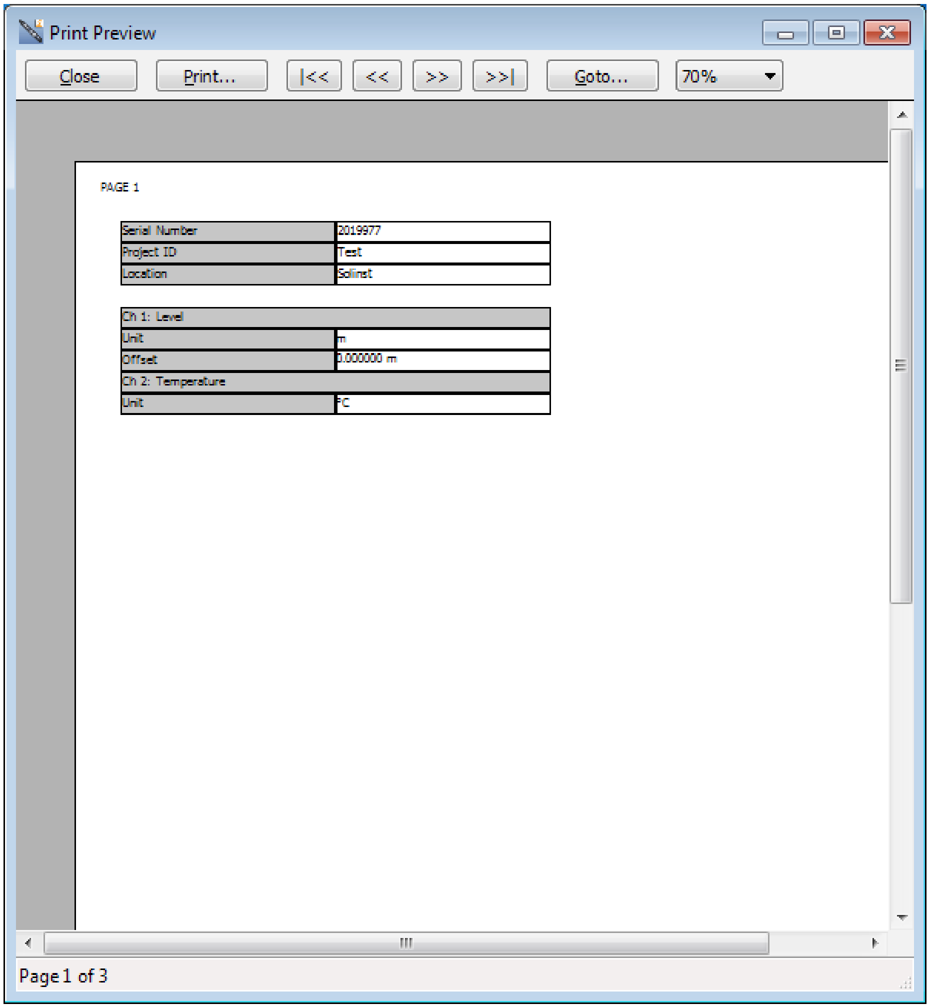
Data can be exported in *.csv (comma separated value) file format or *.xml (extensible markup language) file format by clicking File > Export > Data or

The *.csv and *.xml file formats are supported and can be imported by most spreadsheet and database programs.

Also, the data graph can be exported to a *.bmp file or a *.wmf file by clicking File > Export > Graph.

The Datalogger Settings, data table and data graph can be printed. Click File > Print Preview, to open the Print Preview window. Figure 7-9 shows the print preview of the Datalogger Settings. The Datalogger Settings are always on the first page of the document. The data graph is on the second page of the document and the rest of the document is the data table.

Click Print..., to open the print dialog. You can choose to print the entire document or just a selection. You can also click File > Print, to open the print dialog.



Serial Number	2019977
Project ID	Test
Location	Solinst

Ch 1: Level	
Unit	m
Offset	0.000000 m
Ch 2: Temperature	
Unit	°C

Figure 7-9 Print Preview Window

8 Data Compensation

Data Compensations, such as Barometric Compensation, Manual Data Adjustments and Parameter Adjustments can be performed automatically using the Levelogger Software Data Wizard, or manually, by exporting data to an external spreadsheet program.

8.1 Data Wizard

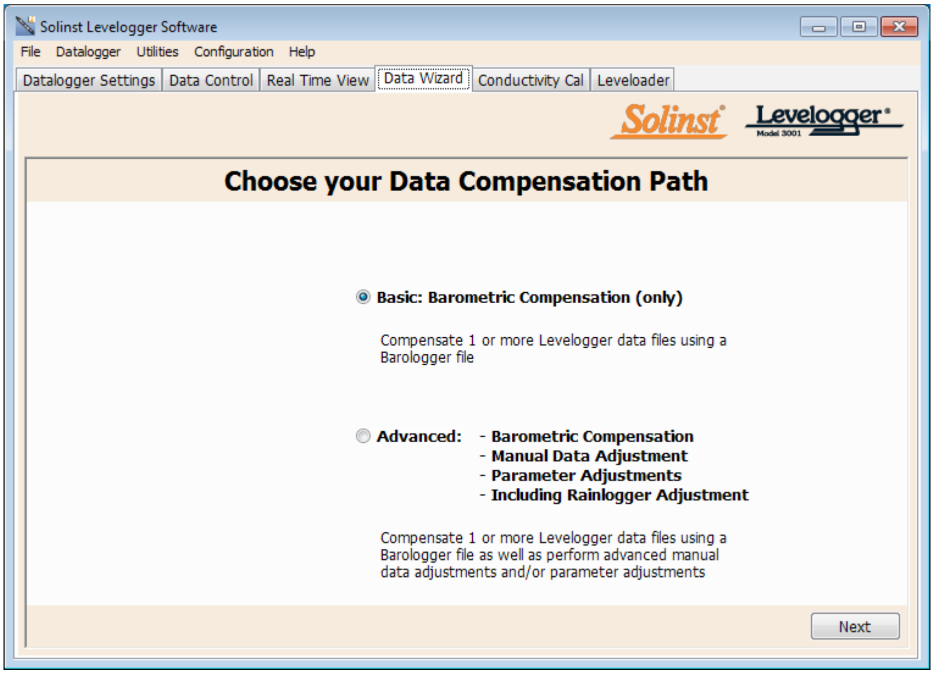
NOTE

Multiple datalogger files can be compensated at once.

Open the Data Wizard tab. The first step is to select your Data Compensation Path. The choices are **Basic** or **Advanced**.

Choosing **Basic** allows you to do a simple Barometric Compensation of Levelogger data only.

The **Advanced** option allows you to perform Barometric Compensation, Manual Data Adjustments and Parameter Adjustments, including adjustments to Rainlogger data.



Choose your Data Compensation Path

● **Basic: Barometric Compensation (only)**

Compensate 1 or more Levelogger data files using a Barologger file

○ **Advanced:**
- **Barometric Compensation**
- **Manual Data Adjustment**
- **Parameter Adjustments**
- **Including Rainlogger Adjustment**

Compensate 1 or more Levelogger data files using a Barologger file as well as perform advanced manual data adjustments and/or parameter adjustments

Figure 8-1 Data Wizard

Barometric Compensation simply subtracts the barometric reading from the corresponding Levelogger reading(s), to give true water level measurements.

Manual Data Adjustment allows you to enter a manual water level measurement or reference point as a field zero, which all Levelogger water level readings can then be adjusted to. There is the option to convert readings to Depth to Water Level measurements (e.g. from the top of a well casing to water level), or Elevation of Water Level measurements (e.g. above sea level).

Parameter Adjustments allow you to change Levelogger, Barologger or Rainlogger data to different units of measurements, add an offset, correct data for elevation differences, convert conductivity to Salinity or Specific Conductance, adjust density, or adjust barometric efficiency. Only the options available for your opened datalogger file types will be active (e.g. Conductivity Conversion is only available for LTC Levelogger Junior data files).

! NOTE

Advanced compensation provides the option of performing one, two, or all three data compensation types, in any combination.

! NOTE

Manual Data Adjustment, and Parameter Adjustments are useful for correcting Levelogger data files to make data consistent across a project.

! NOTE

Parameter Adjustments is the only option for compensating Rainlogger data.

Standard Adjustments:

- **Unit** conversion allows you to convert level readings in a Levelogger file to different units (m, cm, ft, kPa, bar or psi), a Barologger file to kPa, mbar, or psi, temperature readings to °C or °F, conductivity readings to µS/cm or mS/cm, or rainfall values to mm or inches.
- **Offset** allows you to enter any value, positive or negative, which will be added to each reading in the selected Levelogger file to be offset by that amount. It is recommended to stay with the default zero value, unless a known offset has been determined (e.g. to correct for pressure sensor drift. See Solinst Technical Bulletin: Understanding Pressure Sensor Drift).
- **Elevation** is used to correct for altitude differences between Levelogger or Barologger locations. Water column equivalent pressure decreases with altitude at a ratio of approximately 1.21/1000 in the lower atmosphere below 5000 m. You can compensate for this by entering an elevation between -1000 ft below sea level and 16,400 ft (or -300 m and 5000 m) above sea level.
- **Conductivity Conversion** allows you to convert raw Conductivity readings from an LTC Levelogger Junior, to Specific Conductivity (conductivity that is temperature compensated to the standard of 25°C). The Temperature Coefficient default for Specific Conductivity is 2.00. The Temperature Coefficient should not be adjusted, unless you know the value specific to the solution you are measuring. You can also convert Conductivity readings to Salinity expressed in Practical Salinity Units (PSU) (See Section 1.2.4).
- **Rainfall Cal. Constant** allows you to enter a different rainfall calibration constant for a Rainlogger Edge or Rainlogger data file (amount of rainfall per tip of the tipping-bucket rain gauge).

Additional Adjustments:

- **Density Adjustment** corrects the range of the level channel in the Levelogger data file based on a user input adjustment of fluid density. The range of the density adjustment is from 0.9 kg/L to 1.1 kg/L.
- **Barometric Efficiency** adjustment is used to proportionally adjust Barologger data in relation to a particular Levelogger. Barometric efficiency is often expressed as a percentage or proportion. The input field is proportional and has a default value of 1.00. For more information about Barometric Efficiency, see Section 10.1.3.1. The barometric efficiency can be set from 0.01 to 3.00.

! NOTE

Additional Adjustments appear when ">>" is selected. These are application specific, for advanced users.

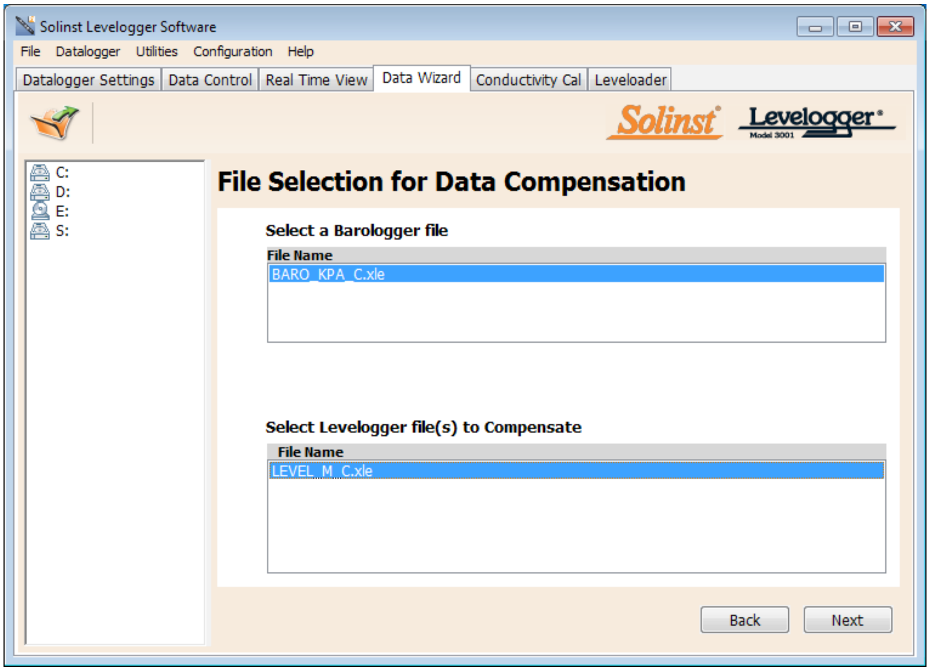
8.1.1 Basic Compensation

When you choose **Basic** compensation, the next step is to select the Barologger file you want to use for compensation, then select the Levelogger file(s) you want to compensate. You can only select one Barologger file to compensate multiple Levelogger files.

For best accuracy, the Levelogger file(s) and Barologger file should have the same start time and logging interval. (The Future Start option in the Datalogger Settings tab is a convenient way to start all of your loggers at the same time.) If there is an inconsistency of the time stamp between the Barometric file and the Levelogger file(s), a linear approximation on the barometric data will be performed.

! NOTE

One Barologger can be used to compensate all Leveloggers in a 20 mile (30 km) radius and/or with every 1000 ft. (300 m) change in elevation.



File Selection for Data Compensation

Select a Barologger file

File Name
BARO_KPA_C.xle

Select Levelogger file(s) to Compensate

File Name
LEVEL_M_C.xle

Figure 8-2 Selecting Files for Barometric Compensation

Any files you have open in the Data Control tab will be listed.

Use the directory on the left of the window or click to open any other Levelogger data files you would like to compensate. Ensure the files you want to compensate are highlighted in the list. Do this by clicking the file name. To de-select a file, click it again. Multiple Levelogger files can be selected at once.

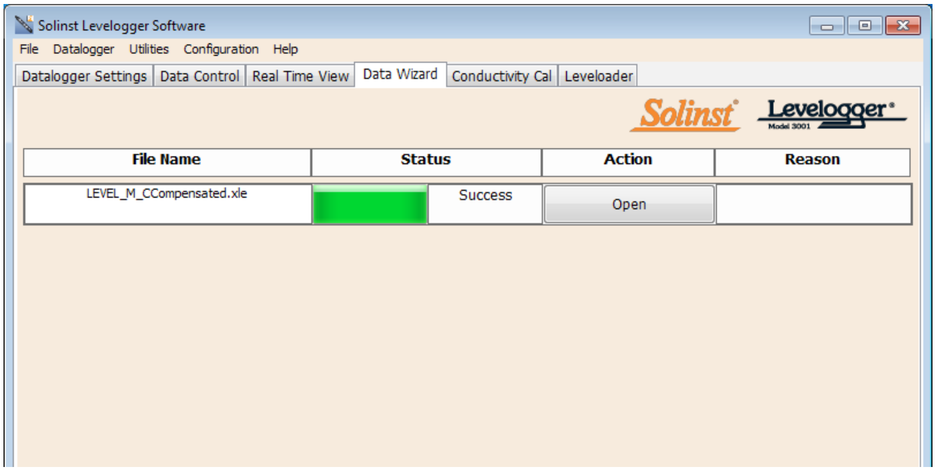
Select Next to complete the compensation.

The compensated data will automatically be saved in a new *.xle file. The default file name will be the <original Levelogger file name> with the word <compensated> added to the file name prefix. Alternatively, the user can rename the compensated file by saving it in the Data Control tab. Do not change or delete the file extension. All data files are saved to the default location: <C:\Program Files\Solinst\Levelogger4_1\Data>.

! NOTE

All data files are saved to the default location: <C:\Program Files\Solinst\Levelogger4_1\Data>. However, the default directory for saved files can be changed by clicking the Configuration menu at the top of the program window, selecting 'Application Settings' and inputting or navigating to a different folder destination.

The next window will show the results of the compensation. If the compensation was unsuccessful, there will be an explanation in the Reason column (e.g. time stamp of Levelogger and Barologger files were not close enough to perform an accurate compensation). You can still view the compensated file in the Data Control tab by clicking 'Open' in the Action column. If the compensation is successful, select 'Open' to view the compensated file in the Data Control tab.

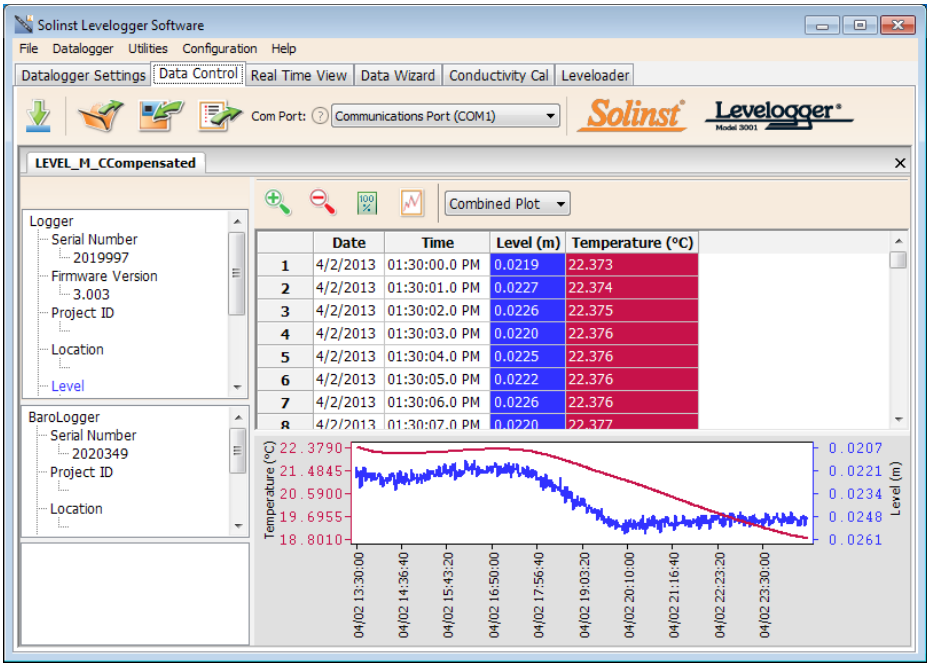


File Name	Status		Action	Reason
LEVEL_M_CCompensated.xle	🟩	Success	Open	

Figure 8-3 Barometric Compensation Results

From the Data Control tab, you can view the data, save the compensated file with a new filename and/or export the data (see Section 7).

All the original Levelogger settings and the channel information effective during data collection are shown on the top left of the window. The bottom left sections of the window are used to display the compensation information. The middle section displays information from the Barologger.



Com Port: Communications Port (COM1)

LEVEL_M_CCompensated

Logger
- Serial Number
  - 2019997
- Firmware Version
  - 3.003
- Project ID
- Location
- Level

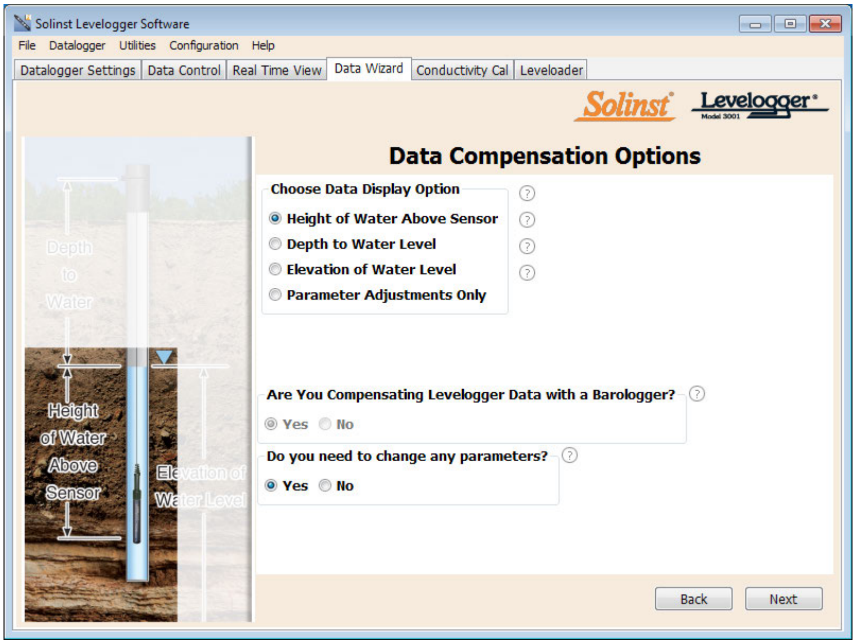
BaroLogger
- Serial Number
  - 2020349
- Project ID
- Location

	Date	Time	Level (m)	Temperature (°C)
1	4/2/2013	01:30:00.0 PM	0.0219	22.373
2	4/2/2013	01:30:01.0 PM	0.0227	22.374
3	4/2/2013	01:30:02.0 PM	0.0226	22.375
4	4/2/2013	01:30:03.0 PM	0.0220	22.376
5	4/2/2013	01:30:04.0 PM	0.0225	22.376
6	4/2/2013	01:30:05.0 PM	0.0222	22.376
7	4/2/2013	01:30:06.0 PM	0.0226	22.376
8	4/2/2013	01:30:07.0 PM	0.0220	22.377

Figure 8-4 Viewing Compensated Files in the Data Control Tab

8.1.2 Advanced Compensation

When you select **Advanced** compensation, the Data Compensation Options window will open.



Data Compensation Options

Choose Data Display Option

- ● Height of Water Above Sensor
- ○ Depth to Water Level
- ○ Elevation of Water Level
- ○ Parameter Adjustments Only

Are You Compensating Levelogger Data with a Barologger?

● Yes ○ No

Do you need to change any parameters?

● Yes ○ No

Figure 8-5 Advanced Data Compensation Options

First, you will select how you want your data displayed (Manual Data Adjustment):

- **Height of Water Above Sensor** is the default display option. Select this option to perform a Barometric Compensation and/or Parameter Adjustments to one or more data files, while keeping the sensor diaphragm (zero point) as the reference point.
- **Depth to Water Level** adjusts water level data to represent depth to water level readings (from the top of a well casing or other reference point) by entering a field zero, such as a manual depth to water level measurement. Adjustments can be made to one or more data files.
- **Elevation of Water Level** adjusts water level data to represent elevation of water level readings (above sea level or other reference point) by entering a measuring point elevation, and a field zero, such as a staff gauge measurement from that point. Adjustments can be made to one or more data files.
- **Parameter Adjustments Only** allows you to adjust one or more data files to different units, elevation, etc., while keeping the sensor diaphragm (zero point) as the reference point for Leveloggers. It also allows you to change Rainlogger data file parameters.

! NOTE

Parameter Adjustments Only, is the only option for compensating Rainlogger data.

Next, you will select Yes or No to **Barometrically Compensating** the data (will not be active if you selected Parameter Adjustments Only).

Next, you will select Yes or No to performing any **Parameter Adjustments** on the data files (will not be active if you selected Parameter Adjustments Only).

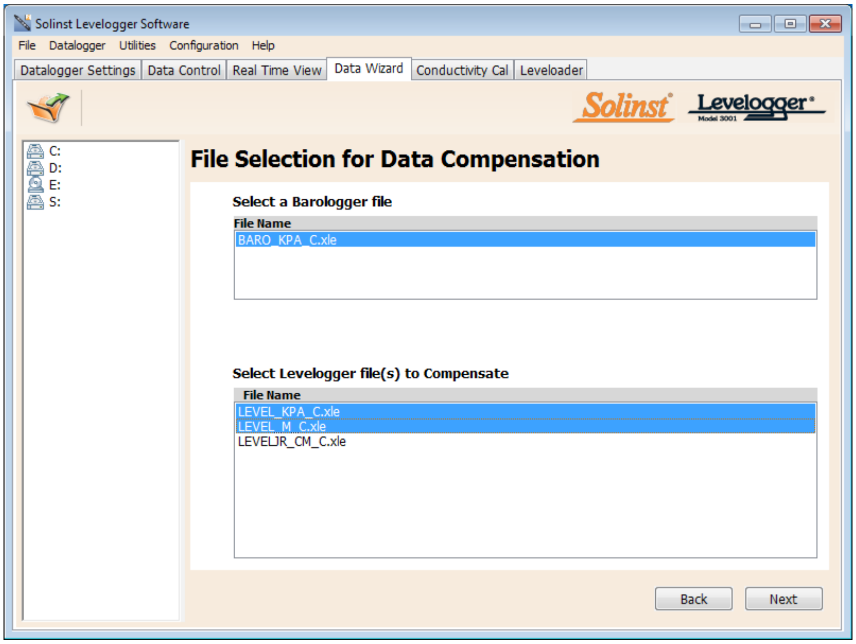
Click Next, after you have selected all of your Data Compensation options.

NOTE

See Section 8.1.1 for more information on selecting files for Barometric compensation.

In the next window, you will choose the Levelogger file(s), Rainlogger file(s), and Barologger file(s) you would like to use in the compensation. Any files you have open in the Data Control tab will be listed.

Use the directory on the left of the window or click ✓ to open any other data files you would like to compensate. Ensure the files you want to compensate are highlighted in the list. Do this by clicking the file name. To de-select a file, click again. Select Next to continue.



File Selection for Data Compensation

Select a Barologger file

File Name
BARO_KPA_C.xle

Select Levelogger file(s) to Compensate

File Name
LEVEL_KPA_C.xle
LEVEL_M_C.xle
LEVELJR_CM_C.xle

Figure 8-6 Selecting Files for Compensation

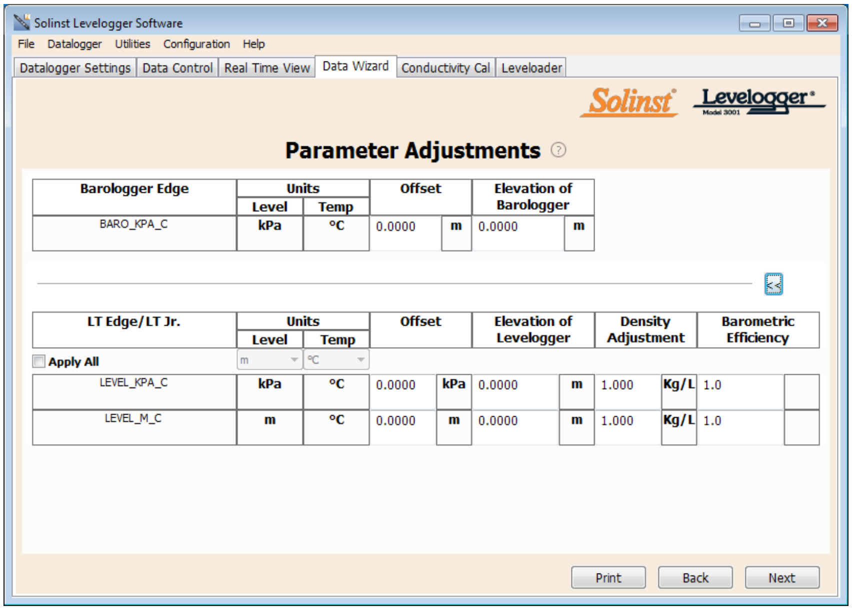
NOTE

When adjusting Units for Levelogger files or Rainlogger files, If you select apply to all, the same unit change will be applied to all of the files being compensated at that time.

If you have selected yes to **Parameter Adjustments**, or selected the **Parameter Adjustments Only** option, in the next window you will enter these. You can expand the window by clicking ">>" to show additional adjustment options. If you did not select to change any parameters, this window will not be shown.

NOTE

To show Additional Parameters that can be adjusted, click on the ">>" icon.



Parameter Adjustments

Barologger Edge	Units		Offset		Elevation of Barologger	
	Level	Temp				
BARO_KPA_C	kPa	°C	0.0000	m	0.0000	m

LT Edge/LT Jr.	Units		Offset		Elevation of Levelogger		Density Adjustment		Barometric Efficiency	
	Level	Temp								
☐ Apply All	m	°C								
LEVEL_KPA_C	kPa	°C	0.0000	kPa	0.0000	m	1.000	Kg/L	1.0	
LEVEL_M_C	m	°C	0.0000	m	0.0000	m	1.000	Kg/L	1.0	

Figure 8-7 Parameter Adjustments

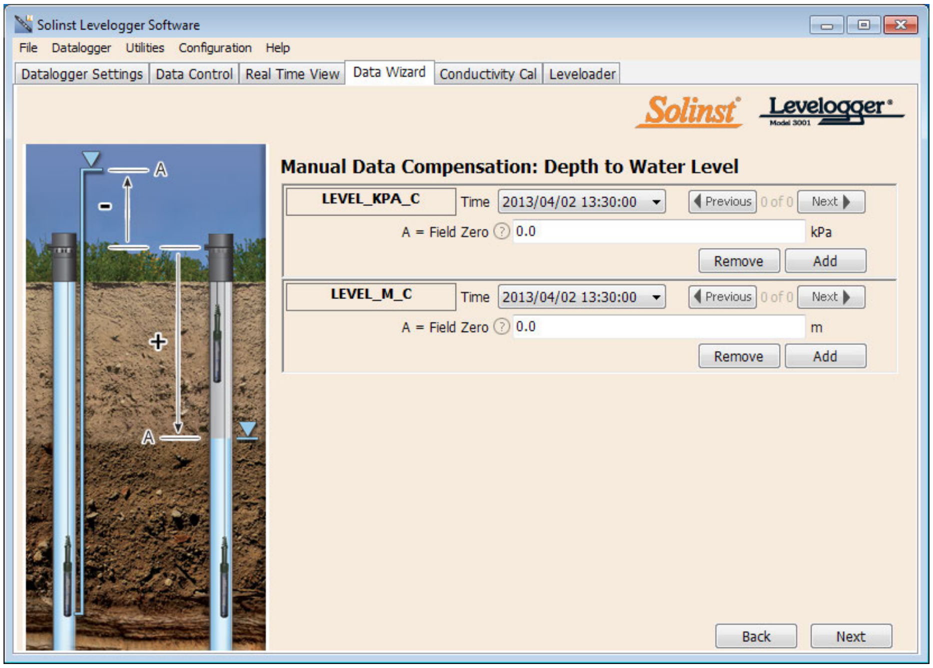
! NOTE

The date and time of measurement of the Field Zero must be recorded to complete the adjustment. The Field Zero must replace an actual reading the Levelogger file. I.e. take a manual measurement immediately after starting the Levelogger, and note that time. .

Next, for each selected Levelogger file, you will enter the Field Zero(s) you would like to use to manually adjust your Levelogger data. (If you have selected **Height of Water Above the Sensor or Parameter Adjustments Only**, this window will not be shown.)

For **Depth to Water Level** adjustments, enter a **Field Zero (A)**. If the static water level is below your Field Zero measurement, the Field Zero is input as a positive value (e.g. a manual water level meter measurement taken from the top of a well casing. See Example 8.1). If the static water level is above your Field Zero, the Field Zero is input as a negative value (such as in an artesian condition).

The Time the Field Zero measurement was taken must replace an actual reading in the Levelogger file. This is selected from the drop-down menu showing all time stamps in the Levelogger file. Click 'Add' to apply the adjustment. If you need to change a Field Zero, click 'Update' after any edits.



Manual Data Compensation: Depth to Water Level

LEVEL_KPA_C Time 2013/04/02 13:30:00
A = Field Zero 0.0 kPa

LEVEL_M_C Time 2013/04/02 13:30:00
A = Field Zero 0.0 m

Figure 8-8 Manual Data Adjustment - Depth to Water Level

Example 8.1 Depth to Water Level Adjustment

When using a manual depth to water measurement taken from the top of a well casing as a Field Zero, enter it as a positive value (e.g. 10 m).

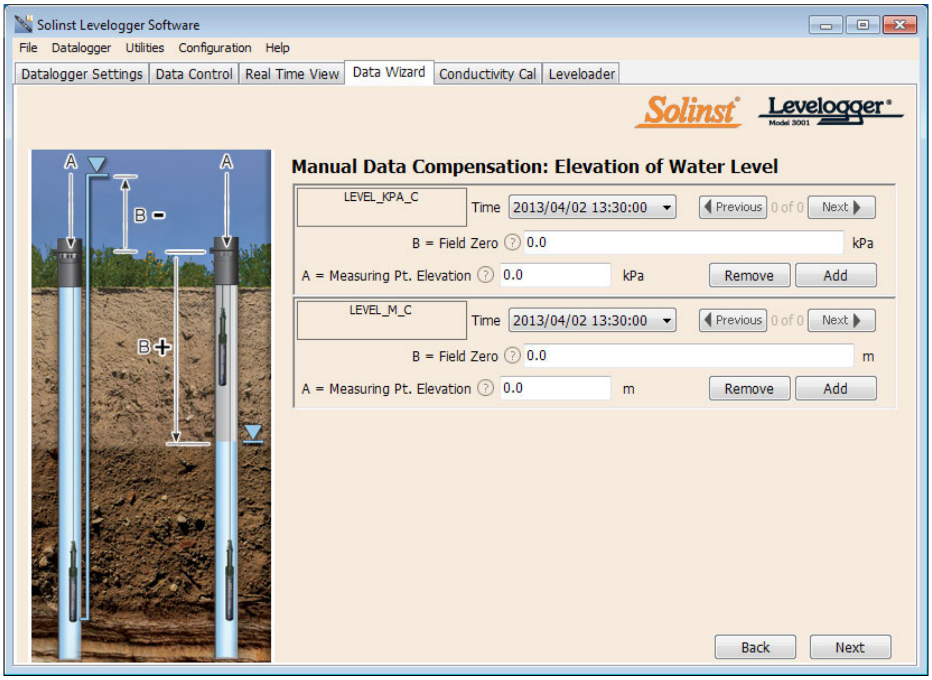
In your adjusted data file, your readings will increase in value as the water level decreases. This is because the depth to static water level from the top of the well casing is increasing. The adjusted readings will decrease in value as the static water level rises.

Original Levelogger Data (barometrically compensated height of water above sensor)	8.75 m	8.50 m	8.75 m	9.0 m	9.25 m
Adjusted Levelogger Data (depth to water)	(A) 10.0 m	10.25 m	10.0 m	9.25 m	9.0 m

For **Elevation of Water Level** adjustments, enter a **Measuring Point Elevation (A)** and a **Field Zero (B)** from that Measuring Point.

If the static water level is below your Measuring Point, the Field Zero is input as a positive value (e.g. if you are using a manual depth to water measurement as a Field Zero, from the top of a well casing as the Measuring Point).

If the static water level is above your Measuring Point, the Field Zero is input as a negative value (such as an artesian condition). The Measuring Point elevation may also be entered as a negative value.



Manual Data Compensation: Elevation of Water Level

LEVEL_KPA_C

Time 2013/04/02 13:30:00

B = Field Zero 0.0 kPa

A = Measuring Pt. Elevation 0.0 kPa

LEVEL_M_C

Time 2013/04/02 13:30:00

B = Field Zero 0.0 m

A = Measuring Pt. Elevation 0.0 m

Figure 8-9 Manual Data Adjustment - Elevation of Water Level

NOTE

The date and time of measurement of the Field Zero must be recorded to complete the adjustment. The Field Zero must replace an actual reading the Levelogger file. I.e. take a manual measurement immediately after starting the Levelogger, and note that time. .

The Time the Field Zero measurement was taken, must replace an actual reading in the Levelogger file, and is selected from the drop-down menu showing all time stamps in the Levelogger file. Click 'Add' to apply the adjustment. If you need to change a Field Zero, click 'Update' after any edits.

You can make multiple adjustments to one data file by selecting 'Add' again to enter another Field Zero. All readings after this Time, will be adjusted to this second measurement. You can add as many adjustments to one Levelogger data file as you would like (as long as it doesn't exceed the total number of readings in that file).

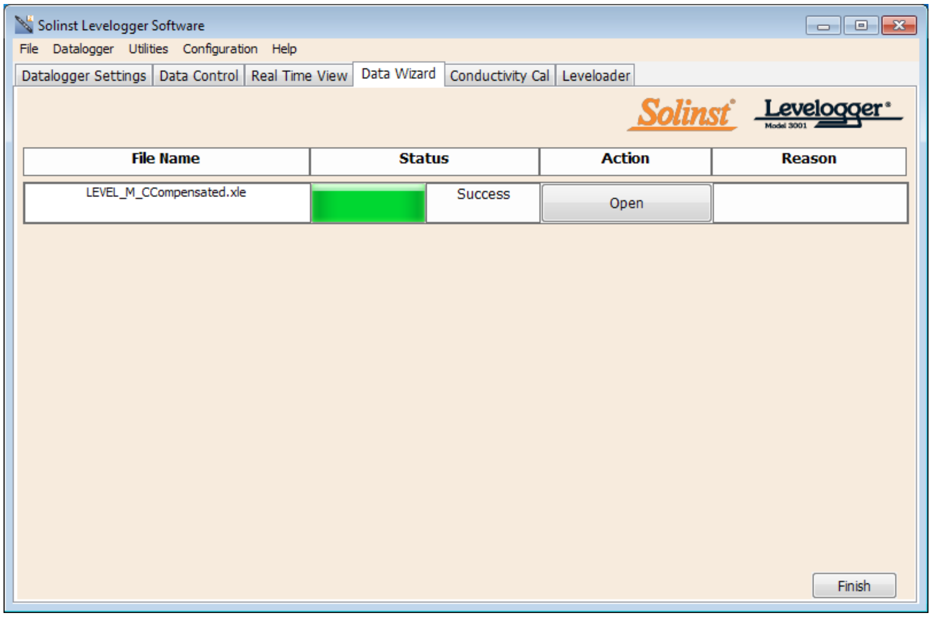
Select Next to complete the compensation.

NOTE

All data files are saved to the default location: <C:\Program Files\Solinst\Levelogger4_1\Data>. However, the default directory for saved files can be changed by clicking the Configuration menu at the top of the program window, selecting 'Application Settings' and inputting or navigating to a different folder destination.

The compensated data will automatically be saved in a new *.xle file. The default file name will be the <original Levelogger file name> with the word <compensated> added to the file name prefix. Alternatively, the user can rename the compensated file by saving it in the Data Control tab. Do not change or delete the file extension. All data files are saved to the default location: <C:\Program Files\Solinst\Levelogger4_1\Data>.

The next window will show the results of the compensation. If the compensation was unsuccessful, there will be an explanation in the Reason column (e.g. time stamp of Levelogger and Barologger files were not close enough to perform an accurate compensation). You can still view the compensated file in the Data Control tab, by clicking 'Open' in the Action column. If the compensation is successful, select 'Open', to view the compensated data file in the Data Control tab.

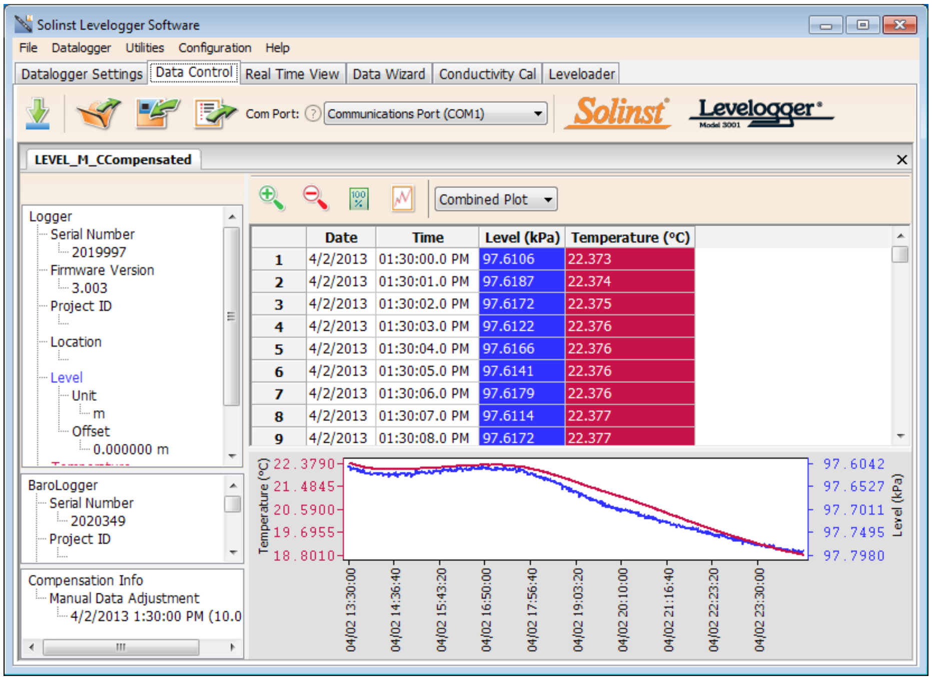


File Name	Status		Action	Reason
LEVEL_M_CCompensated.xle	🟩	Success	Open	

Figure 8-10 Advanced Data Compensation Results

From the Data Control tab, you can view the data, save the compensated file with a new filename and/or export the data (see Section 7).

All the original Levelogger settings and the channel information effective during data collection are shown on the top left of the window. The bottom left sections of the window are used to display the compensation information. The middle section displays information from the Barologger, and the bottom section includes information about manual data and parameter adjustments.



Logger
Serial Number
2019997
Firmware Version
3.003
Project ID
Location
Level
Unit
m
Offset
0.000000 m

BaroLogger
Serial Number
2020349
Project ID

Compensation Info
Manual Data Adjustment
4/2/2013 1:30:00 PM (10.0

	Date	Time	Level (kPa)	Temperature (°C)
1	4/2/2013	01:30:00.0 PM	97.6106	22.373
2	4/2/2013	01:30:01.0 PM	97.6187	22.374
3	4/2/2013	01:30:02.0 PM	97.6172	22.375
4	4/2/2013	01:30:03.0 PM	97.6122	22.376
5	4/2/2013	01:30:04.0 PM	97.6166	22.376
6	4/2/2013	01:30:05.0 PM	97.6141	22.376
7	4/2/2013	01:30:06.0 PM	97.6179	22.376
8	4/2/2013	01:30:07.0 PM	97.6114	22.377
9	4/2/2013	01:30:08.0 PM	97.6172	22.377

Figure 8-11 Viewing Compensated Files in the Data Control Tab

8.2 Manual Barometric Compensation

This section describes how to perform manual barometric compensation on Levelogger Edge and Levelogger Junior Edge data files when a Barologger was not dedicated as a barometric recorder.

For short term tests during which the barometric pressure varies insignificantly, the collection of continuous barometric data may be unnecessary. In this event, take a reading from an open air exposed Levelogger prior to running the short term test and record this level. This level represents the barometric pressure. Similarly, at the end of your test, take another barometric reading and record this measurement. After the submerged Levelogger data has been exported to a spreadsheet program, compensate your submerged Levelogger data files for barometric pressure. If no appreciable change in barometric reading occurred, you may write in the first cell of a new column, a simple calculation that subtracts your barometric reading from the submerged data file, then copy and paste this calculation to all the cells in that new column. The new column will represent the barometrically compensated liquid level.

Barometric data can be collected on site using a recording barometer or from a local weather station. To accomplish an accurate manual barometric compensation, the atmospheric pressure station should not be greater than 20 miles (30 km) away and within an elevation change of 1000 ft (300 m). In addition, the date and time of the barometric data should cover the range of data collected by the Levelogger. If setting up the barometer, set the recording interval to that of the Levelogger sampling interval or some multiple of the Levelogger interval. To compensate submerged Levelogger data using barometric data collected from an on site barometric datalogger or a nearby weather station, these steps must be taken:

1) Export both the Levelogger data file and the barometric file to a spreadsheet.
2) In the spreadsheet, ensure both files are using the same units. If your Levelogger data was recorded in m, cm, or ft, convert the barometric data column from its barometric measurement units (typically atm, mm Hg, psi, mbar or kPa) to feet or meters of water column equivalent using the conversion factors in Table 8-1. (There is also the option to initially set up your Levelogger Edge or Levelogger Junior Edge to record in psi, kPa, or bar. This makes compensation using other atmospheric pressure devices easier.)

Table 8-1

Common barometric units to water column equivalent conversions

Barometric unit	Water column equivalent (ft)	Water column equivalent (m)
1 psi	2.307	0.703
1 kPa	0.335	0.102
1 mbar	0.033	0.0102

Table 8-1 Common Barometric Units to Water column Equivalent Conversions

3) Once the units for each column are the same, subtract the barometric column from the Levelogger data to get the true net water level recorded by the Levelogger Edge.

NOTE

When analyzing barometric data it is important to keep in mind that storm events commonly reduce total atmospheric pressure by about 1.7% from pre-existing high pressure conditions. 1.7% converts to approximately 0.6 ft or 0.2 m of water level equivalent barometric fluctuation.

NOTE

For Manual Barometric Compensation instructions for the Levelogger Gold and Levelogger Junior, visit: www.solinst.com and see the Levelogger Software Version 3.4.1 User Guide in the Downloads Section.
Or view " Automatic or Manual Barometric Compensation of Your Levelogger Data" in the Technical Bulletin Section at: http://www.solinst.com/Prod/3001/Datalogger-Technical-Bulletins.html

NOTE

You can also convert the Levelogger Edge data units to match the Barometric units using the Data Wizard.

NOTE

It is important to remember that weather station barometric data will often contain an offset or normalization (i.e. normalization to sea level). Manual data conversation and barometric compensation should account for any variation of the normalization or offset used between the barometric data sourced and Solinst Leveloggers.

9 Real Time View

Click the Real Time View tab from the main software window (Figure 9-1). The purpose of this tab is to provide on-screen measurement as data is being recorded by the connected datalogger. The data is displayed in tabular and graphical format. All the channel information and Levelogger settings are displayed on the left of the window.

First, select a non-logged view rate seconds ▾ 1 . This rate can be set independently of the logging period of the Levelogger and does not interfere with any logging taking place in the Levelogger itself.

Checking, **Enable Manual Data Adjustment**, allows you to enter a datum/ field zero (e.g. depth to water level) to which the change in Real Time View level measurements are then adjusted against. This is only available when you are taking readings in m, cm, or ft.

Real Time View readings can be displayed as a graph or in tabular format. The same graphing options as the Data Control tab are available for Real Time View readings. Real Time View readings are being recorded within the Levelogger Software and prior to closing the window, they can be saved by exporting the data into a *.csv file, by choosing the file export option .

To start the current readings, click ▶ . Immediately the readings will be displayed.

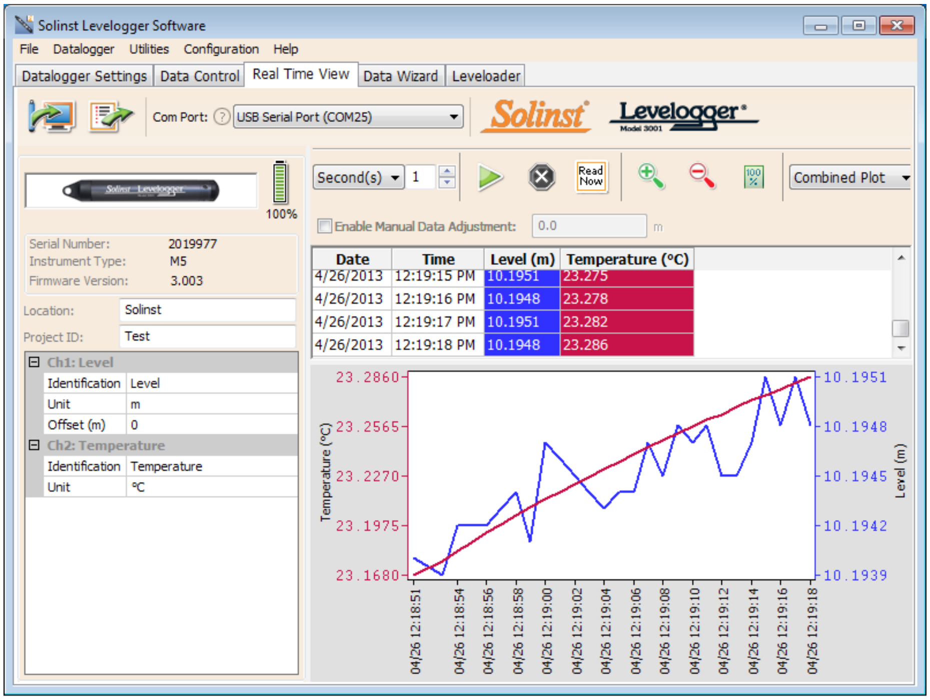
To take a reading at any specific time, click the Read Now button and that reading will be added to the displayed data. To turn the Real Time View monitoring off, decide if you want to save the data as described above, and simply click ✖ .

! NOTE

Datalogger settings can not be changed in the Real Time tab. Changes must be made in the Datalogger Settings tab. The changes are applied when the Real Time readings are started. ▶

! NOTE

You can also view Real Time readings from a Rainlogger Edge or Rainlogger using firmware version 2.000 or higher.



Serial Number: 2019977
Instrument Type: M5
Firmware Version: 3.003

Location: Solinst
Project ID: Test

Ch1: Level
Identification: Level
Unit: m
Offset (m): 0

Ch2: Temperature
Identification: Temperature
Unit: °C

☐ Enable Manual Data Adjustment: 0.0 m

Date	Time	Level (m)	Temperature (°C)
4/26/2013	12:19:15 PM	10.1951	23.275
4/26/2013	12:19:16 PM	10.1948	23.278
4/26/2013	12:19:17 PM	10.1951	23.282
4/26/2013	12:19:18 PM	10.1948	23.286

Figure 9-1 Real Time View Window

10 Installation and Maintenance of Leveloggers

10.1 Installation

Many options exist for installation of the Levelogger, but essentially these installation methods can be classified into two broad categories: free suspended or fixed installations.

1) In free suspended installations, the Levelogger is hung via suspension wire or Direct Read Cable from a well cap, or some fixed tie-off location, at the well head.
2) In fixed installations the Levelogger is fixed in place by a compression fitting, a clamping mechanism or simple metal straps.

It is recommended that the Levelogger be installed in a vertical orientation. However, inclined or horizontal installation is acceptable. The level sensor in the Levelogger is indicated by the machined line about the body of the logger just above the pressure access holes. The pressure transducer is oriented in a plane normal to the long axis of the body and detects pressure directed along the plane of the long axis (Figure 10-1). In vertical orientations, the sensor detects pressure above the pressure transducer line, where as in non-vertical orientations, the pressure zero point is proportional to the angle of inclination.

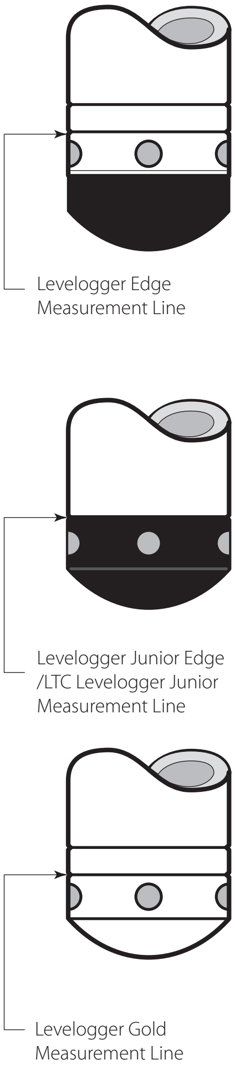


Figure 10-1

Care should be taken to avoid dropping the Levelogger against a hard surface. Leveloggers should always be installed with the installation cap on (if not using a Direct Read Cable), whether it is being suspended by it or not. This prevents unnecessary battery drainage and protects the optical eyes.

Make sure you properly estimate the maximum and minimum expected water levels during the monitoring period. You need to install your Levelogger so it remains submerged at all times, and ensure that its maximum submergence depth throughout the monitoring period remains within its specified range. The pressure transducer can be damaged if the datalogger is over-pressurized by submergence greater than its level range. The Levelogger Edge and Levelogger Junior Edge are warranted to pressures up to 200% of their full scale level range (150% for the Levelogger Gold, Levelogger Junior and LTC Levelogger Junior Models), however accuracy can not be guaranteed beyond its full scale.

Other important considerations when installing the Levelogger in pressurized or intermittently pressurized locations such as pressure vessels, pressurized pipes, pulse flow conditions, drop structures or near hydraulics works, is to keep in mind the potential effect of water or steam hammer and hydraulic jump. Water hammer is caused by an abrupt alteration of flow direction resulting in pressure surges. Steam hammer occurs when steam enters a cold pipe partially filled with water. The hammer effect has the potential to significantly increase hydraulic pressure possibly exposing the pressure sensor to pressures beyond its maximum rating. Hydraulic jump is a phenomenon that occurs when water is 'lifted' or 'ramped' by velocity or flow obstructions. Hydraulic jump causes turbulence and creates non-representative head conditions in the water column. Care should be taken to avoid logger installation at points susceptible to hydraulic jump.

10.1.1 Free Suspended Installations

Figure 10-2
Solinst 2" Locking Well Cap
for Wireline or Kevlar Cord

10.1.1.1 Suspension Wire/Cord Installation

When installing on a suspension wire or cord, the Levelogger is pre-programmed and started using the software. It is then deployed with the suspension wire or cord connected to the installation cap of the Levelogger to the underside of a well cap. The data is retrieved manually, by withdrawing the Levelogger, removing the installation cap and attaching an Optical Reader directly to the datalogger. Data is downloaded to a desktop or laptop PC or by using a Leveloader. This type of installation is applicable to both submerged and barometric record applications.

Solinst supplies stainless steel suspension wire assemblies including SS stranded wire and hooks available in a variety of lengths from 50 ft (15 m) to 500 ft (150 m), and Kevlar cord assemblies to 500 ft (150 m). Solinst also supplies the Model 3001 2" Well Cap Assembly from which the Levelogger can be suspended. An Adaptor for 4" wells also available (see Section 10.1.1.3).

Follow these steps to install the Levelogger using **stainless steel wire and hooks**:

1) Loop the cable through the coil 2 of the hook assembly, then wind the looped strands several times around the hook shaft and pass through coil 1.
2) Pass coil 3 through the Well Cap eyelet or Levelogger/Barologger eyelet and snap coil 3 to the hook shaft.
3) If the Well Cap is not used then some secure tie-off point should be used or installed.
4) If installing a Barologger, ensure the suspension level is above the highest expected water level.
5) When retrieving data and/or reprogramming the Levelogger, extract it from the monitoring location, un-thread the installation cap, interrogate and re-suspend the unit rechecking the security of the wireline clamps each time.

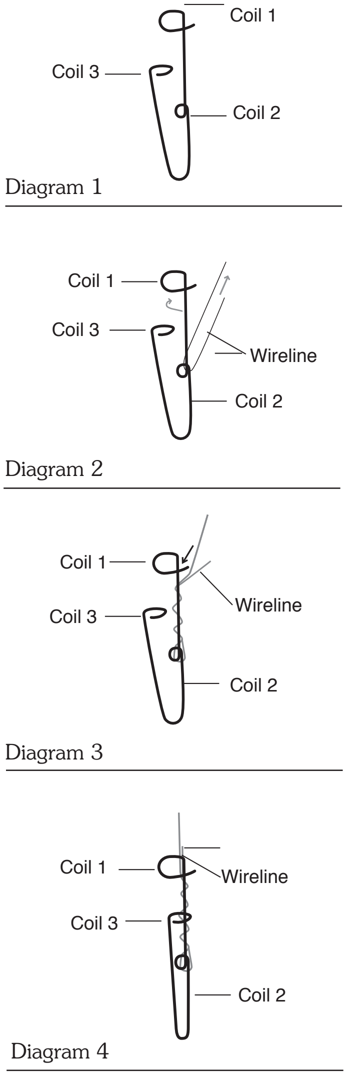


Figure 10-3 Wireline Hook Installation

Figure 10-4 Kevlar Cord

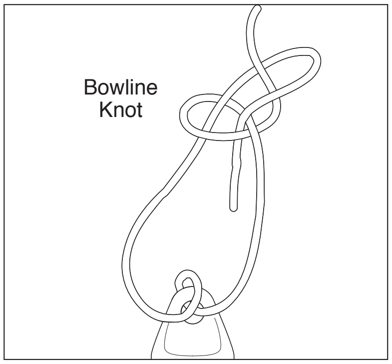


Figure 10-5 Bowline Knot Used to Connect Kevlar Cord to the Levelogger

It is recommended that the **Kevlar cord** be connected to the Levelogger and well cap using a bowline knot (see Figure 10-5). The Kevlar cord is comprised of multiple Kevlar strands braided with black polyester, and has break strength of 150 lbs. Kevlar is very suitable for underwater applications in freshwater and marine environments, as the material resists rusting.

Single Well Cap Option

Dual Well Cap Option

Figure 10-6
Solinst 2" Locking Well Caps for
Direct Read Cable Installation

Figure 10-7
Solinst Direct Read Cable

10.1.1.2 Direct Read Cable Assembly Installation

When installing using a Direct Read Cable Assembly, the Levelogger can be deployed before it is programmed and started with the software. The Levelogger is installed using a Direct Read Cable to a Direct Read Wellhead, where a PC Interface Cable is connected allowing the Levelogger to communicate with a desktop or laptop PC, or a Leveloader.

The Direct Read Cable system is composed of the ordered length of Direct Read Cable, the Model 3001 Well Cap Assembly (see Section 10.1.1.3) and the PC Interface Cable. The Direct Read cable threads to the Levelogger, while the socket at the opposite end of the Direct Read Cable fits into the specially designed Well Cap insert. The PC Interface Cable connects to the Direct Read socket at surface and to either a USB or RS-232 port on the PC. While use of the Model 3001 Well Cap is recommended and convenient, it is optional as long as a satisfactorily secure alternative tie-off point is found for the Direct Read Cable. Follow these steps to install a Direct Read Cable Assembly to the Levelogger:

1) Remove the installation cap from the Levelogger, align and connect the optical socket (two glass 'eyes' using the alignment pin) of the Direct Read cable to the Levelogger by threading the coupling onto the Levelogger tightly.
2) The Levelogger and optical socket will fit through the hole in the Well Cap insert.
3) Remove the protective cap from the non-optical socket at the wellhead end of the Direct Read Cable, seat the socket in the Well Cap Insert and align and thread it to the round socket of the PC Interface Cable.
4) Connect the USB or RS-232 socket of the PC Interface Cable to the USB or RS-232 Com Port on your PC.
5) The two plugged holes in the Well Cap can be opened to provide an access port for a Barologger, as well as a water level meter probe.

When removing a Direct Read Cable from a Levelogger, ensure you only twist the coupling. To avoid possible damage, do not twist the strain relief on the Direct Read Cable.

Figure 10-8 Proper way to remove a Direct Read Cable from a Levelogger

10.1.1.3 Model 3001 Well Cap Assembly

The Model 3001 Well Cap Assembly is designed to fit 2" wells, and provides options for installing Leveloggers with wireline, Kevlar cord, or using a Direct Read Cable.

The well cap base provides a tight friction fit onto the well casing. The cap is secured to the base with a twist lock. For further security, a 3/8" (9.5 mm) shackle diameter lock can be used. The Well Cap is vented to allow for the equalization of barometric pressure in the well. Users can choose to permanently secure the PVC Well Cap to the well casing, using three screw points on the inner shoulder of the Well Cap Base.

For wireline or Kevlar cord suspension, simply use the suspension hook on the underside of the insert to secure the Levelogger to the Well Cap (see Section 10.1.1.1). To install using a Direct Read Cable, lower the Levelogger with the Direct Read Cable through one opening in the insert (see Section 10.1.1.2).

NOTE

The insert has openings to hold two Direct Read Cables in the same well. If only one Direct Read Cable is used, the other hole (0.89" ID) provides access for Solinst Water Level Meters.

Figure 10-9 Model 3001 Well Cap Assembly (#110099)

Figure 10-10 If installing Leveloggers in a 4" well, a reducer adaptor is available. (#110235)

10.1.2 Fixed Installations

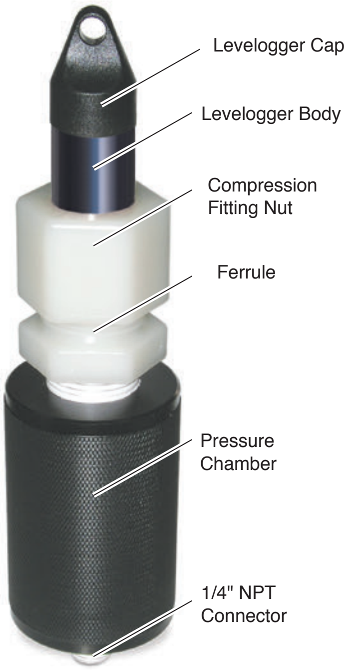


Figure 10-11
7/8" Nylon Compression Fitting with
1/4" NPT Connector

NOTE

The Levelogger NPT Adaptor is not recommended for pressures in excess of 30 psi (66 ft (20 m) of water column).

10.1.2.1 Artesian Monitoring

Monitoring of artesian conditions in which the piezometric surface is above ground surface or more particularly above the top of well casing elevation using Leveloggers can be quite straight forward.

Continuous artesian conditions infer that the piezometric surface never drops below the level the ground surface or particularly the top of casing elevation and the casing is sealed with a sealed wellhead. In this case, where freezing is not a concern, the Levelogger need only be installed on the wellhead itself by means of a large compression fitting with a 1/4" NPT connector, as illustrated in Figure 10-11. Solinst can supply a 7/8" nylon compression fitting for this purpose. First, a 1/4" NPT hole is tapped into the wellhead. The user slides the Levelogger into the compression fitting, leaving about 1/4 of the logger body exposed above the fitting. The compression fitting nut is tightened around the Levelogger. The 1/4" NPT connector on the bottom of the pressure chamber of the fitting threads into the hole in the sealed wellhead. The user can communicate with the logger simply by removing the logger cap and attaching the optical reader. Ensure that the logger and sealed wellhead are enclosed within an outer protective well cap or enclosure. This method should only be used in low pressure conditions (less than 30 psi or 66 ft (20 m) of water column).

When conducting artesian monitoring with Leveloggers a number of considerations must be kept in mind. First, ensure that the maximum hydraulic pressure the Levelogger will encounter within the well at its installation point will not exceed the hydraulic range of the logger. Second, artesian conditions do not preclude the necessity for barometric compensation of Levelogger data. Artesian conditions are caused by aquacludes forming confined aquifers. Confined aquifers, while not acted on by barometric pressure to the same extent as unconfined aquifers, are typically subject to barometric pressure at some barometric efficiency (See Section 10.1.3.1). Finally, bear in mind that the total pressure and subsequent water column equivalent depth measured by the Levelogger after barometric compensation may not represent the actual water level within the artesian well. Sealed intermittent artesian wells can be pressurized when artesian, but can also be de-pressurized when non artesian. The Levelogger's reading after barometric compensation represent the height of the piezometric surface.

10.1.2.2 Vacuum Monitoring

Vacuum monitoring is usually conducted by first installing pressure transducers such as the Levelogger in monitoring wells and then shutting-in or sealing those wells to the atmosphere with pressure sealed wellheads. Air is pumped out from an extraction well amongst the cluster or matrix of monitoring wells, theoretically dropping air pressure in the vicinity of the extraction well. For short-term tests in which data is not required during the extraction event, the Leveloggers can be programmed and simply suspended from hooks or eyelets on the underside of the sealed wellheads, the test run and the data collected at the end of the test by extraction and downloading of the loggers. However, if ongoing data from the Leveloggers is required during the extraction event, the loggers must be installed in a manner similar to the artesian monitoring scenarios described previously in this section. Leveloggers or Barologgers can be used to monitor the drop in pressure.

Figure 10-12 Levelogger and Barologger in Well

NOTE

The Barologger Edge should not be used to monitor water, as the internal mathematics for temperature compensation are based on air rather than water.

10.1.3 Barologger Installation

The Barologger is a Levelogger with a small range adequate to monitor the fluctuations that occur in barometric pressure. The Barologger's readings are used to barometrically compensate Levelogger readings. As a rule of thumb, a Barologger can be used to compensate all the Leveloggers in a 20 mile (30 km) radius and/or with every 1000 ft. (300 m) change in elevation.

To monitor barometric pressure correctly, the Barologger should never be submerged. In well installations, it is recommended that the Barologger be suspended in one of the monitored wells above the high water point (the well must be vented). For best reading accuracy, the Barologger should be installed in a similar thermal environment to that of the Levelogger. In groundwater wells, the Barologger should be suspended beyond the frost line and deep enough to avoid large temperature fluctuations. In surface water applications, the Barologger is best deployed in a dry well – a well embedded in the bottom of the water body, but sealed at the base from water entry and vented to the atmosphere. If a dry well cannot be installed, the Barologger can be installed on a float in the stilling well. Further information on the Barologger and barometric pressure can be found in Section 8.2.

10.1.3.1 Barometric Efficiency

The influence of barometric pressure on a groundwater surface can follow three scenarios. In confined aquifers with capillary or vadose head space, increased atmospheric pressure can tighten the pore spaces in the overlying soil and produce a capillary effect as the water level rises in response to having nowhere else to go but up. Second, some deeper aquifer systems can be quite barometrically isolated from the relatively small change in level that barometric influences can produce. The third scenario occurs in an unconfined aquifer, with high barometric efficiency, in which a barometric pressure change results in an equivalent or highly proportional drop or rise in groundwater pressure. In essence, depending on the aquifer type and depth, increased barometric pressure can result in either increased, static or decreased water levels. Barometric efficiency, the relationship of a barometric change on groundwater pressure, in confined aquifers generally ranges from 20 to 75%, whereas in unconfined aquifers the efficiency can range from 80 - 100%.

A second important element of Barometric efficiency is time lag – the time differential between a unit change in barometric at the surface to the time of transmission of that change to the aquifer. Calculating general barometric efficiency should not be done on a single barometric event, but rather on a statistically significant number of events. As a result, it may take a month or more of submerged Levelogger and Barologger data to determine barometric efficiency and time lag. As Barometric pressure fluctuates over time in excess of 60 cm water column equivalent pressure and as barometric efficiency can be such an important factor in accurately monitoring groundwater levels, it is vital that barometric compensation of the Levelogger data be performed.

The absolute pressure method used in the Levelogger and Barologger provide the user with the data necessary to determine barometric efficiency and time lag. If a barometric efficiency value has been determined from the Levelogger and Barologger data, that value can be applied to Barologger data in the Data Wizard.

Wells puncturing an aquifer have a negligible to non-existent effect on directly transmitting barometric changes to the larger aquifer. Barometric pressure is transmitted through overlying layers. To obtain the best and most accurate long term water level readings from Leveloggers, the user must first understand how the Levelogger calculates a depth of water above the transducer and second whether barometric efficiency should be considered in barometric compensation.

10.1.4 Rainlogger Installation

Solinst Rainloggers (Figure 10-13) are designed to log the tip times of an external tipping-bucket rain gauge, and output the amount of rainfall per tip.

The Rainlogger Edge housing is made of ABS, while the Rainlogger housing is made of stainless steel. Direct exposure to rainfall should be avoided, and Rainloggers should not be submerged. The Rainlogger Edge ABS housing provides extra electrostatic discharge (ESD) protection.

The rain gauge connected to the Rainlogger is supplied by the customer and is a reed-switch type gauge most commonly known as a tipping-bucket rain gauge. The Rainlogger rain gauge connector (Figure 10-14) connects to the 2 m (6.5 ft.) cable supplied with the Rainlogger. The Rainlogger Edge and Rainlogger are supplied with different connector cables, which can not be interchanged. The connector cables have two wires, which are connected to the tipping-bucket by splicing to the tipping-bucket cable. As the tipping-bucket is just an electrical switch, for most models, the wires can be connected to either cable wire. Refer to the manufacturer's operating instructions. Longer, exposed cables should be protected from rodents and vandalism by cable armoring or installation within electrical conduit.

Figure 10-13 Solinst Rainloggers

Figure 10-14
The Tipping-bucket Rain Gauge Connector of the Rainlogger Edge

NOTE

The Rainlogger Edge and Rainlogger are supplied with different connector cables, which can not be interchanged.

Figure 10-15 Rainlogger Connected to Tipping-bucket

10.1.5 Installation in Extreme Environments

10.1.5.1 Freezing or High Temperature Conditions

Levelogger installation at submerged depths that may be at risk of freezing during the monitoring session is not recommended without taking adequate precautions to avoid transducer damage. When water freezes it expands approximately 9% by volume. A 9% expansion can equate to extreme pressure as demonstrated in Example 10.1. Therefore, solid freezing has the potential to damage the pressure transducer, which is rated to withstand up to 200% (150% for the Levelogger Gold and Junior Models) of its depth fluctuation range. Pressures beyond this threshold may damage the transducer. As such, care should be taken when choosing the appropriate pressure transducer range for your application.

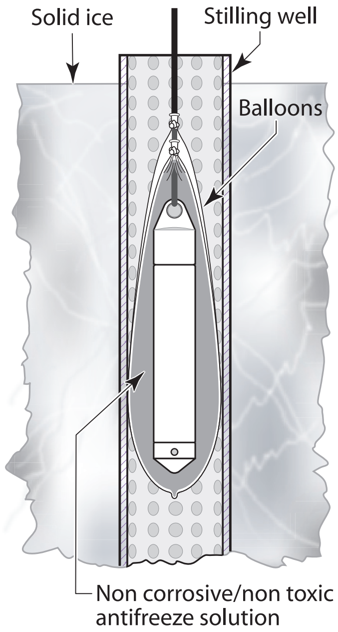


Figure 10-16
Installation in Freezing Liquid

Example 10.1 Solid Freezing Effects

The pressure exerted by the physical expansion or ice crystallization process on a retaining or enclosing contact surface is related to the temperature gradient over which the process occurs, i.e. the speed at which freezing occurs. For example, liquid freezing at -22°C, can create expansion pressures of 22 kg/cm^2 or 313 psi or the equivalent of 721 ft or 220 m water column depth.

NOTE

Although precautions can be taken, placing a Levelogger in a situation where the water may freeze solid can permanently damage the sensor.

With precautions, the Levelogger can be used in freezing liquid environments. If monitoring shallow water bodies or groundwater zones susceptible to freezing, the easiest way to avoid transducer damage is to lower the transducer to a point in the water column below the frost line or ice formation depth. In water bodies such as shallow streams, wetlands or ponds where freezing may penetrate to the bottom, install the Levelogger in a vented stilling well imbedded into the bottom of the water body beyond the frost line.

In cases where the above noted precautions cannot be taken and the Levelogger must be installed in the freezing zone, it is recommended that the logger be placed inside two elongated silicon, rubber or latex balloons, the balloons can be filled with a non-toxic, non-corrosive anti-freeze solution and sealed (Figure 10-16). Place the balloons in a section of perforated, 1.25" (30 mm) ID pipe and install the logger in the monitored water. The antifreeze solution will protect the Levelogger from ice expansion at the pressure transducer, yet transmit any pressure fluctuations that occur. However, it should be noted that even if these precautions are taken, there is still the risk that placing a Levelogger in a situation where the water may freeze solid can permanently damage the sensor (see Example 10.1).

Please note that a similar installation protection can be used when the Levelogger is monitoring liquids which are incompatible with its wetted materials.

The operating temperature range for Leveloggers is -20° to 80°C (-4° to 180°F). At the opposite end of the thermal scale, exposing the Levelogger to temperatures beyond 80°C may damage the thermistor and otherwise affect the Levelogger.

10.1.5.2 Marine or Brackish Installations

When installing the Levelogger in salt or brackish water or in a liquid having a specific gravity (density) different than fresh water, the density difference is compensated for by inputting the density of the monitored fluid in the Datalogger Settings window for the LTC Levelogger Junior and the Levelogger Gold Series (see Section 5.1). Also, see Section 8 for details in compensating the Levelogger Edge and Levelogger Junior Edge for fluid density differences.

The Levelogger Edge can be used for monitoring in salt or brackish water. However, long term use of the stainless steel body Levelogger Junior Edge, LTC Levelogger Junior, Levelogger Junior and first generation LTC and LT Leveloggers in salt or brackish water is not recommended, as the salt or other pollutants may cause pitting which can lead to perforation of the Levelogger's casing. To minimize this effect, regularly lift the Levelogger from the liquid; within seconds a thin protective layer will be formed by oxidation. Again, this precaution applies to the Levelogger Junior Edge, LTC Levelogger Junior, Levelogger Junior, and first generation LTC and LT Leveloggers.

If using these dataloggers in a continuous salt/brackish monitoring scenario, the stainless steel body of the datalogger can be protected in a manner similar to the freezing protection method described in Section 10.1.5.1. The Levelogger can be placed in balloons and the balloons filled with non-corrosive/ non-toxic fluid. As pressure changes, the fluid encasing the loggers will transmit the pressure differential to the datalogger's pressure transducer. Care must be taken in the selection of the balloon material or filling fluid such that the balloon material prevents diffusion of salts across the concentration gradient or that the filling fluid is comprised of polymeric molecules too large to diffuse out of the balloon material.

10.1.5.3 Biofouling Conditions

Biofouling is the unwanted buildup of microorganisms, plants, algae, or organisms such as barnacles and muscles on a wetted surface. When a Levelogger is deployed for an extended period of time, especially in a saltwater environment, there is the risk of biofouling. Biofouling on the pressure sensor and conductivity cell can compromise the accuracy of the measurements.

A Solinst Biofoul Screen can be used to protect the Levelogger from biofouling. The copper-coiled Delrin screen naturally reduces biofouling, and lengthens the time a Levelogger can be deployed before maintenance is required. The Biofoul Screen simply slips onto the sensor end of the Levelogger where it is held in place with its compression fitting. It adds about 3/4" (19 mm) to the length of the Levelogger. It allows water to freely enter the conductivity cell, as well as the pressure transducer inlets. It is replaced as required.

Figure 10-17 Biofoul Screen Dimensions

Figure 10-18 Solinst Biofoul Screen for the Levelogger

NOTE

It is important to ensure the installation cap or a Direct Read Cable is attached to the Levelogger during storage to prevent unnecessary battery drain and to protect the optical eyes.

10.2 Levelogger Maintenance

Levelogger maintenance consists of cleaning the outside casing, the circulation holes and the optical infrared eyes. The required frequency of cleaning is dependent on several aspects of the monitored water quality. In freshwater with good to excellent water quality, the Levelogger cleaning requirements will be very minimal; amounting to a seasonal or even annual maintenance inspection. In most cases cleaning can be accomplished by rinsing the Levelogger and using mild, non-residual, non-abrasive household cleaners using a very soft-plastic, bristled, pipe-cleaner type brush. Do not insert any object through the circulation holes at the sensor end of the Levelogger. In some cases simple cleaners are insufficient to properly clean the Levelogger. Several commonly occurring water conditions require specific maintenance methods, these include hard water, high suspended solids loading, biological or chemical fouling and salt or brackish water conditions.

Hard water monitoring can result in the precipitation of calcium and magnesium deposits on the pressure transducer as well as other components of the Levelogger. These deposits can be safely dissolved using a diluted solution (typically ≤ 10% strength) of acetic or phosphoric acid. Commercially available products for dissolving hard water scaling are also available and can be used if designed for household use. Some industrial strength hard water scaling removers are much higher strength and are not recommended for cleaning the Levelogger.

High suspended solids load may block the circulation ports or clog the internal pressure cell of the Levelogger. The potential clogging effect of solids deposition can be minimized by placing the Levelogger in zones of flow. To remove solids build up, rinse the Levelogger under a low flow of tap water until particles have been washed away.

Bacteriological or chemical fouling can be an important consideration in many ground and surface water monitoring projects. Sessile bacteria will often utilize installed instrumentation as an attachment substrate. Chemical deposit can be the result of electrical charge differential between the instrumentation of the monitored liquid or the result of biological or algal activity. Both forms of fouling can result in difficult to remove deposits on the Levelogger transducer, the conductivity wires and the Levelogger casing. To remove fouling use a diluted (≤ 10%) solution of sulfuric acid. Persistent material may require soaking for several hours.

Cleaning LTC Levelogger Junior sensor pins is recommended before calibrating the unit prior to starting a project. The pins of the LTC Levelogger Junior sensor are platinum-coated, therefore they should not be roughly cleaned or touched with any metal. They can be cleaned with a soft bristle brush, Q-tip, or cloth. Almost any acid solution can be selected to clean the sensor, provided it is highly diluted (generally less than 10% acid). The "soaking" time should be monitored and kept to a minimum.

11 Diagnostics Utility

The Levelogger Diagnostics Utility can be used for troubleshooting Leveloggers and obtaining information about that Levelogger that can assist the Solinst Technical Support representative to identify and fix any problems you may encounter with your Levelogger. The Diagnostics Utility can be launched from the Utilities menu at the top of the software. The utility can be used to run a self-test, do a Memory Dump and create and email reports.

11.1 Run Diagnostics

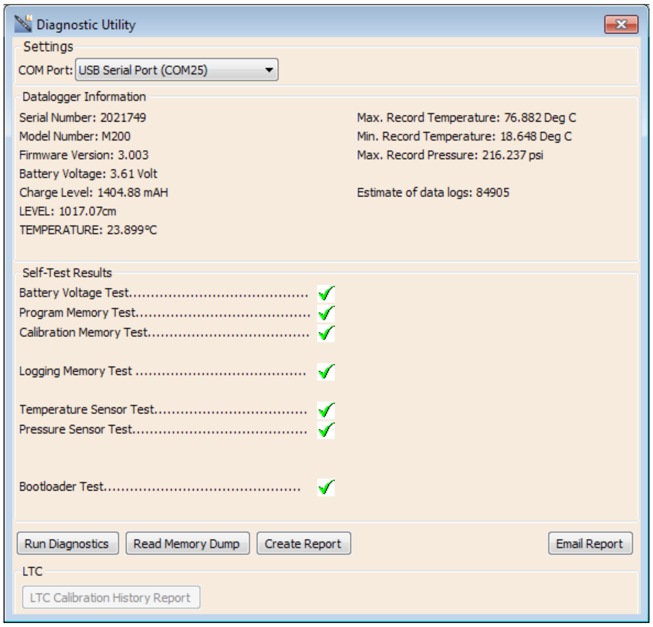
The Run Diagnostics function reads the following information from the Levelogger:

1) Serial Number
2) Model Number
3) Firmware Version
4) Battery Voltage
5) Charge Level
6) Current Level Reading
7) Current Temperature Reading
8) Max/Min Pressure Reading
9) Max/Min Temperature Reading
10) Max/Min Conductivity Reading
11) Total Number of Logs

This information can be used to identify firmware, battery and/or temperature/pressure/conductivity sensor problems. This function also performs a series of self-tests on the Levelogger to check for problems with the battery, memory, pressure/temperature/conductivity sensors. If an LTC Levelogger Junior fails the Conductivity Sensor Test, this could mean that you have not calibrated your LTC in a while (~1 year). It is recommended that you perform a conductivity calibration, then ‘Run Diagnostics’ again. If any of these tests fail then a report should be created and emailed to Solinst Technical Support. To execute this function simply click the ‘Run Diagnostics’ button.

NOTE

If an LTC Levelogger Junior fails the Conductivity Sensor Test, this could mean that you have not calibrated your LTC in a while (~1 year). It is recommended that you perform a conductivity calibration, then ‘Run Diagnostics’ again.



COM Port: USB Serial Port (COM25)

Serial Number: 2021749
Model Number: M200
Firmware Version: 3.003
Battery Voltage: 3.61 Volt
Charge Level: 1404.88 mAH
LEVEL: 1017.07cm
TEMPERATURE: 23.899°C

Max. Record Temperature: 76.882 Deg C
Min. Record Temperature: 18.648 Deg C
Max. Record Pressure: 216.237 psi

Estimate of data logs: 84905

Battery Voltage Test.. ✓
Program Memory Test.. ✓
Calibration Memory Test.................................... ✓
Logging Memory Test .... ✓
Temperature Sensor Test.................................. ✓
Pressure Sensor Test.. ✓
Bootloader Test... ✓

Figure 11-1 Run Diagnostics

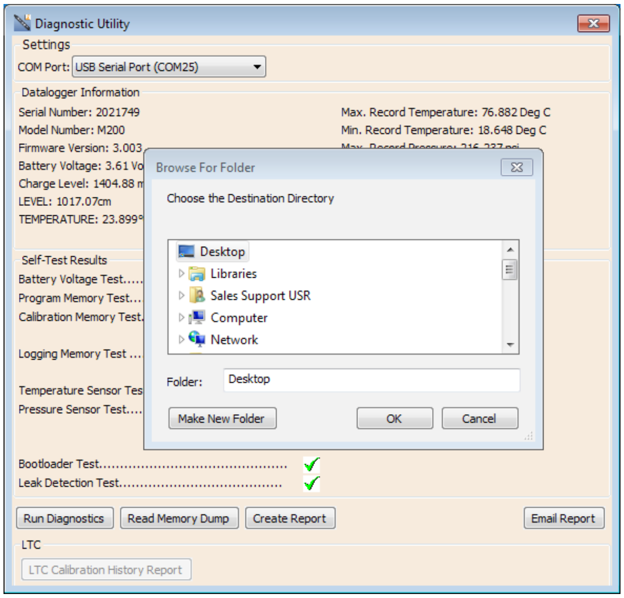
11.2 Read Memory Dump

This function creates a complete dump of the Levelogger's memory, which can then be sent to Solinst Technical Support for analyzing.

To execute this function simply click the Read Memory Dump button. Performing a memory dump will create a *.xle file of the data to save.

NOTE

It is recommended that, before attempting to use this function, you use the 'Create Report' function to send a report to the Solinst Technical Support.


Diagnostic Utility

Settings

COM Port: USB Serial Port (COM25)

Datalogger Information

Serial Number: 2021749

Model Number: M200

Firmware Version: 3.003

Battery Voltage: 3.61 Vo

Charge Level: 1404.88 m

LEVEL: 1017.07cm

TEMPERATURE: 23.899°

Max. Record Temperature: 76.882 Deg C

Min. Record Temperature: 18.648 Deg C

Browse For Folder

Choose the Destination Directory

Folder: Desktop

Self-Test Results

Battery Voltage Test.....

Program Memory Test...

Calibration Memory Test.

Logging Memory Test ...

Temperature Sensor Tes

Pressure Sensor Test....

Bootloader Test... ✓

Leak Detection Test...................................... ✓

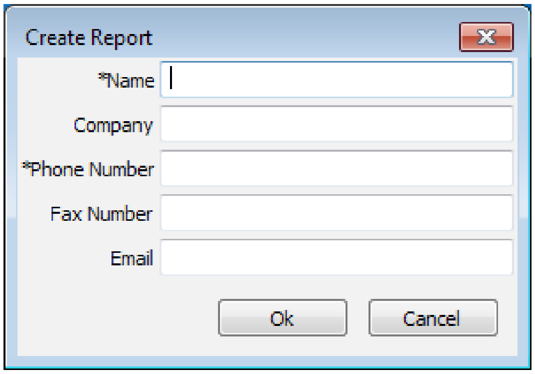
Figure 11-2 Read Memory Dump

11.3 Create Report

This function simply creates a text file containing the information obtained from the Run Diagnostics function. When you click the Create Report button, a window will pop up asking you to fill out your company information. Simply fill this out and the resulting report can be saved or sent to Solinst Technical Support for troubleshooting. If creating a report for an LTC Levelogger Junior, the LTC Calibration History Report will be included.

NOTE

The 'Email Report' option automatically creates a report and attaches it to an email to send to Solinst - all in one step.


Create Report

*Name

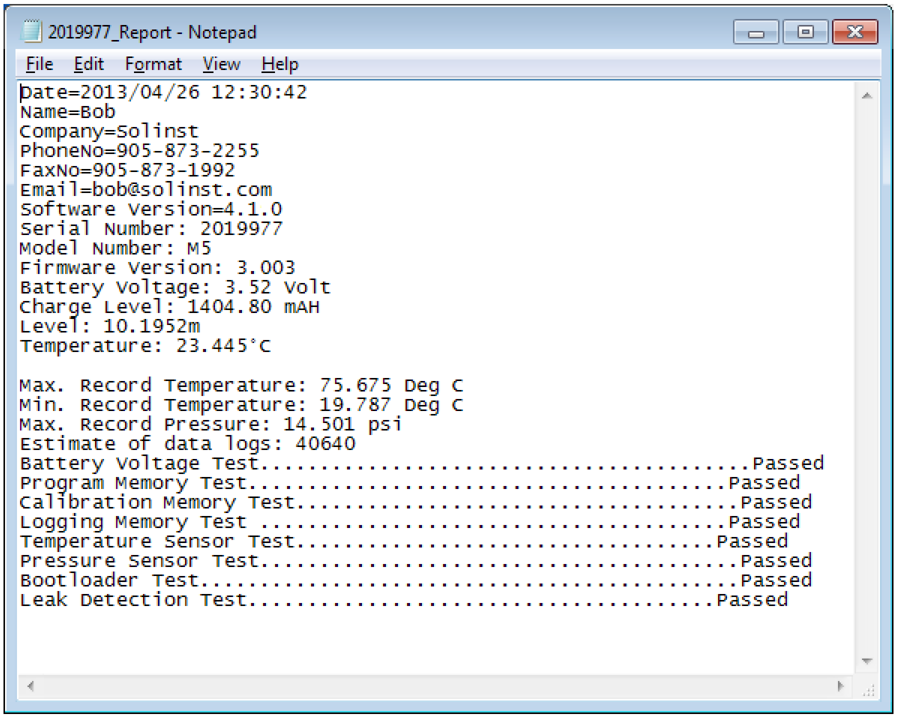
Company

*Phone Number

Fax Number

Email

Figure 11-3 Customer Info Input Window



```
Date=2013/04/26 12:30:42
Name=Bob
Company=Solinst
PhoneNo=905-873-2255
FaxNo=905-873-1992
Email=bob@solinst.com
Software Version=4.1.0
Serial Number: 2019977
Model Number: M5
Firmware Version: 3.003
Battery Voltage: 3.52 Volt
Charge Level: 1404.80 mAH
Level: 10.1952m
Temperature: 23.445°C

Max. Record Temperature: 75.675 Deg C
Min. Record Temperature: 19.787 Deg C
Max. Record Pressure: 14.501 psi
Estimate of data logs: 40640
Battery Voltage Test........................................Passed
Program Memory Test........................................Passed
Calibration Memory Test....................................Passed
Logging Memory Test .......................................Passed
Temperature Sensor Test...................................Passed
Pressure Sensor Test.......................................Passed
Bootloader Test............................................Passed
Leak Detection Test.......................................Passed
```

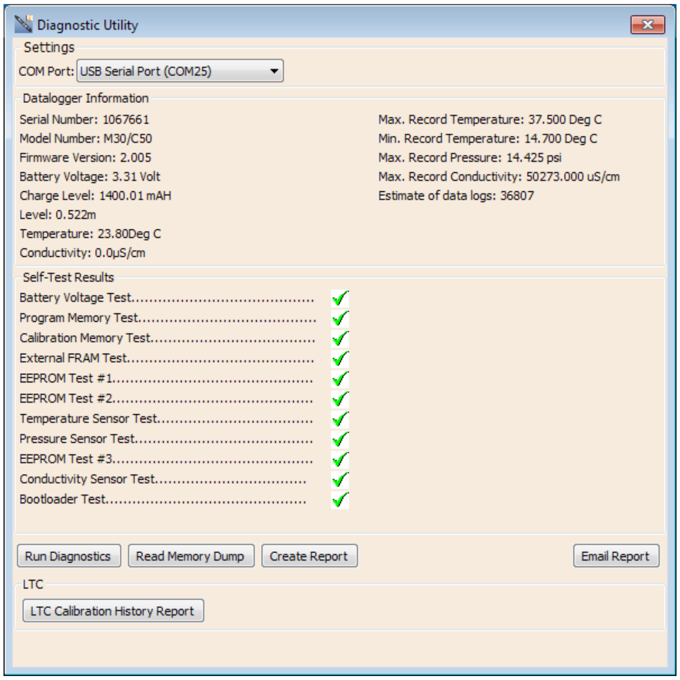
Figure 11-4 Report Example

11.4 Email Report

Clicking Email Report will guide you through the process of creating a Diagnostics Report, and it will automatically attach the report to an email to send to Solinst Technical Staff for troubleshooting. If you are emailing a report for an LTC Levelogger Junior, the LTC Calibration History Report will be included.

11.5 LTC Calibration History Report

This function creates a report of all previous user calibrations performed on the LTC Levelogger Junior. Use it to send a history report to Solinst for analysis if the LTC Levelogger Junior readings are irregular and/or the unit does not maintain its calibration. To execute this function simply click the LTC Calibration History Report button. This creates a text file that can be sent to Solinst Technical Support.



COM Port: USB Serial Port (COM25)

Serial Number: 1067661
Model Number: M30/C50
Firmware Version: 2.005
Battery Voltage: 3.31 Volt
Charge Level: 1400.01 mAH
Level: 0.522m
Temperature: 23.80Deg C
Conductivity: 0.0µS/cm

Max. Record Temperature: 37.500 Deg C
Min. Record Temperature: 14.700 Deg C
Max. Record Pressure: 14.425 psi
Max. Record Conductivity: 50273.000 uS/cm
Estimate of data logs: 36807

Battery Voltage Test.. ✓
Program Memory Test.. ✓
Calibration Memory Test.................................... ✓
External FRAM Test.. ✓
EEPROM Test #1... ✓
EEPROM Test #2... ✓
Temperature Sensor Test................................... ✓
Pressure Sensor Test.. ✓
EEPROM Test #3... ✓
Conductivity Sensor Test.................................. ✓
Bootloader Test... ✓

Figure 11-5 LTC Calibration History Report

11.6 Software/Firmware Updates

Each time the Diagnostic Utility is opened, it automatically checks for software updates. If there is an update, "Software Update Available" will appear in the top right of the window. When you click the message, a web page will open, allowing you to download the software update.

The Utility also checks for firmware updates. "Firmware Update Available" will appear in the top right of the window. Clicking the message will open a web page where you can download the firmware update. See Section 12 for firmware update instructions.

! NOTE

Your Computer must have an Internet connection to check for software and firmware updates.

You can also check for updates using the Help menu.

! NOTE

To check for firmware updates using Levelogger Software, retrieve settings from the connected datalogger (see Section 5). "Firmware Update Available" will appear in the top right menu bar if there is an update available. Clicking the message will open a web page where you can download the firmware update. You can also use the Software's Help menu.

! NOTE

It is important that the communication between the PC and the Levelogger is not interrupted during a firmware/calibration upload so please make sure to close any other running programs, including screen savers, and do not disconnect the Levelogger before the upload is finished.

12 Firmware Upgrade Utility

The Firmware Upgrade Utility is used to upload new firmware files to a Levelogger. The zipped firmware file can be obtained from:
http://www.solinst.com/Downloads/

Make sure to unzip the firmware file after you have downloaded it, so you can access the *.ssf file.

To upload new firmware to a Levelogger, follow these steps:

1) Open the Solinst Firmware Upgrade Utility from the Utilities menu in the main Levelogger Software. Pick the Com Port to which the Levelogger is connected and make sure the Baud Rate is set to 9600.

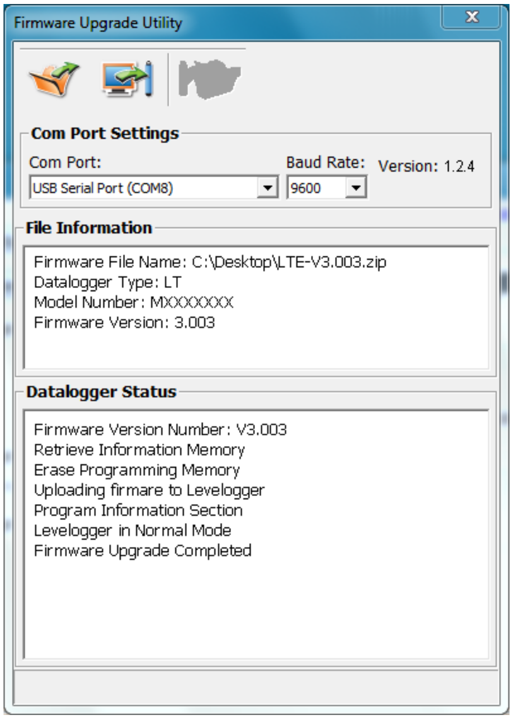
2) Click the 'Open' button , which should open a file dialog asking for the firmware file (*.ssf) to upload. Navigate to the directory where the firmware file was saved on your PC, then click on the file and click 'Open'.

3) Check the 'Firmware File Information' box to make sure that the opened file is the right one.

4) Click the 'Upload Firmware' button , to start the firmware upload process.

5) If a communication error occurs and is indicated in the Levelogger Information Window (Figure 12-1) either before the 'Verified Program Checksum' message or after the 'Program Information Section', then restart the upgrade process.

6) If, however, a communication error occurs between the 'Verified Program Checksum' and the 'Program Information Section' messages, then please contact Solinst. You will need to give the Levelogger Serial Number and explain the exact positioning of the error message.



Com Port: USB Serial Port (COM8)
Baud Rate: 9600
Version: 1.2.4

Firmware File Name: C:\Desktop\LTE-V3.003.zip
Datalogger Type: LT
Model Number: MXXXXXXX
Firmware Version: 3.003

Firmware Version Number: V3.003
Retrieve Information Memory
Erase Programming Memory
Uploading firmare to Levelogger
Program Information Section
Levelogger in Normal Mode
Firmware Upgrade Completed

Figure 12-1
Firmware Upgrade Utility Window

13 Trouble Shooting

13.1 Problems During Installation of Levelogger Software

'Class not Registered' or 'DLL not found' or 'Access violation'

1) You may not have Administrator Rights to install the software in the Windows XP/Windows 7 environment.
   - Ask your System Administrator for assistance.
2) Some files got corrupted during installation of the Levelogger software. Use 'Add/Remove Programs' to uninstall then re-install Levelogger software.

13.2 Error During Software Uninstall Process

The 'Add/Remove Program' cannot locate the Levelogger <setup.exe> file of the software or the link between the software and the 'Add/Remove Program' is damaged.

The record in the Registry Table must be removed:

1) Ask your System Administrator to remove this.
2) Refer to the following link from Microsoft Website for instructions: http://support.microsoft.com/default.aspx?scid=kb;en-us;247501

NOTE

Solinst recommends Keyspan or IO Gear. For problems with converters from other manufacturers, please contact the manufacturer.

13.3 Problems During Installation of RS-232 to USB Converter

Unable to install the RS-232/USB converter from Keyspan or IO Gear

1) After plugging in the RS-232/USB Converter, a Hardware Installation Wizard will open. Follow the instruction from the Wizard and make sure to select the RS-232/USB Converter Driver from the Keyspan or IO Gear Installation CD.
2) If the Hardware Installation Wizard does not open after plugging in the RS-232/USB Converter, follow the steps below to open the Hardware Installation Wizard:
   a. Select Control Panels
   b. Double click on System
   c. Select the Device Manager Tab
   d. Double click on Other devices
   e. Right click on USB Serial Converter
   f. Select Update Driver...

13.4 Data Has Been Erased Accidentally

If Levelogger has been restarted and old data has not been saved, go to Download Options and choose Data Recovery. It downloads the immediately previous log.

13.5 Error Messages During Use of Software

'Communication Time Out' or 'Communication Error' or 'The Command that is sent to the Levelogger Edge is not defined'

1) Try communicating with another Levelogger, Optical Reader or Direct Read Cable. The communication cable, Optical Reader or Levelogger may be damaged.
2) Clean the optical 'eyes' on the Levelogger and the cable, with a soft cloth.
3) Check that the communication cable is connected to the same Com Port that is chosen in the upper middle of the Main Window of the Levelogger software.
4) Check the Com port settings. They should be as follows:
    - Bits per second: 9600
    - Data bits: 8
    - Parity: None
    - Stop bits: 1
    - Flow control: None
      (This may have been set to Xon/Xoff – change it to None, Select [OK] and back out of this pathway.)

The route to view your Com port settings is as follows:

   a. Select Control Panels
   b. Double click on System
   c. Select the Device Manager Tab
   d. Double click on Ports
   e. Double click on Communications Port(s)
   f. Choose the Port Settings Tab

5) Try using a different computer, to see if this is the cause of the problem.
6) If using a laptop (especially in conjunction with a Direct Read Cable) your Com Port may not be powered adequately to receive/transmit data. Try using a desktop computer to test this, or contact Solinst to obtain a PC Interface Booster Cable.
7) If problem persists, contact Solinst.

'Port Cannot Open'

1) If using a USB device, ensure you plugged it in before starting the Levelogger Software.
2) Ensure the correct Com Port is selected in the upper middle of the Main Window of the Levelogger software.
3) If the correct Com Port is not available, a USB Driver installation or update may be required.
4) Check if some other software is using the same Com Port in the background. Shut that software down or choose another Com Port if available. Such background software may be anti-virus software or PDA software.

5) Make sure your Com Port has been enabled:
    a. Select Control Panel
    b. Double click on System
    c. Select the Device Manager Tab
    d. Double click on Ports
    e. Double click on Communications Port(s)
    f. Choose General
    g. Uncheck 'Disable in this hardware profile box'
6) If you are using a virtual Com Port, like a USB optical reader or USB/RS-232 converter, refer to the 'Problems During Installation of RS-232 to USB Converter' section to make sure they are installed properly.

'File Create Error' and 'File Write Error'

1) If you do not have file-writing privileges to the Levelogger default data folder, change the folder as follows: in the Levelogger software, click 'Configuration' then 'Application Settings'. Under 'Default Directory', enter a new destination folder, to which you have file writing privileges, e.g. 'My Documents'. Follow the same procedure if you have the same problem when you export the data file in csv format.
2) Ask your System Administrator for assistance.

'File Open Error' and 'File Read Error'

1) Shut down or disable any other software that is active and using the same file.
2) In Notepad or Wordpad, open the <*.xle> or <*.lls> file to check for corruptions in the file. How are the Levelogger files ended?
3) If problems persist contact Solinst for assistance.

'Time Span Error, some data cannot be compensated'

1) Find another barometric data file that has the same time stamp as the Levelogger.
2) Perform the compensation (a simple subtraction) in a spreadsheet program for any missing time stamps.

'A different type of Levelogger is detected'

Try clicking the Retrieve Settings icon again, or replace the Levelogger currently in the Optical Reader with the one that was previously being worked on, and complete the operation.

'The selected file is not a barometer'

Select a Barologger for the compensation process.

'Data Corrupted'

Contact Solinst for assistance. Use Levelogger Diagnostic Utility to do a memory dump and sent the dump file to Solinst for further analysis.

'Internal Error'

Contact Solinst for assistance.

‘Fail to append data - A different Levelogger has been detected!’ or ‘Fail to append data - A different start time has been detected!’ or ‘Fail to append data - New data is not available in the Levelogger!’

The Levelogger software can only append data to a file that has the same serial number and start time as the connected Levelogger. Find the correct file, or use ‘All Data’ to download the complete file.

‘Only Levelogger Gold/Edge supports this function’

The ‘Append Data’, ‘Partial Download’ and ‘Data Recovery’ functions are only supported by the Levelogger Gold/Edge loggers, not previous version Leveloggers.

‘Schedule cannot be empty’

When using the ‘Schedule’ sampling option in a Levelogger Gold/Edge, the schedule must contain at least one item.

‘Readings in schedule exceed the maximum’

The number of readings in a schedule should not result in more than 40,000 (or up to 120,000) individual readings.

www.solinst.com

High Quality Groundwater and Surface Water Monitoring Instrumentation

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Solinst®

APPENDIX D
HOBO LOGGER MANUAL

HOBOware® User's Guide

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Pocasset, MA 02559-3450

Phone: 1-800-LOGGERS (1-800-564-4377) or 508-759-9500
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Technical Support Hours: 8AM to 8PM ET, Monday through Friday
Customer Service Hours: 8AM to 5PM ET, Monday through Friday

12730-O

Chapter 1:
An Overview of HOBOware

HOBOware software is used for launching, reading out, and plotting data from HOBO® data loggers and wireless HOBO data nodes. There are two versions of HOBOware: HOBOware Pro and HOBOware Lite. To upgrade from HOBOware Lite to HOBOware Pro, call 1-800-564-4377 and ask for Onset Customer Service.

HOBOware Pro

With HOBOware Pro, you can quickly launch, read out, and plot data recorded by HOBO data loggers. You can also:

- Filter data to extract key series information such as minimum, maximum, or average values
- Scale data to sensor units
- Save graphs as project files
- Export data to Microsoft® Excel® or other ASCII-compatible programs
- Export multiple files with the Bulk Export Tool
- View a subset of data with the Subset Statistics Tool
- Use Data Assistants to create new data series by combining data recorded by the logger with additional data that you enter before you display the plot. For example, the kWh Assistant converts logged pulse data from an energy transducer to kWh, average kW, and energy cost
- Set Launch and Readout Time-Saving Options to help you work efficiently with multiple loggers
- Work in Secure mode for 21 CFR Part 11 compliance
- Run HOBOnode Manager for configuring and maintaining a wireless HOBO data node network

HOBOware Pro is compatible with the following devices:

- HOBO U-Series loggers
- HOBO Weather Stations, including HOBO U30 Station
- HOBO Micro Stations
- HOBO Energy Logger Systems
- HOBO U-Shuttle and Waterproof Shuttle
- HOBO FlexSmart Modules
- HOBO Data Nodes (Wireless Sensors)
- HOBO 4-Channel Pulse Input (UX120-017)
- Energy and Power Meter (T-VER-E50B2)

HOBOware Lite

HOBOware Lite is entry-level software for HOBO U-Series loggers. With HOBOware Lite, you can:

- Launch and read out U-Series loggers

- Check the logger status and current readings
- Plot, filter, and export data
- Save changes to graphs in a project file

For a comparison between HOBOware Pro and HOBOware Lite, see http://www.onsetcomp.com/sites/all/themes/foliage/hoboware_comparison.html.

Getting Started

If you are using HOBO data loggers, follow the instructions in the Getting Started Guide to install the software, connect your logger, launch, and readout data. You can expect to be comfortable with HOBOware fundamentals within a few minutes.

If you are using HOBO wireless data nodes, refer to HOBOnode Manager.

For an introduction to the HOBOware interface, see A Tour of the HOBOware Interface.

Installing HOBOware

You can install HOBOware by from the Onset website or software CD. **Note:** You must be an administrator to install HOBOware.

Before you begin the installation:

- Check the README file at http://www.onsetcomp.com/hoboware or on the installation CD for detailed information about the hardware and software needed to run HOBOware. If you have additional questions, please contact Onset Technical Support.
- Make sure you have the license key, which is located in the email confirmation or online receipt you received when purchasing the software. If you have a HOBOware CD, the license key is printed on the back of the CD case. If you don't have a license key, you can run HOBOware in Trial Mode for 30 days.

Installing HOBOware from the Onset Website

To download HOBOware from the Onset website, go to the following URL and follow the instructions for downloading and installing HOBOware:

http://www.onsetcomp.com/products/software

Installing HOBOware from the Installation CD

Windows

1. Insert the CD in your computer's CD-ROM drive. The installation program should start automatically. If it does not, navigate to the CD drive in My Computer or Windows Explorer and double-click HOBOware_Setup.exe to launch the HOBOware installer.

   Note: HOBOware for Windows requires the Java Runtime Environment. If the correct Java Runtime Environment version is not already installed on your computer, the HOBOware Setup program will ask if you want to install it now. (You must be logged in as an administrator on your computer to install the Java Runtime Environment.) Click Yes and follow the prompts. After the Java Runtime Environment is installed, the HOBOware installation will continue.

2. Follow the prompts to install HOBOware.
3. To start HOBOware, double-click the HOBOware icon on your desktop or select Programs> Onset Applications > HOBOware from the Start menu.

Mac

1. Insert the CD in your computer's CD-ROM drive.
2. Double-click the CD icon in the Finder and double-click the HOBOware.pkg to launch the HOBOware installer.
3. When you reach the final screen of the installation program, click Restart.
4. After restarting, open HOBOware by double-clicking the HOBOware icon in your computer's Applications folder.

Activating HOBOware

The first time you open HOBOware, you will be prompted to enter your license key from the email confirmation, online receipt, or the CD case. Type the license key in the License Key Manager and click OK. You will need to reopen HOBOware after entering the license key. Note that you will not be required to enter the license key when upgrading to subsequent versions of HOBOware.

License Key Manager

Thank you for installing HOBOware.

● I have a HOBOware license key.

ENTER LICENSE KEY

Your license key (####-####-####-####) is located:

- On the front of the CD case, or
- On your order confirmation email

NOTE: You will need to restart HOBOware after you update the license key.

○ I want to use HOBOware Pro Trial.

(Available for 30 days from installation)

You will be able to enter a license key at any point after installation.

Please visit www.onsetcomp.com/hoboware for more information on HOBOware licensing or call 1-800-LOGGERS for assistance.

If you don't have a license key, select "I want to use HOBOware Pro Trial" and click OK. Your trial period of HOBOware will last for 30 days. The date the trial will expire appears at the top of the HOBOware window. The License Key Manager will continue to appear each time you open HOBOware during the 30 days. Select "I want to use HOBOware Pro Trial" and click OK each time you open HOBOware until the trial is over. When the trial expires, you will be prompted to enter a license key to continue to use HOBOware. Contact Onset Computer if you'd like to purchase the software.

Running the Setup Assistant (HOBOware Pro)

The HOBOware Setup Assistant appears the first time you open HOBOware Pro to help you quickly select key settings for device types and serial ports, units of measurement, and data assistants. To run the Setup Assistant, click Start and follow the prompts to change some key preferences. Click Cancel to use HOBOware Pro with its default settings. With the Setup Assistant, you can select:

- **Device Types.** Select USB, USB and serial devices, or serial devices only. If you select serial devices, you can choose the serial port.
- **Unit System.** Select either US or SI units.
- **Data Assistants.** Select the installed Data Assistants you want to show when relevant data is present. All loaded Data Assistants are checked by default. You can also load a new Data Assistant if one is available.

You can also run the setup assistant at a later time. From the File menu in Windows or the HOBOware menu in Macintosh, select Preferences. Click the Setup Assistant button at the bottom of the Preferences window.

Checking for Software Updates

If you have an Internet connection, HOBOware will periodically ask if you would like it to check the Onset website for software updates. The default is to check once per week. To change the frequency:

1. From the File menu in Windows or the HOBOware menu on Macintosh, select Preferences
2. Select the General category on the left and then click Startup on the right.
3. Choose the frequency and the type of updates you want to check for and click OK.

You can also check for updates manually at any time by selecting Check for Software Updates from the Help menu.

Note: If you are using HOBOnode Manager with a HOBO ZW wireless network, you must stop device communication before you can upgrade HOBOware.

Upgrading HOBOware Lite

To upgrade from HOBOware Lite to HOBOware Pro, call 1-800-564-4377 and ask for Onset Customer Service.

New HOBOware Features

The following new features are available in HOBOware 3.6:

- Support for the new HOBO 4-Channel Analog logger (UX120-006M), including launch capability, pre-launch filters, alarms, burst logging, statistics logging (maximum, minimum, average, and standard deviation), and the ability to stop and restart logging during a single deployment.
- A new preference for exporting the information in the Details Pane and series data from the Points Table in the same file.

New Features in Previous Releases

HOBOware 3.5:

- Support for the new HOBO 4-Channel Thermocouple logger (UX120-014M), including launch capability, pre-launch filters, alarms, burst logging, statistics logging (maximum, minimum, average, and standard deviation), and the ability to stop and restart logging during a single deployment.
- The ability to assign labels to sensors for all logger models in the Launch Logger window, a feature previously only available for station loggers, such as the HOBO U30 and Micro Station.
- Enhancements to the export table data feature, including the ability to set the default order of measurement types in the Export Settings preferences and to quickly reorder series in the Export window by dragging them.

HOBOware 3.4.1:

- Device menu options specific to HOBO U30 Stations are now available through a new "Manage U30" menu choice.

HOBOware 3.4:

- Support for the new HOBO UX100 series data loggers, including launch capability, pre-launch filters, alarms, burst logging, statistics logging (maximum, minimum, average, and standard deviation), and the ability to stop and restart logging during a single deployment.
- Pie charts for loggers with state series that you can view, print, and save as .png files for additional analysis beyond line graphs. This is especially helpful for light and occupancy data from UX90-005x and -006x loggers.

- A firmware upgrade tool that automatically detects when a new firmware file is available for UX90 and UX100 series data loggers and walks you through the update process.
- Improvements to the process of exporting data points, including the ability to select individual series or event types and to sort columns.
- A new preference for setting the logger launch description as the serial number so that you can easily differentiate files when launching and reading out several loggers of the same type.
- The ability to shows gaps in series when merging datafiles or when plotting a UX100 logger that had stopped and resumed logging.
- Improved the Network Map feature in HOBOnode Manager. (This requires a ZW Receiver firmware upgrade.)
- Support for the new Windows 8 operating system. The current list of supported operating systems is Windows 8, Windows 7 (Pro, Ultimate, and Home Premium), and Windows XP (Pro and Home) on the PC and OS X Versions 10.6.x, 10.7.x, and 10.8.x on Mac.

Note: The Alarm & Readout Tool is no longer installed with HOBOware as of version 3.4. However, you will still have access to the software if it was installed with an older version of HOBOware.

HOBOware 3.3.2:

- Support for the following languages and their associated formats in the software user interface: Spanish (Spain), Portuguese (Portugal), and German (Germany); Help and user guides are available in English only.
- Improved field calibration accuracy in the Conductivity Assistant.

HOBOware 3.3.1:

- Support for the new HOBO U26 Dissolved Oxygen logger, including launch and readout capability, a Lab Calibration tool to calibrate the logger to 100% and/or 0% saturation, and a Dissolved Oxygen Data Assistant that corrects for measurement drift from fouling and generates salinity-adjusted DO concentration as well as percent saturation data.
- The ability to update firmware for receivers and data nodes in the HOBO ZW Wireless System, with the option to update a single device at a time or multiple data nodes in a group.
- A data encoding preference added to the General preferences that controls whether data in HOBOware is imported and exported based on UTF-8 or operating system standards.
- French language support for the software user interface (Help and user guides are available in English only).

HOBOware 3.3:

- Support for the new HOBO UX90 series data loggers, including launch capability, advanced sensor configuration, and pre-launch filters. The models supported with this release are the State/Pulse/Event/Runtime logger (UX90-001x), Light On/Off logger (UX90-002x), Motor On/Off logger (UX90-004x), and Occupancy/Light logger (UX90-005x/-006x).

HOBOware 3.2.2:

- Enhanced display preferences for sorting data series in the Status and Plot Setup windows.
- A utility for upgrading the HOBOnode Manager database to improve performance.
- Performance improvements for the HOBO data nodes data delivery feature.
- A change to the FTP option for the HOBO data nodes data delivery feature so that it uses passive mode, which allows for better connections through firewalls.

- An update to the Conductivity Assistant, which includes refinements in the calculation of temperature compensation and a new option for non-linear, sea water compensation based on PSS-78.
- A revision to the calculation for T-CDI-5200-10S and T-CDI-5400-20S sensors when used with U-Series loggers ensuring data is displaying properly.
- Support for Java 7®.

HOBOware 3.2.1:

- The integration of the Alarm & Readout Tool, which is now automatically installed and available for use from the Tools menu.
- The ability for all non-administrator users to run HOBOware on Windows (administrator privileges are required to install HOBOware, map and unmap file assocations, and load new Data Assistants).
- Compatibility with iMac® and MacBook® Pro and Intel® Core™ i5 and i7 processors.
- A revision to the calculation for the S-SMD Soil Moisture Sensor ensuring data is displaying accurately.
- The option to create new files or overwrite existing ones via FTP when using the data delivery feature for HOBO Data Nodes. This allows you to automatically import wireless node CSV data into other applications, such as Microsoft® Excel®.

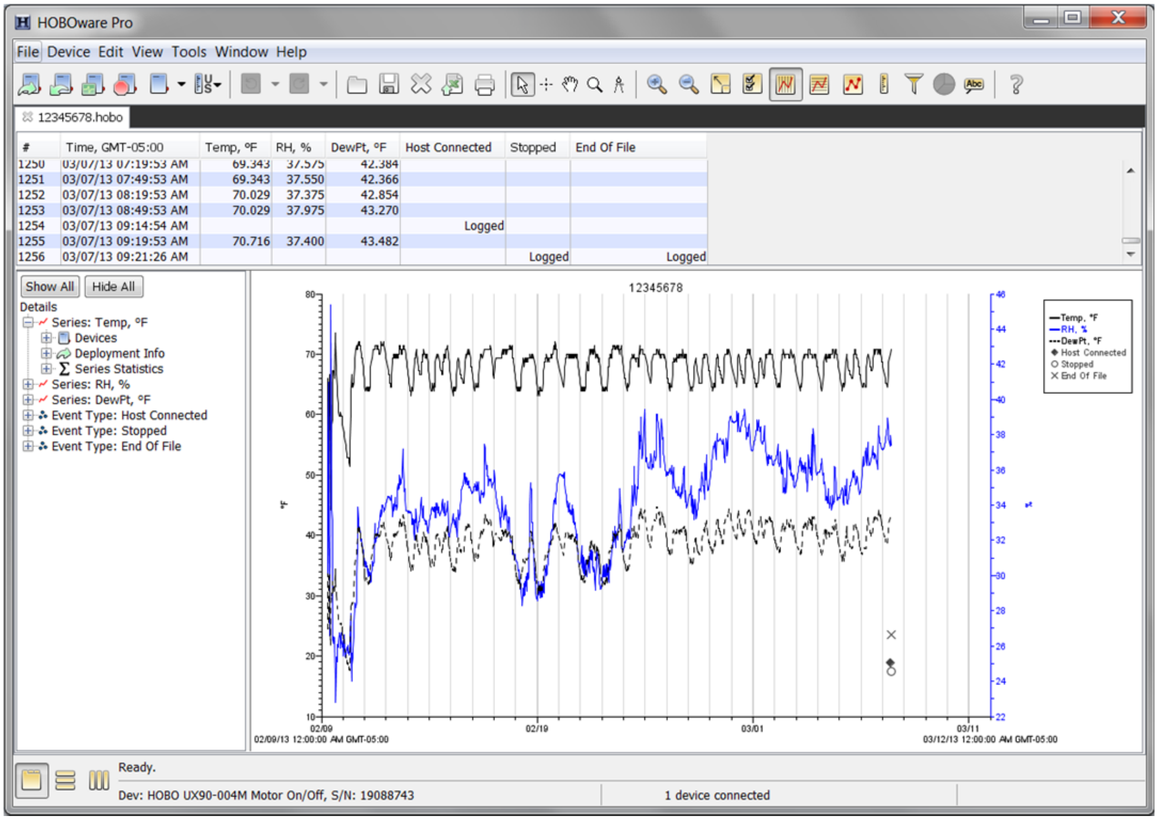
HOBOware 3.2:

- A redesigned launch window for quick logger configuration and easy sensor setup.
- Faster processing times for opening large data files (512KB and up).
- The ability to configure filtered series when launching the logger, which automatically generates custom series, such as average temperature per day, when you read out the logger and plot data.
- The ability to configure Pulse Scaling, Linear Scaling, and kWh Data Assistant series when launching any logger with applicable external sensors
- Support for the new HOBO 4-Channel Pulse Input Data Logger (UX120-017x), including advanced sensor configuration for setting maximum pulse frequency and lockout times as needed in raw pulse and event channels.
- Support for the new E50B2 Power & Energy Meter (T-VER-E50B2), including single-step configuration with the HOBO 4-Channel Pulse Input Data Logger (UX120-017x) and automatic calculation of numerous additional data series for analysis.
- Support for the new HOBO Conductivity Logger (U24-002).
- The option to disable logging the battery channel by default on some loggers, which can extend battery life and memory space.

Note: Loggers launched in HOBOware 3.2 or later with series created by the Pulse Scaling, Linear Scaling, and kWh Data Assistants or with filtered series cannot be read out in earlier versions of HOBOware.

A Tour of the HOBOware Interface

This is the main HOBOware window. Use the menu bar or tool bar to access all the features within HOBOware. The status bar at the bottom of the window shows the current view in place (as selected by the Window menu) as well as the device currently selected or connected, if any.



#	Time, GMT-05:00	Temp, °F	RH, %	DewPt, °F	Host Connected	Stopped	End Of File
1250	03/07/13 07:19:53 AM	69.343	37.575	42.384			
1251	03/07/13 07:49:53 AM	69.343	37.550	42.366			
1252	03/07/13 08:19:53 AM	70.029	37.375	42.854			
1253	03/07/13 08:49:53 AM	70.029	37.975	43.270			
1254	03/07/13 09:14:54 AM				Logged		
1255	03/07/13 09:19:53 AM	70.716	37.400	43.482			
1256	03/07/13 09:21:26 AM					Logged	Logged

Ready.

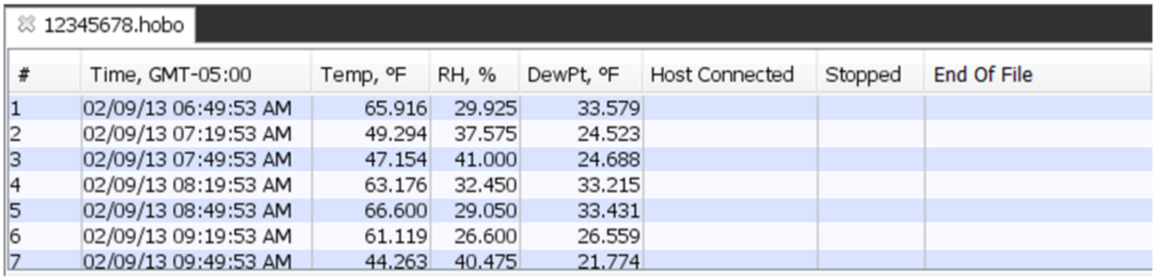
Dev: HOBO UX90-004M Motor On/Off, S/N: 19088743

1 device connected

This example shows a file that has been opened and plotted. There are three components to a plotted datafile: the Points Table, the Details Pane, and the Plot.

The Points Table

The Points Table is a list of data points, or values, and logged events displayed in the plot. The Points Table is linked to the graph: only the data for the series and events on the plot are listed in the Points Table.



#	Time, GMT-05:00	Temp, °F	RH, %	DewPt, °F	Host Connected	Stopped	End Of File
1	02/09/13 06:49:53 AM	65.916	29.925	33.579			
2	02/09/13 07:19:53 AM	49.294	37.575	24.523			
3	02/09/13 07:49:53 AM	47.154	41.000	24.688			
4	02/09/13 08:19:53 AM	63.176	32.450	33.215			
5	02/09/13 08:49:53 AM	66.600	29.050	33.431			
6	02/09/13 09:19:53 AM	61.119	26.600	26.559			
7	02/09/13 09:49:53 AM	44.263	40.475	21.774			

The data points are listed chronologically. Each point or event is listed in a single row and each series or event type is displayed in a column. You can resize the columns by clicking and dragging the dividers between the column headers.

Use the arrow keys or scroll bars to move up, down, left, and right in the Points Table. Additionally, as you click the crosshair tool -¦- in the plot, the corresponding point is selected in the Points Table. Similarly, if you click a value or event cell in the Points Table, the crosshair will appear on the graph at the time corresponding to that cell.

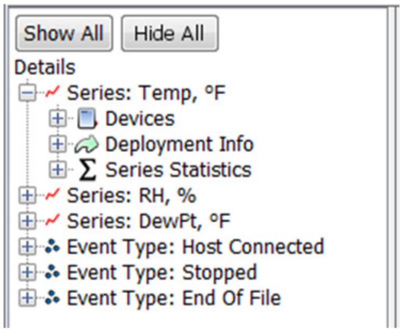
To resize the pane, drag the divider between the Points Table and the plot. To hide the Points Table, select Points Table from the View menu.

If you do not want the Points table to be displayed by default when you plot data, open the Preferences, select Plotting, and then Layout. Disable the "Show the points table when plotting data" checkbox.

The Details Pane

The Details Pane shows information for each series and event displayed in the plot including:

- Information about the devices, such as model and serial numbers.
- Deployment information, such as the launch description, deployment number, start time and time zone, logging interval, and battery voltage at launch.
- Σ Series statistics, such as the total number of sensor samples and events, time of the first and last sample, and the maximum, minimum, average, and standard deviation for each sensor series in the plot,
- 🔒 Audit trail information for secure files,



Click the + or - button to expand or collapse an entry in the Details Pane. Click the Show All/Hide All buttons to expand or collapse the entire details tree.

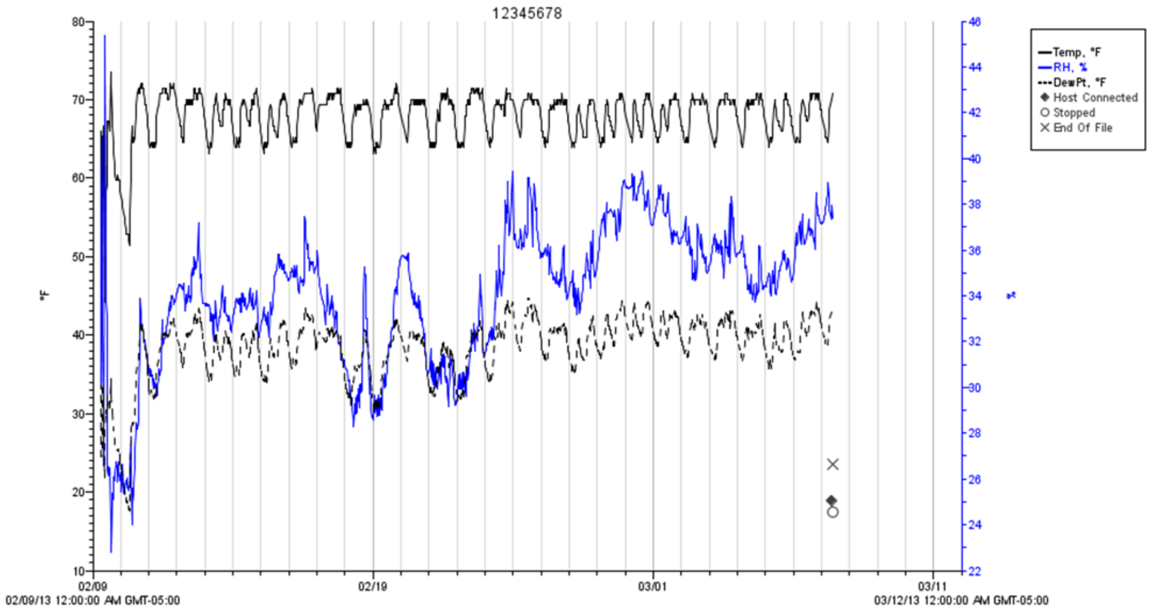
Click a series node in the details tree to select the corresponding series on the graph and corresponding column in the Points Table.

To resize the pane, drag the divider between the Details pane and the graph. To hide the Details Pane, select Details Pane from the View menu.

If you do not want the Points table to be displayed by default when you plot data, open the Preferences, select Plotting, and then Layout. Disable the "Show the details table when plotting data" checkbox.

The Plot

The plot displays the data series and events in a graph. The plot has a time axis (x-axis) and a value axis (y-axis) for each series selected in the Plot Setup window. The title, displayed at the top of the plot by default, is the Description in the Plot Setup window. The legend, displayed to the right of the plot by default, lists the keys for each series (line colors and marker types). If the crosshair tool is in use, it also lists the date, time and point values currently selected by the crosshair. For secure files (.hsec and .dsec), a padlock icon 🔒 appears in the legend next to the names of the series that were verified as original data.



To show or hide the title or legend, use the View menu. Double-click a plot element (series, axis, title, or legend) to change its properties or right-click the plot and select the item from the menu.

For more details on working with plot, see Reading Out, Plotting, and Analyzing Data.

Working in Secure Mode: 21 CFR Part 11 Compliance

You can create secure files in HOBOware Pro to comply with 21 CFR Part 11, or simply to add a level of security when working with datafiles. When Secure Mode is enabled, HOBOware Pro begins an audit trail in the logger when you launch it and adds an encoded digital signature to the new datafile when you read it out. A digitally signed file, or "secure file," has a filename extension of .hsec (for most U-Series loggers) or .dsec (for station-type loggers).

Notes:

- Issues may arise if you do not always use HOBOware Pro in the Secure Mode, if you sometimes use HOBOware Lite, or if you sometimes use a version of HOBOware prior to 2.3.0. The resulting file issues are described later in this section.
- This feature is not available for use with HOBOnode Manager and its associated ZW series data node files.
- Project (.hproj) and export files are not secure, even if you create them from secure files.

To enable secure mode:

1. From the File menu in Windows or the HOBOware menu in Mac, select Preferences
2. Select General and then select Data Verification.
3. Select the Enable Secure Mode checkbox.
4. Click OK. When Secure mode is enabled, a padlock icon 🔒 appears in the lower right corner of the main HOBOware Pro window

Opening a Secure File and Data Verification

Secure files can be opened with HOBOware Pro 2.3.0 or greater. You can open .hsec files only with HOBOware Lite 2.3.0 or greater.

Every time you open a secure file – even when you are not in Secure mode – HOBOware verifies the encoded digital signature to detect whether the file has been corrupted or tampered with. When a file is verified as secure, the padlock icon 🔒 appears in the legend next to the series that were verified as original data.

- Filtered series set up prior to launching or created after readout are not verified.
- Series that were created as a result of user input after readout, such as running a data assistant or entering a constant temperature value for pressure or humidity, are not verified.
- Series retain their verification status (and padlock icon) when copied and pasted into other plots.

In the Details pane, audit trail information is displayed under the Data Verification node for each series. HOBOware Pro automatically obtains the Launch User and Readout User names from your computer's operating system. To save the Launch User name, you must have Secure Mode enabled when you launch the logger.

If the digital signature cannot be verified when you open a file and even a single bit of data has changed since readout, a warning message will appear that verification has failed. This means that the file has been altered or become corrupted since it was originally saved. You may still be able to plot the data from the file, but the padlock icon will not display in the legend or there will be no signing information in the Details pane. You will still be able to perform typical HOBOware functions on the file.

File Compatibility

Depending on the type of logger, the version of HOBOware that launched the logger, and the version of HOBOware that reads out the logger, the resulting datafile may not be compatible with versions of HOBOware prior to 2.3.0 or you may not be able to read out the logger at all. The following files are created when launching and reading out in these scenarios:

- **Launching and reading out in non-secure mode with any version of HOBOware.** A backward-compatible datafile (.hobo or .dtf) is created.
- **Launching in non-secure mode with any version of HOBOware and reading out in secure mode.** A secure file (.hsec or .dsec) is created with an audit trail that lists the readout user, but not the launch user. Secure files are not backward-compatible.
- **Launching in secure mode and reading out in a pre-2.3 version of HOBOware.** Most U-Series loggers cannot be read out. A backward-compatible datafile (.dtf) is created for station loggers.
- **Launching in secure mode and reading out in non-secure HOBOware 2.3.** A datafile (.hobo) is created for U-Series loggers, but it is not backward-compatible. A backward-compatible datafile (.dtf) is created for station loggers.
- **Launching and reading out in secure mode.** A secure file (.hsec or .dsec) is created with a full audit trail. Secure files are not backward-compatible.

Chapter 2
Working with HOBO Data Loggers

Working with HOBO data loggers involves the following basic steps:

1. Connect the logger to the computer for the initial setup and launch.
2. Launch the logger. Enter or select the appropriate parameters for the logger deployment and then launch, or start, the logger.
3. Check the status of the logger. You have the option of checking the current status of the logger and any current readings while it is still connected to the computer. This can be helpful to verify that the launch configuration is as expected.
4. Read out the logger. After deploying the logger, read out all recorded data and save it to a file. Many devices also work with shuttles that allow you to keep the logger in the field, but still read out any recorded data. You can then bring the shuttle back to the office, connect it to the computer, offload and save the files.
5. Plot the data. After reading out the logger and saving the data, you can select and define the data series you wish to plot in a graph. HOBOware Pro also provides Data Assistants for automatic scaling of certain data when plotting.
6. Analyze the data and customize the plot. There are numerous tools available for working with the data and changing the plot, such as exporting, filtering, merging files, cropping, and more.
7. Save changes to the plot as a project file. Changes to the axis, series, plot, and legend properties as well as any filtering or merging can be saved as a .hproj file.

Connecting Devices

Most HOBO data loggers and shuttles connect to the computer with a USB cable as shipped with the device. The HOBO Weather Station, HOBO Micro Station, and HOBO Energy Logger connect to the computer with a serial cable (or to a USB port with a Keyspan™ serial adapter).

Some loggers require an optic USB base station/coupler to connect to the computer. Consult the manual that came with your device for specific information about required base stations/couplers or cables.

Once a device is properly connected to the computer as described below, the device name is listed in the status bar at the bottom of the main HOBOware window.

Notes:

- For instructions on connecting HOBOware compatible shuttles or using the HOBO Waterproof shuttle as a base station, refer to the shuttle's user guide.
- HOBOware Pro is required for loggers that use a serial cable.
- For details on working with HOBO ZW Wireless Data Nodes, see HOBOnode Manager.
- Windows only: If the device has never been connected to this computer before, it may take some time for the computer to detect the new hardware and report that it has connected successfully. One or more messages will appear, indicating that new hardware has been found. You may also hear a chime.
- Windows only: Your computer may tell you to reboot before you can use the device. It is not necessary to reboot.

Connecting a USB logger or Shuttle

To connect a logger or shuttle to HOBOware using a USB cable:

1. Open HOBOware.
2. Plug the large end of the USB interface cable into a USB port on the computer.
3. Plug the small end of the USB interface cable into the port on the device.

For instructions on connecting shuttles or using the HOBO Waterproof Shuttle as a base station, refer to the shuttle's user guide.

Connecting a Serial Device

To connect a device to a computer using a serial cable:

1. Open HOBOware Pro.
2. Plug the 9-pin end of the serial interface cable into a serial port on the computer or Keyspan adapter.
3. Plug the other end of the serial interface cable into the communications port on the device. (Refer to the diagram and instructions that came with the device if you need help finding the port.)
4. Click the Select Device icon on the toolbar to ensure that the device is listed in the Select Device window. Click the button next to the device in the window, then click OK.

If you are using a serial port other than COM1 (PC) or Default (Macintosh), you will need to set up HOBOware to use another port. To change the serial port:

1. From the File menu in Windows or the HOBOware menu in Macintosh, select Preferences.
2. Select Communications.
3. Select the serial port you want to use. Note that checking multiple serial ports can take some time, even when no devices are attached.
4. Click OK.

Connecting a Base Station/Coupler

To connect a logger to a base station/coupler:

1. Open HOBOware.
2. Plug the base station/coupler cable into a USB port on the computer. **Important:** Make sure the base/station coupler is the correct model for the logger you want to use. Consult the manual that came with the logger if you are not sure.
3. Attach the logger to the base station/coupler as described in the documentation that came with your logger.

Disconnecting a Device

To disconnect the device, simply unplug the USB or serial cable or unplug the device from the base station/coupler.

To attach another logger via a base station/coupler, remove the logger, leaving the base station/coupler connected and then connect the next logger.

Connecting Multiple Devices

If your computer has multiple USB and serial ports, you can connect multiple devices and work with one at a time (HOBOware Lite can only be used for USB Ports). When multiple devices are connected, the Select Device window opens every time you select Launch, Readout, Stop, or Status from the Device menu. Click the button next to a device on the list to select it, then click OK. The selected action will then proceed. The status bar lists the number of devices connected.

To access the Select Device window at any time, click the Select Device icon on the toolbar, or choose Select Device from the Device menu.

Click the Blink Device Light button in the Select Device window to verify that you have selected the appropriate device. This briefly illuminates the light on the devices that you have selected. If the device does not have a light, or if the light is not visible when the devices is in the base station/coupler, simply check the serial number (S/N) on your devices to make sure that it matches the one that is selected in this window.

Notes:

- If serial devices are selected in Preferences, it may take some time for HOBOware Pro to scan all the serial ports. You can select the device you want as soon as it is displayed. You do not have to wait for all of the ports to be scanned.
- Serial devices that you have added or removed are not reflected in the device count until you click the Select Device icon on the toolbar to update the device list.
- If you work with multiple U-Series devices frequently and are using HOBOware Pro, you can set the Default Action in the Device menu to Launch and enable Launch Time-Saving Options to work more efficiently.

Launching Devices

To set up a logger to record data, you must specify several parameters and launch, or start, the logger.

Tip: Check that the time on the computer is correct before configuring a launch. If it is not correct, close HOBOware, update your computer's clock manually or synchronize it with an online time server (if available) and then reopen HOBOware.

To launch a logger:

1. Connect the logger to the computer.
2. Click the Launch icon on the toolbar, or select Launch from the Device menu.
3. Different messages may appear depending on the state of the logger. Answer each of the prompts accordingly.

   A warning appears if the logger has already been launched. Click Yes to continue or click No to cancel.

   For U-Series loggers only (other than the HOBO U30 Station), a warning appears if the logger has recorded data since its last readout. Click Yes to proceed to the launch window, or click No to cancel the launch and read out the data first. Because loggers are tested before shipping, there may be data in your logger the first time you launch it. In this case, it is not necessary to read out the logger. Click Yes to proceed.
4. Select the options for the launch in the Launch Logger window.
5. Click the Start button when you are finished choosing the launch settings. Note that the text on the Start button varies depending on when you chose logging to begin. HOBOware displays the progress of the launch and warns you not to unplug the logger while it is being configured.

Once the logger begins logging, it will continue logging until the memory is full, it is stopped, or the battery runs out.

Launch Logger Window

Use the Launch Logger window to set up your logger to record data. The Launch Logger window is divided into the following three panes:

- **Logger Information.** The name of the logger currently selected appears at the top of this pane, which also includes the serial number, deployment number, and current battery level.

  Use the Description field to type up to a 40-character name for the logger deployment. The description you enter here will be used as the default file name when you read out the logger and save the data. It will also be the default title on the plot. For new loggers, the description defaults to the logger serial number.

  Click the Status button in this pane to see the current status of the logger and the settings used on the previous launch.

  A User Notes button may also appear for some loggers. Click it to enter more extensive notes about the deployment.

- **Sensors.** This pane displays a list of the sensors available for the logger. Choose the sensors, or channels, that you wish to log in this deployment, select any external sensors you may be using, and type labels for sensors as desired. Note that labels may not be applied to some calculated or derived channels, such as filtered series. This pane also displays any utilities available for your logger, such as Alarms, Scaling, and Filters.
- **Deployment.** Use this pane to select the logging interval (the rate at which you want the logger to record data) and to choose when the logger should begin recording data. Loggers can be configured to start logging immediately or on a specific date/time. Some loggers also can be configured to start at an interval or start with push button/coupler start. The coupler start (also known as a triggered start) involves removing the logger from its coupler or base station and then taking it to the deployment location. When you are ready for logging to begin, insert the logger in the coupler without the base station for three seconds. Refer to the logger manual for details.

This pane also displays the logging duration, which is the approximate time it will take to fill the logger memory based on the logging interval, sensors, and other settings currently selected. For some loggers, you can also set a sampling interval, choose when to stop logging, and select other options in this pane.

When you are done choosing the launch settings, click the button in the lower right-hand corner of the window to send the settings to the logger. Note that the button text changes based on when you chose to start logging.

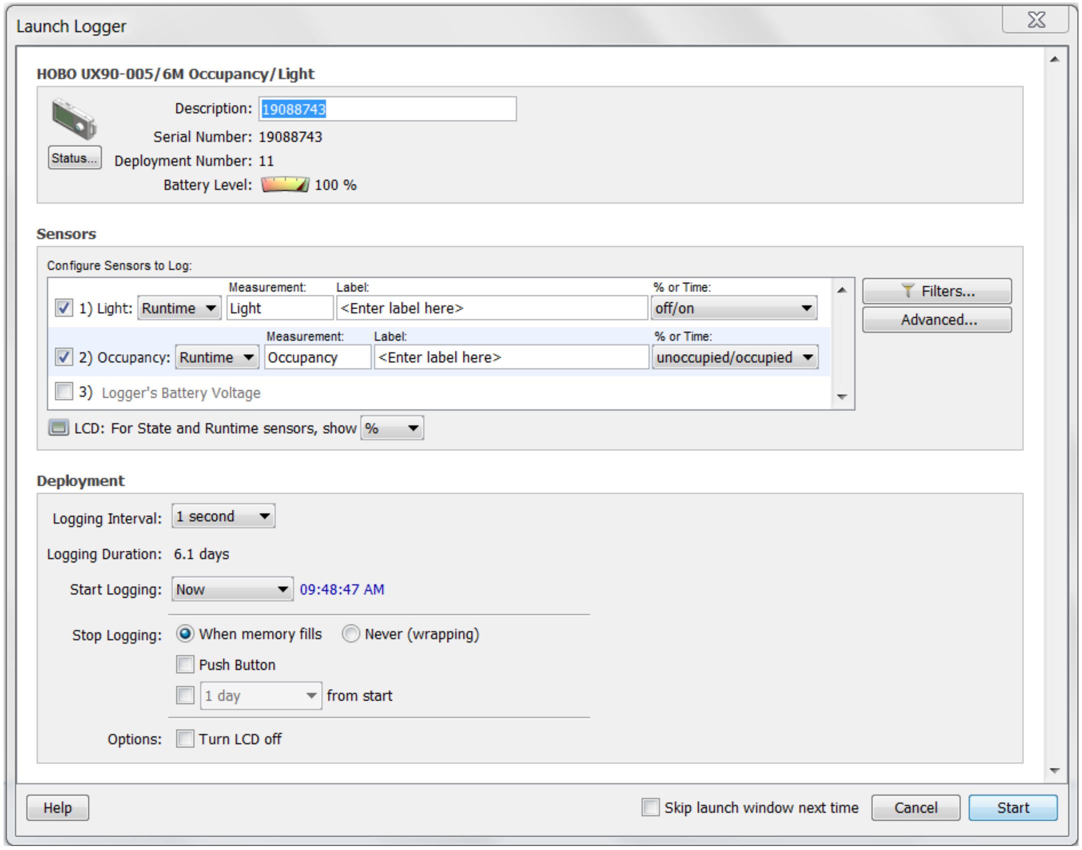
HOBOware Pro Tip: If you will be using the same launch settings for multiple deployments of the same logger type, select the Skip Launch Window Next Time checkbox to bypass this window the next time you launch a device. This will cause the next logger to be launched with either the previous launch settings or the current logger settings as set in Launch Time-Saving Options subcategory of the General preferences.

The options available in the Logger Launch window vary depending on the type of logger you are using. For more details about launching your particular device, refer to the following topics:

- Launch Options for HOBO UX90 Series Loggers
- Launch Options for HOBO UX100 Series Loggers and the HOBO 4-Channel Thermocouple Logger (UX120-014M)
- Launch Options for the HOBO 4-Channel Pulse Input Data Logger (UX120-017x)
- Launch Options for Other U-Series Loggers
- Launch Options for Station Loggers

Launch Options for HOBO UX90 Series Loggers

The following launch options are available for HOBO UX90 series data loggers. Note that the Launch Logger window may vary from the example shown below.



Launch Logger

HOBO UX90-005/6M Occupancy/Light

Description: 19088743
Serial Number: 19088743
Deployment Number: 11
Battery Level: 100 %

Sensors

Configure Sensors to Log:

	Measurement:		Label:	% or Time:
☑ 1) Light:	Runtime	Light	<Enter label here>	off/on
☑ 2) Occupancy:	Runtime	Occupancy	<Enter label here>	unoccupied/occupied
☐ 3) Logger's Battery Voltage				

☐ LCD: For State and Runtime sensors, show %

Deployment

Logging Interval: 1 second
Logging Duration: 6.1 days
Start Logging: Now 09:48:47 AM
Stop Logging: ● When memory fills ○ Never (wrapping)
☐ Push Button
☐ 1 day from start
Options: ☐ Turn LCD off

☐ Skip launch window next time

Logger Information

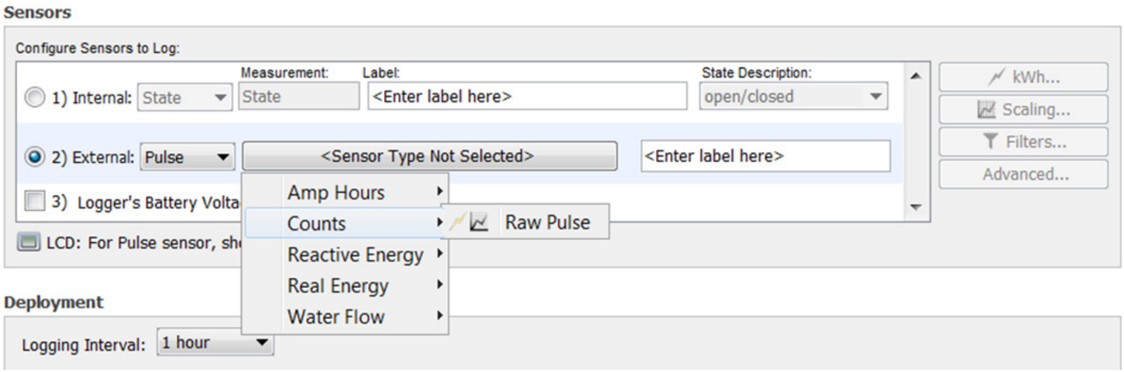
- **Description.** Enter a description for the launch, up to 40 characters, in this field. This description is used as the default file name when you read out and save the data recorded by the logger. It is also the default title of the plot.
- **Serial Number.** This is the serial number for the logger. Note that some external sensors or devices also have serial numbers, which are not listed here.
- **Deployment Number.** This is the number of times (including this time) the logger has been launched. Each time you start a new launch, the deployment number increases by one.
- **Battery Level.** This shows the current battery level in the logger.
- **Status.** Click the Status button to check the logger settings from the previous launch.

Sensors

The Sensors List displays all internal and external sensors available for recording data. Choose the sensors, or channels, that you wish to log in this deployment. To configure a sensor:

1. Select the sensor(s) you wish to log.
2. Choose the measurement to log (e.g. State, Runtime, etc.) from the drop-down list.
3. Type a label for the sensor, if desired.

4. Complete additional details for the sensor. This will vary depending on what the logger will be measuring. For most sensors, type a name and select a description pair from the drop-down list. For external Pulse channels, click the button for the corresponding channel in the sensor list to select the sensor type as shown below. If you select Raw Pulse for the sensor type, you can use Data Assistants to set up kWh and pulse scaling information as necessary (HOBOware Pro only), which will also display on the logger LCD screen. Note that sensors that support Data Assistants at launch time display the kWh and/or scaling icon next to their name.



5. Repeat steps 1 through 4 if your logger supports multiple sensors.

6. Set the units that display on the logger's LCD screen. When the sensor is configured to log State or Runtime, choose either:

   - "Time" to show the total amount of time the switch has been closed or on since logging began, ranging from seconds to days; or
   - "%" to show the percentage of time the switch has been closed or on since logging began.

When the sensor is configured to log Pulse or Event, the LCD will display the units in three characters. Accept either the default units or type your own three-character units.

Notes on configuring sensors:

- Click the Filters button to create additional filtered series for any of the channels you configured. The filtered series will then be automatically calculated when you read out the logger and plot the data.
- Click the Advanced button to access the following settings specific to the logger: Pulse Frequency and Lockout Time, Occupancy, and Calibration.
- When setting up a pulse sensor, consider setting up the launch for a delayed or push button start and then connect the sensors/devices later before logging begins. **Important:** Sensors that are connected after logging begins may not log accurate data.
- The Occupancy/Light logger (UX90-005x/-006x) also automatically generates additional series upon reading out the logger to give you combined statistics, such as how long the lights were left on while the room was unoccupied. These series will be available in the Plot Setup dialog when opening the datafile.
- You have the option to record the logger's battery voltage at each sample time; this is the last channel in the sensors list. Like the other data channels, logging the internal battery channel consumes some of the logger's memory. Unless you suspect abnormal battery performance, you do not need to log the battery voltage. You can also hide the battery channel with Series preferences (in Preferences, select Display, then Series).
- Note that labels do not apply to calculated or derived channels, such as filtered series.

Deployment

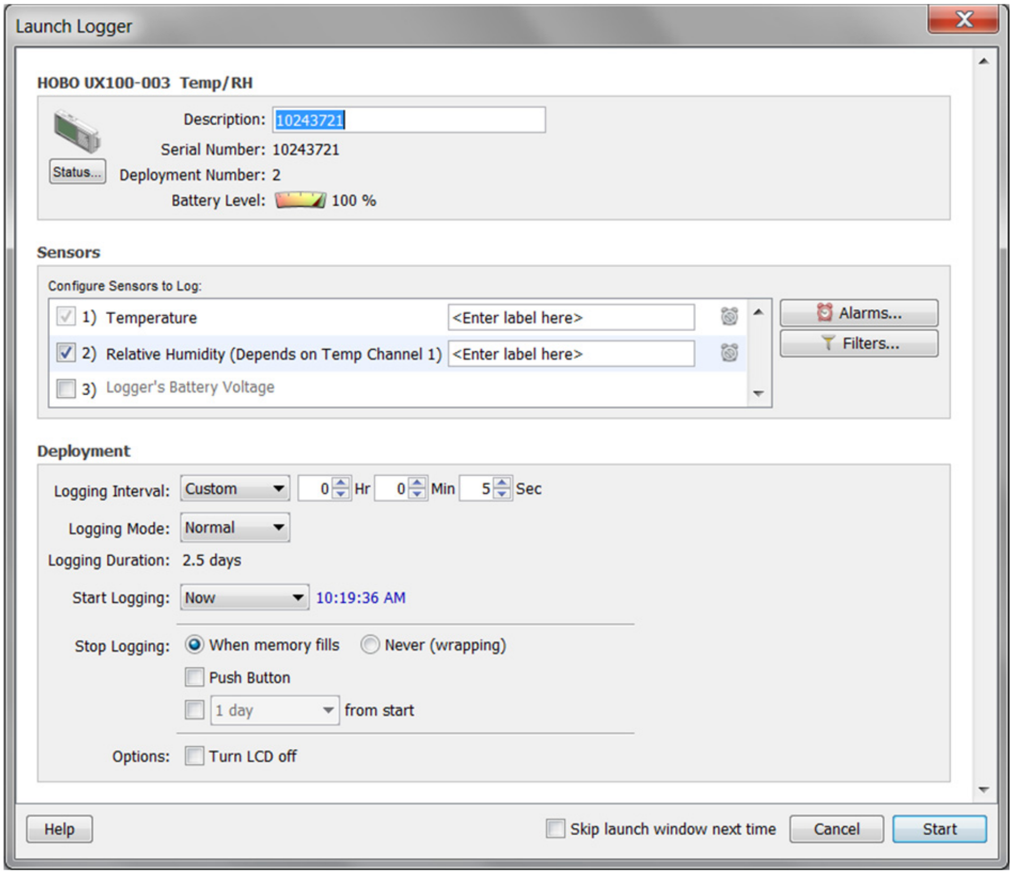
- **Logging Interval.** Select how often the logger will record data (only available for sensors configured to log Pulse or Runtime). You can choose either one of the preset logging intervals or specify a custom logging interval. The minimum logging interval is one second and the maximum for most loggers is 18 hours, 12 minutes, and 15 seconds. The shorter the logging interval, the more quickly memory fills and battery power is consumed. See also Multiple Logging Intervals and Fast Logging Intervals.
- **Logging Duration.** This lists the approximate time it will take to fill the logger memory based on the logging interval and sensors currently selected. This is a theoretical estimate only; battery life and frequent state and event logging will affect your deployment. This estimate is only available when the sensors are configured to log Pulse or Runtime. For estimates with State and Event logging, refer to the logger documentation, also available at http://www.onsetcomp.com/support/manuals.
- **Start Logging.** Select when to launch the logger. This defaults to the setting for the logger's previous launch (you can change this in HOBOware Pro with the Launch Time-Saving Options subcategory of the General preferences). You can choose to launch this logger:
    - Now. Logging begins as soon as you click the **Start** button in the Launch Logger window.
    - At Interval. Logging will begin at an exact interval (for example 9:00:00 rather than 8:47:00 when you choose a one-hour logging interval). The exact start time depends on the logging interval you choose. This option is only available when the sensors are configured to log Pulse or Runtime.
    - Push Button. Logging will not start until you press the Start/Stop button on the logger and hold it down for at least three seconds. The LCD screen on the logger will display "Start" until you press the button.
    - On Date/Time. Logging will begin at a date and time you specify, up to approximately six months from the present. The LCD screen will count down to that start date/time and then logging will begin.
- **Stop logging.** Select when you want the logger to stop logging. You can choose:
    - When memory fills or Never (wrapping). If you select "When memory fills," then the logger will stop recording data once the memory is full. If you select "Never (wrapping)," the logger will record data continuously until either the logger battery runs out or you stop it. Once the logger is full, the newest data will overwrite the oldest data. When wrapping, the memory segment on the logger LCD screen will blink.
    - Push button. When this option is selected, the logger will stop recording data when you press the Start/Stop button on the logger itself for 3 seconds. The LCD screen on the logger will display "Stop" when this option has been selected.
    - Specific stop date. Select the date you want the logger to stop recording data. Choose either a preset time or set your own custom date and time.
- **Options.** Select "Turn LCD off" if you want the logger to operate in "stealth mode" with the LCD screen turned off. You can override this temporarily by pressing the Start/Stop button on the logger. The LCD will then remain illuminated for 10 minutes.

Skip launch window next time (HOBOware Pro)

Check this box if you would like to bypass the Launch Window the next time you choose Launch from the Device menu or click the Launch icon. This will cause the next logger to be launched with either the previous launch settings or the current logger settings as set in Launch Time-Saving Options subcategory of the the General preferences.

Launch Options for HOBO UX100 Series Loggers and the HOBO 4-Channel Thermocouple Logger (UX120-014M)

The following launch options are available for HOBO UX100 series data loggers and the HOBO 4-Channel Thermocouple Logger (UX120-014M). Note that the Launch Logger window may vary from the example shown below.



Launch Logger

HOBO UX100-003 Temp/RH

Description: 10243721
Serial Number: 10243721
Deployment Number: 2
Battery Level: 100 %

Sensors

Configure Sensors to Log:
☑ 1) Temperature <Enter label here>
☑ 2) Relative Humidity (Depends on Temp Channel 1) <Enter label here>
☐ 3) Logger's Battery Voltage

Deployment

Logging Interval: Custom 0 Hr 0 Min 5 Sec
Logging Mode: Normal
Logging Duration: 2.5 days
Start Logging: Now 10:19:36 AM
Stop Logging: ● When memory fills ○ Never (wrapping)
☐ Push Button
☐ 1 day from start
Options: ☐ Turn LCD off

☐ Skip launch window next time

Logger Information

- **Description.** Enter a description for the launch, up to 40 characters, in this field. This description is used as the default file name when you read out and save the data recorded by the logger. It is also the default title of the plot.
- **Serial Number.** This is the serial number for the logger. Note that some external sensors or devices also have serial numbers, which are not listed here.
- **Deployment Number.** This is the number of times (including this time) the logger has been launched. Each time you start a new launch, the deployment number increases by one.
- **Battery Level.** This shows the current battery level in the logger.
- **Status.** Click the Status button to check the logger settings from the previous launch.

Sensors

The Sensors List displays all sensors available for recording data. Choose the sensors, or channels, that you wish to log in this deployment. If connecting a thermocouple, select the appropriate type from the drop-down list. Type a label for the sensor, if desired.

Notes:

- Click the Alarms button to set an alarm for this logger. Note that the Logging Mode must be set to Normal or Statistics to configure an alarm. For thermocouple loggers (UX100-014M and UX120-014M models), alarms can only be configured on thermocouple channels; they are not available on the internal 10K thermistor (temperature) channel.
- Click the Filters button to create additional filtered series for any of the channels you configured. The filtered series will then be automatically calculated when you read out the logger and plot the data.
- You have the option to record the logger's battery voltage at each sample time; this is the last channel in the sensors list. Like the other data channels, logging the internal battery channel consumes some of the logger's memory. Unless you suspect abnormal battery performance, you do not need to log the battery voltage. You can also hide the battery channel with Series preferences (in Preferences, select Display, then Series).
- Note that labels do not apply to all calculated or derived channels, such as filtered series channels.

Deployment

- **Logging Interval.** Select how often the logger will record data. You can choose either one of the preset logging intervals or specify a custom logging interval. The minimum logging interval is one second and the maximum for most loggers is 18 hours, 12 minutes, and 15 seconds. The shorter the logging interval, the more quickly memory fills and battery power is consumed.
- **Logging Mode.** Select the type of logging mode you wish to use: Normal, Burst Logging, or Statistics. With Burst Logging mode, you can configure the logger to use a different logging interval when specific conditions are met. With Statistics mode, you can configure the logger to calculate maximum, minimum, average, and standard deviation for all enabled sensors (except battery voltage) during logging at a sampling interval you specify. Keep in mind that the more statistics you record, the shorter the logger duration and the more memory is required. Once you launch the logger, the selected statistics will be displayed on the logger LCD. After you set up Burst or Statistics logging, there will be an Edit button next to Logging Mode in the Launch Logger window to make additional changes as necessary. Note that Normal or Statistics mode is required if you want to set up alarms for the logger. On thermocouple loggers, burst logging and statistics are only available on thermocouple channels and not on the internal temperature channel.
- **Logging Duration.** This lists the approximate time it will take to fill the logger memory based on the logging interval, logging mode, and sensors currently selected. This is a theoretical estimate only; battery life and other factors will also affect the deployment.
- **Start Logging.** Select when to launch the logger. This defaults to the setting for the logger's previous launch (you can change this in HOBOware Pro with the Launch Time-Saving Options subcategory of the General preferences). You can choose to launch this logger:
  - Now. Logging begins as soon as you click the Start button in the Launch Logger window.
  - At Interval. Logging will begin at an exact interval (for example 9:00:00 rather than 8:47:00 when you choose a one-hour logging interval). The exact start time depends on the logging interval you choose.
  - On Date/Time. Logging will begin at a date and time you specify, up to approximately six months from the present. The LCD screen will count down to that start date/time and then logging will begin.
  - Push Button. Logging will not start until you press the Start/Stop button on the logger and hold it down for at least three seconds. The LCD screen on the logger will display "Start" until you press the button.
- **Stop Logging.** Select when you want the logger to stop logging. You can choose:

  - When memory fills or Never (wrapping). If you select "When memory fills," then the logger will stop recording data once the memory is full. If you select "Never (wrapping)," the logger will record data continuously until either the logger battery runs out or you stop it. Once the logger is full, the newest data will overwrite the oldest data. When "Never (wrapping)" is selected, a wrap indicator icon will display on the logger LCD screen. **Note:** You cannot select "Never (wrapping)" on UX100 series loggers if Burst is selected for the Logging Mode.
  - Push button. When this option is selected, the logger will stop recording data when you press the Start/Stop button on the logger for three seconds. The LCD screen on the logger will display "Stop" when this option has been selected.
  - Resume logging on next button push. This setting is available when "Push button" is selected as a "Stop Logging" option. If you select this option, you can resume logging on a stopped logger by pressing the Start/Stop button for three seconds. For example, press the Start/Stop logging button on the logger once to stop logging. Then, a few minutes, hours, or even days later when you are ready to continue logging, press the Start/Stop button on the logger again and logging will resume using the same logging interval from the last launch. You can then continue to start and stop logging as often as you'd like during this same deployment. Any gaps between when you stopped and restarted logging during this deployment will be reflected on the plotted data when you read out the logger. Once you relaunch the logger with HOBOware or the U-Shuttle, a new deployment and datafile will begin. The data from the previous deployment will not be carried over to the new one.
  - Specific stop date. Select the date you want the logger to stop recording data. Choose either a preset time or set your own custom date and time. **Note:** If you select a specific stop date and also have the logger configured to resume logging on the next button push, then the logger will stop logging at the date you select regardless of how many times you stop and restart the logger with the Start/Stop button.
- **Options.** Select "Turn LCD off" if you want the logger to operate in "stealth mode" with the LCD screen turned off. You can override this temporarily by pressing the Start/Stop button on the logger. The LCD will then remain illuminated for 10 minutes.

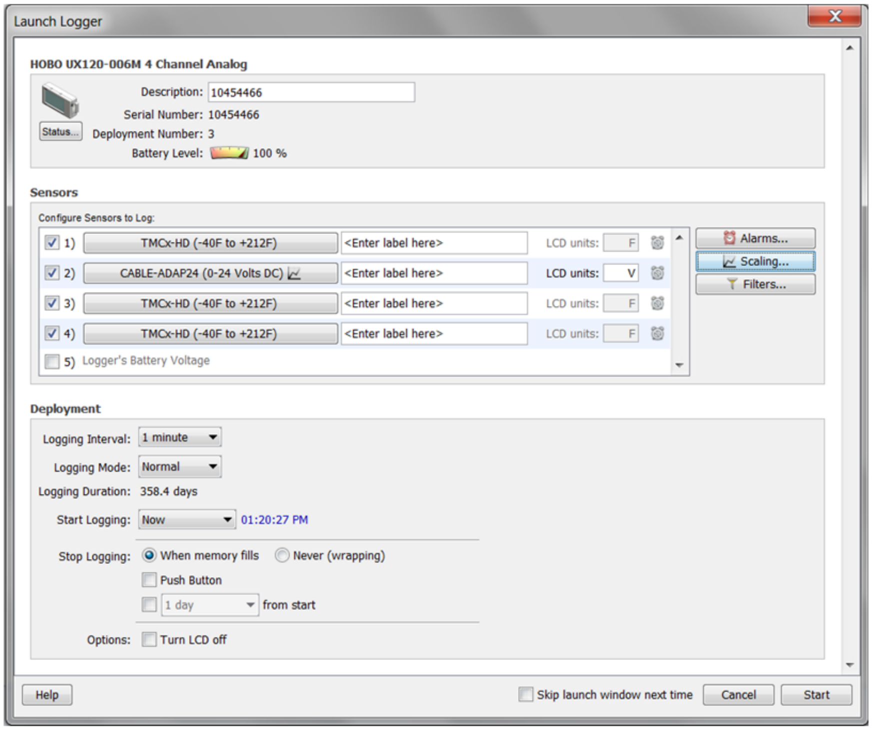
Skip launch window next time (HOBOware Pro)

Check this box to bypass the Launch Window the next time you choose Launch from the Device menu or click the Launch icon. This will cause the next logger to be launched with either the previous launch settings or the current logger settings as set in the Launch Time-Saving Options subcategory of the General preferences.

Important: After you choose the launch settings in this window and click Start, the settings are then loaded into the logger. The LCD screen on the logger will display "LOAD" during this process. If you disconnect the logger from the USB cable before this process is finished, "Err" will appear on the LCD screen instead. If you see "Err" at any point during launch configuration, check the USB connection between the computer and the logger, reopen the Launch Logger window and click Start again.

Launch Options for the HOBO 4-Channel Analog Logger (UX120-006M)

The following launch options are available for the HOBO 4-Channel Analog logger (UX120-006M). Note that the Launch Logger window may vary from the example shown below.



HOBO UX120-006M 4 Channel Analog

Description: 10454466
Serial Number: 10454466
Deployment Number: 3
Battery Level: 100 %

Sensors

Configure Sensors to Log:

☑ 1)	TMCx-HD (-40F to +212F)	<Enter label here>	LCD units:	F
☑ 2)	CABLE-ADAP24 (0-24 Volts DC)	<Enter label here>	LCD units:	V
☑ 3)	TMCx-HD (-40F to +212F)	<Enter label here>	LCD units:	F
☑ 4)	TMCx-HD (-40F to +212F)	<Enter label here>	LCD units:	F
☐ 5)	Logger's Battery Voltage			

Deployment

Logging Interval: 1 minute
Logging Mode: Normal
Logging Duration: 358.4 days
Start Logging: Now 01:20:27 PM
Stop Logging: ● When memory fills ○ Never (wrapping)
☐ Push Button
☐ 1 day from start
Options: ☐ Turn LCD off

☐ Skip launch window next time

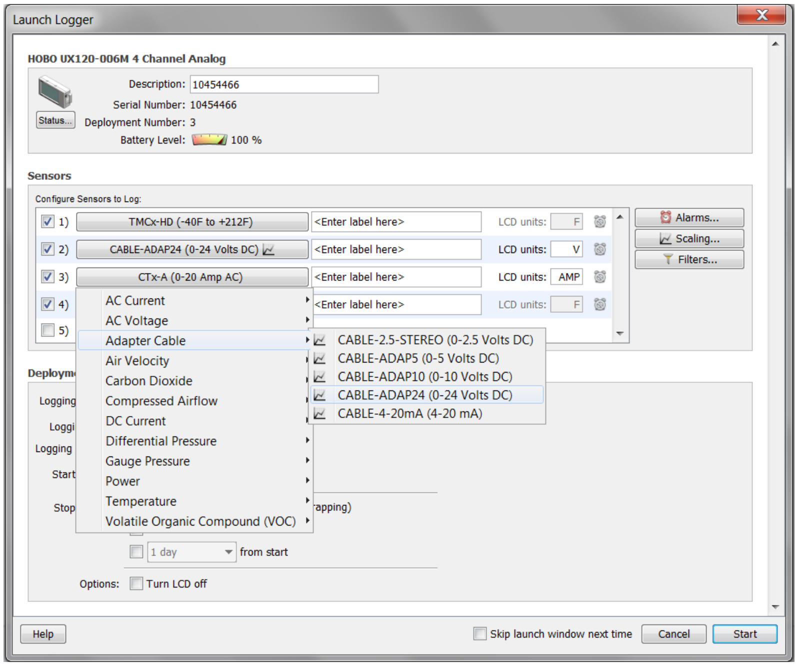
Logger Information

- **Description.** Enter a description for the launch, up to 40 characters, in this field. This description is used as the default file name when you read out and save the data recorded by the logger. It is also the default title of the plot.
- **Serial Number.** This is the serial number for the logger. Note that some external sensors or devices also have serial numbers, which are not listed here.
- **Deployment Number.** This is the number of times (including this time) the logger has been launched. Each time you start a new launch, the deployment number increases by one.
- **Battery Level.** This shows the current battery level in the logger.
- **Status.** Click the Status button to check the logger settings from the previous launch.

Sensors

The Sensors list displays all internal sensors and external channels available for recording data. Choose the sensors, or channels, that you wish to log in this deployment. To configure a sensor:

1. Select the checkbox next to the channel number to enable the sensor.
2. Select the type of sensor or cable that will be connected to that channel on the logger as shown in the following example.



Description: 10454466
Serial Number: 10454466
Deployment Number: 3
Battery Level: 100 %

☑ 1) TMCx-HD (-40F to +212F) <Enter label here> LCD units: F
☑ 2) CABLE-ADAP24 (0-24 Volts DC) <Enter label here> LCD units: V
☑ 3) CTx-A (0-20 Amp AC) <Enter label here> LCD units: AMP
☑ 4) <Enter label here> LCD units: F
☐ 5)

☐ 1 day from start

Options: ☐ Turn LCD off

☐ Skip launch window next time

3. Type a label for the sensor, if desired.
4. Type a 3-character description for the units that the LCD will display for that sensor or use the default units.
5. Set up scaling for the sensor, if applicable. Click the Scaling button and enter the scaled values and units as recommended in the sensor documentation.
6. Repeat steps 1 through 5 for each sensor you wish to configure.

Notes on configuring sensors:

- Although it is helpful to see the connected sensors/devices when setting up the launch, it is not required that you physically connect them while selecting sensor type options. You may set up the launch for a delayed or push button start, then connect the sensors/devices later, before logging begins. Be sure to connect each sensor into the correct numbered jack based on you configured the corresponding channel. Important: Sensors that are connected after logging begins may not log accurate data.
- Click the Filters button to create additional filtered series for any of the channels you configured. The filtered series will then be automatically calculated when you read out the logger and plot the data.
- You have the option to record the logger's battery voltage at each sample time; this is the last channel in the sensors list. Like the other data channels, logging the internal battery channel consumes some of the logger's memory. Unless you suspect abnormal battery performance, you do not need to log the battery voltage. You can also disable the battery channel with Series preferences (in Preferences, select Display, then Series).Note that labels do not apply to calculated or derived channels, such as filtered series.
- Although it is possible to set up more than one scaling value for each sensor, only the first scaling value for that sensor will be used.

Deployment

- **Logging Interval.** Select how often the logger will record data. You can choose either one of the preset logging intervals or specify a custom logging interval. The minimum logging interval is one second and the maximum for most loggers is 18 hours, 12 minutes, and 15 seconds. The shorter the logging interval, the more quickly memory fills and battery power is consumed. If you did not select any channels to log, this field will be disabled.

- **Logging Mode.** Select the type of logging mode you wish to use: Normal, Burst Logging, or Statistics. With Burst Logging mode, you can configure the logger to use a different logging interval when specific conditions are met. With Statistics mode, you can configure the logger to calculate maximum, minimum, average, and standard deviation for all enabled sensors (except battery voltage) during logging at a sampling interval you specify. Keep in mind that the more statistics you record, the shorter the logger duration and the more memory is required. Once you launch the logger, the selected statistics will be displayed on the logger LCD. After you set up Burst or Statistics logging, there will be an Edit button next to Logging Mode in the Launch Logger window to make additional changes as necessary. Note that Normal or Statistics mode is required if you want to set up alarms for the logger.
- **Logging Duration.** This lists the approximate time it will take to fill the logger memory based on the logging interval and sensors currently selected. This is a theoretical estimate only; battery life and other factors will affect your deployment.
- **Start Logging.** Select when to launch the logger. This defaults to the setting for the logger's previous launch (you can change this in HOBOware Pro with the Launch Time-Saving Options subcategory of the General preferences). You can choose to launch this logger:
    - Now. Logging begins as soon as you click the Start button.
    - At Interval. Logging will begin at an exact interval (for example 9:00:00 rather than 8:47:00 when you choose a one-hour logging interval). The exact start time depends on the logging interval you choose.
    - Push Button. Logging will not start until you press the button on the logger and hold it down for at least three seconds. The Waiting LED will blink on the logger until you press the Start/Stop button. Resume logging on next button push. This setting is available when "Push button" is selected as a "Stop Logging" option. If you select this option, you can resume logging on a stopped logger by pressing the Start/Stop button for three seconds. For example, press the Start/Stop logging button on the logger once to stop logging. Then, a few minutes, hours, or even days later when you are ready to continue logging, press the Start/Stop button on the logger again and logging will resume using the same logging interval from the last launch. You can then continue to start and stop logging as often as you'd like during this same deployment. Any gaps between when you stopped and restarted logging during this deployment will be reflected on the plotted data when you read out the logger. Once you relaunch the logger with HOBOware or the U-Shuttle, a new deployment and datafile will begin. The data from the previous deployment will not be carried over to the new one.
    - On Date/Time. Logging will begin at a date and time you specify, up to approximately six months from the present. The Waiting LED will blink on the logger until logging begins on the selected date/time.
- **Stop logging.** Select when you want the logger to stop logging. You can choose:
    - When memory fills or Never (wrapping). If you select "When memory fills," then the logger will stop recording data once the memory is full. If you select "Never (wrapping)," the logger will record data continuously until either the logger battery runs out or you stop it. Once the logger is full, the newest data will overwrite the oldest data.
    - Push button. When this option is selected, the logger will stop recording data when you press the Start/Stop button on the logger itself for 3 seconds. If you also configured a Push Button start, then you must wait 5 minutes after logging begins before you can use the button to stop logging.
    - Specific stop date. Select the date you want the logger to stop recording data. Choose either a preset time or set your own custom date and time.
    - Options. Select "Turn LCD off" if you want the logger to operate in "stealth mode" with the LCD screen turned off. You can override this temporarily by pressing the Start/Stop button on the logger. The LCD will then remain illuminated for 10 minutes.

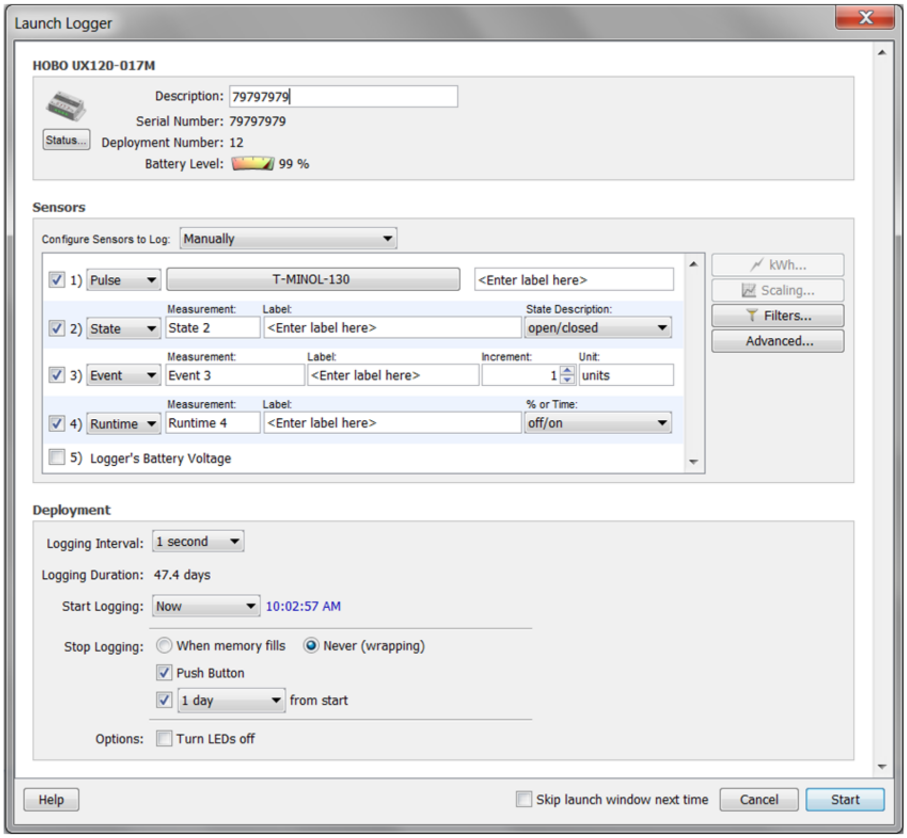
Skip launch window next time (HOBOware Pro)

Check this box if you would like to bypass the Launch Window the next time you choose Launch from the Device menu or click the Launch icon. This will cause the next logger to be launched with either the previous launch settings or the current logger settings as set in the Launch Time-Saving Options subcategory of the General preferences.

Important: After you choose the launch settings in this window and click Start, the settings are then loaded into the logger. The LCD screen on the logger will display "LOAD" during this process. If you disconnect the logger from the USB cable before this process is finished, "Err" will appear on the LCD screen instead. If you see "Err" at any point during launch configuration, check the USB connection between the computer and the logger, reopen the Launch Logger window and click Start again.

Launch Options for the HOBO 4-Channel Pulse Input Data Logger (UX120-017x)

The following launch options are available for the HOBO 4-Channel Pulse Input Data Logger (UX120-017x). Note that the Launch Logger window may vary from the example shown below.



Launch Logger

HOBO UX120-017M

Description: 79797979
Serial Number: 79797979
Deployment Number: 12
Battery Level: 99 %

Sensors

Configure Sensors to Log: Manually

☑ 1) Pulse T-MINOL-130 <Enter label here>
☑ 2) State Measurement: State 2 Label: <Enter label here> State Description: open/closed
☑ 3) Event Measurement: Event 3 Label: <Enter label here> Increment: 1 Unit: units
☑ 4) Runtime Measurement: Runtime 4 Label: <Enter label here> % or Time: off/on
☐ 5) Logger's Battery Voltage

Deployment

Logging Interval: 1 second
Logging Duration: 47.4 days
Start Logging: Now 10:02:57 AM
Stop Logging: ○ When memory fills ● Never (wrapping)
☑ Push Button
☑ 1 day from start
Options: ☐ Turn LEDs off

☐ Skip launch window next time

Logger Information

- **Description.** Enter a description for the launch, up to 40 characters, in this field. This description is used as the default file name when you read out and save the data recorded by the logger. It is also the default title of the plot.
- **Serial Number.** This is the serial number for the logger. Note that some external sensors or devices also have serial numbers, which are not listed here.
- **Deployment Number.** This is the number of times (including this time) the logger has been launched. Each time you start a new launch, the deployment number increases by one.

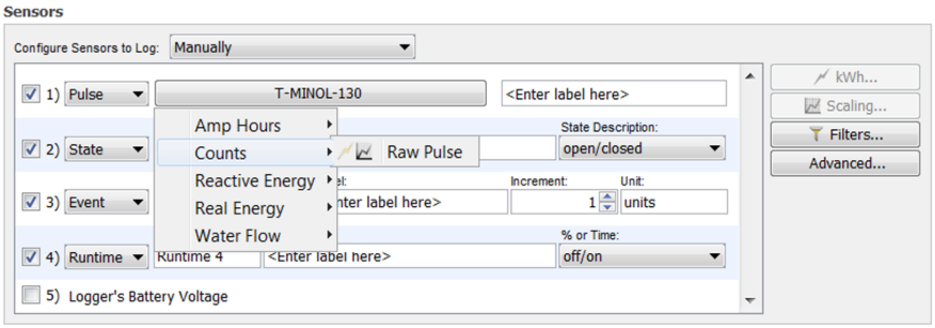
- **Battery Level.** This shows the current battery level in the logger.
- **Status.** Click the Status button to check the logger settings from the previous launch.

Sensors

The Sensors List displays all internal sensors and external channels available for recording data. Choose the sensors, or channels, that you wish to log in this deployment. To configure a channel:

1. If you are using the logger with an E50B2 Power & Energy Meter, then select "for E50B2 Power & Energy Meter" in the Configure Sensors drop-down list at the top of the Sensors pane. This will automatically preselect the appropriate channels and pulse scaling factors, which you can then customize further in the following steps.

   For all other sensors/devices, select "Manually" in the Configure Sensors drop-down list.
2. Make sure the checkbox is enabled for the external channel you wish to log.
3. Choose either Pulse, State, Event, or Runtime from the drop-down list.
4. For Pulse channels, click the button for the corresponding channel in the sensor list to select the sensor type as shown below. If you select Raw Pulse for the sensor type, you can use Data Assistants to set up kWh and pulse scaling information as necessary (HOBOware Pro only). You can also adjust maximum pulse frequency and lockout time by clicking the Advanced button. Note that sensors that support Data Assistants at launch time display the Scaling and/or kWh icon next to their name.

   Sensors

   Configure Sensors to Log: Manually

   ☑ 1) Pulse T-MINOL-130 <Enter label here>

   ☑ 2) State State Description: open/closed

   ☑ 3) Event Increment: 1 Unit: units

   ☑ 4) Runtime Runtime 4 <Enter label here> % or Time: off/on

   ☐ 5) Logger's Battery Voltage

   For State and Runtime channels, type a name and select a description.

   For Event channels, type a name, adjust the increment, and type a unit description (or accept the default "units" for the description).
5. Type a label for the sensor, if desired.
6. Repeat steps 1 through 4 for each channel you wish to configure.

Notes on configuring sensors:

- Although it is helpful to see the connected sensors/devices when setting up the launch, it is not required that you physically connect them while selecting sensor type options. You may set up the launch for a delayed or push button start, then connect the sensors/devices later, before logging begins. **Important:** Sensors that are connected after logging begins may not log accurate data.
- Click the Filters button to create additional filtered series for any of the channels you configured. The filtered series will then be automatically calculated when you read out the logger and plot the data.
- You have the option to record the logger's battery voltage at each sample time; this is the last channel in the sensors list. Like the other data channels, logging the internal battery channel consumes some of the logger's memory. Unless you suspect abnormal battery performance, you do not need to log

the battery voltage. You can also disable the battery channel with Series preferences (in Preferences, select Display, then Series).

- Note that labels do not apply to calculated or derived channels, such as filtered series.

Deployment

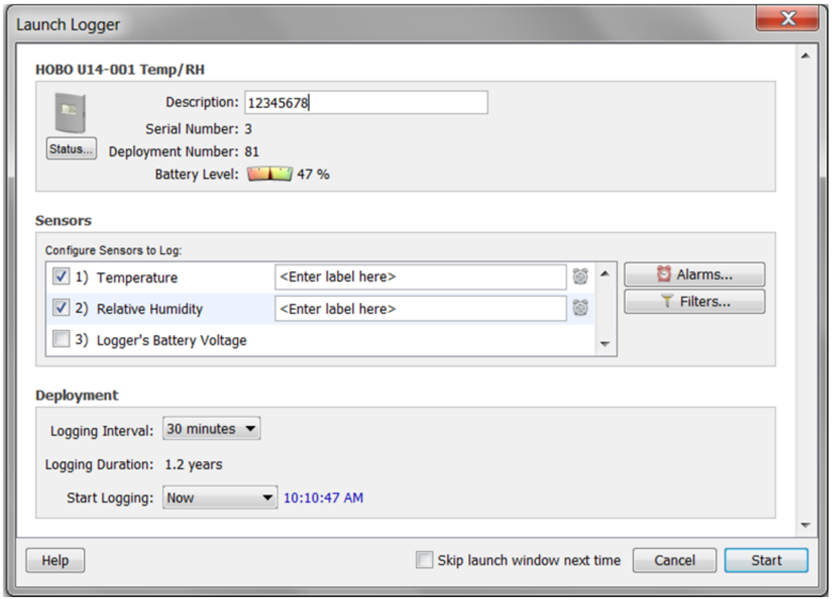
- **Logging Interval.** Select how often the logger will record data. You can choose either one of the preset logging intervals or specify a custom logging interval. The minimum logging interval is one second and the maximum for most loggers is 18 hours, 12 minutes, and 15 seconds. The shorter the logging interval, the more quickly memory fills and battery power is consumed. If you did not select any channels to log, this field will be disabled.
- **Logging Duration.** This lists the approximate time it will take to fill the logger memory based on the logging interval and sensors currently selected. This is a theoretical estimate only; battery life and frequent state and event logging will affect your deployment. If you are logging only state changes and events, no estimation is possible.
- **Start Logging.** Select when to launch the logger. This defaults to the setting for the logger's previous launch (you can change this in HOBOware Pro with the Launch Time-Saving Options subcategory of the General preferences). You can choose to launch this logger:
  - Now. Logging begins as soon as you click the **Start** button.
  - At Interval. Logging will begin at an exact interval (for example 9:00:00 rather than 8:47:00 when you choose a one-hour logging interval). The exact start time depends on the logging interval you choose.
  - Push Button. Logging will not start until you press the button on the logger and hold it down for at least three seconds. The Waiting LED will blink on the logger until you press the Start/Stop button.
  - On Date/Time. Logging will begin at a date and time you specify, up to approximately six months from the present. The Waiting LED will blink on the logger until logging begins on the selected date/time.
- **Stop logging.** Select when you want the logger to stop logging. You can choose:
  - When memory fills or Never (wrapping). If you select "When memory fills," then the logger will stop recording data once the memory is full. If you select "Never (wrapping)," the logger will record data continuously until either the logger battery runs out or you stop it. Once the logger is full, the newest data will overwrite the oldest data.
  - Push button. When this option is selected, the logger will stop recording data when you press the Start/Stop button on the logger itself for 3 seconds. If you also configured a Push Button start, then you must wait 5 minutes after logging begins before you can use the button to stop logging.
  - Specific stop date. Select the date you want the logger to stop recording data. Choose either a preset time or set your own custom date and time.
- **Options.** Select "Turn LEDs off" if you want the logger to operate in "stealth mode," which disables the Logging LED on the logger. The Waiting LED and the Test button/Activity lights will still remain operational when this option is selected.

Skip launch window next time (HOBOware Pro)

Check this box if you would like to bypass the Launch Window the next time you choose Launch from the Device menu or click the Launch icon. This will cause the next logger to be launched with either the previous launch settings or the current logger settings as set in the Launch Time-Saving Options subcategory of the General preferences.

Launch Options for Other U-Series Loggers

The following launch options are available for USB U-Series loggers other than the UX90, UX100, and UX120-017x. Note that the Launch Logger window may vary from the example shown below.



HOBO U14-001 Temp/RH

Description: 12345678

Serial Number: 3

Deployment Number: 81

Battery Level: 47 %

☑ 1) Temperature <Enter label here>

☑ 2) Relative Humidity <Enter label here>

☐ 3) Logger's Battery Voltage

Logging Interval: 30 minutes

Logging Duration: 1.2 years

Start Logging: Now 10:10:47 AM

Logger Information

- **Description.** Enter a description for the launch, up to 40 characters, in this field. This description is used as the default file name when you read out and save the data recorded by the logger. It is also the default title of the plot.
- **Serial Number.** This is the serial number for the logger. Note that some external sensors also have serial numbers, which are not listed here.
- **Deployment Number.** This is the number of times (including this time) the logger has been launched. Each time you start a new launch, the deployment number increases by one.
- **Battery Level or State.** This shows the current battery level in the logger or whether the battery state is good or bad (depending on the logger model).
- **Status.** Click the Status button to check the logger settings used in the previous launch.

Sensors

The Sensors List displays all internal sensors and external channels available for recording data. Choose the sensors, or channels, you wish to log in this deployment. To configure an external sensor:

1. Make sure the checkbox is enabled for the external channel you wish to configure.
2. Click the button for the corresponding channel in the sensor list to select the sensor type as shown below. If the external sensor has not been configured, the button reads <Sensor Type Not Selected>. Otherwise, the previous sensor type selected will be displayed on the button.
3. Select the measurement category and then the specific sensor part number and range (if applicable). Note that the sensor part number must match the part number listed on the shrink tube on the sensor cable to record accurate data.
4. Type a label for the sensor, if desired.
5. Repeat steps 1 through 4 for each additional external sensor you wish to configure.

Notes on configuring sensors:

- Although it is helpful to see the connected sensors when setting up the launch, it is not required that you connect the sensors during launch set-up. You may set up the launch for a delayed or push button start, then connect the sensors later, before logging begins. **Important:** Sensors that are connected after logging begins will not log any data. Alternatively, if you select an external channel, but do not plug the sensor in, false data will be recorded for that channel.

- Some loggers with RH or pressure sensors require that you also select the internal temperature sensor to log relative humidity or pressure. The dependency may be noted in the sensors list (see Relative Humidity channel in the example above). Refer to the manual that came with your logger for additional information.

- When both the internal temperature and RH sensors are selected, dew point will be calculated automatically.

- If external events or states are available for your logger, you can enter names to identify the event and state channels that are in use. You can also rename the Open and Closed descriptions for each state, and enter increments and units for each event channel.

- HOBOware Pro Data Assistants let you create new data series by combining data recorded by the logger with additional data. When you use a Data Assistant from the Launch Logger window, the parameter set is saved and applied to data every time you read out a logger or open the resultant data file. The derived data is also shown when you check the latest readings in the Status window. Click the Scaling button to access the Data Assistants window and choose the Linear Scaling or Pulse Scaling Assistant. Click the Create button to run the assistant. After you enter values, click Save. Sensors that support Data Assistants at launch time display the Scaling icon next to their name.

- Some loggers have alarm functionality. Click the Alarms button, if available, to set alarms as desired. Sensors that have alarm functionality display the Alarms icon next to their name.

- Click the Filters button to create an additional filtered series, such as average temperature per day, automatically when you read out the logger and plot the data.

- You have the option to record the logger's battery voltage at each sample time; this is the last channel in the sensors list. Like the other data channels, logging the internal battery channel consumes some of the logger's memory. Unless you suspect abnormal battery performance, you do not need to log the battery voltage. You can also disable the battery channel with Series preferences (in Preferences, select Display, then Series).

- Note that labels do not apply to calculated or derived channels, such as filtered series.

Deployment

- **Logging Interval.** Select how often the logger will record data. You can choose either one of the preset logging intervals or specify a custom logging interval. The shorter the logging interval, the more quickly memory fills and battery power is consumed. If you did not select any channels to log, this field will be disabled. See also Multiple Logging Intervals and Fast Logging Intervals.

- **Logging Duration.** This lists the approximate time it will take to fill the logger memory based on the logging interval and sensors currently selected. This is a theoretical estimate only; battery life and frequent state and event logging will affect your deployment. If you are logging only state changes and events, no estimation is possible.

- **DO Sensor Cap Expires (HOBO U26 Dissolved Oxygen logger only).** If a DO sensor cap is installed on the U26 logger, the date the cap expires is listed. The logger will not collect any data after the cap expires. For more details on the DO sensor cap, see Working with the HOBO U26 Dissolved Oxygen Logger.

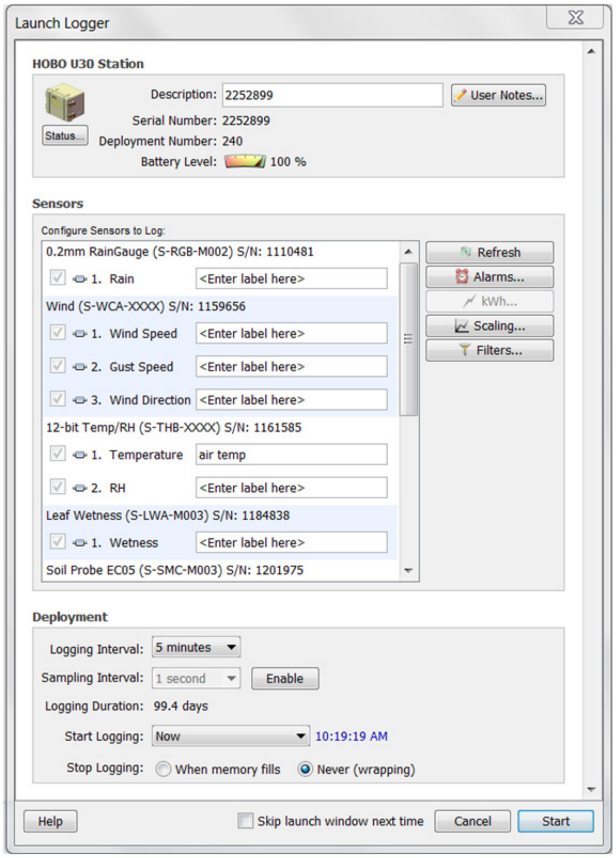
- **Start Logging.** Select when to launch the logger. This defaults to the setting for the logger's previous launch (you can change this in HOBOware Pro with the Launch Time-Saving Options subcategory of the General preferences). For U-Series loggers, you can choose to launch the logger:
  - Now. Logging begins as soon as you click the **Start** button.
  - At Interval. Logging will begin at an exact interval (for example 9:00:00 rather than 8:47:00 when you choose a one-hour logging interval). The exact start time depends on the logging interval you choose.
  - Push Button/Using Coupler. (Available only on certain loggers.) Logging will not start until you press the button on the logger and hold it down for at least three seconds, or return the logger to the coupler without the base station for at least three seconds (refer to your logger manual for more information). If the logger has a light, it will flash quickly when logging begins.
  - On Date/Time. Logging will begin at a date and time you specify, up to approximately six months from the present.

Skip launch window next time (HOBOware Pro)

Check this box if you would like to bypass the Launch Window the next time you choose Launch from the Device menu or click the Launch icon. This will cause the next logger to be launched with either the previous launch settings or the current logger settings as set in the Launch Time-Saving Options subcategory of the General preferences.

Launch Options for HOBO U30 and Other Station Loggers

The following launch options are available for Station loggers, which connect to the computer via serial cable instead of USB cable. Note that the Launch Logger window may vary from the example shown below.



Launch Logger

HOBO U30 Station

Description: 2252899
Serial Number: 2252899
Deployment Number: 240
Battery Level: 100 %

Sensors

Configure Sensors to Log:

0.2mm RainGauge (S-RGB-M002) S/N: 1110481
☑ 1. Rain <Enter label here>
Wind (S-WCA-XXXX) S/N: 1159656
☑ 1. Wind Speed <Enter label here>
☑ 2. Gust Speed <Enter label here>
☑ 3. Wind Direction <Enter label here>
12-bit Temp/RH (S-THB-XXXX) S/N: 1161585
☑ 1. Temperature air temp
☑ 2. RH <Enter label here>
Leaf Wetness (S-LWA-M003) S/N: 1184838
☑ 1. Wetness <Enter label here>
Soil Probe EC05 (S-SMC-M003) S/N: 1201975

Deployment

Logging Interval: 5 minutes
Sampling Interval: 1 second
Logging Duration: 99.4 days
Start Logging: Now 10:19:19 AM
Stop Logging: ○ When memory fills ● Never (wrapping)

☐ Skip launch window next time

Logger Information

- **Description.** Enter a description for the launch, up to 40 characters, in this field. This description is used as the default file name when you read out and save the data recorded by the logger. It is also the default title of the plot.
- **Serial Number.** This is the serial number for the logger. Note that some external sensors also have serial numbers, which are listed in the Sensors pane.
- **Deployment Number.** This is the number of times (including this time) the logger has been launched. Each time you start a new launch, the deployment number increases by one.
- **Battery Level.** This shows the current battery level in the logger.
- **User Notes.** Click this button to type up to 2000 characters of information about the deployment. This text will be displayed in the Details pane after you read out the logger and plot the data.
- **Status.** Click the Status button to check the logger settings from the previous launch.

Sensors

Only the sensors that are currently plugged in or built into the logger are listed. **Sensors are listed in ascending order by serial number, regardless of their physical position in the logger.** If you add or remove sensors, click the Refresh button to make sure your changes are seen by the logger and displayed in this list.

You can assign a name to each sensor (up to 30 characters). This is helpful if you want to specify a location where the sensor will be placed or if you need to differentiate multiple sensors of the same type.

Sensors must be connected prior to launching if you will be entering a name for the sensor or configuring FlexSmart modules or Analog Sensor Ports (use the Configure button to the right of the Label field). Otherwise, sensors do not have to be connected when setting up the launch. You may set up the launch for a delayed or push button start, then connect the sensors later before logging begins.

Notes about configuring sensor channels:

- Do not attach more than 15 channels of sensors. The logger cannot accommodate more than 15 channels.
- In addition to logging up to 15 channels, the HOBO Energy Logger and HOBO U30 Station can record their internal battery channel (other sensors must be attached; the logger cannot log battery alone). The logger's battery voltage is recorded at each interval. However, logging the internal battery channel consumes some of the logger's memory. Unless you are using excitation power or suspect abnormal battery performance, you probably do not need to log the battery voltage in loggers other than the HOBO U30 Station.
- Always enable the logger's internal battery channel when logging with excitation power. This will help you determine whether and when excitation power was turned off during a deployment.
- HOBOware Pro Data Assistants let you create new data series by combining data recorded by the logger with additional data. When you use a Data Assistant from the Launch Logger window, the parameter set is saved and applied to data every time you read out a logger or open the resultant data file. The derived data is also shown when you check the latest readings in the Status window. You can use the following Data Assistants from the Launch window (others can only be used from the Plot Setup window): Pulse Scaling, Linear Scaling, and kWh. This feature is available for the HOBO U30, the HOBO H21 (Weather Station and Micro Station) and the HOBO H22 (Energy Logger) loggers. Click the kWh or Scaling button to access the Data Assistants window. Select the desired assistant and click the Create button to run the selected assistant. After you enter values, click Save. Sensors that support Data Assistants at launch time display the Scaling and/or kWh icon next to their name.
- Click the Filters button to create an additional filtered series, such as average temperature per day, automatically when you read out the logger and plot the data.

- Note that labels do not apply to calculated or derived channels, such as filtered series.

Deployment

- **Logging Interval.** Select how often the logger will record data. You can choose either one of the preset logging intervals or specify a custom logging interval. The minimum logging interval is one second and the maximum for most loggers is 18 hours, 12 minutes, and 15 seconds. The shorter the logging interval, the more quickly memory fills and battery power is consumed. Some sensors (specifically, the FlexSmart TRMS modules) require a logging interval of two seconds or greater. If you choose a faster logging interval, erroneous data will be logged on these channels.

- **Sampling Interval.** The sampling interval allows you to take multiple measurements within the logging interval, then average them together to create a single logged measurement. The sampling interval is optional and is valid only for sensors that support measurement averaging. Refer to the sensor's user manual to determine whether measurement averaging is available on the sensor. If you have at least one sensor that supports measurement averaging, click the Enable button, then set the sampling interval at less than or equal to the logging interval (up to four minutes). Rapid sampling (faster than one minute) will reduce the logger's battery life. If you do not have any sensors with measurement averaging or wish to turn off the sampling interval, click the Disable button.

- **Logging Duration.** This lists the approximate time it will take to fill the logger memory based on the logging interval and sensors currently selected. This is a theoretical estimate only; battery life and frequent state and event logging will affect your deployment. If you are logging only state changes and events, no estimation is possible. If you add or remove sensors while viewing the Launch window, click the Refresh button to get an updated Logging Duration.

- **Start Logging.** Select when to launch the logger. This defaults to the setting for the logger's previous launch (you can change this in HOBOware Pro with the Launch Time-Saving Options subcategory of the General preferences). You can choose to launch the logger:

  - Now. Logging begins as soon as you click the **Start** button. If you do not have at least one sensor attached, the logger will not launch.

  - At Interval. Logging will begin at an exact interval (for example 9:00:00 rather than 8:47:00 when you choose a one-hour logging interval). The exact start time depends on the logging interval you choose.

  - Push Button. Logging will not start until you press the button on the logger and hold it down for at least three seconds. If the logger has a light, it will flash quickly when logging begins. This is not available for the U30 Station.

  - On Date/Time. Logging will begin at a date and time you specify, up to approximately six months from the present.

  - Save Settings in Logger. Logging will not start, but the launch settings will be saved so that you do not have to re-enter them when you are ready to launch at a later time. The next time you view the Launch window for this logger, the settings you entered will still be in place.

- **Stop Logging.** There are two options for stopping the logger: either "when memory fills" or "never (wrapping)." If you select "when memory fills," then the logger will stop recording data once the memory is full. If you select "never (wrapping)," the logger will record data continuously until either the logger battery runs out or you stop it. Once the logger is full, the newest data will overwrite the oldest data.

Skip launch window next time (HOBOware Pro)

Check this box if you would like to bypass the Launch Window the next time you choose Launch from the Device menu or click the Launch icon. This will cause the next logger to be launched with either the previous launch settings or the current logger settings as set in the Launch Time-Saving Options subcategory of the General preferences.

Note: For additional details on launching the HOBO U30 Station, see Working with the HOBO U30 Station.

Multiple Logging Intervals

Some loggers can be configured with multiple logging intervals, which allow you to define separate intervals for different phases of the deployment.

To configure multiple logging intervals:

1. From the Device menu, select Launch.
2. In the Launch Logger window, click the Add New Interval button for each interval you wish to add (the maximum number of intervals allowed varies by logger model). If there is no Add New Interval button, then the logger does not support multiple logging intervals.
3. Set the hours, minutes, and seconds for each interval, and the number of samples you want the logger to record at each interval.
4. Use the Start and End times in the Duration column to decide how many samples to record at each interval. **Note:** Because internal logger events, such as coupler events, do take up some of the logger's memory, the number of samples and end times are only estimates. Frequent events will cause the logger to fill up sooner.
5. Set any other launch options and click Start.

To delete an interval, click the Remove button next to the interval in the Launch Logger window.

Fast Logging Intervals

Some loggers can be configured with fast logging intervals, which allow you to log more than once per second, up to 100 measurements per second (hertz).

To use fast logging intervals:

1. From the Device menu, select Launch.
2. In the Launch Logger window, click the Fast button. If there is no Fast button, then the logger does not support fast logging intervals.
3. Choose a logging frequency from the Hertz drop-down list or enter the logging interval in decimal form in the Sec field.
4. Set any other launch options and click Start.

Notes:

- A logger cannot communicate with a computer or shuttle while it is logging at a fast interval. The logger will stop logging if you connect the logger to a computer, base station, or shuttle while it is logging in fast interval mode.
- Be aware that a fast logging interval typically means a very short logging duration. Make sure the logger will run long enough to collect the data you need. Disabling unnecessary channels can extend the logging duration and help to compensate for decreased duration while operating in fast interval mode.
- Because fast logging deployments are so brief, the logger must be launched with a coupler or button start. Follow the instructions that came with your logger for a trigger (coupler or button) start. If the logger has a light, it will flash quickly when logging begins.

Setting a Default Action on Multiple U-Series Devices

By default, HOBOware does not take any action when you connect a device. You can change this behavior by setting a default action to Launch, Readout, or Get Status. This can save you time when working with multiple loggers of the same type. **Note:** This feature is only available with HOBOware Pro and U-Series loggers.

To set a default action:

1. From the Device menu, select Default Action.
2. Select Launch, Readout, or Get Status.

If you set the default action to launch, you can also change the preferences to automatically populate the Launch Logger window with the same settings as the previous launch. This is helpful if you are launching numerous loggers of the same type with the same settings. To set this preference:

1. Select Preferences from the File menu in Windows or the HOBOware menu in Macintosh.
2. Select General and then select Launch Time-Saving Options.
3. For the "Fill launch window with contents of" setting, select Previous Launch.
4. Click OK.

When a device is connected, the default action you set will take place automatically. For example, if you chose Readout, HOBOware Pro will read out the logger immediately. You can then disconnect that logger, connect another logger, and the next logger will be read out automatically. If you connect a shuttle, the shuttle's new files will be offloaded automatically. Similarly, if you chose Launch for the Default Action, the Launch Logger window will open automatically when you connect the logger. The next time you connect a logger of the same time, the Launch Logger window will open automatically and be populated with the previous launch settings if you configured the Launch Time-Saving Options in the Preferences. A note will appear in the Launch Logger window when this preference is in use.

Important Note for Windows: The first time you connect a device, the Default Action may not be triggered. After the device has been connected to the computer and disconnected at least once, the Default Action should then be triggered.

Using Launch Utilities

There are several utilities available from the Launch Logger window for setting up customized data series, configuring alarms, and setting advanced logger options. These utilities vary depending on the type of logger you are using. They include:

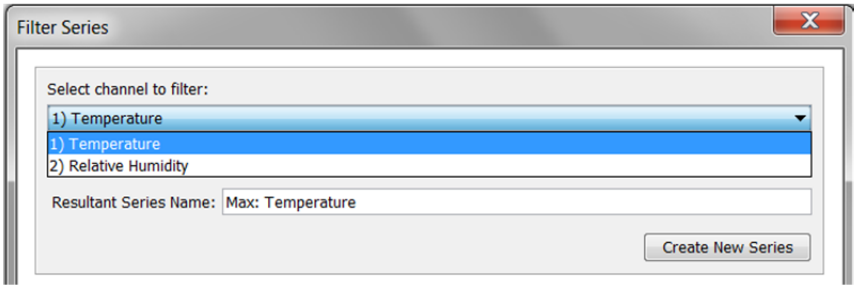
- Scaling
- Filters
- Alarms
- Advanced Sensor Properties: Pulse Frequency and Lockout Time
- Advanced Sensor Properties: Calibration
- Advanced Sensor Properties: Occupancy
- Statistics: Maximum, Minimum, Average, and Standard Deviation
- Filtered Series vs Statistics Logging
- Burst Logging

Filter Series at Launch

As part of the launch setup, you can create a filtered series that automatically calculates additional values, such as maximum, minimum, average, or total, for a set interval upon readout of the logger. The filtered series is saved as an additional series in the datafile so it is always available when plotting your data. This saves you the time of manually filtering data for each series after readout using the regular HOBOware filter tool, although this tool is still available should you need to further filter data later.

To set up a filtered series at launch:

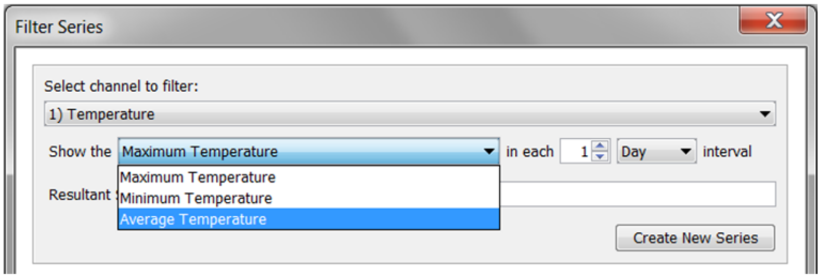
1. Select the channel, or sensor type, you wish to filter.



Select channel to filter: 1) Temperature

Resultant Series Name: Max: Temperature

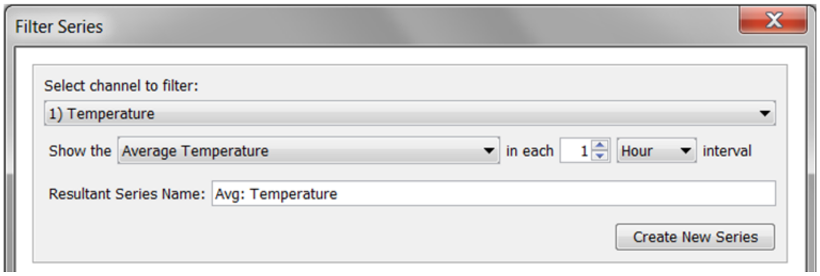
2. Select the type of filter and the interval you wish to use. In this example, the type of filter is "Average Temperature" in every hour. Filters vary depending on the channel's measurement type.



Select channel to filter: 1) Temperature

Show the Maximum Temperature in each 1 Day interval

3. Edit the Resultant Series Name as desired and click Create New Series. In this example, the Resultant Series Name is edited to be "Avg Hourly Temperature."



Select channel to filter: 1) Temperature

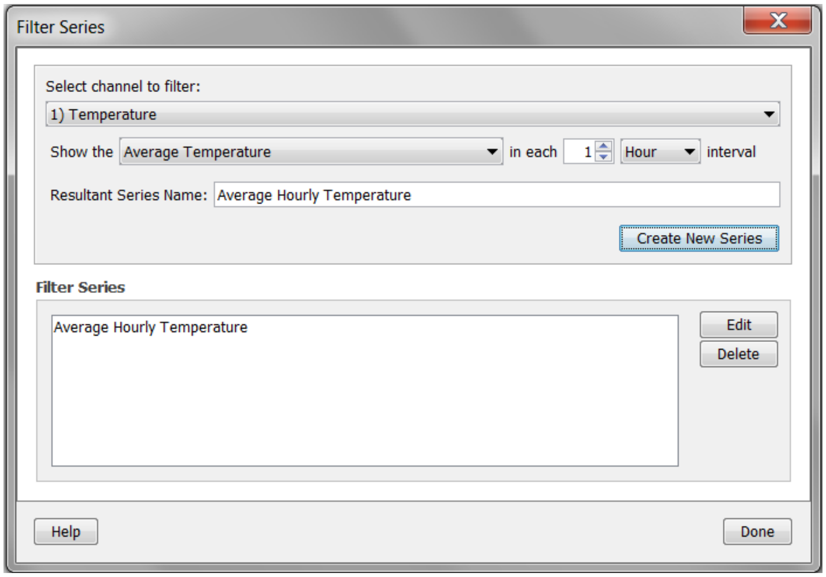
Show the Average Temperature in each 1 Hour interval

Resultant Series Name: Avg: Temperature

4. The newly created series is added to the Filtered Series list as shown below.

To make a change to a filtered series, either double-click the series name or select the series name and click Edit.

To delete a filtered series, select the series name and click Delete.



Select channel to filter: 1) Temperature

Show the Average Temperature in each 1 Hour interval

Resultant Series Name: Average Hourly Temperature

Average Hourly Temperature

5. Repeat steps 1 through 4 to create additional filtered series. Not only can you create filtered series for all channels, but you can also create multiple filtered series on a single channel (for example, you can show the maximum, minimum, and average temperature for a single temperature channel).
6. Click Done when finished. The number of filtered series that you created is displayed on the Filter button in the Logger Launch window.
7. After you launch the logger and read it out, the filtered series will automatically be listed in the Plot Setup dialog, from which you can select the series you wish to plot. **Note:** If you change the GMT offset for the filtered series, the data points will not reflect that change. They will continue to be filtered based on times within the original GMT offset at launch.

Notes:

- Loggers launched in HOBOware 3.2 with series created by the Pulse Scaling, Linear Scaling, and kWh Data Assistants or with filtered series cannot be read out in earlier versions of HOBOware.
- Filtered series created at launch time are not available for use with the Barometric Compensation, Grains Per Pound, and Conductivity Data Assistants.

See also:

- Filtered Series vs. Statistics Logging

Data Assistants Window (Scaling)

When you run a Data Assistant from the Launch Logger window, you can create a derived series, which is an additional data series automatically calculated each time you read out the logger. The Data Assistants window lists only those assistants available for the currently selected sensor and logger at launch time. There may be other Data Assistants available for use after reading out the logger.

To set up a derived series with a Data Assistant:

1. Select the Data Assistant you wish to use and click Create.
2. Select the information, or scaling parameters, you want the series to contain and click Save.
3. The new series appears in the My Derived Series list. Create additional series as desired.

   To make a change to a derived series, either double-click the derived series name or select it and then click Edit.

To delete a derived series, select the series and then click Delete.

4. After you have finished creating or editing the derived series, click Done. Depending on the type of logger you are using, the total number of derived series created appears on the kWh and/or Scaling buttons in the Launch Logger window. Derived series are also listed in the Status window.

After you launch the logger and read it out, the derived series will automatically be listed in the Plot Setup dialog, from which you can select the series you wish to plot.

Notes:

- Loggers launched in HOBOware 3.2 with series created by the Pulse Scaling, Linear Scaling, and kWh Data Assistants or with filtered series cannot be read out in earlier versions of HOBOware.
- When setting up kWh or scaling for UX90 series loggers, the scaled series information will appear on the LCD screen on the logger. In addition, only the Energy series appears on the LCD screen when configuring kWh. Average power and cost series will not display on the screen; they are available in HOBOware only.
- Although it is possible to set up more than one scaling value for each sensor on the HOBO 4-Channel Analog logger (UX120-006M), only the first scaling value for that sensor will be used.

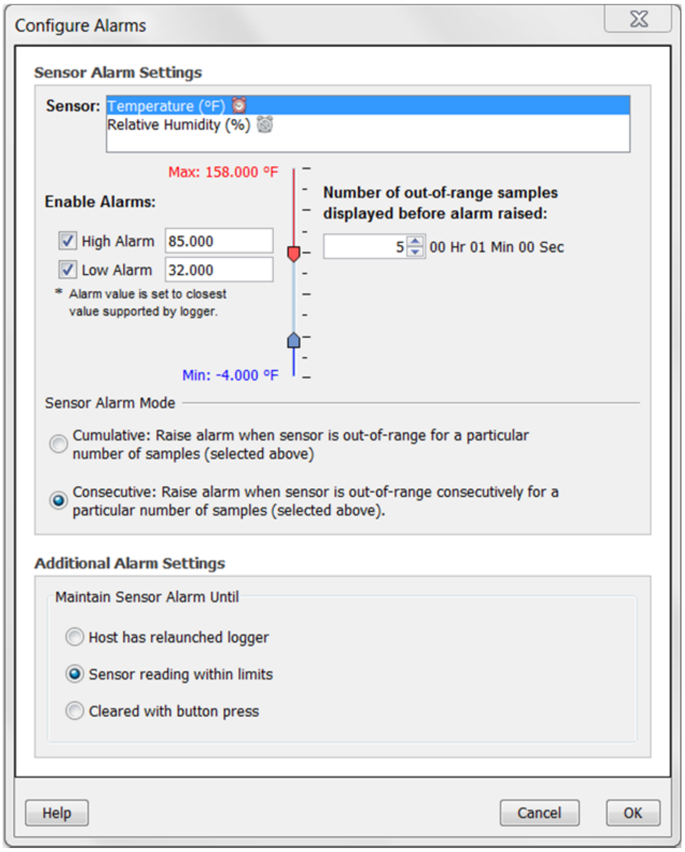
Configure Alarms

You can set an alarm to trip when a sensor reading rises above or falls below a specified value on certain logger models, including the UA-001, U14-00x, UX100 series and UX120-014M loggers. **Note:** The U30 Station also has alarms capability; see Setting Alarms on a HOBO U30 Station for more details.

To set an alarm:

1. If the Alarms window is not already open, click the Alarms button from the Launch Logger window. If there is no Alarms button, then the logger does not have alarm capability. If the Alarms button is disabled, be sure you have enabled logging on a sensor that supports alarms. If the Alarms button is disabled for a UX100 series or UX120-014M logger, make sure the Logging Mode is not set to Burst. Alarms are not available for UX100 series and UX120-014M loggers when the Logging Mode is set to Burst in the Launch Logger window.

2. In the Alarms window, select the sensor that you want to have an alarm. **Note:** The example below is for a UX100 series logger. Any differences for other logger models are noted in these steps.



Configure Alarms

Sensor Alarm Settings

Sensor: Temperature (°F) / Relative Humidity (%)

Max: 158.000 °F

Min: -4.000 °F

Enable Alarms:

☑ High Alarm 85.000

☑ Low Alarm 32.000

* Alarm value is set to closest value supported by logger.

Number of out-of-range samples displayed before alarm raised: 5 00 Hr 01 Min 00 Sec

Sensor Alarm Mode

○ Cumulative: Raise alarm when sensor is out-of-range for a particular number of samples (selected above)

● Consecutive: Raise alarm when sensor is out-of-range consecutively for a particular number of samples (selected above).

Additional Alarm Settings

Maintain Sensor Alarm Until

○ Host has relaunched logger

● Sensor reading within limits

○ Cleared with button press

3. Select the High Alarm checkbox if you want an alarm to trip when the sensor reading rises above the high alarm value. Type the reading next to the High Alarm checkbox or drag the red upper slider. In this example, we've set an alarm to trip when the temperature rises above 85°F.

4. Select the Low Alarm checkbox if you want an alarm to trip when the sensor reading falls below the low alarm value. Type in the reading next to the Low Alarm checkbox or drag the blue lower slider. In this example, we've set an alarm to trip when the temperature falls below 32°F.

   Note: The actual values for the high and low alarm limits are set to the closest value supported by the logger. For example, the closest value to 85°F that the UX100 series logger can record is 84.990°F and the closest value to 32°F is 32.043°F. In addition, alarms can trip or clear when the sensor reading is within the logger specifications of 0.02°C resolution. This means the value that triggers the alarm may differ slightly than the value entered. For example, if the High Alarm is set to 75.999°F, the alarm can trip when the sensor reading is 75.994°F (which is within the 0.02°C resolution).

5. Set the "Number of out-of-range samples <displayed> (UX100 series, UX12-014M, and U14-00x) <logged> (UA-001) before alarm is raised," which is the number of samples that are needed to trigger each alarm. For example, we've set this number to 5. This means there will need to be 5 sensor readings above 85°F or below 32°F before the alarm will trip. The time indicates how long it would take for the alarm to trip based on the number of samples you entered and the logging interval (UA-001 loggers) or the LCD refresh rate (UX100 series, UX120-014M, and U14-00x). In the example above, it would take 1 minute for the alarm to trip (only if Consecutive is selected as described in the next step). **Note:** The UA-001 and U14-00x loggers have two "Number of out-of-range samples...." fields: one for the high alarm and a separate one for the low alarm.

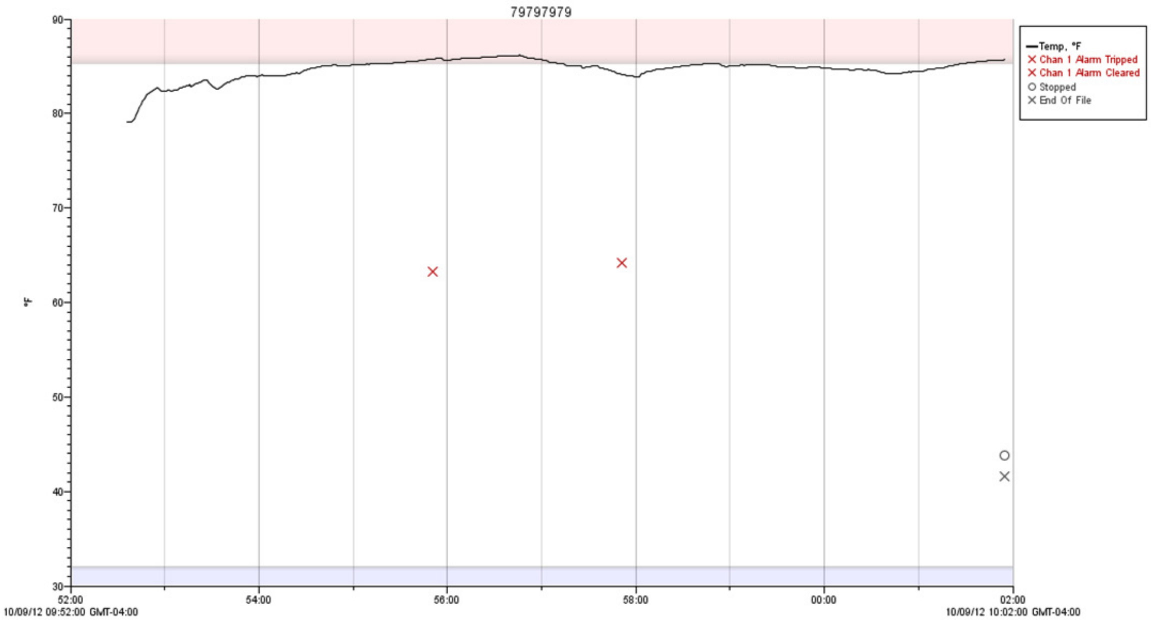
6. UX100 series, UX120-014M, and UA-001 loggers only: Select either Cumulative or Consecutive for the Sensor Alarm Mode. If you select cumulative, then the alarm will trip after a specific number of

samples (as set in the previous step) are outside the limits (the high or low samples do not need to be consecutive). If you select Consecutive, then the alarm will trip after a specific number of samples (as set in the previous step) outside the limits are logged in a row. In the example above, if there are 5 readings in a row above 85°F, then an alarm will trip. If we had chosen Cumulative, the 5 readings could have taken place at any time during the deployment for the alarm to trip.

7. UX100 series, UX120-014M, and U14-00x loggers only: Choose how long the logger should maintain the sensor alarm once it has tripped. Select "Host has relaunched logger" if you want the alarm to remain visible on the LCD until the next time you relaunch the logger. Select "Sensor reading within limits" if you want the alarm to clear once the sensor reading returns to the normal range between the high and low alarm limits. UX100 series and UX120-014M loggers have an additional option; select "Cleared with button press" if you want the alarm to remain on and visible on the LCD until you press the Alarm button on the logger.
8. U14-00x loggers only: You can set the Relay Contacts to Normally Open or Normally Closed as described in the logger manual. Click the Test Set Alarm button to test the relay switches. Deselect the "Set Alarm on Low Battery" checkbox if you do not want an alarm to trip when the logger's battery is running low.
9. Click OK to save the alarm settings and return to the Launch Logger window.

Once the logger is launched, alarms will trip as determined by these settings. Logger alarms will display on the LCD screen for UX100 series, UX120-014M, and U14-00x loggers. For UA-001 loggers, a "high" or "low" LED will blink when an alarm is tripped. **Note for UX100 series, UX120-014M, and U14-00x loggers:** The alarm limits are only checked when the logger's LCD screen refreshes. This is every 15 seconds for UX100 series and UX120-014M loggers and every 30 seconds for U14-00x loggers. Therefore, if you set the logging interval to less than 15 seconds on a UX100 series or UX120-014M logger or less than 30 seconds on a U14-00x logger and the sensor reading falls outside the alarms limits, the alarm will not trip until the next refresh cycle. (UA-001 loggers check the alarm alarms at every logging interval.)

When you read out the logger, high and low alarm levels will be displayed on the plot. In the example below, the temperature rose above 85°F so those readings are in the red, or high alarm, portion of the plot. The temperature never fell below the low alarm limit, which is the blue portion at the bottom of the plot. UX100 series and UX120-014M loggers also display alarm events showing when the alarm tripped (and cleared if applicable). In this example, there are "Chan 1 Alarm Tripped" and "Chan 1 Alarm Cleared" events showing when the temperature alarm tripped and cleared. The "Chan 1 Alarm Cleared" event contains the value that was furthest out of range for the sensor before the alarm cleared (see the Points table for the actual value).



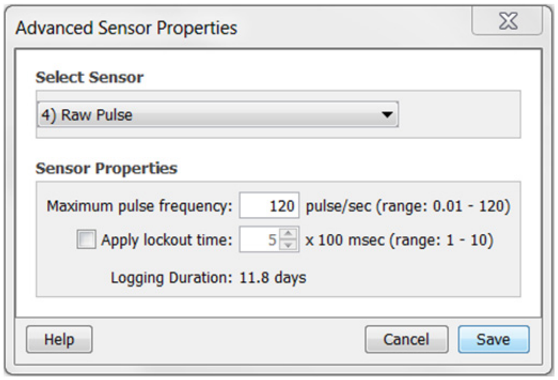
Advanced Sensor Properties: Pulse Frequency and Lockout Time

Use the Advanced Sensor Properties window to set the maximum pulse frequency for raw pulse channels and to specify a lockout time for raw pulse and event channels, which prevents false readings from mechanical sensors as their relay state changes.

Setting maximum pulse frequency is not required, but it can help optimize logging duration. The maximum pulse frequency, multiplied by the logging interval, determines the maximum count of pulses possible within each interval. The logger then can use this value to adjust the amount of memory (bits) used to log each data point. This means the logger uses memory as efficiently as possible, which in turn maximizes logging duration.

To configure maximum pulse frequency and lockout time:

1. Select the sensor that corresponds with the pulse channel you wish to configure.
2. Set the maximum pulse frequency, which controls how many pulses per second can be processed by the logger on a single pulse channel. The option to set the maximum pulse frequency is only available for raw pulse channels (sensors for which you have selected Raw Pulse as the sensor type in the Launch Logger window). Refer to the specifications in your sensor or device documentation for recommended maximum pulse frequency values. In general, the larger the maximum pulse frequency, the shorter the logging duration will be for the deployment. Note that the pulse frequency ranges in this window vary depending on the logger model.



Select Sensor: 4) Raw Pulse

Maximum pulse frequency: 120 pulse/sec (range: 0.01 - 120)

☐ Apply lockout time: 5 x 100 msec (range: 1 - 10)

Logging Duration: 11.8 days

3. Click the "Apply lockout time" checkbox if you wish to specify a time period when pulses will be ignored. Select the lockout time value from 1 to 10. On sensors with both pulse frequency and lockout time settings, lockout time will affect the maximum pulse frequency: the higher the lockout time, the lower the maximum pulse frequency will be.

Notes:

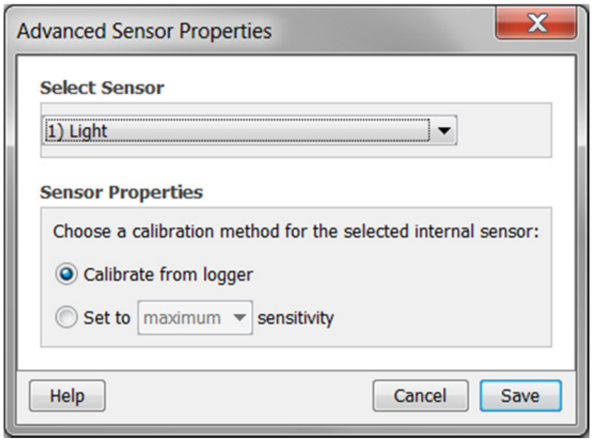
- If the logger has multiple sensors, then all sensors will have the same lockout time. This means if you are using multiple sensors with different lockout time requirements, this may result in lost pulses or false pulses.
- Lockout time is only available for raw pulse channels and event channels.
- When lockout time is enabled, you can specify a value from 1 to 10 (with a default of 5), which is then multiplied by 100 milliseconds for a range of 0.1 to 1 second. The available range for the maximum pulse frequency is automatically recalculated based on the lockout time. For example, if the lockout time is set to 2, the maximum pulse frequency range changes to 0.01 to 5 Hz. The maximum pulse frequency also varies depending on the logger model. Refer to the specifications in the logger documentation for maximum pulse frequency (documentation is also available at http://www.onsetcomp.com/support/manuals).

4. Click Save. Note that the selections will not take effect in the logger until you launch it.

Advanced Sensor Properties: Calibration

Use the Advanced Sensor Properties window to set the calibration method used for internal light or motor sensors in UX90 series data loggers. The default calibration method is to "calibrate from logger," which is an auto-calibration procedure using the Calibrate button on the logger. Alternatively, you can set the calibration method to a maximum or minimum sensitivity level as defined by HOBOware. To change the calibration method:

1. Select the sensor that corresponds with the internal light/motor channel you wish to configure.
2. Select "Calibrate from logger" to use auto-calibration or select "Set to maximum or minimum sensitivity" to use HOBOware for calibration. See below for more details on both procedures.



Advanced Sensor Properties

Select Sensor

1) Light

Sensor Properties

Choose a calibration method for the selected internal sensor:

● Calibrate from logger

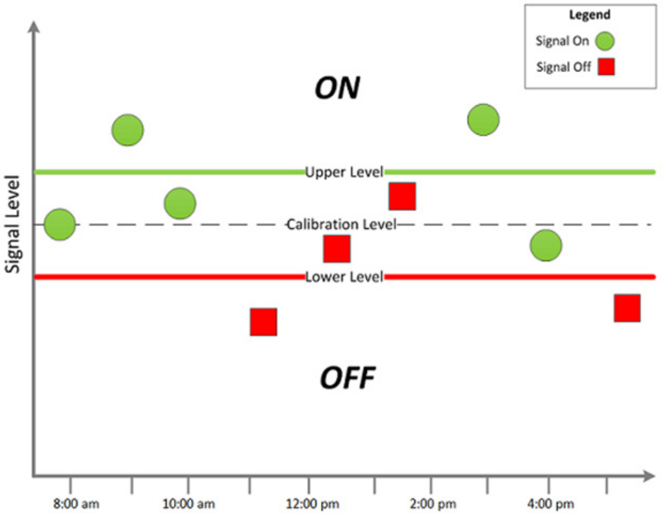
○ Set to maximum sensitivity

3. Click Save. Note that the selections will not take effect in the logger until you launch it.

Calibrate from Logger

Calibrating from the logger with the calibration button, also called auto-calibration, is used to calibrate the ON and OFF threshold of the logger to achieve reliable readings in an environment where motor or light levels are unknown prior to deployment or where logger light levels are variable. In the auto-calibration process, the light level or the AC magnetic field for a motor sensor is measured via a built-in analog-to-digital converter and the resulting value is used to generate a calibration threshold.

The logger has a built-in hysteresis level of approximately 12.5% for the light sensor and 6.25% for the motor sensor to prevent the sensor from toggling between ON and OFF when the signal level is near the calibration threshold. This plot shows how the logger handles hysteresis. The logger interprets the signal as ON until it drops below the lower level of the calibration threshold. Once it switches to off, the signal will not switch back to ON until it bypasses the upper limit of the calibration level.



When auto-calibrating from the logger (button calibrating):

1. Deploy the logger near the light/motor to be monitored. Turn the light or motor on.
2. Press the Calibrate button for 1 second. The LCD screen will display the signal strength of the light/motor. The signal strength should ideally be at least 3 bars. Orient the logger as necessary to increase the signal strength. The signal strength indicator will remain on the display for ten minutes or until calibration is complete.
3. Press the Calibrate button for 3 seconds while "HOLD" appears on the LCD screen. For the light sensor, move your hand away from the logger to prevent shadowing. The logger will count down to the auto-calibration and then display either "PASS" or "FAIL" after calibration is complete.
4. If the auto-calibration fails, point the sensor directly at the light or position it closer to the motor source and then repeat these steps.

Set to Maximum/Minimum Sensitivity

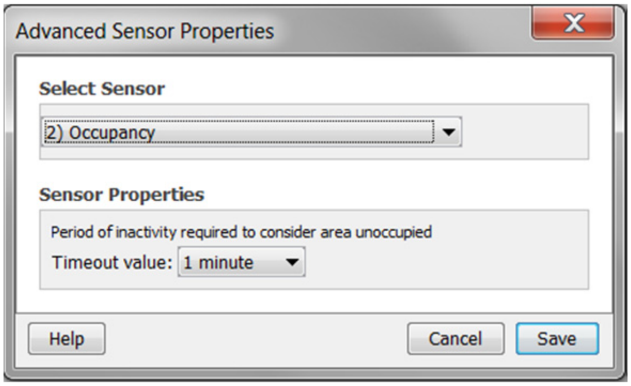
If you cannot manipulate the light source or access the motor, you can set the calibration level in this window. The lower the light/magnetic field level, the higher the sensitivity needs to be to record changes between ON and OFF conditions. For light sensors, the maximum sensitivity is approximately 100 lux (for rooms with low light levels, such as residential environments) and the minimum sensitivity is approximately 500 lux (for rooms with high light levels, such as retail environments). For motor sensors, the maximum sensitivity is approximately 40 mG (for a weak magnetic field) and the minimum sensitivity is set to approximately 100 mG (for a strong magnetic field).

Advanced Sensor Properties: Occupancy

Use the Advanced Sensor Properties window to set the timeout value for an occupancy sensor (UX90-005x/006x models). The timeout value is the period of inactivity required for the sensor to consider the area unoccupied. The timeout value is set to 1 minute by default. You can change this to one of the preset values or enter a custom value.

To change the timeout value for an occupancy sensor:

1. Select the sensor that corresponds with the occupancy channel you wish to configure.
2. Select a preset timeout value as shown in the example below or select Custom and enter your own value in minutes and seconds.



Select Sensor: 2) Occupancy

Period of inactivity required to consider area unoccupied

Timeout value: 1 minute

3. Click Save. Note that the selections will not take effect in the logger until you launch it.

Statistics: Maximum, Minimum, Average, and Standard Deviation

You can configure UX100 series and UX120-014M loggers to calculate maximum, minimum, average, and standard deviation statistics for all enabled sensors during logging at each logging interval based on samples taken at a rate you specify. This will result in up to four additional series per sensor that record the following information at each logging interval:

- The maximum, or highest, sampled value,
- The minimum, or lowest, sampled value,
- An average of all sampled values, and
- The standard deviation from the average for all sampled values.

For example, let's say both the temperature and RH sensors have been enabled, the logging interval is set to 5 minutes and the sampling interval is set to 30 seconds (with maximum, minimum, average, and standard deviation all enabled). Once logging begins, the logger will measure and record the actual temperature and RH sensor values every 5 minutes. In addition, the logger will take a temperature and RH sample every 30 seconds and temporarily store them in memory. The logger will then calculate the maximum, minimum, average, and standard deviation using the samples gathered over the previous 5-minute period and log the resulting value(s). When reading out the logger, this would result in 10 data series (not including any derived series, such as dew point): two sensor series (with temperature and RH data logged every 5 minutes) plus eight maximum, minimum, average, and standard deviation series (four for temperature and four for RH with values calculated and logged every 5 minutes based on the 30-second sampling).

Notes:

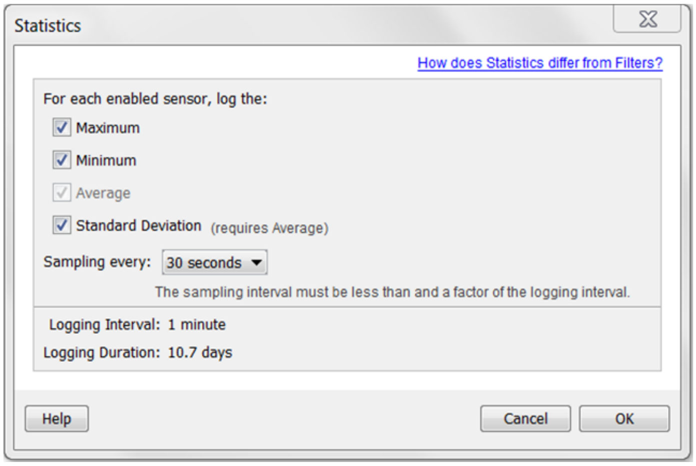
- Statistics are not available for logging if Normal or Burst has been chosen as the Logging Mode in the Launch Logger window.
- On thermocouple loggers, statistics are only available on thermocouple channels and not on the internal temperature channel.

To configure statistics:

1. If the Statistics window is not already open, select Statistics from the Logging Mode drop-down menu in the Launch Logger window. Or, if Statistics has already been configured, click the Edit button.
2. Click the Maximum, Minimum, Average, and Standard Deviation checkboxes for each of the statistics you want to calculate during logging. Note that Average is automatically selected when selecting Standard Deviation. **Important:** Statistics apply to all enabled sensors; every selected statistic will be calculated for all sensors (except battery voltage). For example, if both the temperature and RH sensors have been selected in the Launch Logger window and you select Average, then the average

will be calculated for both temperature and RH. In addition, the more statistics you record, the shorter the logger duration and the more memory is required.

3. Set the sampling interval, which must be less than and a factor of the logging interval. Choose either a preset sampling interval or select Custom and enter your own sampling interval. Keep in mind that the more frequent the sampling rate, the greater the impact on battery life.



Statistics

How does Statistics differ from Filters?

For each enabled sensor, log the:

☑ Maximum

☑ Minimum

☑ Average

☑ Standard Deviation (requires Average)

Sampling every: 30 seconds

The sampling interval must be less than and a factor of the logging interval.

Logging Interval: 1 minute

Logging Duration: 10.7 days

4. Click OK when done. This will return you to the Launch Logger window. Click the Edit button next to Logging Mode in the Launch Logger window to make additional changes.

Once logging begins, press the Alarm/Stats button on the logger for 1 second to cycle through the current maximum, minimum, average, and standard deviation data (as applicable) on the LCD screen (it is not available in the HOBOware Status window). You can plot the statistics series once you read out the logger.

See also:

- Filtered Series vs. Statistics Logging
- Launch Options for HOBO UX100 Series Loggers and the HOBO 4-Channel Thermocouple Logger (UX120-014M)

Filtered Series vs. Statistics Logging

UX100 series loggers support filtered series and statistics logging, both of which involve calculating maximum, minimum, and average values that you can plot after the logger is read out. Both are accessed from the Launch Logger window; for filtered series, click the Filters button and for statistics logging, select Statistics as the Logging Mode. However, there are some key differences between the two features. The following table compares filtered series to statistics logging so that you can choose the best solution for your deployment. **Note:** There is also another filtering option available after you read out the logger, which is available from the Filter button on the toolbar. This allows you to create filtered series based on the data in the plotted datafile. For more information on filtering after reading out a logger, see Filtering a Series.

	Filtered Series	**Statistics Logging**
What logger models work with this feature?	All logger models.	Only UX100 series loggers.
Which sensors does this apply to?	Only those that you select; you must set up individual filters for each sensor.	Automatically calculated for all enabled sensors (each sensor selected in the Launch Logger window except for Battery).
Which measurement types are compatible?	All measurement types, including state, event, pulse, and runtime.	Only those supported by the UX100 series (temperature and RH).
Can I view the data on the	No, filtered series are only available after	Yes, you can press the Alarm/Stats

	Filtered Series	Statistics Logging
logger's LCD screen (if available)?	the logger is read out.	button on the logger to cycle through each of the enabled statistics.
What kind of data can be calculated with this feature?	Maximum, minimum, and average; standard deviation is not available.	Maximum, minimum, average, and standard deviation.
How often can data be calculated?	By day, hour, minute, or second using samples taken at the logging interval. The filter interval should be greater than the logging interval. It is also recommended that it is a multiple of the logging interval so that every filter interval has an equal number of samples.	Data is calculated at each logging interval using samples taken at the sampling interval. The sampling interval must be less than and a factor of the logging interval (i.e., if the logging interval is set to 10 minutes, statistics cannot be calculated every hour; the sampling interval would have to be less than and a factor of 10 minutes).
Can I select different intervals for each calculated series?	Yes, you can select a different interval for each filter you set up.	No, the logging and sampling intervals apply to all selected statistics.
How is the data recorded?	Sensor data is recorded at every logging interval and filtered data points are calculated at the rate you specified (for example, the average temperature is calculated every hour). This requires more memory as every sample is recorded.	The logger takes a sample at every sampling interval, but only records statistics data at the logging interval. This requires less memory as every sample is not recorded.

Burst Logging

Burst logging is a logging mode available for UX100 series and UX120-014M loggers that allows you to set up more frequent logging when a specified condition is met. For example, let's say the logger is recording data at a 5-minute logging interval and burst logging is configured log every 10 seconds when the temperature goes above 85°F (the high level) or falls below 32°F (the low level). This means the logger will record data every 5 minutes as long as the temperature remains between 85°F and 32°F. Once the temperature reaches 90°F, for example, the logger will switch to the faster logging rate and record data every 10 seconds until the temperature falls back below the high level (or 85°F in this case). At that time, logging then resumes every 5 minutes at the normal logging interval. Similarly, if the temperature falls to 30°F, for example, then the logger would switch to burst logging mode again and record data every 10 seconds. Once the temperature rises back to 32°F, the logger will then return to normal mode, logging every 5 minutes.

Notes:

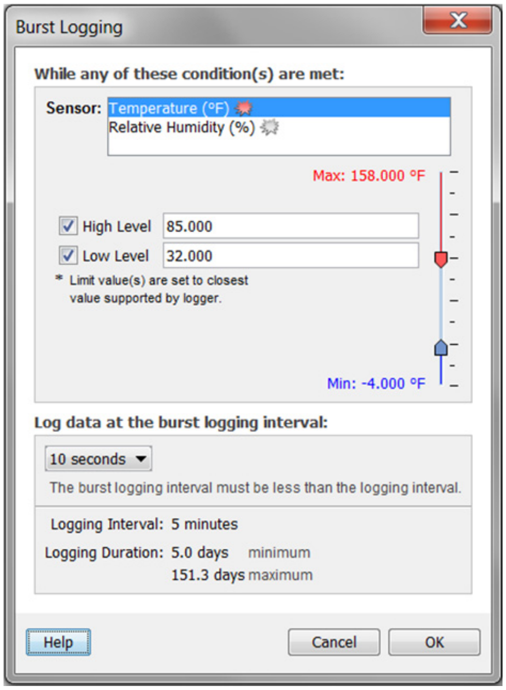
- Burst logging is not available if alarms have been enabled for the logger.
- The Stop Logging option "Never (wrapping)" is not available when burst logging is configured on a UX100 series logger.
- The actual values for the burst logging levels are set to the closest value supported by the logger. For example, the closest value to 85°F that the logger can record is 84.990°F and the closest value to 32°F is 32.043°F.
- Burst logging mode can begin or end when the sensor reading is within the logger specifications of 0.02°C resolution. This means the value that triggers burst logging may differ slightly than the value entered. For example, if the High Level for a temperature alarm is set to 75.999°F, burst logging can start when the sensor reading is 75.994°F (which is within the 0.02°C resolution).

- Once the high or low condition clears, the logging interval time will be calculated using the last recorded data point in burst logging mode, not the last data point recorded in "normal mode." For example, let's assume the logger has a 10-minute logging interval and logged a data point at 9:05. Then, the high level was surpassed and burst logging began at 9:06. Burst logging then continued until 9:12, when the sensor reading fell back below the high level. Now back in normal mode, the next logging interval will be 10 minutes from the last burst logging point, or 9:22 in this case. If burst logging had not occurred, the next data point would have been at 9:15.
- A New Interval event will appear on the plot (if you select events for plotting in the Plot Setup window) each time the logger enters or exits burst logging mode.
- On thermocouple loggers, burst logging is only available on thermocouple channels and not on the internal temperature channel.

To set up burst logging:

1. If the Burst Logging window is not already open, select "Burst logging" from the Logging Mode drop-down menu in the Launch Logger window. Or, if Burst logging has already been configured, click the Edit button.
2. Select the sensor you want to configure for burst logging.
3. Select the High Level checkbox if you want to set up a condition in which burst logging will occur when the sensor reading rises above the high level value. Type in the value or drag the red upper slider.
4. Select the Low Level checkbox if you want to set up a condition in which burst logging will occur when the sensor reading falls below the low level value. Type in the value or drag the blue lower slider.

In this example, both the high and low levels were selected. You may choose only one if you wish.



While any of these condition(s) are met:

Sensor: Temperature (°F)
Relative Humidity (%)

Max: 158.000 °F

☑ High Level 85.000
☑ Low Level 32.000

* Limit value(s) are set to closest value supported by logger.

Min: -4.000 °F

Log data at the burst logging interval:

10 seconds

The burst logging interval must be less than the logging interval.

Logging Interval: 5 minutes
Logging Duration: 5.0 days minimum
151.3 days maximum

5. Set the burst logging interval, which must be less than the logging interval. Select either a preset burst logging interval or select Custom and enter your own interval. Keep in mind that the more frequent the burst logging rate, the greater the impact on battery life and the shorter the logging duration.
6. Click OK when done. This will return you to the Launch Logger window. Click the Edit button next to Logging Mode in the Launch Logger window to make additional changes.

Once the logger is launched, the high and low burst logging levels are only checked when the logger's LCD screen refreshes once every 15 seconds. Therefore, if you set the logging interval to less than 15 seconds and the sensor reading falls outside the levels, the burst logging will not log until the next 15-second refresh cycle.

Important: If high and/or low levels have been configured for more than one sensor, then burst logging will begin when any high or low condition goes out of range. Burst logging will not end until all conditions on all sensors are back within normal range.

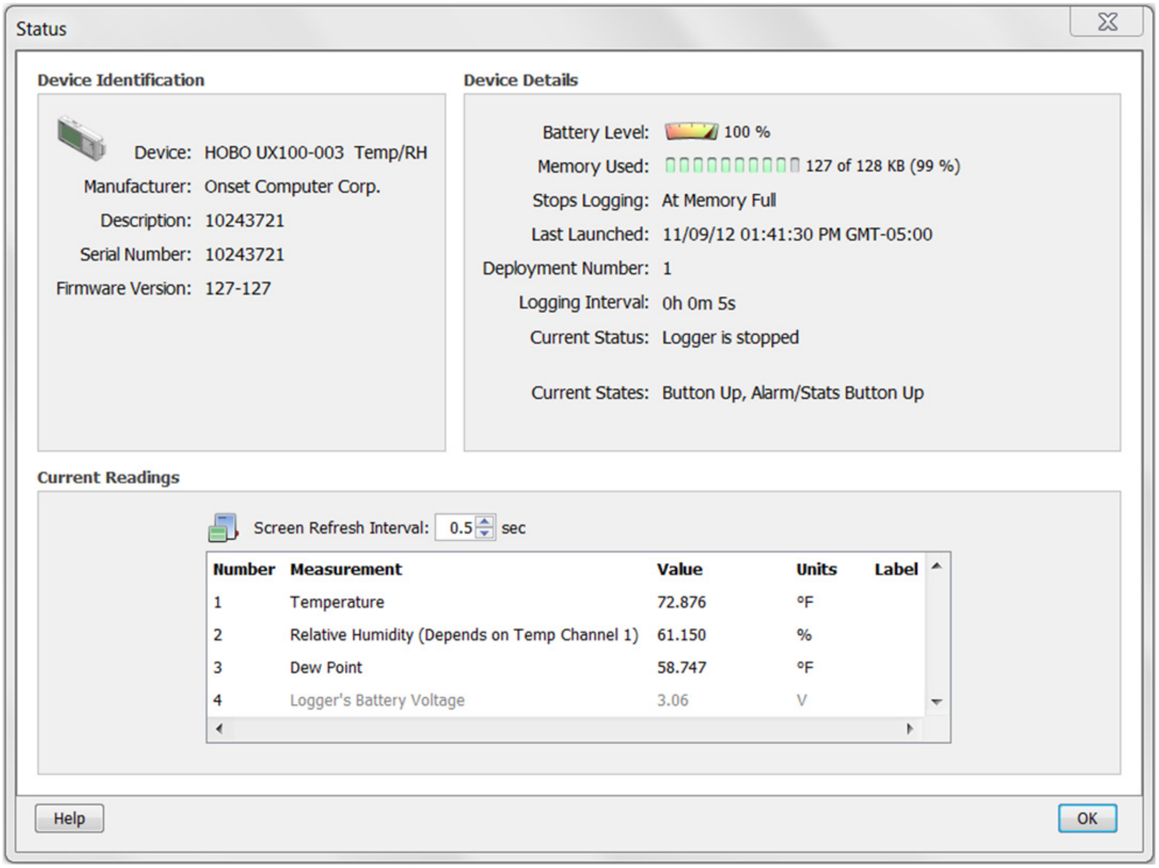
Checking Device Status

The Status window displays real-time information about the attached logger, including the current state of the logger, logging start time, current readings, and memory used. You can check the status for a logger whether it is waiting for logging to begin, actively logging (unless it is logging at a fast logging interval), or stopped.

To check the status of a logger:

1. Connect the logger to the computer.
2. Click the Status icon on the toolbar, or select Status from the Device menu. You can also check the status by clicking the Status button on the Launch window, but this will show details from the previous launch.

This is an example of the Status window. The information displayed varies depending on the logger that is connected. See Status window for details on the type of information displayed.



Device: HOBO UX100-003 Temp/RH
Manufacturer: Onset Computer Corp.
Description: 10243721
Serial Number: 10243721
Firmware Version: 127-127

Battery Level: 100 %
Memory Used: 127 of 128 KB (99 %)
Stops Logging: At Memory Full
Last Launched: 11/09/12 01:41:30 PM GMT-05:00
Deployment Number: 1
Logging Interval: 0h 0m 5s
Current Status: Logger is stopped

Current States: Button Up, Alarm/Stats Button Up

Screen Refresh Interval: 0.5 sec

Number	Measurement	Value	Units	Label
1	Temperature	72.876	°F	
2	Relative Humidity (Depends on Temp Channel 1)	61.150	%	
3	Dew Point	58.747	°F	
4	Logger's Battery Voltage	3.06	V	

Important: Battery power is drained more rapidly while checking status. Keep this in mind when frequently checking status during a deployment. You can significantly reduce the demand on the battery by adjusting the Screen Refresh Interval to five seconds or higher (not available on all loggers).

The Status Window

The Status window displays the current status of the logger. If you clicked Status from the Launch Logger window, then details from the previous launch is displayed. The Status window is divided into three panes: Device Identification, Device Details, and Current Readings.

Device Identification

The Device Identification pane shows the logger selected for status. It lists the device name and model number, description entered when the logger was last launched (which is also used as the default file name and title in the plot), serial number, and firmware number.

Device Details

The Device Details pane shows detailed information about the logger deployment including the following items. Note that not all of these items are displayed for every logger model.

- **Battery Level/Battery State.** This is the condition of the battery. Consult the logger documentation for specifics on battery capacity.
- **Memory Used.** This is the percentage of logger memory used so far in the deployment. Consult the logger documentation for specifics on memory capacity. Note that if the battery died during logging, the Memory Used will be 100% even if only a small amount of the memory was used.
- **Stops Logging.** This displays the date/time or the condition under which the logger will stop logging.
- **Last Launched.** This is the date and time, including the offset to Greenwich Mean Time (GMT), when the logger was last launched. This is not necessarily the time when the first sample was recorded; it is the time all the launch settings were loaded in the logger.
- **Delayed Start (if applicable).** If the logger has been launched, but is waiting to start on a particular date/time or at the next interval, the scheduled start time is shown here in local time.
- **Deployment Number.** This is the number of times the logger has been launched, including the most recent launch.
- **Logging Interval (if applicable).** This is the rate at which the logger was set up to record data. If multiple logging intervals are available, the interval currently in use (if the logger is logging) will be shown in bold.
- **Sampling Interval (if applicable).** This is the rate at which sensors are sampling data in between the logging interval.
- **DO Sensor Cap Information (HOBO U26 Dissolved Oxygen logger only).** For HOBO U26 Dissolved Oxygen loggers, the DO sensor cap expiration date, initialization date, and manufactured date is shown. For more details about the DO sensor cap, see Checking Dates for the HOBO U26 Dissolved Oxygen Logger Sensor Cap.
- **Current Status.** This is a message that describes the state of the logger. Messages include:
    - **Awaiting Button/Coupler Start.** The logger has been launched with a coupler or push button start (if available). Press and hold down the button on the logger for three seconds to begin logging, or follow the instructions that came with your logger if it offers a triggered (coupler) start but does not have a button.
    - **Awaiting Delayed Start.** The logger will begin recording data at a specific time because the logger was configured to start on a specific date/time or at the next interval.
    - **Launched, Logging.** The logger has been launched is actively recording data.
    - **Logger Is Full.** The logger has reached its memory capacity and is no longer recording data.

  - **Logger Is Stopped.** The logger is not logging, is not full, and is not awaiting a start.
  - **On Hold for Later Launch.** The logger has been launched with a Save Settings start (if available). Logging is not scheduled to begin, but the launch settings have been entered and saved.
  - **Relay is open/Relay is closed.** For the HOBO U30 Station, the current state of the relay is also displayed.
- **Current States, if applicable.** This is the current condition of the logger button(s). Refer to the logger documentation for details on logger operation, buttons, and interval events.

Current Readings

The Current Readings pane lists the latest measurement for each data series. Sensors that measure state changes do not show current readings. To change the order of series displayed in the Status window, go to the Preferences and select Display and then Series.

You can also set the Screen Refresh Interval for some loggers. This is the frequency the current readings are updated, up to 3,600 seconds (one hour). A higher number results in less drain on the logger's battery.

A Contact HOBOlink button also appears at the bottom of the Status window for the HOBO U30 Station only. Click this button when you want the HOBO U30 Station to connect to HOBOlink. When you click Contact HOBOlink, a confirmation message is displayed. Once you click Yes, the Status screen will close and then the HOBO U30 Station will attempt to connect to HOBOlink within 30 seconds. A warning may appear in the event that a live connection with HOBOlink is already underway.

Notes:

- Readings are displayed for all available sensors, even if they are not being logged. Sensors not being logged are dimmed.
- If a logger has channels for external sensors, a description and reading will be given for the external channels even if no sensors are plugged in.
- For event loggers, the event count displayed in Current Readings will always start at zero, even if many events have already been logged.
- Sensor labels (if applicable) are displayed following the sensor name.
- For station loggers, the location (if defined) is displayed next to the reading.
- If a HOBO U30 Station has an Analog Sensor Port, readings for one or both channels are displayed.
- When a Station logger is logging, the last sample taken by the logger at the last interval will be displayed.
- The RSSI (Signal Level) is displayed for the HOBO U30/GSM Station. This helps you determine if there is enough signal strength in the current location for the HOBO U30 Station to contact a cellular tower for connecting with HOBOlink. Signal level is measured on a scale of 0 to 10, with 0 being no signal, 1 being a weak signal, and 10 being a strong signal
- Battery voltage is displayed for some loggers.
- For acceleration loggers only, color-coded tilt meters display X, Y, and Z-axis tilt graphically (relative to vertical, assuming that the only acceleration force on the logger is gravity).

Stopping a Device

A logger automatically stops recording data when the memory is full (unless it has been configured to never stop logging) or when the battery runs down. Depending on the launch settings selected, you can also press the

Start/Stop Logging button to stop logging on certain logger models. In addition, you can use HOBOware to stop the logger manually at any time.

To stop a logger:

1. Connect the logger to the computer.
2. Click the Stop icon on the toolbar, or select Stop from the Device menu.

After the logger has been stopped, the data remains in the logger until the next launch. Be sure to read out the logger before setting up the next launch.

Chapter 3

Reading Out, Plotting, and Analyzing Data

After a logger has recorded data, you can then do the following:

- Read out the data from the logger
- Plot the data
- Modify the plot if desired
- Use Data Assistants
- Export the data
- Import data

Reading Out Data

To retrieve data recorded by a logger, you must read out the logger. Reading out the logger copies data from the logger to your computer, allowing you to save the data and plot it. During readout, the logger continues to record data unless you have stopped it or it is full.

You can also read out many logger types to a shuttle and then offload the datafiles from the shuttle to your computer. See Offloading and Saving Shuttle Files for more details.

To read out a logger to the computer:

1. Connect the logger to the computer.
2. Click the Readout icon on the toolbar or select Readout from the Device menu. If the logger is still logging, confirm whether to stop the logger. Click either Don't Stop or Stop as desired.
3. A progress bar displays while the data is being read out. Once the readout is complete, choose a location and/or a new filename or accept the default location and name to save the data. The default location is:

    - C:\Documents and Settings\<user>\My Documents\HOBOware
      (for Windows XP)
    - C:\Users\<user>\Documents\HOBOware
      (for Windows 7 or Windows 8)
    - Users/<user>/Documents/HOBOware
      (for Macintosh OS X)

    If you save the file to a different folder, that folder will be the new default save location for future readouts.

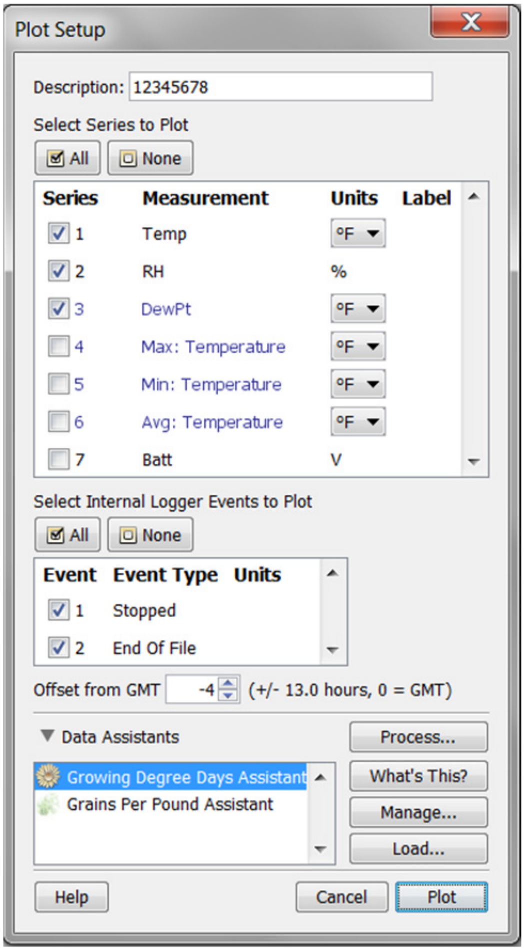
4. Click Save. Most datafiles have a .hobo extension. Station loggers read out with HOBOware Pro have a .dtf extension. If you are using HOBOware Pro in secure mode, the file extensions will be .hsec (U-Series loggers) or .dsec (Station loggers).
5. After saving the data, select the sensors and/or events you wish to display in a graph and click Plot. See the Plotting Data for more details on the options available when plotting.

Notes:

- Once a logger is read out, the data will remain in the logger memory until the next time the logger is launched. Logger memory is therefore never empty.
- You can read out some U-Series loggers when the batteries are low if the logger can be powered by a USB cable. In this case, a warning appears before the readout begins indicating the battery is very low and that you may experience communications problems. Once the readout is complete, be sure to replace the batteries as suggested.
- You can bypass the Save window during the readout process by setting the Readout Time-Saving Options in the General subcategory of Preferences.

Plotting Data

After you read out a logger or open a saved file, you can plot the data with the Plot Setup window like the following example.



Description: 12345678

Series	Measurement	Units	Label
☑ 1	Temp	°F	
☑ 2	RH	%	
☑ 3	DewPt	°F	
☐ 4	Max: Temperature	°F	
☐ 5	Min: Temperature	°F	
☐ 6	Avg: Temperature	°F	
☐ 7	Batt	V	

Event	Event Type	Units
☑ 1	Stopped	
☑ 2	End Of File	

Offset from GMT -4 (+/- 13.0 hours, 0 = GMT)

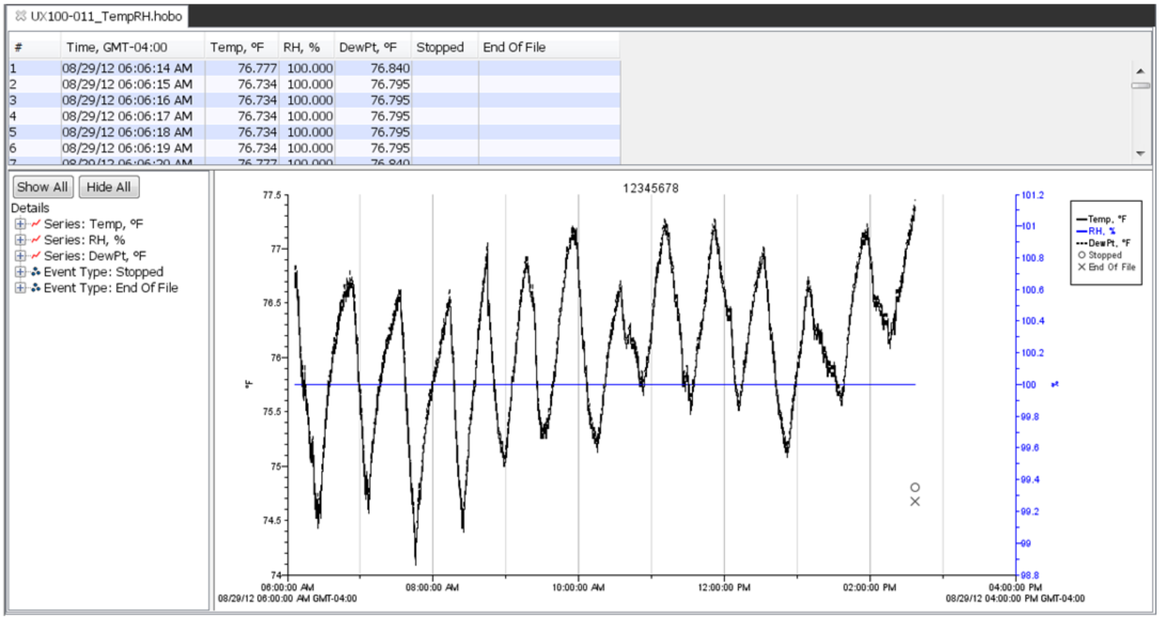
Growing Degree Days Assistant
Grains Per Pound Assistant

To plot the data:

1. Use the existing description or type a new one. The default description matches the one used when launching the logger and will be used for the plot title.
2. Select the series you wish to view on the plot. Click the All or None button to select or deselect all series, or click the checkboxes to select or deselect individual series. Series types can include:

  - Logged data series, which is a series containing the sensor measurements, state changes, or statistics (select loggers only) recorded by the logger.
  - Derived series, which is a series calculated based on one or more logged data series. This could be an automatically generated series for a measurement type, such as Dew Point when temperature and RH is logged. Or, it could be a filtered or scaled series if you configured a filters or scaling with a data assistant in the Launch Logger window (select loggers only).
  - Battery voltage, which lists the logger battery voltage recorded at each logging interval.

3. Change the default units for selected series if desired. You can also change the units for a series after it is plotted.
4. Select the internal logger events to view on the plot. Click the All or None button to select or deselect all events, or click the checkboxes to select or deselect individual events. Internal logger events are individually logged occurrences that can be recorded at any time during deployment, regardless of the logging interval. These events can include started or stopped logging, low battery, or an alarm trip. Refer to the logger manual for a complete list of internal events if applicable.
5. Adjust the time zone offset, if necessary. By default, data is shown in the offset used to launch the logger with HOBOware (not a shuttle). To select a different offset, enter the hours offset from GMT (UTC) in decimal form. You may find this useful if you logged in multiple time zones, or if you took the logger to a different time zone after launching it.
6. HOBOware Pro Only: If data assistants are available, you can use them to create additional series. Select an assistant from the list and click Process to create a new series.
7. Click the Plot button to generate a plot. The plot is drawn and includes a title, a time axis (x-axis), one or more value axes (y-axis), and a legend. The data for each series are listed in a points table above the plot. Details about each series, such as the type of logger and deployment information are listed in the Details pane to the left of the plot. You can show or hide these elements using the View menu. To organize several plots, use the Window menu to switch between Tabbed View, Tile Horizontally, or Tile Vertically.

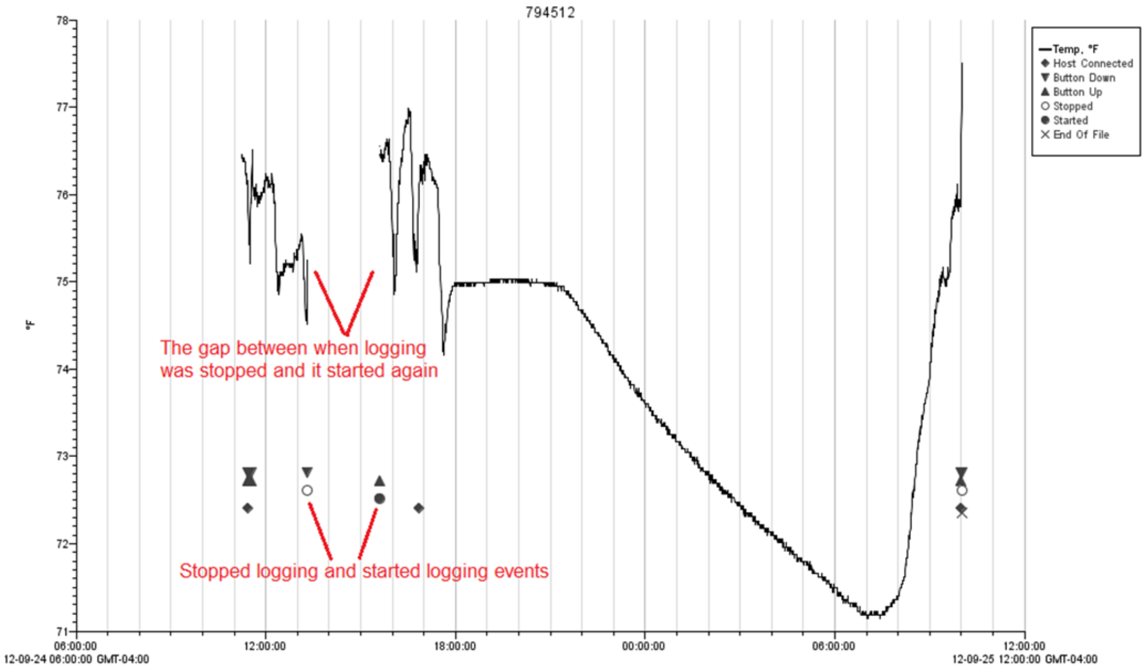


#	Time, GMT-04:00	Temp, °F	RH, %	DewPt, °F	Stopped	End Of File
1	08/29/12 06:06:14 AM	76.777	100.000	76.840		
2	08/29/12 06:06:15 AM	76.734	100.000	76.795		
3	08/29/12 06:06:16 AM	76.734	100.000	76.795		
4	08/29/12 06:06:17 AM	76.734	100.000	76.795		
5	08/29/12 06:06:18 AM	76.734	100.000	76.795		
6	08/29/12 06:06:19 AM	76.734	100.000	76.795		

Notes:

- To change the order of series displayed in the Plot Setup window, open the Preferences, select Display and then Series.

- To change the series and events that are selected by default in the Plot Setup window or to control whether four possible Light/Occupancy series are derived on supported loggers, open the Preferences, select Plotting and then Plot Setup.
- To bypass the Plot Setup window when opening a datafile, open the Preferences, select General and then select Open File Time-Saving Options.
- If a pie chart icon appears in the Plot Setup window, this means the data in the file you are plotting can also be plotted in a pie chart. See Viewing a Pie Chart for more details.
- On some loggers, the Started and Stopped internal events can only occur once. However, UX100 series loggers can start and stop logging multiple times in a single deployment (as configured in the Launch Logger window). Multiple stopped and started events in a single file are not only displayed on the plot if selected in the Plot Setup window, but the resulting gap that occurs in the data is also represented in the series. In this example, the logger was stopped at 1:19 and then started again at 2:35; both events are on the plot. The temperature series shows a break between those two times. That represents the gap between when logging was stopped and when it resumed, both using the button on the logger.



The gap between when logging was stopped and it started again

Stopped logging and started logging events

Opening Files

HOBOware Pro and HOBOware Lite can open .hobo files. The following files can be opened by HOBOware Pro:

- .hsec, which are secure files (21 CFR Part 11 Conformance) from U-Series loggers.
- .hproj, which is HOBOware Project file.
- .dtf, which are files from a HOBO U30 Station, Weather Station, Micro Station, or Energy Logger. Other .dtf files are not compatible with HOBOware Pro.
- .dsec, which are secure files (21 CFR Part 11 Conformance) from Station loggers.
- .txt, .csv, and most ASCII files can be imported.

To open a file:

1. Double-click a compatible file from Windows Explorer or Mac Finder. Or in HOBOware, click the Open icon on the toolbar or select Open Datafile from the File menu.
2. Select one or more files and click Open.
3. Select the series and/or events you wish to view in the plot and click the Plot button. If you selected multiple files to open, you will be prompted with a Plot Setup window for each file (unless you have set the preference to automatically plot data as described in General Preferences).

For details on verification failure when opening a file in HOBOware Pro, see Working in Secure Mode.

To open a project file:

1. From the File menu, select Open Project.
2. Select a project (.hproj) file and click Open.

Recently opened files are listed in the File menu. From the File menu, select Recent Files and then choose the file you wish to open. To empty the recent file list, select Recent Files from the File menu and then select Clear Recent Files.

Opening Files from Unsupported Loggers

Although the following loggers cannot be launched or read out using HOBOware, datafiles from these loggers can be opened and plotted by HOBOware Pro. All graphing tools, filters, and Data Assistants can be used with the files and data can be exported to text and project files.

H08 (8-bit)

- H08-001-04
- H08-002-04
- H08-003-04
- H08-004-04
- H08-006-04
- H08-008-04

TBI/WTA

- TBI32-05+37
- TBI32-20+50
- WTA08-05+37
- WTA08-39+75
- WTA32-05+37
- WTA32-39+75

H08 (12-bit)

- H08-030-08
- H08-031-08
- H08-032-08

H20

- H20-001

H06

- H06-001-02
- H06-002-02
- H06-003-02
- H06-004-02

H07

- H07-001-02
- H07-001-04

H14

- H14-001
- H14-002

H12

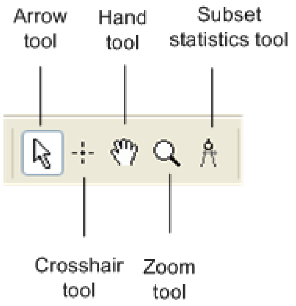
- H12-001
- H12-002
- H12-003

Working with Plots

There are several tools available for working with plots.

Tools

There are five tools available on the toolbar for viewing the plot and isolating data.

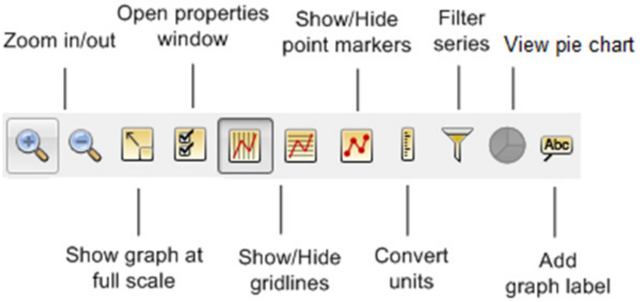


- Use the Arrow tool to point to and select items on the graph to edit their properties (through a right-click menu).
- Use the Crosshair tool to zero in on a specific date and time in the plot and any data points associated with that date and time. Click the Crosshair icon and then place your cursor anywhere on the plot to draw a red vertical line at a particular point.
- Use the Hand Drag tool to move different areas of the graph into view (panning) or adjust the position of one series so it can be viewed more easily. This is particularly useful when you are zoomed into the graph and want to see another section of the graph without zooming out and then zooming back in on the new location.
- Use the Zoom tool to focus on one area of the graph, allowing you to see more detail.

- Use the Subset Statistics tool to view statistics for a particular time span (HOBOware Pro only).

Actions

Use the Actions buttons on the toolbar to perform a number of actions on a plot or a series.



- Use the Zoom In/Zoom Out buttons to keep the plot centered as you zoom.
- Click the Grow Graph at Full Scale button to return to the original, full-scale version of the plot when the datafile was first opened.
- Click the Open Properties button to open the properties window the plot element that is currently selected, such as axis, series, legend, or title.
- Use the Gridline buttons to toggle all horizontal or vertical gridlines on and off. You can also toggle gridlines on and off for each axis individually. Using the arrow tool, double-click an axis to get the Axis Properties window. Select or deselect the Show Gridlines checkbox to toggle the gridlines for that axis.
- Click the Point Markers button to toggle the point markers for all series on and off. To show or hide markers for an individual series, right-click the series to open the Series Properties window. Select or deselect the Mark Points checkbox to toggle the markers for that series.
- Click the Convert Units button to open the Convert Plot window, which allows you to convert the units on certain series on the plot to other units (for example, from degrees Fahrenheit to degrees Celsius).
- Click the Filter Series button the Filter Series window, which allows you to add a statistical series to the plot.
- Click the Pie Charts button if a pie chart is available for the plot (only available on loggers that support state series)
- Click the Add Graph Label button to open the Graph Label Properties window.

Menus

Use the Edit and View menus to access various controls when working with a plot. You can also right-click an element in the plot to access many of the same options available from the Edit and View menu and to open properties windows.

Using the Arrow Tool

Use the Arrow tool to select items on the plot. Click the Arrow icon on the toolbar or press A to select the arrow tool.

If you are currently using another tool and do not want to switch tools, press N on your keyboard to select each graph item (including hidden items, such as value axes for states or events) in sequence.

The selected item (if visible) is shaded or boxed. You can then right-click the selected item, double-click it, or press the Enter key on your keyboard to open the Properties window for that item.

To deselect, click an area within the axes that does not have series data. Click the View menu and choose Select None or press D.

Using the Crosshair Tool

Use the crosshair tool to zero in on a specific date and time in the plot and any data points associated with that date and time. To use the crosshair:

1. Click the Crosshair icon -¦- on the toolbar or press C.
2. Click a point on the graph to mark it.
3. Click another point to move the marker.

When you click on a graph, the nearest data point is selected. When series are very close together and the location you click is between two points, it is possible that the nearest point is not on the series you clicked.

You can also mark the point on the graph by clicking the corresponding cell in the Points table. If you are zoomed in and click a point in the Points table that is outside the zoom area, the plot will scroll to that area of the graph. To prevent scrolling in this situation, go to the Preferences, select Plotting and then Points Table & Details Pane. Deselect the "When selected value in table is out of plot range, drag series to that value.

The plot changes in several ways when the crosshair is in use. The Points table shifts to the row that contains the data point. Where the crosshair intersects a data point, a square surrounds the data point. The intersection points are also marked by small color-coded arrows on the left and right value axes.

If the legend is displayed next to the graph, the point values for each series are updated to reflect the crosshair location. Values are listed in the legend differently depending on whether the data is a logged sample, state, or event:

- Values that are not in parentheses are actual data points logged at the time selected by the crosshair.
- Values in parentheses are estimated because there were no exact values for the series at the time selected by the crosshair. Zoom in or move the crosshair to see actual values.
- A value of "…" indicates that there is no series data during the time selected. This is seen most frequently for events. If the time selection falls within an event series, but does not contain an event, parentheses surround the "…" value.
- A value of "logged" indicates an internal logger event happened at the selected time.

The legend must expand in height to list the point values. If your application window is too small to accommodate the expanded height, the values will not be added to the legend. You can still refer to the Points table to find the values of the selected points.

To remove the crosshair from the graph, right-click the plot and select Remove Crosshair or choose remove Crosshair from the View menu.

Zooming, Panning, and Smart Scaling Plots

You can adjust the viewing area of the plot by zooming, panning, and smart scaling.

Zooming

There are two ways to zoom: either by using the zoom tool 🔍 (or pressing Z) or by selecting Zoom In 🔍or Zoom Out 🔍 from the toolbar or the View menu. Use the zoom tool to zoom anywhere on the plot that you select, clicking the right-mouse button to zoom in or out. Use the Zoom In/Zoom Out icons to keep the plot centered as you zoom.

When zooming:

- Right-click to toggle between zoom in and zoom out.
- Check the symbol inside the zoom tool to determine the direction you are zooming. A plus sign (+) or arrows pointing outward will zoom in, while a minus sign (-) or arrows pointing in will zoom out.
- Click an area on the graph inside the axes to zoom one level (a factor of two). Continue clicking to zoom multiple levels.
- Hold down the left mouse button in one location to zoom continuously. Release the mouse button to stop zooming.
- Hold down the left mouse button while drawing a rectangle around the area you wish to zoom in on, then click inside the rectangle. The area inside the rectangle expands to fill the whole graph.
- To constrain the zoom to horizontal or vertical zooming, place the cursor over the axis you want to zoom and click the mouse button. Hold the mouse button down to continue to zoom. Or, press the X key while zooming to restrict motion horizontally and press the Y key while zooming to restrict motion vertically.
- If you are currently working with the crosshair, arrow, or hand tool, you can click the Zoom In/Out icons on the toolbar to quickly zoom into and out of the middle of the display without changing tools.
- Zooming will not work on an axis that is locked. To unlock an axis, double-click the axis with the arrow tool and deselect the Lock Axis Scaling and Tick Marks in the Axis Properties window.

Panning

Use the hand drag tool or press H to pan the graph, which is dragging the plot viewing area along the x- or y-axis. Panning is especially helpful when you are zoomed into a detailed plot and want to focus on a different area without zooming out. Click within the graph and hold down the left mouse button to pan a different section of the graph into view. The graph follows the movement of the mouse, and the axes are continuously updated in response to the movement. To stop dragging, release the left mouse button.

To limit dragging to horizontal or vertical panning, place the cursor over the axis you want to drag, hold down the mouse button, and drag in the direction you want the plot to move. Or, press the X key will dragging to restrict motion horizontally and press the Y key while dragging to restrict motion vertically. Similarly, click the axis associated with a series and hold down the left mouse button. Only the series connected with the axis will follow the movement of the mouse.

Use the hand tool to move different areas of the graph into view or adjust the position of one series so it can be viewed more easily. This is particularly useful when you are zoomed into the graph and want to see another section of the graph without zooming out and then zooming back in on the new location.

Panning will not work on an axis that is locked. To unlock an axis, double-click the axis with the arrow tool and deselect the Lock Axis Scaling and Tick Marks in the Axis Properties window.

Smart Scaling

When you first display a graph, the numerical bounds of the axes are on tick marks. After you have panned or zoomed, this may no longer be the case. Use smart scaling to correct that. With the hand drag, arrow, or crosshair tool, right-click anywhere on the graph and select SmartScale Graph. This will automatically adjust the axes to end on tick marks.

Note: You can always return to the original plot view by clicking the View at Full Scale from the toolbar or the View menu.

Copying Data Points and the Plot

To copy the data points from the Points Table to paste into other software:

1. Select the data you wish to copy in the Points Table.
2. Press Ctrl+C in Windows or Command-C in Macintosh to copy the data.

   Windows: press Ctrl + C

   Mac: press Command - C
3. Open any text editor, word processor, or spreadsheet software.
4. Press Ctrl+V in Windows or Command-V in Macintosh to paste the data into the other application. Fields are delimited by tabs, and records are separated by paragraph returns.

You can also copy the plot as a bitmap for pasting into other programs and documents. To copy the plot:

1. From the Edit menu, select Copy Graph to Clipboard.
2. Go to the other application and paste the plot.

Closing a Plot

To close a single plot, click the ✖ on the tab or toolbar, or choose Close from the File menu. On Macintosh, click the red button in the upper-left corner of the internal frame containing the plot when in Tabbed View. To close all open plots, select Close All from the File menu.

Important: Any changes you made to the plot are not saved when you close the datafile. You must save the plot as a project file to preserve the changes. Either select Save Project from the File menu before closing the plot or close the file and click Save when prompted. If you only want to save an image of the plot, you can paste a bitmap of the graph into another program and save it there.

Note: If you do not want HOBOware to prompt you to save the plot as a project file when you close it, open the Preferences. Select Warnings and then select General. Deselect the "Prompt me if there is any remaining unsaved data when closing plot or application" checkbox.

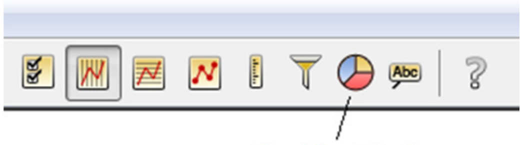
Viewing a Pie Chart

Pie charts are available for plotted state series, such as those from the UX90 data loggers. This provides you with a graphical representation of the data for viewing, saving, and printing in addition to the default line graph. This is particularly useful for the UX90 Occupancy/Light Data Logger (UX90-005x/-006x) because it allows you to quickly compare when the:

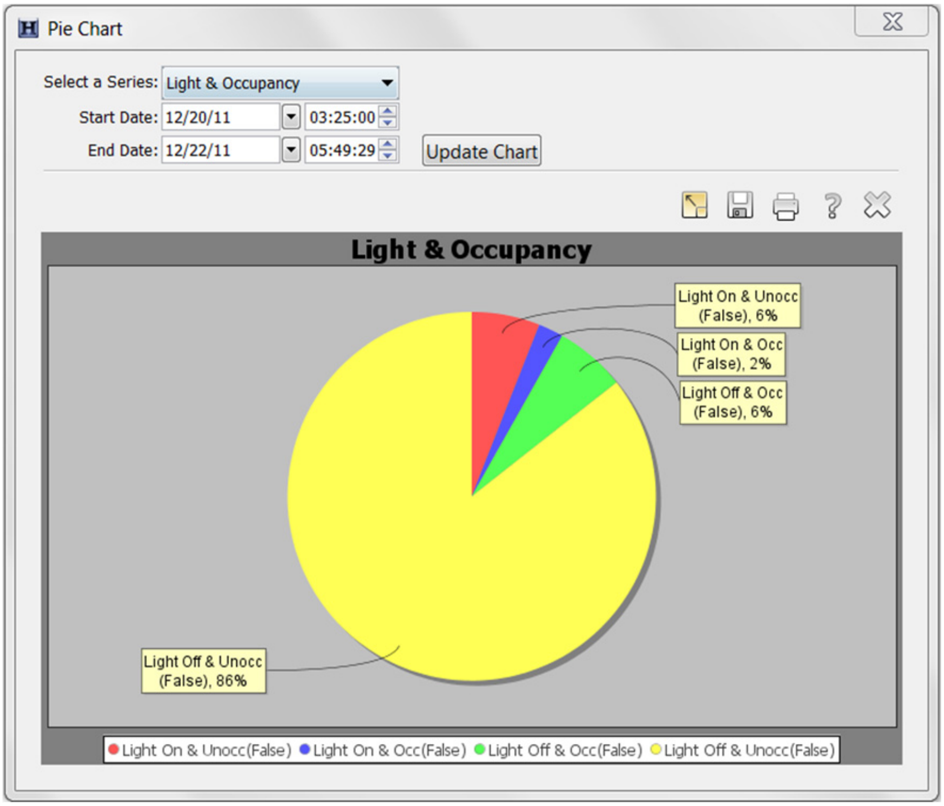
- Lights were on and the room was unoccupied
- Lights were on and the room was unoccupied
- Lights were off and the room was occupied
- Lights were off and the room was unoccupied

To view a pie chart:

1. Open a file from a logger with state series and plot the state series and derived series (as applicable) that you want to view in the pie chart. Note that a pie chart icon appears in the Plot Setup window if the file you are opening can be plotted in pie chart.
2. Click the Pie Chart button on the toolbar.



3. A pie chart is drawn based on the selected series. In this example, light & occupancy are plotted in the pie chart. The legend at the bottom of the chart indicates what series each piece of the pie represents. Percentages for each pie wedge are shown in the yellow boxes.


Pie Chart

Select a Series: Light & Occupancy

Start Date: 12/20/11 03:25:00

End Date: 12/22/11 05:49:29

- To change the series used to generate the pie chart, click the "Select a Series" drop-down arrow and then click the Update Chart button.
- To change the timeframe used to create the pie chart, change the Start and End Date/Time as necessary and then click the Update Chart button.
- To reset the pie chart to use the Start and End Date/Time for the current selected series, click the Reset/Show at Full Scale button.
- To save the pie chart as an image (.png file), click the Save button.
- To print the pie chart, click the Print button.

4. When you are done viewing pie charts, click the Close button.

Notes:

- The pie chart button on the toolbar will only be enabled when one or more state series is plotted. If you have plotted data and the pie chart button is not enabled as expected, close the plot. Reopen the file and make sure you select the state series from the Plot Setup window. Note that if the sensor channels were configured as runtime instead of state, then pie charts will not be available.

- If you merge datafiles, pie charts may not function properly if the time overlaps between merged series. If you are having difficulty viewing a pie chart for a merged file, try returning to the original separate files to view the individual pie charts from each file.
- If you are working with a plot that has two series, such as Light and Occupancy and you crop one of those series, the time range for the pie chart data will be constrained to the shorter of the two series.
- If you paste a new state series into the plot, it will also be available from the Select a Series pull-down list. You will need to select the series to view it in a pie chart; it will not display automatically.

Printing Plot Elements

Printing a Graph

You can simply print the graph, or you can set up the page and preview it before printing.

To set up the paper for printing the graph:

1. From the File menu, choose Page Setup.
2. Change the paper type, orientation, and margins as necessary and click OK.
3. From the File menu, choose Print Preview.
4. Zoom as necessary.
5. Click the Print icon 🖨 to print directly from Print Preview. Or, click Close to exit the preview window without printing.

To print the graph:

1. From the File menu, select Print or click the Print icon 🖨 on the toolbar.
2. Select the appropriate printer, if applicable, and click OK.

Printing Points and Details

You can print all the data in the Points or Details panes. From the File menu, select Print Points (available only with Java 1.5 or higher) or Print Details.

If you highlight a selection of points with your mouse before choosing Print Points, you will also be given the option to print only the selected points.

Chapter 4
Modifying a Plot

Once data is plotted, there are many things you can do to further refine the plot. This includes:

- Setting Properties for Plot Elements
- Adding a Graph Label
- Selecting a Subset of the Plot (Subset Statistics Tool)
- Moving a Series from Front to Back on a Plot
- Filtering a Series
- Cropping a Series
- Removing a Series from the Plot
- Copying a Series to Another Plot
- Merging Files
- Converting Units
- Undoing or Redoing Plot Changes
- Saving Project Files

Setting Properties for Plot Elements

You can set the properties for all the plot elements, including the axes, series, title, and legend. You can access the properties window for a plot element by selecting the Arrow tool and then right-clicking that element. Or, right-click anywhere on the plot and select Other Graph Items and then choose a particular item.

- Setting Axis Properties
- Setting Series Properties
- Setting Legend Properties
- Setting Title Properties
- Setting View Properties

There are also plotting preferences that control the global properties for all plots. To modify these settings, open the Preferences and select Plotting. With Plotting preferences, you can:

- Show or hide the Points table by default
- Show or hide the Details pane by default
- Include the sensor label in the Points table and Details pane by default
- Customize series lines for specific measurement types
- Set default minimum and maximum values for specific series types on the Value Axis

- Enable auto-scrolling to keep marked points in view while zooming
- Automatically select all data series and/or events
- Automatically label the time axis
- Mark all points in a plot by default
- Include the sensor label in the legend
- Control whether horizontal and/or vertical gridlines are displayed automatically
- Set the font style and point size used in plots
- Enable or disable the undo/redo feature

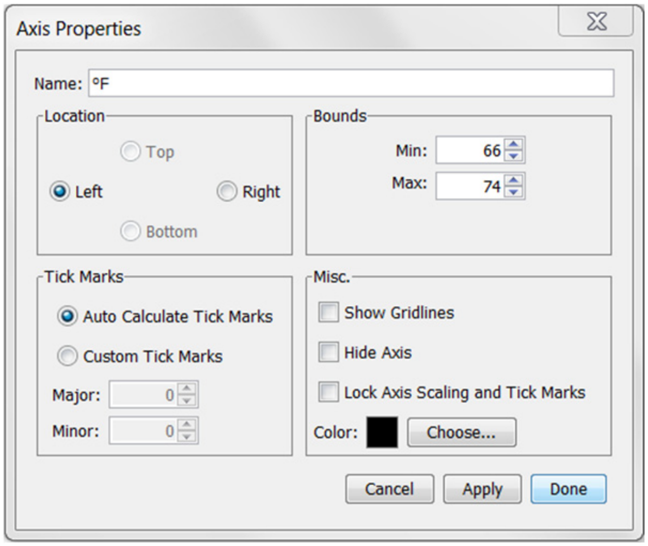
You can also use the Display preferences to set the default unit types and date/time format.

Setting Axis Properties

You can change the appearance of the time axis (x axis) and the value axis (y axis) on the plot. You can customize the axis name, change the location, bounds, tick marks, color, and more.

To change the axis properties:

1. Double-click the axis in the plot with the arrow tool, or select the axis and click the Properties icon ☑ to open the Axis Properties window.



Axis Properties

Name: °F

Location
○ Top
● Left
○ Right
○ Bottom

Bounds
Min: 66
Max: 74

Tick Marks
● Auto Calculate Tick Marks
○ Custom Tick Marks
Major: 0
Minor: 0

Misc.
☐ Show Gridlines
☐ Hide Axis
☐ Lock Axis Scaling and Tick Marks
Color: ■

2. In the Name field, enter up to a 40-character name for the axis. The default name for a value axis is the unit type (for example, "°F" is the name for a temperature axis and "%" is the name for an RH axis). The time axis does not have a default name. To add "Time" as the default name for this axis, open Preferences. Select Plotting and then select Other Options. Enable the "Label the time axis" checkbox.
3. Change the location of the axis. The value axis can be located on the left or right while the time axis can be located at the top or bottom
4. By default, tick marks are auto-calculated. Numbers or values are listed next to major tick marks and minor tick marks are not numbered. To change the default tick marks, select Custom Tick Marks and then choose the values for Major and Minor tick marks as desired.

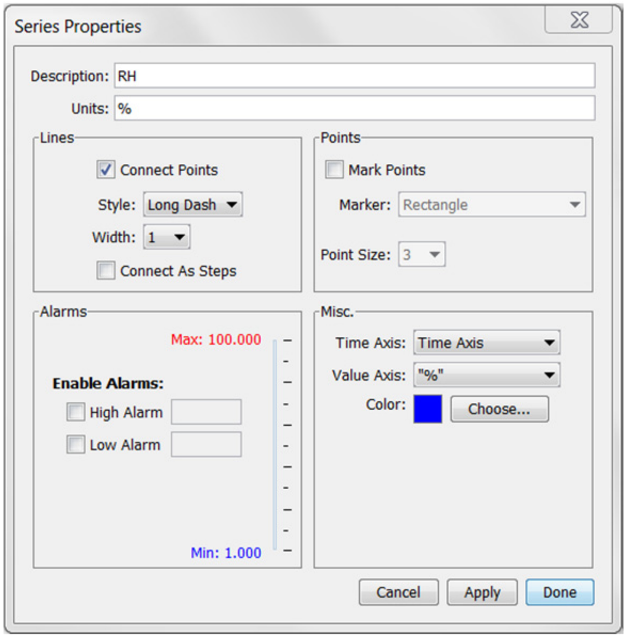
5. Change the default bounds used on each axis. For the time axis, select the dates and times you want the axis to display. For the value axis, type the minimum and maximum value you want the axis to display.
6. You can also modify the appearance of the axis with these options:
    - **Show Gridlines.** This toggles whether gridlines are displayed in the background. Gridlines are shown by default for the time axis, but not for the value axis.
    - **Hide Axis.** This controls whether the axis is displayed or temporarily hidden.
    - **Lock Axis Scaling and Tick Marks.** This controls whether the axis and associated tick marks remain in their original position when zooming or navigating with the hand tool. Locking the axis and tick marks helps to avoid inadvertently zooming or navigating to an area on the graph without data.
    - **Color.** Black is the default color for the time axis. The color of the value axis matches the series color by default. You can change the color for either axis as desired.
7. Click Apply to update the plot and keep the Axis Properties window open. Click Done to update the plot and close the window.

Setting Series Properties

A series is the group of data points you selected to display in the plot. You can change the appearance of a series on the plot including the line style, point marker, alarm values, associated axes, and color.

To change series properties:

1. Double-click the series you wish to modify or select the series and click the Properties icon to open the Series Properties window.



Series Properties

Description: RH

Units: %

Lines

☑ Connect Points

Style: Long Dash

Width: 1

☐ Connect As Steps

Points

☐ Mark Points

Marker: Rectangle

Point Size: 3

Alarms

Max: 100.000

Enable Alarms:

☐ High Alarm

☐ Low Alarm

Min: 1.000

Misc.

Time Axis: Time Axis

Value Axis: "%"

Color: 🟦

2. Change the default description. Type up to a 40-character name for the series. The series name will be updated in the legend, series pane, and details pane to the new name you entered.
3. Change the default units. Enter a different unit type as needed. The unit type will be updated in the legend, series pane, and details pane to the new unit type. Note that if you subsequently convert the

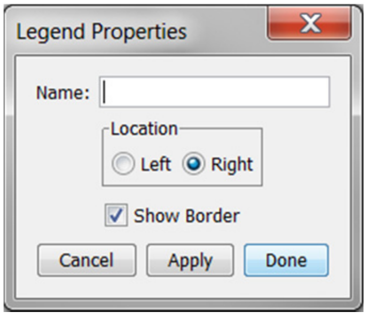
units while viewing the plot, your custom unit type will no longer be displayed. For example, let's say you change the unit type for a temperature series from °F to "degrees." Then, while viewing the plot, you decide to convert the data points to Celsius. The unit type for the temperature series automatically changes to °C instead of the custom "degrees" unit that you had entered.

4. Adjust the appearance of the lines with the following options:
    - Connect Points. This controls whether the plotted data points in the series are connected with a line.
    - Style. This changes the appearance of the line used to connect the points in a series.
    - Width. This changes the width of the line used to connect the points in a series.
    - Connect as Steps. This controls whether the lines between the points in a series are connected as a curve or a step. When this option is selected, the line drawn between points keeps the value of the previous point until the next point in the series. Connecting as steps is useful when plotting state or event series.
5. Set High Alarm and/or Low Alarm thresholds. Enabling alarms will show lines on the plot for the series to indicate a visual threshold over or under which data may be falling (for example, if you want to quickly see how many points fall below 32 degrees). Alarms are available for sensor measurement series only, not for state or event series. Select the High Alarm checkbox and type a value relative to the series where you want the maximum (red) alarm line to appear. Select the Low Alarm checkbox and type a value relative to the series where you want the minimum (blue) alarm line to appear.
6. Select the Mark Points checkbox to add a marker for each data point in the series. To avoid cluttering the plot, this option is only enabled by default for series with event data or that have only one data point. If you enable Mark Points, you can change the shape of the marker and the point size.
7. You can also modify the following:
    - Time Axis. This allows you to create an additional time axis for this series. This is useful for comparing data from two different time periods.
    - Value Axis. This changes the axis being used for the series. Choose one of the axes already in view or select New Value Axis from the dropdown list to create your own.
    - Color. This changes the color used for the series.
8. Click Apply to update the plot and keep the Series Properties window open. Click Done to update the plot and close the window.

Setting Legend Properties

You can modify the Legend displayed on the plot. To change the Legend properties:

1. Double-click the Legend or right-click the plot with the arrow tool and select Other Graph Items > Legend Properties.
2. In the Legend Properties window, type a name for the Legend if desired.



Name:

Location: ○ Left ● Right

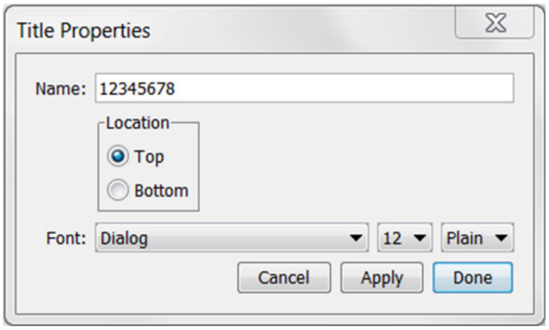
☑ Show Border

3. Set the location to either the left or right of the plot.
4. Select the Show Border checkbox to have a box around the legend. Deselect this if you do not want the box around the legend.
5. Click Apply to update the plot and keep the Legend Properties window open. Click Done to update the plot and close the window.

Setting Title Properties

You can modify the title displayed on the plot. To change the Title properties:

1. Double-click the plot title or right-click the plot with the arrow tool and select Other Graph Items > Title Properties.
2. In the Title Properties window, change the default name if desired. The name originated from the Plot Setup window.



Name: 12345678

Location: ● Top ○ Bottom

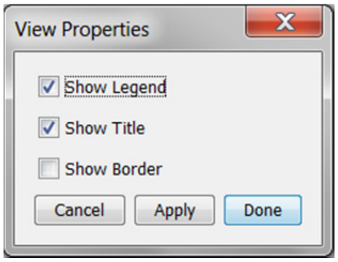
Font: Dialog 12 Plain

3. Set the location of the title to either the top or bottom of the plot.
4. Adjust the font, point size, and style.
5. Click Apply to update the plot and keep the Title Properties window open. Click Done to update the plot and close the window.

Setting View Properties

You can show or hide certain plot elements. To change the View properties for the plot:

1. Right-click the plot and select View Properties.
2. In the View Properties window, select the Show Legend checkbox if you want the Legend to be displayed on the plot. Deselect this checkbox if you do not want to see the Legend on the plot.



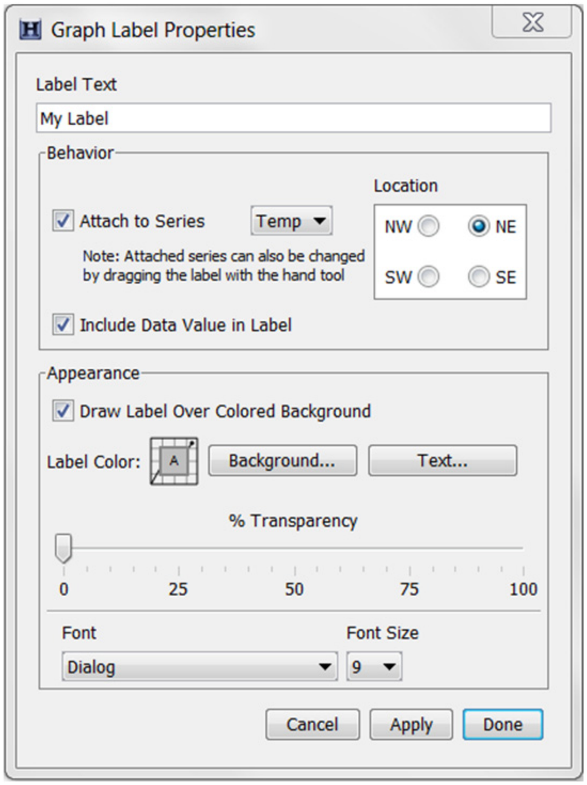
☑ Show Legend
☑ Show Title
☐ Show Border

3. Select the Show Title checkbox if you want a title to be displayed on the plot. Deselect this checkbox if you do not want to see a title.
4. Select the Show Border checkbox if you want a border to be drawn around the plot. Deselect this checkbox if you do not want a border around the plot.
5. Click Apply to update the plot and keep the Title Properties window open. Click Done to update the plot and close the window.

Adding a Graph Label

You can add multiple labels to a graph to identify specific points or call attention to a region of the graph. To add a graph label:

1. Right-click the graph at the desired location and choose Add Graph Label from the pop-up menu to open the Graph Label Properties window. Or, select Add Graph Label from the Edit menu. **Note:** To change an existing label, double-click the label or select the label and click the Properties icon on the toolbar.



Label Text: My Label

☑ Attach to Series: Temp

Note: Attached series can also be changed by dragging the label with the hand tool

Location: ○ NW ● NE ○ SW ○ SE

☑ Include Data Value in Label

☑ Draw Label Over Colored Background

% Transparency: 0

Font: Dialog

Font Size: 9

2. Type up to a 24-character name for the label.

3. Select the Attach to Series checkbox to attach the label to a point on the series. Choose the name of the series to attach it to from the drop-down list. Select the Include Data Value in Label checkbox to display the value of the point in the label. Select the compass point to described the preferred location of the label relative to the labeled point. **Important:** This indicates the preferred location of the label (space permitting) with respect to the data point it references. This is only available when the label is attached to a series.

4. Adjust the appearance of the label with these options:

   - Draw Label Over Colored Background. Select this option if you want the label to appear in a box with a colored background.
   - Label Color Background. If you chose to give the label a colored background, click this button to select a background color.
   - Label Color Text. Click this button to select a color for the label text.
   - % Transparency. Adjust the label's transparency, which refers to the ability to see the graph through the label. At 0%, the label is opaque and you cannot see the graph through it. At 100%, the label is invisible and only the graph can be seen.
   - Font. Select a font for the label text.
   - Font Size. Select a font size for the label text.

5. Click Apply to update the plot and keep the Graph Label Properties window open. Click Done to update the plot and close the window.

Use the hand tool to drag the label to another location if necessary. If the label is attached to a series, you can drag the label to attach it to any other point on the graph. (The hand tool must be close enough to a point to attach the label.) Labels that are attached to a point will move with that point during zooming and panning. Free-floating labels do not move during zooming and panning.

To delete a label from the graph, select the label you wish to remove and press the Delete key, or right-click the label and choose Remove from the menu that appears.

Selecting a Subset of the Plot (Subset Statistics Tool)

The Subset Statistics tool allows you to select a subset, or a range of data, of a graph, and display the maximum, minimum, average, and standard deviation for the measurements in that range.

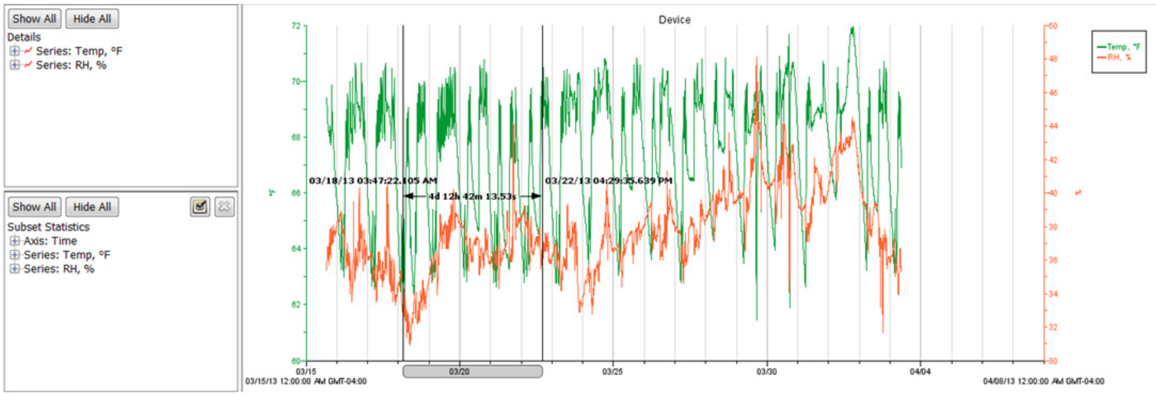
To use the Subset Statistics tool:

1. Select the Subset Statistics tool from the toolbar. The mouse cursor will change to the Subset Statistics Tool icon .
2. Draw the subset on the plot. With the left mouse button, click within the graph to define the start time of the subset and drag to the right. Release the mouse button when you reach the end time of the subset.

The graph subset appears in the graph and the subset statistics pane appears beneath the Details pane as in the example below. Two black vertical indicators appear on the graph to show the range of the subset with date/time labels marking the start and end of the range. To move the vertical indicators and date/time labels, press the up or down arrow keys (make sure the Subset Statistics Tool is selected first).

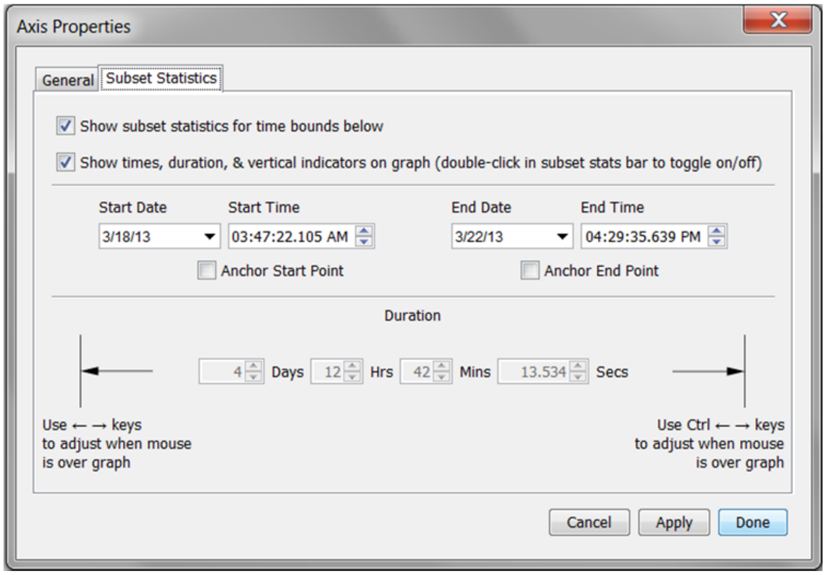
A subset bar is added to the time axis. Double-click this bar to toggle between showing and hiding the vertical indicators and date/time labels. If the plot has one than more time axis, this bar is attached to the one that was created when you first displayed the plot. Click inside the subset bar to drag it to a different time axis.

To quickly adjust the start or end of the subset, click and drag the left or right end of the subset bar on the time axis (make sure the Subset Statistics Tool is selected first). You can also use the arrow keys to move the left boundary and Ctrl+arrow key (or Command-arrow key on Mac) to move the right boundary. Place the cursor in the middle of the subset bar and drag it to move the entire range left or right.



To further refine the subset range:

1. Click the checkmark icon ☑ in the Subset Statistics pane.



☑ Show subset statistics for time bounds below

☑ Show times, duration, & vertical indicators on graph (double-click in subset stats bar to toggle on/off)

Start Date: 3/18/13
Start Time: 03:47:22.105 AM
☐ Anchor Start Point
End Date: 3/22/13
End Time: 04:29:35.639 PM
☐ Anchor End Point

Duration: 4 Days 12 Hrs 42 Mins 13.534 Secs

Use ← → keys to adjust when mouse is over graph

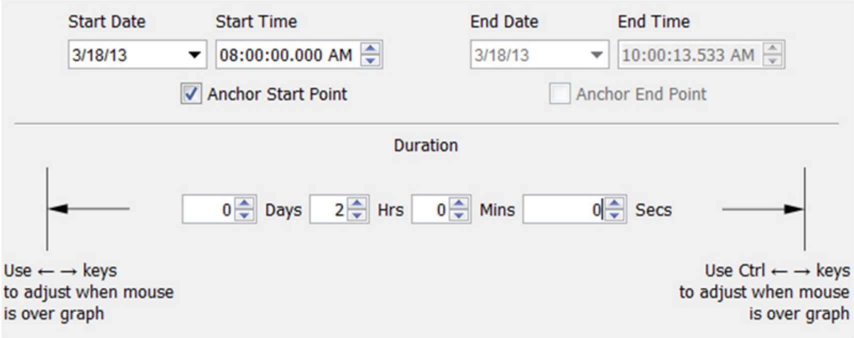
Use Ctrl ← → keys to adjust when mouse is over graph

2. The two checkboxes are enabled by default. Deselect "Show subset statistics for time bounds below" if you want to remove the subset from the current time axis. Note that only one time axis can have a subset. If you enable subset statistics for one time axis when another time axis already has a subset, the other time axis's subset will be removed.

   Deselect the "Show times, duration, & vertical indicators on graph" checkbox to toggle the display of subset indicators and labels on the plot. If you disable this option, the Subset Statistics pane and the shaded subset statistics bar on the time axis will still remain visible.

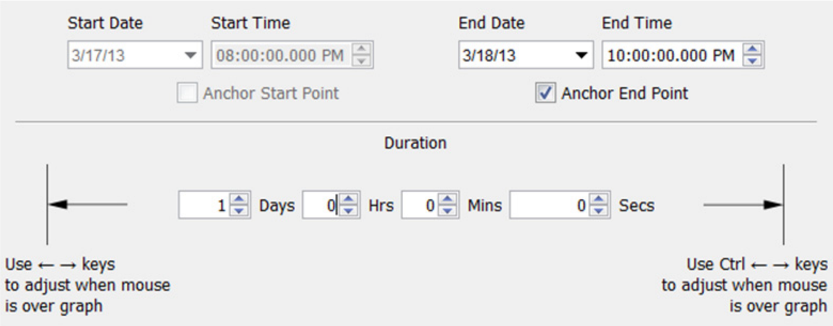
3. The easiest method to set a range for the subset is to indicate a fixed Start Date/Time or End Date/Time and then indicate the duration. Alternatively, you can enter both a Start Date/Time or End Date/Time without specifying a duration.

   For example, to set a range beginning at 8:00 a.m. on 3/18/13 with a duration of 2 hours, set the Start Date to 3/18/13 and the Start Time to 8:00:00.000 AM. Select the Anchor Start Point checkbox and set the Duration to 2 hours as shown below.



Start Date: 3/18/13
Start Time: 08:00:00.000 AM
End Date: 3/18/13
End Time: 10:00:13.533 AM
☑ Anchor Start Point
☐ Anchor End Point
Duration: 0 Days 2 Hrs 0 Mins 0 Secs

As another example, to set a range of 1 day ending at 10:00 PM on 3/18/13, set the End Date to 3/18/13 and the End Time to 10:00:00.000 PM. Select the Anchor End Point checkbox and set the Duration to 1 day.



Start Date: 3/17/13
Start Time: 08:00:00.000 PM
End Date: 3/18/13
End Time: 10:00:00.000 PM
☐ Anchor Start Point
☑ Anchor End Point
Duration: 1 Days 0 Hrs 0 Mins 0 Secs

To remove the subset and related elements:

- Right-click the plot and select Remove Subset Stats,
- From the View menu, select Remove Subset Stats, or
- Click the X icon in the upper-right corner of the Subset Statistics pane.

Moving a Series from Front to Back on the Plot

You can shuffle the order of series by moving a series to the front or back on the plot. This is helpful if one series is hidden behind another. It also changes the order of series in the Details pane, Points table, and the legend.

To change the order of the series:

1. Select the arrow tool .
2. Select the series you wish to move.
3. Right-click and select either Bring Series to Front or Send Series to Back.

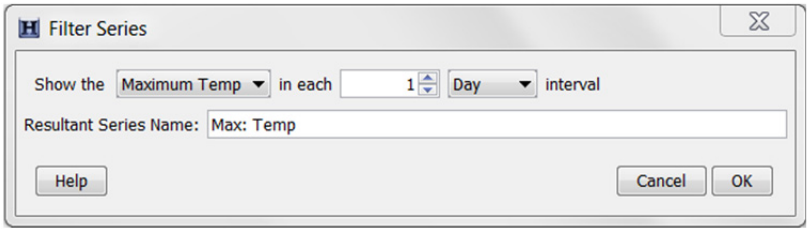
Filtering a Series

You can filter data from existing series in the plot to create a new statistical series showing calculated data such as average, minimum, and maximum values over a specified period of time. This filter applies to existing data files only; there is an additional filter tool available when launching most loggers.

To filter a series in a plot:

1. Select the series with the arrow tool , right-click it and select Filter Series. Or from the Edit menu, select Filter Series.

2. Select the statistic to use for the filter and the interval. The options available vary depending on the series type. In the example below, "Maximum Temp" in each day is selected.



Show the Maximum Temp in each 1 Day interval

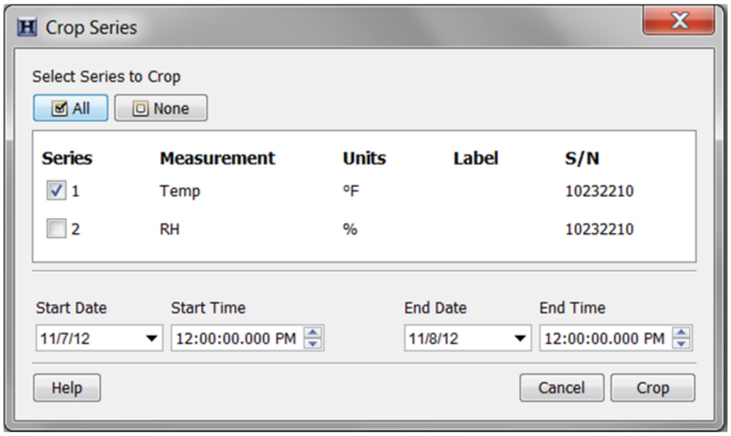
Resultant Series Name: Max: Temp

3. Type a Resultant Series Name or use the default name entered based on the filter type.
4. Click OK. The new series is added to the graph, the Details pane, and the Points table. Note that when you apply a filter, the graph rescales to accommodate all the displayed data.

Cropping a Series

You can crop one or more series in a plot to focus on a particular date/time range instead of the default range. To crop a series:

1. With the arrow tool, right-click the series you wish to plot and select Crop Series. To crop multiple series, right-click anywhere in the plot (without a series selected).
2. In the Crop Series window, make sure the series you want to crop is selected. Deselect any series you do not want to crop.



Series	Measurement	Units	Label	S/N
☑ 1	Temp	°F		10232210
☐ 2	RH	%		10232210

Start Date: 11/7/12

Start Time: 12:00:00.000 PM

End Date: 11/8/12

End Time: 12:00:00.000 PM

3. Enter the new Start Date/Time and End Date/Time for the series. The boundaries are limited to the minimum and maximum date/time of the Time Axis. If subset statistics have been added to the plot, the start and end points on the subset will be redefined automatically based on how it is affected by cropping.
4. Click the Crop button. The plot displays the cropped series. The Details pane and Points table are both updated to reflect the new cropped series.

Removing a Series from a Plot

You can remove sensor, state, and event data series from the plot. This is helpful if the datafile contains multiple series and you cannot easily view them all together.

To remove a series from a plot:

1. Select the arrow tool from the toolbar.
2. Click the series you wish to remove and press the Delete key, or right-click the series and select Remove.
3. A warning appears, indicating that the only way to add the series back to the plot is to reopen the plot. Click Yes.

The series is removed from the graph, the Details pane, and the Points table.

Copying a Series to Another Plot

To copy a series from one plot to another:

1. Open the source plot (the plot that includes the series you want to copy) and the destination plot (the plot where you want to paste the series).
2. In the source plot, choose the arrow tool and select the series you want to copy. From the Edit menu, select Copy Series or right-click the series and select Copy Series. Or, press Ctrl+C on Windows or Command-V on Macintosh.
3. Switch to the destination plot. From the Edit menu, select Paste Series or right-click the plot with the arrow tool and select Paste Series. Or, press Ctrl+V on Windows or Command-V on Macintosh.

The new series is added to the graph, the Details pane, and the Points pane.

Overlaying Series

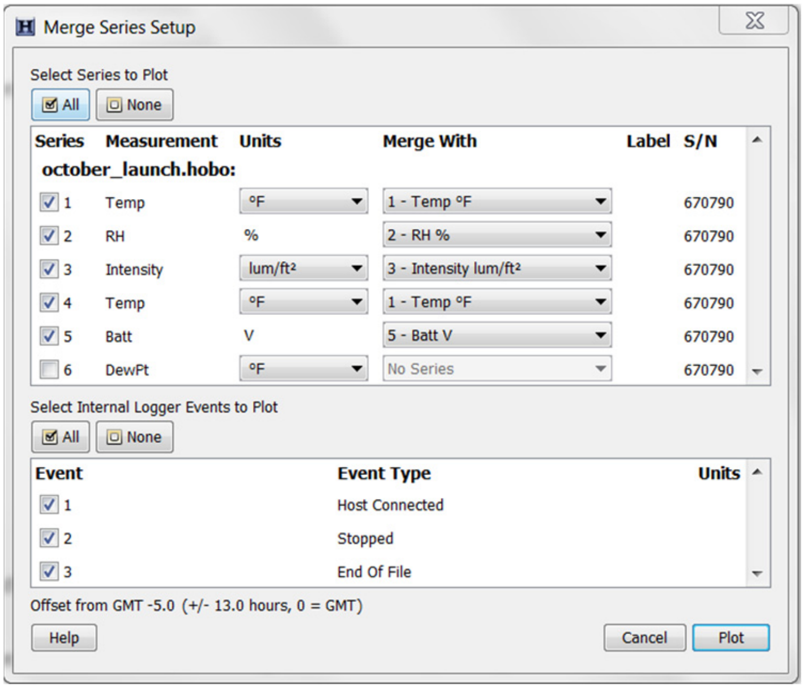
If the series you want to copy to the plot was logged at a different time, you will need to make some adjustments to the plot in order to view the series together.

1. Display the source plot(s) and the destination plot.
2. On the destination plot, choose the arrow tool
3. Double-click the time axis to access the Axis Properties window.
4. In the Axis Properties window, time a unique name in the Name field and click Done.
5. Copy a series from a source plot (right-click the series and select Copy Series).
6. Paste the series into the destination plot (from the Edit menu, select Paste Series).
7. Double-click the new time axis for the pasted series to open the Axis Properties window.
8. Type a unique name in the Name field, different than the name used in step 4, and click Done.
9. Repeat steps 5 through 8 for each series you want to paste.
10. Identify the periods of interest in each series you want to combine and note the times for each. Also, determine which period is the longest; this should be the length of time shown on each axis.
11. Double-click a time axis and adjust its Min and Max bounds. The new bounds should include the period of interest for the series, and be the same length as the longest period identified in the original time axis in the destination plot. Repeat for each time axis.
12. Use the hand tool on each time axis to adjust the series horizontally as needed.

Merging Files

This feature allows you to combine multiple datafiles one file. Note that only series of the same type and name can be merged and there cannot be an overlap in the time in the series.

1. Open the first file (oldest).
2. From the File menu, select Merge Datafile(s).
3. Select the datafiles you want to merge and click Open.
4. Select the series to plot. All series available in the selected datafiles are listed in the Select Series to Plot section. Click the checkbox to add or remove series as necessary, or select the All or None buttons in that section to select all series or no series accordingly.



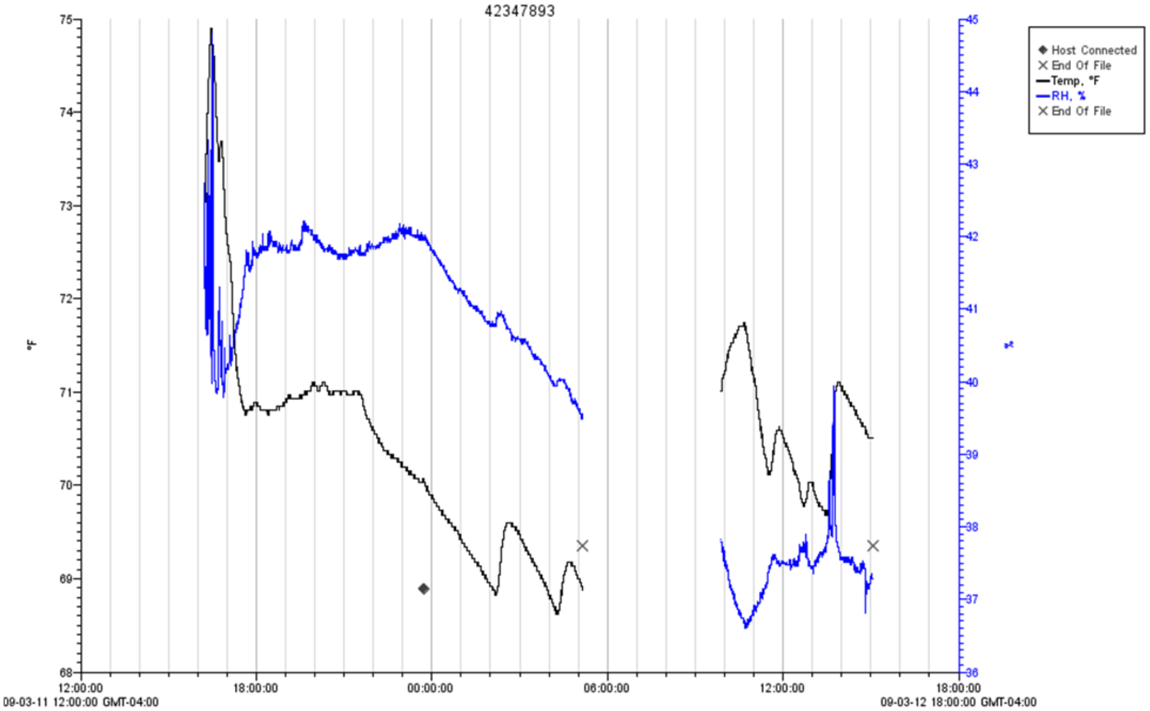
Series	Measurement	Units	Merge With	Label	S/N
october_launch.hobo:					
☑ 1	Temp	°F	1 - Temp °F		670790
☑ 2	RH	%	2 - RH %		670790
☑ 3	Intensity	lum/ft²	3 - Intensity lum/ft²		670790
☑ 4	Temp	°F	1 - Temp °F		670790
☑ 5	Batt	V	5 - Batt V		670790
☐ 6	DewPt	°F	No Series		670790

Event	Event Type	Units
☑ 1	Host Connected	
☑ 2	Stopped	
☑ 3	End Of File	

Offset from GMT -5.0 (+/- 13.0 hours, 0 = GMT)

5. All matching series available in the selected series will be populated with the corresponding series listed in the Merge With column. Each new series can only be merged with the series of the same measurement type and units. If no matching series is available in the plot, the Merge With column will display No Series for that series. If a matching series is found, you can still append the series without merging by choosing No Series from the corresponding drop-down list in the Merge With column. The series will be appended to the plot without being merged with any series.
6. Select any internal logger events to plot, if applicable. Click the checkbox to add or remove each event as necessary, or select the All or None buttons in that section to select all events or no events accordingly.
7. Click the Plot button to merge the selected series with their matching series. Save the new plot as a project file if desired.

There will be a gap between the last sample in the older series and the first sample in the next series as shown here in both the Temperature and RH series.



After the series have been merged, the Details Pane will be regenerated and the Series Statistics will be recalculated. The Points Table will be regenerated and will show samples of both series in one column. The new logger information is added to the Details Pane, showing the specific information about the different loggers that collected the data samples.

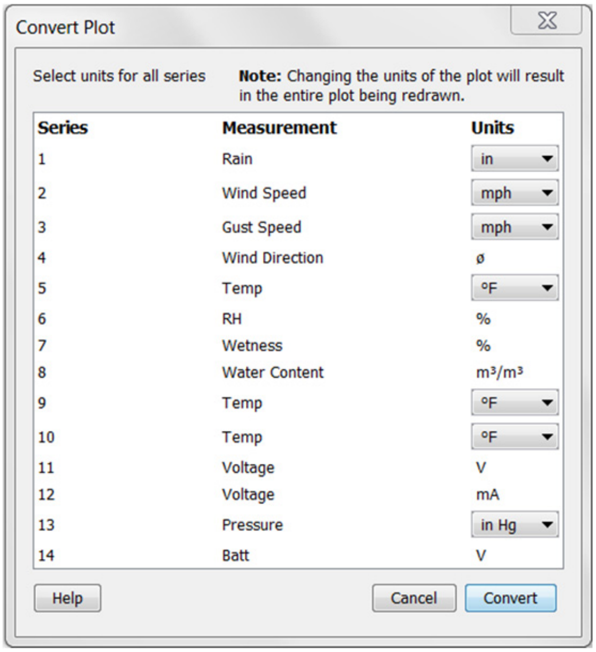
Converting Units

Plots display data points in either SI or US units as defined within the Preferences (select Display and then Default Unit System). You can switch between SI and US units on a single series or an entire plot without changing the overall system preferences.

To change the units for a single series, right-click the series with the arrow tool and select Convert Series Units and then select the unit you want to use.

To change the units for multiple series within the plot, click the Units icon on the toolbar or select Convert Units from the Edit menu.

If a series can be configured with multiple units, there will be drop-down list in the units field as in the example below. Select the desired units from the drop-down list for all the series you wish to change and then click Convert. This changes the units displayed on the axis, in the legend, in the Details pane, and in the Points table.



Select units for all series

Note: Changing the units of the plot will result in the entire plot being redrawn.

Series	Measurement	Units
1	Rain	in
2	Wind Speed	mph
3	Gust Speed	mph
4	Wind Direction	ø
5	Temp	°F
6	RH	%
7	Wetness	%
8	Water Content	m³/m³
9	Temp	°F
10	Temp	°F
11	Voltage	V
12	Voltage	mA
13	Pressure	in Hg
14	Batt	V

1. For each series that supports unit options, select the desired units from the drop-down list
2. Click **Convert**.

This changes the units displayed on the axis, in the legend, in the Details pane, and in the Points table.

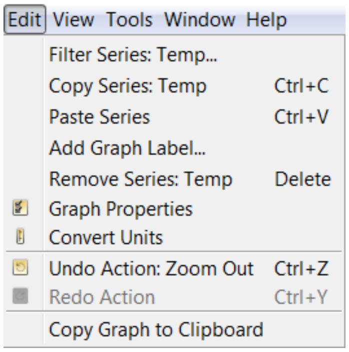
Undoing and Redoing Plot Changes

You can undo and redo changes made to the plot display, including zooming, panning, crosshair placement, graph and axis properties modifications, and more.

To undo the most recent change, click the Undo Action icon on the toolbar or select Undo Action from the Edit menu.

To redo the most recent change that had previously been undone, click the Redo Action icon on the toolbar or select Redo Action from the Edit menu.

When using the Edit menu for Undo or Redo, the most recent change is listed with the menu choice. In the following example, the most recent change that can be undone is to "Zoom Out."



HOBOware keeps track of the changes that you make within each plot window and temporarily stores them as "undoable actions." To see a complete list of all the actions that can be undone or redone, click the down arrow to the right of either icon on the toolbar.

The number of undoable actions stored is set within the plot preferences. You can configure HOBOware to either store a specific number of undoable actions or an unlimited number. In addition, you can enable or disable the feature altogether. Note that storing an unlimited number of actions can impact HOBOware performance on slower computers.

Saving Project Files

A project file (.hproj) is a plot that you have customized using the various features and tools of HOBOware. When you open a project file, the plot appears as it did when you saved the project file and contains all of the same data.

To save your current data with a customized view of the plot, click the Save icon 💾 on the toolbar, or choose Save Project from the File menu. To open an existing project file, choose Open Project from the File menu.

Using Data Assistants

With Data Assistants, you can create new series by combining data recorded by the logger with additional data for analysis. For example, the kWh Assistant converts logged pulse data from an energy transducer to kWh, average kW, and energy cost.

When you read out a logger or open a datafile, all available assistants are listed in the Data Assistants section at the bottom of the Plot Setup window. To use a Data Assistant, click the assistant name to select it, and then click the Process button.

For some data loggers, you can also run the Linear Scaling, Pulse Scaling, and kWh Data Assistants from the Launch Logger window to create additional data series that are automatically available each time you read out the logger and open the resultant data file. To use an assistant from the Launch Logger window, click the Scaling or kWh button and then double-click the desired assistant, or select the assistant and click the Create button.

The following Data Assistants are available in HOBOware Pro:

- **Barometric Compensation Assistant.** Use the Barometric Compensation Assistant to compensate for barometric pressure and create a water level or sensor depth series. The BCA uses water pressure data from a HOBO U20 Water Level logger and additional information you provide.
- **Conductivity Assistant.** Use the Conductivity Assistant to apply compensation to absolute conductance data from a HOBO U24 Conductivity logger.
- **Dissolved Oxygen Assistant.** Use the Dissolved Oxygen Assistant to generate a series adjusted for salinity and a series for percent saturation based on data from a HOBO U26 Dissolved Oxygen logger. Also use this assistant to enter field calibration readings to compensate for fouling.
- **Grains Per Pound Assistant.** Use the Grains Per Pound Assistant to calculate the absolute amount of water in the air, based on temperature, humidity, dew point, and altitude. You can also create an altitude-corrected dew point series.
- **Growing Degree Days Assistant.** Use the Growing Degree Days Assistant to calculate growing degree days based on temperature data spanning at least one full calendar day (midnight to midnight). Growing degree days are used for agricultural and turf management applications, such as estimating harvest time or pest growth.
- **kWh Assistant.** Use the kWh Assistant to convert logged pulse data from a WattNode, Veris, or other energy transducer to kWh, average kW, and energy cost. The kWh Assistant can be run during Plot Setup or at Launch.
- **Linear Scaling Assistant.** Use the Linear Scaling Assistant to convert a data series from a compatible sensor to some other measurement. You enter two raw values and their corresponding measurement values. The conversion must be based on a linear relationship. Nonlinear scaling is not available.

- **Pulse Scaling Assistant.** Use the Pulse Scaling Assistant to convert a data series from a compatible sensor to some other measurement. You enter a raw value and its corresponding measurement value. The Pulse Scaling Assistant can be run during Plot Setup or at Launch.

Default Settings

The parameters last entered into any given Data Assistant will be the default used the next time the Data Assistant is run, unless it is being used to edit existing series. If you run a Data Assistant at Plot Setup time and then later you run it from the Launch Logger window, the default values are the value you entered at Plot Setup time.

Hiding Assistants

To prevent unwanted assistants from appearing in the Plot Setup window, or to bring back assistants that you have previously hidden, click the **Manage** button. This will open the Preferences window to allow you to change these settings.

Software Updates

If you have an Internet connection, HOBOware Pro can periodically check the Onset website for software updates. This includes updates to your data assistants.

The default is to check once per week, but you can configure HOBOware Pro to check daily or monthly. In Preferences, go to the General pane and select Startup. In the Check for HOBOware Updates drop-down list, select how frequently you want the software to check for updates.

You may also check for updates manually at any time. Choose Check for Updates from the Help menu.

Installing a Data Assistant

Data Assistants are automatically installed (they require a HOBOware Pro license key). There may also be times when a new Data Assistant is available between HOBOware releases and needs to be installed manually. To do this, click the Load button on the Plot Setup window and select the assistant's .jar file. **Note:** On Windows, you must be an administrator to load a new Data Assistant. To temporarily run HOBOware as an Administrator, right-click the HOBOware icon and select Run as Administrator. Enter the Administrator name and password as prompted.

License Agreement

This software is furnished in accordance with a separate license agreement included with the software, and subject to any restrictions set forth therein. For more information about Onset's licensing terms and policies, contact Onset Customer Service at 1 800 LOGGERS, or visit http://www.onsetcomp.com/corporate/legal.

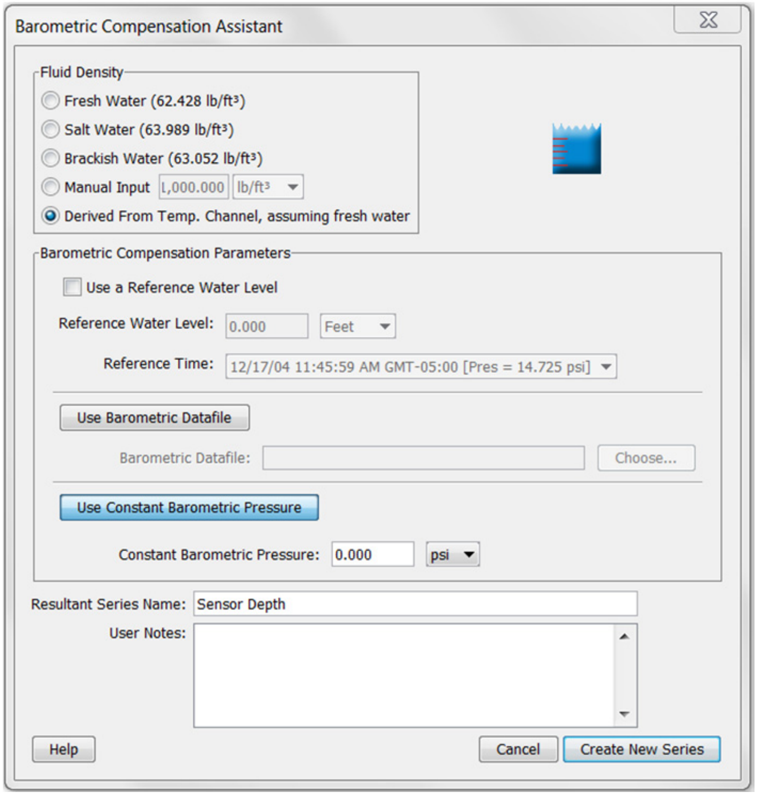
Barometric Compensation Assistant

The Barometric Compensation Assistant uses water pressure data from a HOBO U20 Water Level Logger and additional information from you to compensate for barometric pressure and create a water level or sensor depth series.

After you use the assistant and display the plot, you may apply filters to the new series.

To create a water level or sensor depth series:

1. Read out a logger or open a datafile that contains water pressure data from a U20 Water Level Logger.
2. From the Plot Setup window, select Barometric Compensation Assistant and click Process.
3. Provide Fluid Density information by choosing a water type (fresh, salt, or brackish), entering a specific constant value, or using the temperature series (if logged) to use temperature-compensated density assuming fresh water.



Barometric Compensation Assistant

Fluid Density

- ○ Fresh Water (62.428 lb/ft^3)
- ○ Salt Water (63.989 lb/ft^3)
- ○ Brackish Water (63.052 lb/ft^3)
- ○ Manual Input 1,000.000 lb/ft^3
- ● Derived From Temp. Channel, assuming fresh water

Barometric Compensation Parameters

☐ Use a Reference Water Level

Reference Water Level: 0.000 Feet

Reference Time: 12/17/04 11:45:59 AM GMT-05:00 [Pres = 14.725 psi]

Barometric Datafile:

Constant Barometric Pressure: 0.000 psi

Resultant Series Name: Sensor Depth

User Notes:

4. To enter a reference water level, check the Use a Reference Water Level box, enter the water level, and indicate whether it is in feet or meters.

    - Enter the water level as a *positive number* if it is measured upward from a reference point below the water's surface, such as the water's height above sea level.
    - Enter the water level as a *negative* number if it is measured downward from a reference point above the water's surface, such as a well cap.

Then, from the drop-down, select the logged time and value that is closest to the time when you measured the water level.

- When selecting a logged value and time to link to the reference level, make sure the logger readings have stabilized. When a logger is first deployed in water, it takes some time for its temperature to reach equilibrium. You will get the best accuracy if you link your reference reading to a stabilized logger reading.
- When using a reference water level, the resulting series data will contain water level values relative to this reference level. If you do not use a reference water level, the resulting series data will contain values for absolute sensor depth.

5. You can either use a barometric data file from another source, or enter a fixed barometric pressure. For the most accurate water level results, use a reference water level and a barometric data file. The barometric data can come from another HOBO U20 Water Level Logger in air; a HOBO Weather Station, HOBO Micro Station, HOBO U30, or HOBO Energy Logger; or a text file from another source.

    - To use another file to provide barometric information, click the Use Barometric Datafile button and enter (or browse to) the name of a .hobo, .hsec, .dtf, .dsec, or .txt file that contains a barometric pressure series from an overlapping time period. You will have the option to display this series on the plot. **Important**: To use a .txt file, see Import Text Files Requirements.

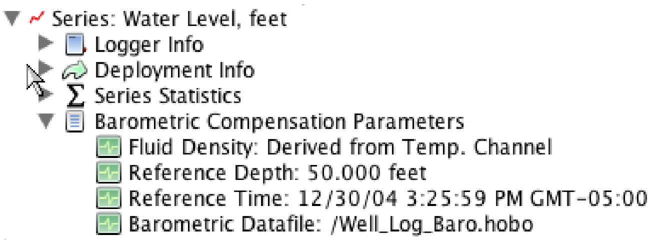
- To use a constant pressure value, click the Use Constant Barometric Pressure button. Enter the constant value and indicate whether it is in psi or kPa. (You cannot use a constant pressure value in combination with a reference water level.)

6. Keep the default Resultant Series Name, or enter a new one. You may also enter User Notes concerning the series you are creating.

   Note: Your settings are retained, so you do not need to re-select your density and barometric file each time you use the Barometric Compensation Assistant as long as they still apply to the new water level data set.

7. Click Create New Series. The new series is listed and selected in the Plot Setup window. You can click Process on the Plot Setup window again to create another series using different barometric compensation parameters.

8. Click the Plot button. The scaled series will appear in the plot and the settings for the scaled series are listed in the Details pane:



- Series: Water Level, feet
  - Logger Info
  - Deployment Info
  - Series Statistics
  - Barometric Compensation Parameters
    - Fluid Density: Derived from Temp. Channel
    - Reference Depth: 50.000 feet
    - Reference Time: 12/30/04 3:25:59 PM GMT-05:00
    - Barometric Datafile: /Well_Log_Baro.hobo

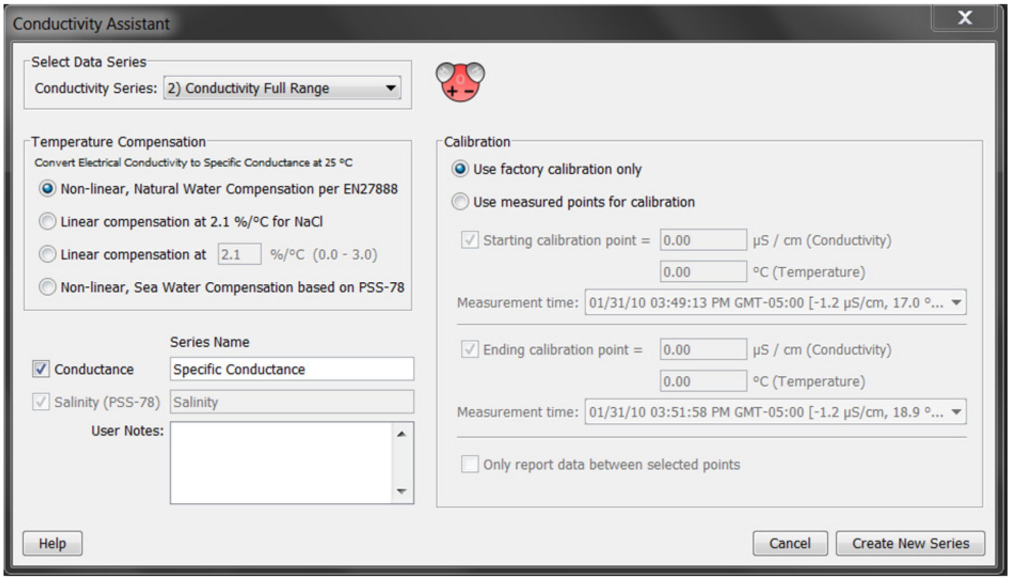
After the plot is displayed, you may apply minimum, maximum, and average filters to the new water level or sensor depth series as you would for any sensor data series in HOBOware Pro.

Conductivity Assistant

The Conductivity Assistant converts raw conductivity data from a U24 logger to Specific Conductance and/or Salinity. You can also use it to enter field calibration measurements recorded at the beginning and end of a deployment for calibration and to compensate for drift and sensor fouling effects.

1. Read out a U24 series logger or open a datafile from a U24 logger.
2. From the Plot Setup window, select the Conductivity Assistant and click the Process button.
3. In the Conductivity Assistant window, select the conductivity series that corresponds to the range of your data. **Note:** If you only selected one range at launch time, only one series will be listed.

   - For the U24-001 logger, select either Conductivity Low Range when the data is always less than 1,000 µS/cm or select Conductivity Full Range (default) when the data goes above 1,000 µS/cm as shown below.



Conductivity Assistant

Select Data Series

Conductivity Series: 2) Conductivity Full Range

Temperature Compensation

Convert Electrical Conductivity to Specific Conductance at 25 °C

● Non-linear, Natural Water Compensation per EN27888

○ Linear compensation at 2.1 %/°C for NaCl

○ Linear compensation at 2.1 %/°C (0.0 - 3.0)

○ Non-linear, Sea Water Compensation based on PSS-78

Series Name

☑ Conductance: Specific Conductance

☑ Salinity (PSS-78): Salinity

User Notes:

Calibration

● Use factory calibration only

○ Use measured points for calibration

☑ Starting calibration point = 0.00 µS / cm (Conductivity)

0.00 °C (Temperature)

Measurement time: 01/31/10 03:49:13 PM GMT-05:00 [-1.2 µS/cm, 17.0 °...

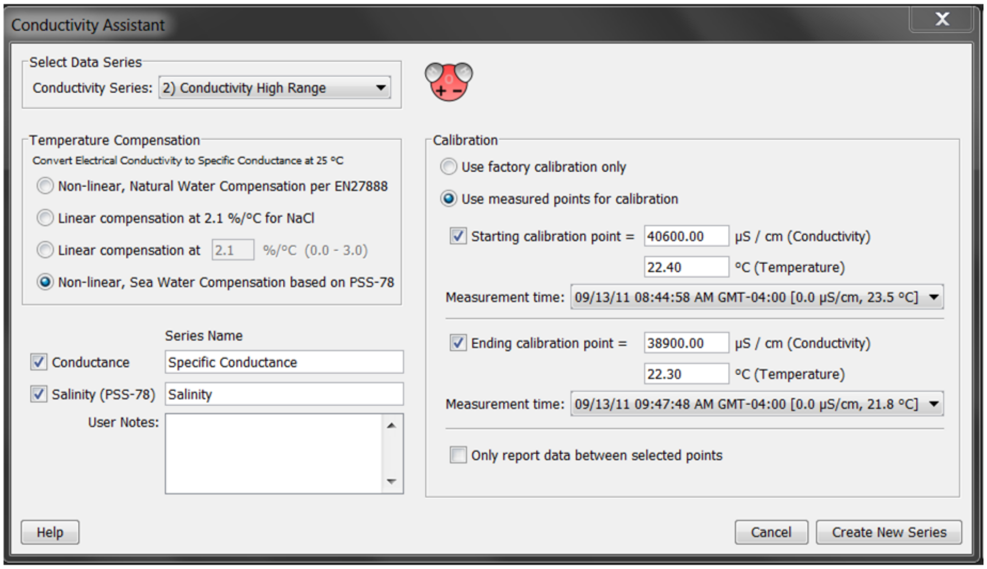
☑ Ending calibration point = 0.00 µS / cm (Conductivity)

0.00 °C (Temperature)

Measurement time: 01/31/10 03:51:58 PM GMT-05:00 [-1.2 µS/cm, 18.9 °...

☐ Only report data between selected points

- For the U24-002-C logger, select either Conductivity Low Range when the data is always less than 10,000 µS/cm or select Conductivity High Range (default) when the data goes above 10,000 µS/cm as shown below.



Conductivity Assistant

Select Data Series

Conductivity Series: 2) Conductivity High Range

Temperature Compensation

Convert Electrical Conductivity to Specific Conductance at 25 °C

○ Non-linear, Natural Water Compensation per EN27888

○ Linear compensation at 2.1 %/°C for NaCl

○ Linear compensation at 2.1 %/°C (0.0 - 3.0)

● Non-linear, Sea Water Compensation based on PSS-78

Series Name

☑ Conductance: Specific Conductance

☑ Salinity (PSS-78): Salinity

User Notes:

Calibration

○ Use factory calibration only

● Use measured points for calibration

☑ Starting calibration point = 40600.00 µS / cm (Conductivity)

22.40 °C (Temperature)

Measurement time: 09/13/11 08:44:58 AM GMT-04:00 [0.0 µS/cm, 23.5 °C]

☑ Ending calibration point = 38900.00 µS / cm (Conductivity)

22.30 °C (Temperature)

Measurement time: 09/13/11 09:47:48 AM GMT-04:00 [0.0 µS/cm, 21.8 °C]

☐ Only report data between selected points

4. Select your desired Temperature Compensation method.

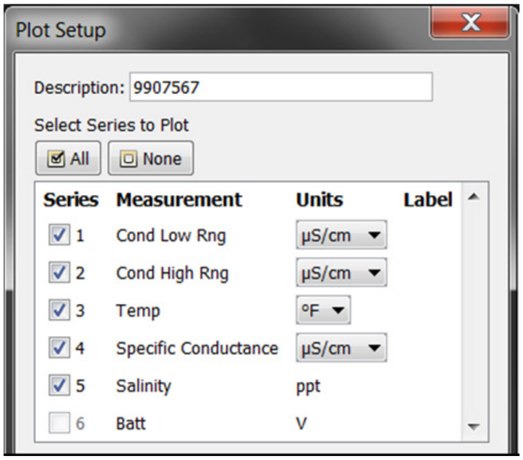
    - Use "Non-linear, Natural Water Compensation per EN27888" for freshwater lakes and streams.
    - Use "Linear compensation default at 2.1 %/°C" or "Linear compensation at <your own value>" for NaCl solutions or other linear solutions.
    - Use "Non-linear, Sea Water Compensation based on PSS-78" for salt water or salt marshes.

5. Select a Calibration Method. By default, data is calibrated using the factory calibration. To enter your own calibration values, select "Use measured points for calibration" and then enter temperature and actual conductivity (not specific conductance) values from your calibration readings taken with a field meter. These field measurements will be used to provide calibrated conductivity and salinity data series by adjusting the data as a percentage of the reading. See *Calibration* below for more information.

- Starting and Ending Value: This method calibrates your data and adjusts for sensor drift or fouling. This assumes there is a linear change in calibration adjustment required.
- Starting value only: All readings are adjusted up or down by a fixed percentage of the reading based on this calibration point.
- Ending Value Only: The factory calibration value is used as the starting point. This assumes there is a linear change in calibration adjustment required.

Note: You cannot use a zero-point calibration solution for starting and ending values. The first data point cannot be used as the ending value; consider using that as the starting value instead.

6. Select the Only Report Data Between the Selected Points checkbox if you want readings from before or after the calibration points to be removed from the resulting series.
7. In the Series Name field, keep the default name or type a new one.
8. Type any User Notes concerning the series you are creating (optional).
9. Click the Create New Series button.
10. The Plot Setup dialog lists a series called Specific Conductance (or the name you entered for Series Name). The default units are microSiemens/cm (µS/cm). You can change the units to milliSiemens/cm (mS/cm) if desired. The default units for salinity are ppt (parts per thousand) and this cannot be changed.

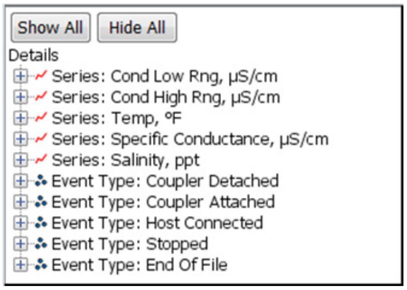


Description: 9907567

Select Series to Plot

Series	Measurement	Units	Label
☑ 1	Cond Low Rng	µS/cm	
☑ 2	Cond High Rng	µS/cm	
☑ 3	Temp	°F	
☑ 4	Specific Conductance	µS/cm	
☑ 5	Salinity	ppt	
☐ 6	Batt	V	

11. Click the Plot button to plot the data. The Details Pane will show the series selected in the Plot Setup:



Details
Series: Cond Low Rng, µS/cm
Series: Cond High Rng, µS/cm
Series: Temp, °F
Series: Specific Conductance, µS/cm
Series: Salinity, ppt
Event Type: Coupler Detached
Event Type: Coupler Attached
Event Type: Host Connected
Event Type: Stopped
Event Type: End Of File

After the plot is displayed, you may apply minimum, maximum, and average filters to the scaled series as you would for any sensor data series in HOBOware Pro.

12. Save this plot as a Project to preserve this processed data.

Calibration

It is important to take temperature and conductivity calibration readings with a portable conductivity meter at both the beginning (launchtime) and end of a deployment (readout) because these readings are necessary for data calibration and to compensate for any measurement drift during deployment. The temperature and conductivity calibration readings should be the actual conductivity values (not in specific conductance at 25°C), and should be recorded in a notebook with the time and location of the reading. See the logger manual for details on different methods of obtaining water samples to record these values.

1. Once the logger is deployed and logging, record in a notebook the temperature and actual conductivity meter readings along with the date and time which will be entered into the Conductivity Assistance to correct the field data.
2. Before you remove the logger and read out its data, take another temperature and conductivity reading with the meter and record the exact date and time.
3. Enter these values under the "Use measured points for calibration" option in the Conductivity Assistant.

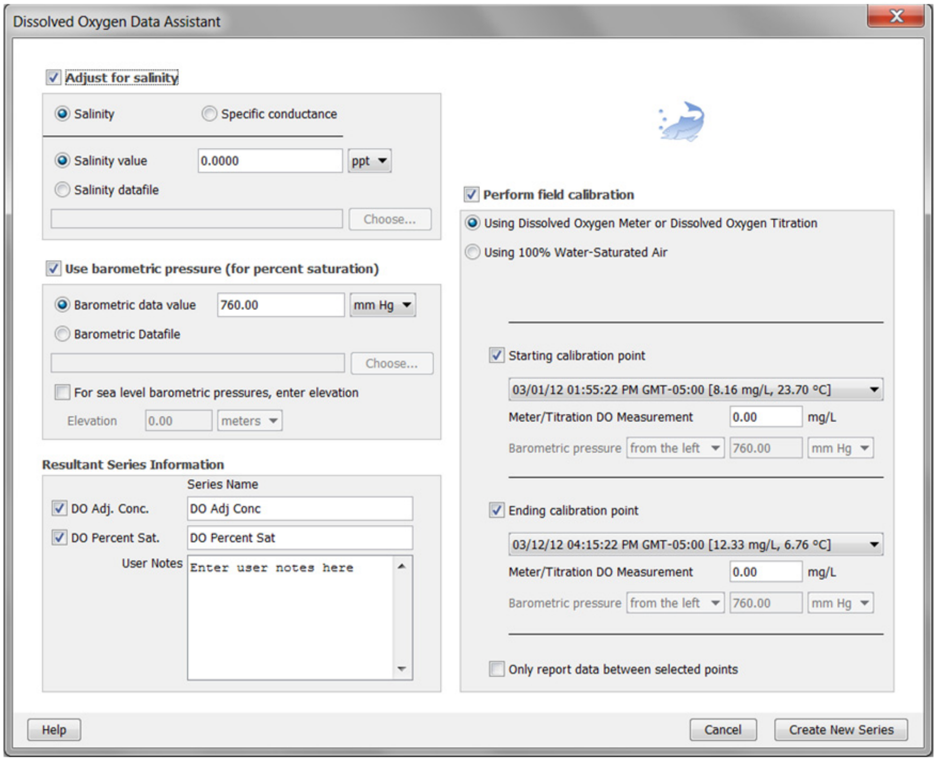
Notes:

- Whenever a logger is removed for downloading data, clean the sensor window using a cotton swab with a mild detergent and rinse.
- If the water in the field is not accessible to the conductivity meter sensor, such as in a deep well, a bailer can be used to fetch a water sample for testing. See the logger manual for more details.

Dissolved Oxygen Assistant

The Dissolved Oxygen Assistant corrects for measurement drift from fouling and provides salinity-adjusted DO concentration as well as percent saturation data.

1. Read out a U26 series logger or open a datafile from a U26 logger.
2. From the Plot Setup window, select the Dissolved Oxygen Assistant and click the Process button.
3. With the Dissolved Oxygen Data Assistant, you can adjust the data for salinity (step 4), enter barometric pressure information for percent saturation calculation (step 5), select the resultant series you wish to generate (step 6), and enter field calibration data (step 7).



Dissolved Oxygen Data Assistant

☑ Adjust for salinity

● Salinity ○ Specific conductance

● Salinity value 0.0000 ppt

○ Salinity datafile

☑ Use barometric pressure (for percent saturation)

● Barometric data value 760.00 mm Hg

○ Barometric Datafile

☐ For sea level barometric pressures, enter elevation

Elevation 0.00 meters

Resultant Series Information

	Series Name
☑ DO Adj. Conc.	DO Adj Conc
☑ DO Percent Sat.	DO Percent Sat
User Notes	Enter user notes here

☑ Perform field calibration

● Using Dissolved Oxygen Meter or Dissolved Oxygen Titration

○ Using 100% Water-Saturated Air

☑ Starting calibration point

03/01/12 01:55:22 PM GMT-05:00 [8.16 mg/L, 23.70 °C]

Meter/Titration DO Measurement 0.00 mg/L

Barometric pressure from the left 760.00 mm Hg

☑ Ending calibration point

03/12/12 04:15:22 PM GMT-05:00 [12.33 mg/L, 6.76 °C]

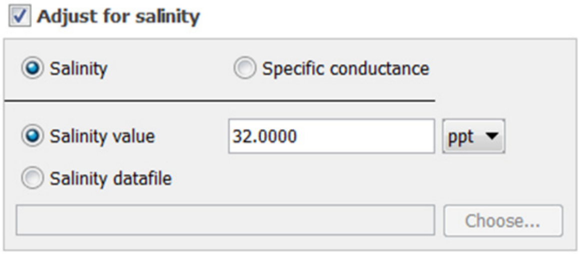
Meter/Titration DO Measurement 0.00 mg/L

Barometric pressure from the left 760.00 mm Hg

☐ Only report data between selected points

4. **Adjust for salinity.** If you deployed the logger in saltwater, you must adjust for salinity to get either a DO concentration or percent saturation. To do this, select the "Adjust for Salinity" checkbox (you will also need to select the checkboxes under Resultant Series Information for the series you would like). Select whether the series should be adjusted based on salinity or specific conductance.

   - **If you chose salinity:** Select "Salinity value" if you have a specific value from a conductivity meter reading or other source; type the value in ppt as shown below. This works well if the salinity is constant during the deployment. If the salinity changes during the deployment, select "Salinity datafile" to use a data file from a U24 conductivity logger or a text file. Click the Choose button and select the file. (See the Important note for more details about using files.)



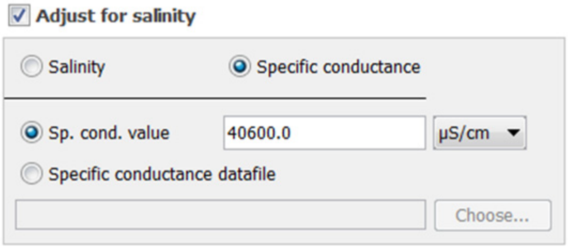
☑ Adjust for salinity

● Salinity ○ Specific conductance

● Salinity value 32.0000 ppt

○ Salinity datafile

   - **If you chose specific conductance:** Select "Sp. cond. value" if you have a specific conductance value from a meter reading or other source; type the value in either µS/cm or mS/cm as shown below. This works well if the specific conductance is constant during the deployment. If it is not constant, select "Specific conductance datafile" to use a data file from a U24 conductivity logger or a text file. Click the Choose button and select the file. (See the Important note for more details about using files.)



☑ Adjust for salinity

○ Salinity ● Specific conductance

● Sp. cond. value 40600.0 µS/cm

○ Specific conductance datafile

Important: When using a file for salinity or specific conductance data, you can select either a .hobo file from a HOBO U24 Conductivity Logger or a .txt file from a U24 logger after it has been calibrated with the Conductivity Assistant. Using a U24 .hobo file is the easiest while a calibrated U24 text file provides the highest accuracy. Follow these steps to create a text file from a U24 Conductivity Logger in the proper format:

A. Click Cancel to close the DO Assistant and Plot Setup windows if they are open.

B. From the File menu, select Preferences.

C. In the General Preferences, select Export Settings.

D. Click the "Use default BoxCar Pro export settings" button and click OK. This will ensure the text file you create is the proper format for the Dissolved Oxygen Assistant.

E. From the File menu, select Open Datafile and select the U24 .hobo file.

F. In the Plot Setup window, select the Conductivity Assistant and click Process.

G. In the Conductivity Assistant, create a calibrated specific conductance or salinity data series.

H. Back in the Plot Setup window, select the specific conductance or salinity series only. Click None under Select Internal Events to Plot so that no events are plotted.

I. Click the Plot button.

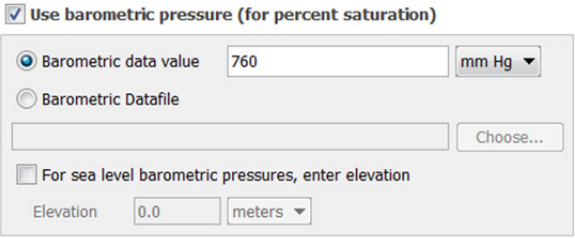
J. From the File menu, select Export Table Data. Choose "Export to single file" if prompted.

K. To use the calibrated conductivity file, open the DO file again. In the Plot Setup window, select the Dissolved Oxygen Assistant and click Process. Select the text file you just created in the previous step for the salinity or specific conductance datafile. This file will be used to generate the series adjusted for salinity.

5. **Use barometric pressure (for percent saturation).** Check the "Use barometric pressure (for percent saturation)" box if you want to generate a DO percent saturation series (you will also need to select the DO Percent Sat. checkbox under Resultant Series Information). For the best accuracy, use a data file from a HOBO Water Level logger deployed in the air or a nearby weather station. Select "Barometric Datafile" and click the Choose button to select the .hobo or .txt file. **Important:** If you are using a .txt file from a non-HOBO device, it must follow specific requirements as described in Import Text File Requirements.

   If you do not have a barometric pressure file, then select "Barometric data value" and type in the average barometric pressure during your deployment in one of the five available units.

   If the barometric pressure readings are from barometric data that has been adjusted to sea level readings (such as those taken from a National Weather Service weather station), then you must also select the "For sea level barometric pressures, enter elevation" checkbox and type the elevation where the logger was deployed in either meters or feet. Absolute pressure values, such as those obtained from a HOBO Water Level logger, do not need to be adjusted for elevation.



☑ Use barometric pressure (for percent saturation)

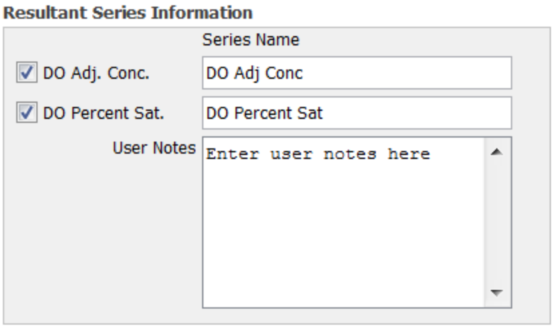
● Barometric data value 760 mm Hg

○ Barometric Datafile

☐ For sea level barometric pressures, enter elevation

Elevation 0.0 meters

6. **Resultant Series Information.** Make sure the series you want to plot are selected in the Resultant Series Information pane. To generate a series for adjusted DO concentration, check the "DO Adj Conc." box. To generate a series for percent saturation, check the "DO Percent Sat." box. The default series names display automatically to the right of the selected series. Edit those series names as needed. You can also type up to 250 characters of optional user notes.



Resultant Series Information

Series Name

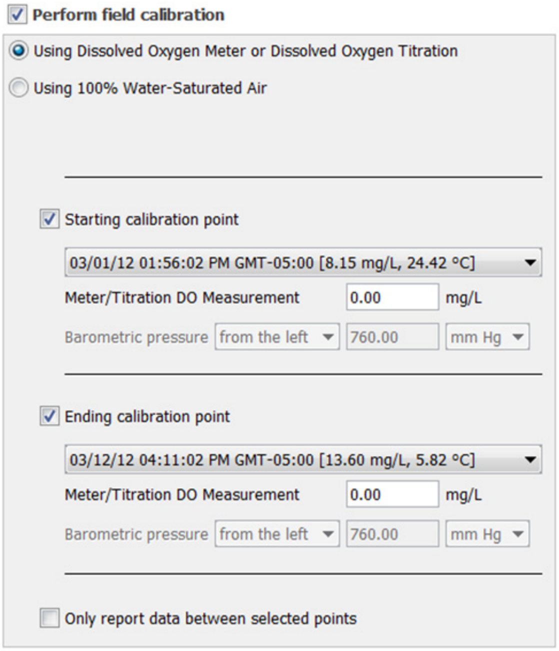
☑ DO Adj. Conc. DO Adj Conc

☑ DO Percent Sat. DO Percent Sat

User Notes Enter user notes here

7. **Perform Field Calibration.** Use field calibration to compensate for measurement drift due to fouling or if the logger was not lab calibrated. (Lab calibration typically remains accurate for the full 6-month life of the sensor cap if there is no fouling.) Check the "Perform field calibration" checkbox and select the type of field calibration: either "Using Dissolved Oxygen Meter or Dissolved Oxygen Titration" or "Using 100% Water-Saturated Air."

    - **For calibration using a dissolved oxygen meter or titration:** Select the "Starting calibration point" checkbox and select the date/time of the calibration reading. View the logged data values shown in the drop-down box to be sure that the logger readings have stabilized. It is more important that you use a good stabilized logger reading than exactly matching the times. Type in the Meter/Titration DO Measurement in mg/L taken at that date/time. If using an ending calibration reading, or, if desired, select the "Ending calibration point" checkbox and select the date/time of that calibration reading. Make sure the logger reading you use for calibration is one from when the logger was in the water, keeping in mind that the logger time may be slightly different from the time used for your field readings. You can usually see the data points that were recorded when the logger was out of the water. Type in the Meter/Titration DO Measurement in mg/L for this ending calibration point.



☑ Perform field calibration

● Using Dissolved Oxygen Meter or Dissolved Oxygen Titration

○ Using 100% Water-Saturated Air

☑ Starting calibration point

03/01/12 01:56:02 PM GMT-05:00 [8.15 mg/L, 24.42 °C]

Meter/Titration DO Measurement 0.00 mg/L

Barometric pressure from the left 760.00 mm Hg

☑ Ending calibration point

03/12/12 04:11:02 PM GMT-05:00 [13.60 mg/L, 5.82 °C]

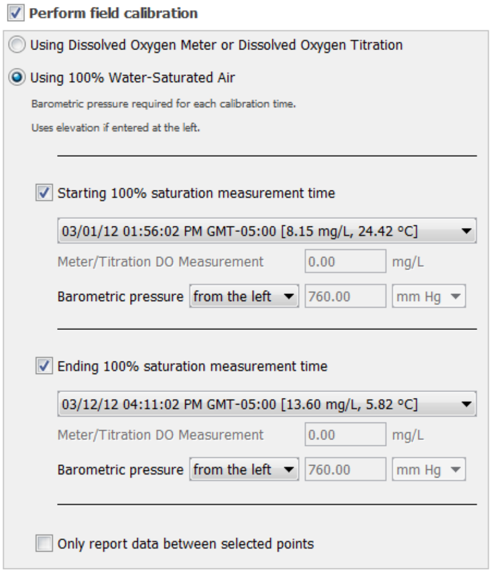
Meter/Titration DO Measurement 0.00 mg/L

Barometric pressure from the left 760.00 mm Hg

☐ Only report data between selected points

Note: If only an “Ending calibration point” is entered (“Starting calibration point” not checked), then the assistant will use the logger calibration for the starting calibration. This assumes you are starting with an accurately calibrated logger and saves you from having to do your own starting point calibration. However, if you select a “Starting calibration point” and no “Ending calibration point,” the series will be adjusted for the one calibration point. This may be accurate enough for applications where there is no significant fouling during the deployment time.

- **For calibration using 100% water-saturated air:** Select the "Starting calibration point" checkbox and the "Ending calibration point" checkbox and select the date/time for the first calibration reading. View the values shown in the drop-down list to be sure the readings are stable at this calibration point (using a calibration point from when the logger is in air or has not reached temperature equilibrium will result in incorrect calibration). Select the source of the barometric pressure readings. From the Barometric Pressure drop-down list, select "from the left" to use the barometric pressure data file already entered in the assistant or select "entered here" to enter a specific barometric pressure value in one of five available units. If you are using an ending calibration reading, select the “Ending calibration point” checkbox and select the date/time of that calibration reading following the same guidelines as you did for the starting calibration point. For the ending point, enter the barometric pressure information (select “from the left” or “entered here” as described above).



☑ **Perform field calibration**

○ Using Dissolved Oxygen Meter or Dissolved Oxygen Titration

● Using 100% Water-Saturated Air

Barometric pressure required for each calibration time.

Uses elevation if entered at the left.

☑ Starting 100% saturation measurement time

03/01/12 01:56:02 PM GMT-05:00 [8.15 mg/L, 24.42 °C]

Meter/Titration DO Measurement 0.00 mg/L

Barometric pressure from the left 760.00 mm Hg

☑ Ending 100% saturation measurement time

03/12/12 04:11:02 PM GMT-05:00 [13.60 mg/L, 5.82 °C]

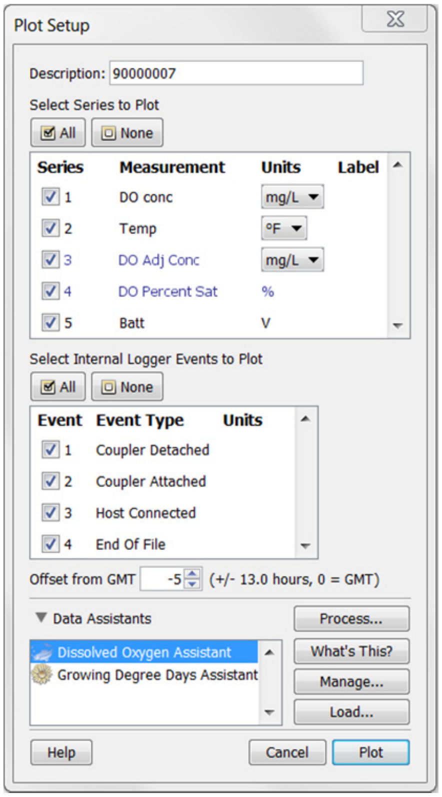
Meter/Titration DO Measurement 0.00 mg/L

Barometric pressure from the left 760.00 mm Hg

☐ Only report data between selected points

Check the "Only report data between selected points" if you want the new series to only include data between the selected calibration points. Leave this option unchecked to include all data.

8. Click the Create New Series button when finished entering information in the data assistant.
9. Depending on which series you selected to add, the Plot Setup dialog lists two news series: DO Adj Conc and DO Percent Sat (or the names you entered for Series Names). The default units for the DO Adj Conc series are mg/L. You can change the units to ppm if desired.



Description: 90000007

Select Series to Plot

Series	Measurement	Units	Label
☑ 1	DO conc	mg/L	
☑ 2	Temp	°F	
☑ 3	DO Adj Conc	mg/L	
☑ 4	DO Percent Sat	%	
☑ 5	Batt	V	

Select Internal Logger Events to Plot

Event	Event Type	Units
☑ 1	Coupler Detached	
☑ 2	Coupler Attached	
☑ 3	Host Connected	
☑ 4	End Of File	

Offset from GMT -5 (+/- 13.0 hours, 0 = GMT)

Data Assistants

Dissolved Oxygen Assistant

Growing Degree Days Assistant

10. Click the Plot button to plot the data. After the plot is displayed, you may apply minimum, maximum, and average filters to the scaled series as you would for any sensor data series in HOBOware Pro.
11. Save this data and plot setup as a Project to preserve the new series you created for future use.

Field Values

These are the minimum and maximum values allowable in the fields in this assistant.

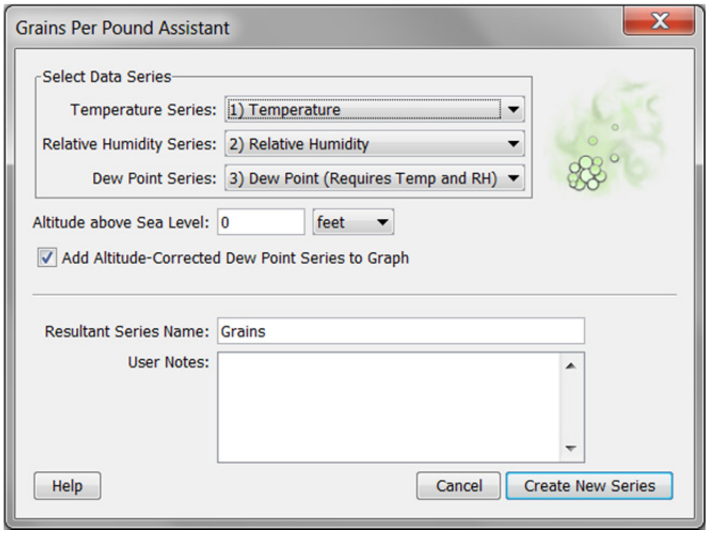
Measurement, Units	Minimum	Maximum
pressure, mm Hg	380.00	836.00
pressure, in Hg	14.9700	32.9100
pressure, millibars	507.0	1,114.0
pressure, kPa	51.000	112.000
pressure, Pa	51,000	112,000
pressure, psi	7.3480	16.1600
elevation, m	-304.80 2	2,438.40
elevation, ft	-1000.00	8,000.00
salinity, ppt	0.0000	42.0000
sp. cond., µs/cm	0.0	65,000.0
sp. cond., ms/cm	0.0000	65.0000
meter/titration DO conc, mg/L	0.00	30.00

Grains Per Pound Assistant

The Grains Per Pound Assistant calculates the absolute amount of water in the air, based on temperature, humidity, dew point, and altitude. You can also create an altitude-corrected dew point series.

To create a grains per pound and altitude-corrected dew point series:

1. Read out a logger or open a datafile that contains temperature, humidity, and dew point series.
2. From the Plot Setup window, select the Grains Per Pound Assistant and click the Process button.
3. In the Grains Per Pound Assistant window, choose the data series you want to convert from the Temperature, Relative Humidity, and Dew Point Series drop-down lists.



Select Data Series

Temperature Series: 1) Temperature

Relative Humidity Series: 2) Relative Humidity

Dew Point Series: 3) Dew Point (Requires Temp and RH)

Altitude above Sea Level: 0 feet

☑ Add Altitude-Corrected Dew Point Series to Graph

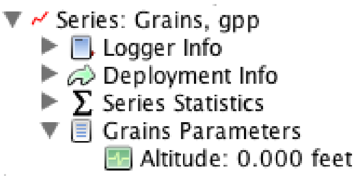
Resultant Series Name: Grains

User Notes:

4. To correct for the Altitude above Sea Level (optional), enter the altitude and use the drop-down menu to indicate whether this number is in feet or meters.
5. Select the Add Altitude-Corrected Dew Point Series to Graph checkbox to plot an altitude-corrected dew point series.
6. In the Resultant Series Name field, keep the default name or type a new one.
7. Type any User Notes concerning the series you are creating (optional).
8. Click the Create New Series button. The new grains per pound series (and altitude-corrected dew point series, if applicable) is listed and selected in the Plot Setup window.

9. Click the Plot button.

The scaled series will appear in the plot and the settings for the scaled series are listed in the Details pane:



- Series: Grains, gpp
  - Logger Info
  - Deployment Info
  - Series Statistics
  - Grains Parameters
    - Altitude: 0.000 feet

After the plot is displayed, you may apply minimum, maximum, and average filters to the grains per pound and altitude-corrected dew point series as you would for any sensor data series in HOBOware Pro.

Growing Degree Days Assistant

The Growing Degree Days Assistant calculates growing degree days based on temperature data spanning at least one full calendar day (midnight to midnight). Growing degree days are used for agricultural and turf management applications, such as estimating harvest time or pest growth.

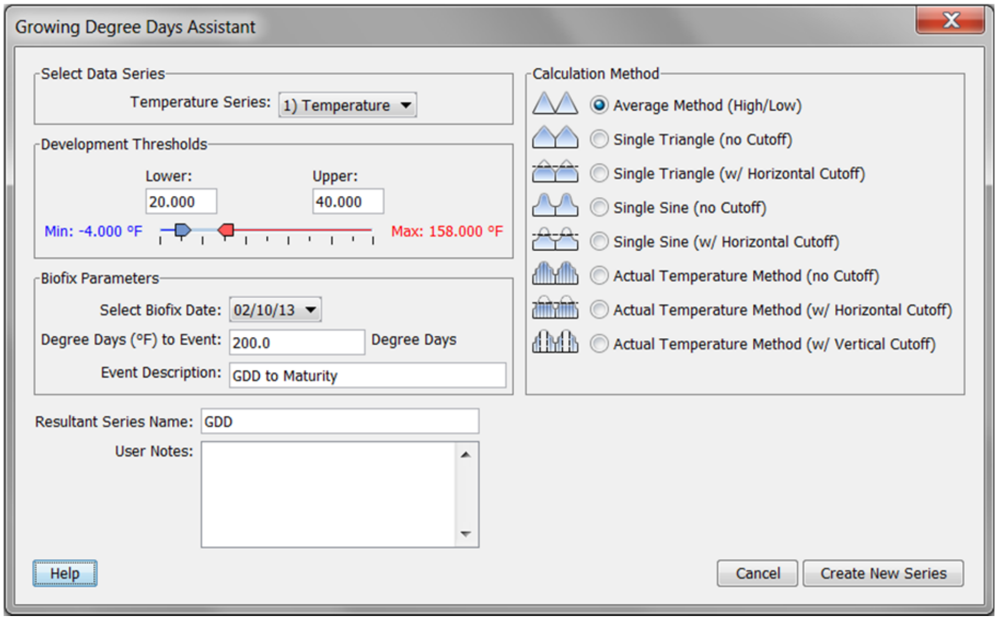
One growing degree day (GDD) is equivalent to a one degree increase above a minimum threshold temperature for a period of one day. For example, assuming no horizontal cutoff, if the minimum threshold temperature is 70°F and the temperature was a constant 85°F for the day, the GDD for that day is 15 GDD.

A single GDD value is calculated for each full calendar day of temperature data, and plotted at noon for that day. GDD values are cumulative; that is, the GDD for each day adds to the previous days’ GDD value.

Important: Time of day is a factor in the GDD computation. When you launch a logger, be sure that your computer’s clock is set to the proper time zone for the area where the logger will be deployed. If you try to correct it later by entering a different offset in the Plot Setup window, you may get confusing or misleading results.

To create a series for growing degree days:

1. Read out a logger or open a datafile that contains data from a temperature sensor.
2. From the Plot Setup window, select Growing Degree Days Assistant and click the Process button.
3. In the Growing Degree Days Assistant window, choose the data series you want to convert from the Temperature Series drop-down list.



Growing Degree Days Assistant

Select Data Series
Temperature Series: 1) Temperature

Development Thresholds
Lower: 20.000
Upper: 40.000
Min: -4.000 °F
Max: 158.000 °F

Biofix Parameters
Select Biofix Date: 02/10/13
Degree Days (°F) to Event: 200.0 Degree Days
Event Description: GDD to Maturity

Calculation Method
● Average Method (High/Low)
○ Single Triangle (no Cutoff)
○ Single Triangle (w/ Horizontal Cutoff)
○ Single Sine (no Cutoff)
○ Single Sine (w/ Horizontal Cutoff)
○ Actual Temperature Method (no Cutoff)
○ Actual Temperature Method (w/ Horizontal Cutoff)
○ Actual Temperature Method (w/ Vertical Cutoff)

Resultant Series Name: GDD
User Notes:

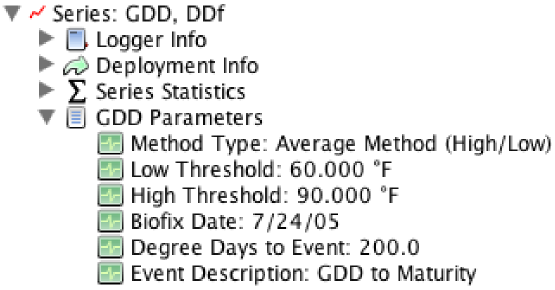
4. Select the Calculation Method you want to use.

    - **Average Method:** Calculates the average of the high and low temperatures for the day (adjusted to the lower and upper thresholds, if necessary), then subtracts the low threshold to compute the GDD.
    - **Single Triangle (no Cutoff):** Uses the low and high daily temperatures to compute a set of two linear equations to generate a triangle. The area between the curve and the low threshold is then used to compute the GDD.
    - **Single Triangle (with Horizontal Cutoff):** Uses the low and high daily temperatures to compute a set of two linear equations to generate a triangle. Then it adjusts any temperatures above the upper threshold to the upper threshold. The remaining area between the curve and the low threshold is then used to compute the GDD.
    - **Single Sine (no Cutoff):** Uses the low and high daily temperatures to compute a sine wave that assumes the low temperature occurred at midnight and the high temperature occurred at noon. The area between the curve and the low threshold is then used to compute the GDD.
    - **Single Sine (with Horizontal Cutoff):** Uses the low and high daily temperatures to compute a sine wave that assumes the low temperature occurred at midnight and the high temperature occurred at noon. Then it adjusts any temperatures above the upper threshold to the upper threshold. The remaining area between the curve and the low threshold is then used to compute the GDD.
    - **Actual Temperature Method (no Cutoff):** Uses the logging interval of the temperature data to perform a numerical integration. The area between the curve and the low threshold is used to compute the GDD.
    - **Actual Temperature Method (with Horizontal Cutoff):** Adjusts any temperatures above the upper threshold to the upper threshold. Then it uses the logging interval of the temperature data to perform a numerical integration. The area between the curve and the low threshold is then used to compute the GDD.
    - **Actual Temperature Method (with Vertical Cutoff):** Uses the logging interval of the temperature data to perform a numerical integration. Any interval in which the temperature exceeds the upper threshold is excluded from the calculation. The remaining area between the actual curve and the low threshold is then used to compute the GDD.

5. Select lower and upper Development Threshold values. These are the minimum and maximum thresholds that will be used in the GDD calculation. Use the sliders to set these thresholds, or enter the values manually. If the calculation method you chose does not use an upper threshold, the upper threshold option will be disabled. Temperatures are in degrees Fahrenheit if your default unit preference is US, and in degrees Celsius if your default unit preference is SI.
6. In the Biofix Parameters panel, choose a date that marks the beginning of the development phase for the Biofix date. The dates in this list are the full days contained in the datafile.
7. In the Degree Days to Event, enter the number of degree days needed to reach an event of interest (harvest time, pest emergence, etc.). This will create an alarm line on the graph to indicate when the event took place. Degree days are in Fahrenheit (DDf) if your default unit preference is US, and in Celsius (DDc) if your default unit preference is SI.
8. In the Event Description field, type any text to identify the event (optional).
9. In the Resultant Series Name field, keep the default name or type a new one.
10. Type any User Notes concerning the series you are creating (optional).
11. Click the Create New Series button.

12. The new series is listed and selected in the Plot Setup window. Click the Plot button.

The scaled series will appear in the plot and the settings for the scaled series are listed in the Details pane:



Series: GDD, DDf
- Logger Info
- Deployment Info
- Series Statistics
- GDD Parameters
  - Method Type: Average Method (High/Low)
  - Low Threshold: 60.000 °F
  - High Threshold: 90.000 °F
  - Biofix Date: 7/24/05
  - Degree Days to Event: 200.0
  - Event Description: GDD to Maturity

kWh Assistant

The kWh Assistant converts logged pulse data to kWh, average kW, and energy cost with WattNode, Veris, or other energy transducers, and from Raw Pulse sensors attached to a HOBO 4-Channel Pulse Input Data Logger (UX120-017x).

This assistant can be applied to logged data from a S-UCA-xxxx or S-UCC-xxxx Electronic Switch Pulse Input Adapter. It is not compatible with the S-UCB-xxxx or S-UCD-xxxx Contact Closure Pulse Input Adapter.

After you use the assistant and display the plot, you may apply filters to the new series.

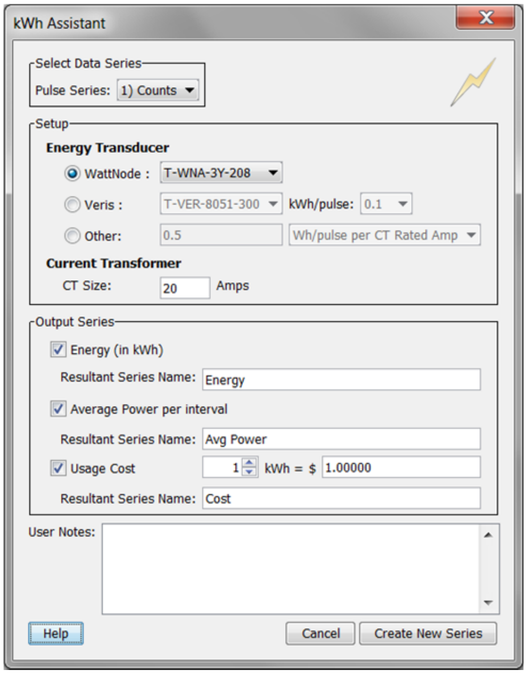
This data assistant is one of several launch utilities that can also be used at launch time for certain loggers.

Using the kWh Assistant

1. **At launch time:** Using a logger or sensor that supports scaling at launch time, click the Launch icon on the toolbar. Click the Scaling button. Double click the assistant name or select the assistant and click the Create button.

   At plot setup: Read out a logger or open a file that supports kWh scaling. Select the kWh Assistant and click the Process button.

2. In the kWh Assistant window, choose the data series you want to convert from the Pulse Series drop-down list.



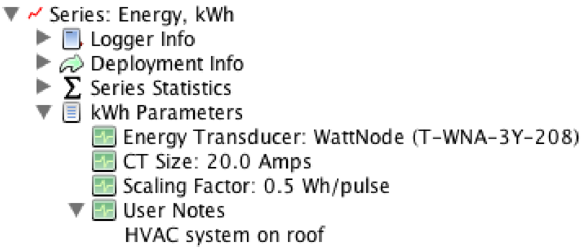
Select Data Series
Pulse Series: 1) Counts

Setup
Energy Transducer
● WattNode : T-WNA-3Y-208
○ Veris : T-VER-8051-300 kWh/pulse: 0.1
○ Other: 0.5 Wh/pulse per CT Rated Amp
Current Transformer
CT Size: 20 Amps

Output Series
☑ Energy (in kWh)
Resultant Series Name: Energy
☑ Average Power per interval
Resultant Series Name: Avg Power
☑ Usage Cost 1 kWh = $ 1.00000
Resultant Series Name: Cost

User Notes:

3. In the Setup panel, select the Energy Transducer that was used, and choose the model number from the drop-down list. (Since the Veris transducers have a switch to define kWh/pulse, you must specify that here as well.) If your transducer is not listed, select Other and enter the conversion factor. Choose the type of conversion (Wh/pulse per CT Rated Amp, Wh/pulse, or kWh/pulse) from the drop-down list. Refer to the manual that came with your energy transducer for help with identifying the conversion factor
4. Enter the current transformer size (in Amps) in the CT Size field. (Veris transducer CT sizes are predefined.)
5. In the Output Series panel, select one or more series you wish to create. For each series, you may keep the default Resultant Series Name or type a new one.
   - To create a series that shows energy in kWh, check the Energy box.
   - To create a series that shows average power, check the Average Power per interval box.
   - To create a cost series, check the Usage Cost box and enter the cost per kWh.
6. Type any User Notes concerning the series you are creating (optional).
7. Click Create New Series.
8. If you are running this assistant at launch time, the kWh button displays the number of newly created series. If using this assistant while plotting, the new series is listed and selected in the Plot Setup window. Click the Plot button to display the series.
9. The scaled series will appear in the plot immediately or when you read out the logger if configuring this at launch time. The settings for the scaled series are listed in the Details pane of the plot:


- Series: Energy, kWh
  - Logger Info
  - Deployment Info
  - Series Statistics
  - kWh Parameters
    - Energy Transducer: WattNode (T-WNA-3Y-208)
    - CT Size: 20.0 Amps
    - Scaling Factor: 0.5 Wh/pulse
    - User Notes
      - HVAC system on roof

After the plot is displayed, you may apply filters to the new series as you would for any other series in HOBOware Pro. In addition to the minimum, maximum, and average filters that are available for most series, the energy and cost series allow you to create new series showing totals over a period of time.

Linear Scaling Assistant

The Linear Scaling Assistant converts a data series from a compatible sensor to some other measurement when you enter two raw values and their corresponding measurement values. The conversion must be based on a linear relationship. Nonlinear scaling is not supported.

Supported Sensors

This assistant is available for the following sensors:

- CABLE-2.5-STEREO Voltage Input Cable (for U12 loggers)
- CABLE-4-20-mA Input Cable (for U12 loggers)
- CABLE-ADAP5 (for U12 loggers)
- CABLE-ADAP10 (for U12 loggers)
- S-CIA-xxxx 12-bit 4-20mA Input Adapter
- S-VIA-xxxx 12-bit Voltage Input Adapter
- S-FS-CVIA FlexSmart™ Analog Module
- S-FS-TRMSA FlexSmart TRMS Module
- U30 Analog Sensor Port
- S-LWA-xxxx Leaf Wetness
- S-SMx-xxxx Soil Moisture

The Linear Scaling Assistant can be applied only to logged data from these sensors.

Other Types of Scaling

There are also other types of scaling available within HOBOware Pro which may apply to your configuration:

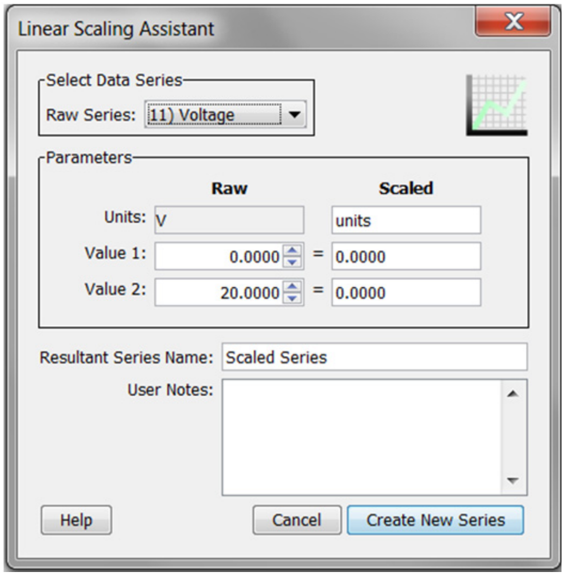
- FlexSmart™ modules are set up for scaling prior to launch, as part of the module configuration process. You can later rescale these scaled series using the Linear Scaling Assistant if you need to create a different measurement. See Configuring an Analog Module/Port.
- The Pulse Scaling Assistant is similar to the Linear Assistant, but only allows scaling of pulse data.

Using the Linear Scaling Assistant

1. **At launch time:** Using a logger with a sensor that supports scaling at launch time, click the Launch icon on the toolbar. Click the Scaling button. Double click the assistant name or select the assistant and click the Create button.

   At plot setup: Read out a logger or open a file that supports linear scaling. Select the Linear Scaling Assistant and click the Process button.

2. In the Linear Scaling Assistant window, choose the data series you want to convert from the Raw Series drop-down list.



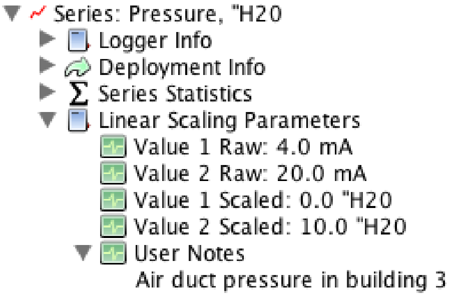
Raw Series: 11) Voltage

	Raw		Scaled
Units:	V		units
Value 1:	0.0000	=	0.0000
Value 2:	20.0000	=	0.0000

Resultant Series Name: Scaled Series

User Notes:

3. In the Scaled column of the Parameters panel, type the units name for the scaled series and enter the scaled values in the Scaled column to correspond with the numbers in the Raw column. (The default values in the Raw column are based on the high and low values supported by the sensor, but you may use different values, as long as those values fall within the sensor's range.) These numbers establish a linear relationship between raw and scaled values.
4. In the Resultant Series Name field, keep the default name or type a new one.
5. Type any User Notes concerning the series you are creating (optional).
6. Click the Create New Series button.
7. If you ran the assistant from the Launch window, the Scaling button displays the number of newly created series. If using this assistant while plotting, the new series is listed and selected in the Plot Setup dialog. Click the Plot button to display the series.
8. The scaled series will appear in the plot immediately or when you read out the logger if configuring this at launch time. The settings for the scaled series are listed in the Details pane of the plot:



- Series: Pressure, "H20
  - Logger Info
  - Deployment Info
  - Series Statistics
  - Linear Scaling Parameters
    - Value 1 Raw: 4.0 mA
    - Value 2 Raw: 20.0 mA
    - Value 1 Scaled: 0.0 "H20
    - Value 2 Scaled: 10.0 "H20
    - User Notes
      - Air duct pressure in building 3

After the plot is displayed, you may apply minimum, maximum, and average filters to the scaled series as you would for any sensor data series in HOBOware Pro.

Pulse Scaling Assistant

The Pulse Scaling Assistant converts a data series from a compatible sensor to some other measurement when you enter a raw value and its corresponding measurement value. The conversion must be based on a linear relationship. Nonlinear scaling is not supported

The Pulse Scaling Assistant can be run from the Launch window (Pre-set Parameters) or from the Plot Setup window. If you run the assistant from the Plot Setup window, you must run the assistant each time you readout the logger or open a datafile.

Supported Sensors

This assistant is available for the following sensors:

- S-UCA-xxxx and S-UCC-xxxx Electronic Switch Pulse Input Adapter
- S-UCB-xxxx and S-UCD-xxxx Contact Closure Pulse Input
- Raw Pulse sensors connected to HOBO UX series loggers that support pulse logging

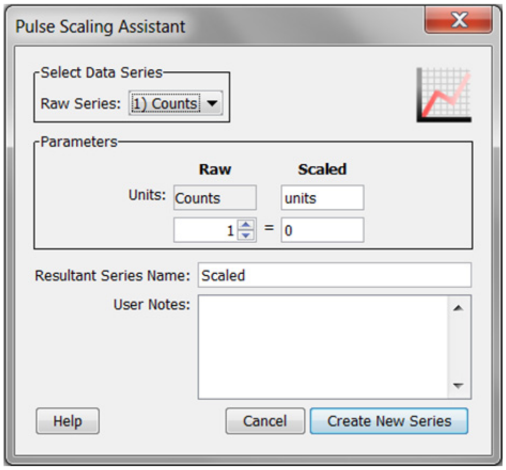
Other Types of Scaling

There are also other types of scaling available within HOBOware Pro which may apply to your configuration:

- FlexSmart™ modules are set up for scaling prior to launch, as part of the module configuration process. See Configuring an Analog Module/Port.
- The Linear Scaling Assistant is similar to the Pulse Scaling Assistant, but has slightly different input options and is compatible with a different group of sensors. See the Linear Scaling Assistant for more information.

Using the Pulse Scaling Assistant

1. **At launch time:** Using a logger with a sensor that supports scaling at launch time, click the Launch icon on the toolbar. Click the Scaling button. Double click the assistant name or select the assistant and click the Create button.
2. **At plot setup:** Read out a logger or open a file that supports pulse scaling. Select the Pulse Scaling Assistant and click the Process button.
3. In the Pulse Scaling Assistant window, choose the data series you want to convert from the Raw Series drop-down list.



Raw Series: 1) Counts

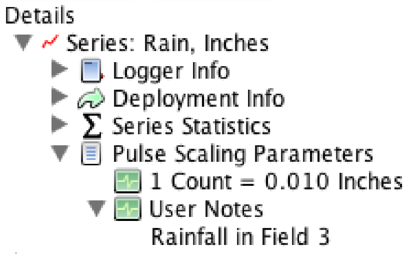
Units: Counts units

1 = 0

Resultant Series Name: Scaled

4. In the Scaled column of the Parameters panel, enter the units name for the scaled series and enter a scaled value in the Scaled box to correspond with the number in the Raw box. These numbers establish the relationship between the raw and scaled values.
5. In the Resultant Series Name field, keep the default name or type a new one.
6. Type any User Notes concerning the series you are creating (optional).
7. Click the Create New Series button.

8. If you ran the assistant from the Launch window, the Scaling button displays the number of newly created series. If using this assistant while plotting, the new series is listed and selected in the Plot Setup window. Click the Plot button to display the series.
9. The scaled series will appear in the plot immediately or when you read out the logger if configuring this at launch time. The settings for the scaled series are listed in the Details pane of the plot:



Details
- Series: Rain, Inches
  - Logger Info
  - Deployment Info
  - Series Statistics
  - Pulse Scaling Parameters
    - 1 Count = 0.010 Inches
    - User Notes
      - Rainfall in Field 3

After the plot is displayed, you may apply filters to the scaled series as you would for any other series in HOBOware Pro. In addition to the minimum, maximum, and average filters that are available for most series, the scaled pulse series allows you to create a new series showing totals over a period of time.

Exporting Data

While HOBOware offers many tools for analyzing data, there may be instances where you need to export data for use in other software. Refer to the following for exporting data and other related topics:

- Exporting Table Data
- Exporting Data in Classic (BoxCar Pro) Format
- Exporting Details
- Copying Points Data into Another Application
- Formatting the Date/Time Column in Excel
- The Bulk Export Tool

Exporting Table Data

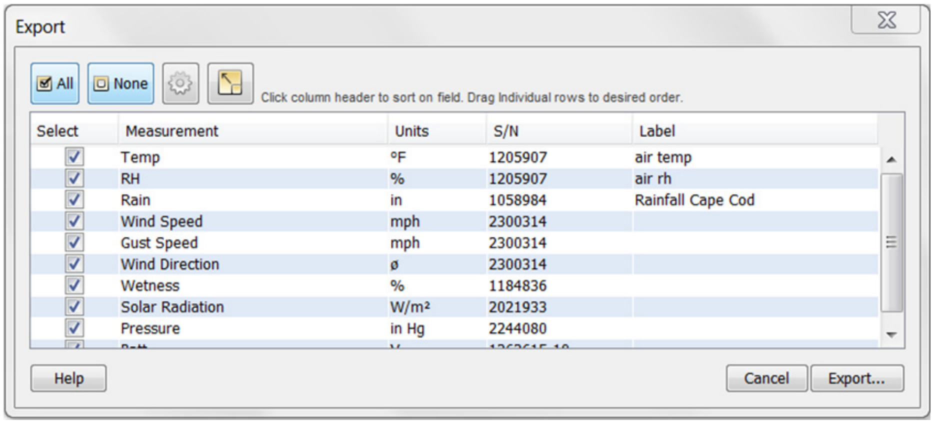
You can export the data shown in the points table to a Microsoft Excel file or to a text file (.csv or .txt) for importing into other applications. You can also export the data points gathered in a ZW wireless network via the Plot/Export Wireless Data window.

To export data:

1. From HOBOware files: Open a data or project file. Make sure the points table includes the series you want to export. This might include series pasted from other datafiles or series derived through filters or Data Assistants. Make any changes as necessary.

   From the Plot/Export Wireless Data window: Make the changes necessary to select the desired series and then click the Export button. Skip to step 3.

2. From the File menu, select Export Table Data or click the Export icon on the toolbar.



Click column header to sort on field. Drag individual rows to desired order.

Select	Measurement	Units	S/N	Label
☑	Temp	°F	1205907	air temp
☑	RH	%	1205907	air rh
☑	Rain	in	1058984	Rainfall Cape Cod
☑	Wind Speed	mph	2300314	
☑	Gust Speed	mph	2300314	
☑	Wind Direction	ø	2300314	
☑	Wetness	%	1184836	
☑	Solar Radiation	W/m^2	2021933	
☑	Pressure	in Hg	2244080	

3. To change the export settings, click the Preferences button. Make any changes to the settings and then click OK in the Preferences window to return to the Export window. **Note:** Changes to the "Use export ordering rules" preference are not automatically displayed in the Export window; they will take effect the next time you open the Export window.
4. Select the series you wish to include in the exported file. Use the All and None buttons or the checkboxes in the Select column to make your changes. **Note:** Only the series that are listed in the points table in a plotted HOBOware file or selected from the Plot/Export Wireless Data window are available to export from this window. To make additional series appear in this window, click Cancel and go back to step 1.
5. The data will be exported in the order displayed in the Export window. To change this sort order, click a column header in the Export window. You can sort the Measurement, Units, sensor S/N, and Label columns in both ascending and descending order. Or, click a row to drag that series to a different position in the list. To return to the original sort order, click the Restore Order button. Note that if you have the export preferences set to "Use export ordering rules," then the series will be listed in the order defined in that preference when you click the Restore Order button. If the datafile contains series with measurement types that are not defined in the export ordering rules preference, then those series will be listed after the defined series.
6. Click the Export button and then select where you want to save the file.
7. Click Save. You can now open the exported file in Excel or another software application. Note that if you have the export preference "Include plot details in exported file" enabled, then any information in the Details pane of the plot will be included in the exported file along with the sensor data.

Exporting Data in Classic (BoxCar Pro) Format

BoxCar Pro is legacy software from Onset Computer. HOBOware includes a preference setting that allows you to export and import data in a format compatible with Onset's Box Car Pro software. To change the export preferences to use settings compatible with BoxCar Pro:

1. From the File menu in Windows or the HOBOware menu on Macintosh, select Preferences.
2. Select the General category and then click Export Settings.
3. Click the "Use classic export settings" button and then click OK.

See Export Settings for details on all export preference settings.

Exporting Details

You can export the information in the Details pane to a text file, which can be opened in any text editor or imported into numerous applications, such as Microsoft Word or Excel.

To export details:

1. Make sure the Details pane includes the series you want to export. This might include series pasted from other datafiles or series derived through filters or Data Assistants.
2. From the File menu, select Export Details.
3. Accept the default file name, or type a new name.
4. Click Save.

If you would prefer to have the information in the Details pane and sensor data in the same file, select Preferences from the File menu in Windows or the HOBOware menu in Macintosh and click the General category. Click Export Settings and then enable the "Include plot details in exported file" checkbox and click OK. The next time you use the Export Table Data feature, the plot details will be included in the exported file along with the sensor data.

Formatting the Date/Time Column in Excel

In Excel, dates and times for each data point may initially appear as ####### and times may not have seconds listed. To display the full date and time with seconds in Excel:

1. Adjust the time column width so you can see the whole date and time.
2. Select the time column from row 3 down.
3. From the Format menu, click Cells.
4. Select the Custom category and then select "m/d/yyyy h:mm" as the type.
5. Add ":ss" (or ":ss.000" if you used a fast logging interval) to the end of the string in the Type field:

   m/d/yyyy h:mm:ss (normal logging interval)
   m/d/yyyy h:mm:ss.000 (fast logging interval)

6. Click OK. The seconds should be listed automatically.

To export the date and time in separate columns, go to Preferences> General > Export Settings and enable the "Date and time format: Separate into two columns" option.

The Bulk Export Tool

The Bulk Export Tool is a plug-in tool for HOBOware Pro that exports HOBOware files to text or Microsoft Excel format for use in other programs. This tool is particularly helpful when you need to export multiple files at once.

With the Bulk Export Tool, you can export the following file types:

- .hobo
- .dtf
- .hsec
- .dsec

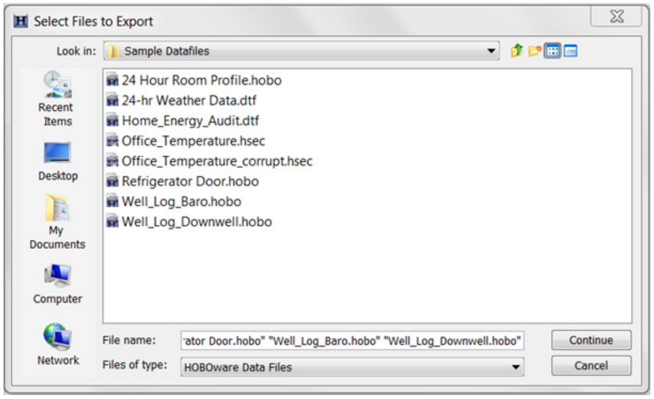
Any naming conflicts are automatically resolved to prevent overwriting any pre-existing files. A log summarizing the export results is saved in the same directory as the newly exported files.

The Bulk Export Tool uses the general export settings for HOBOware Pro. To configure the Export Settings, go to the File menu in Windows or the HOBOware menu in Macintosh and select Preferences. In the General category, select Export Settings.

Using the Bulk Export Tool

To export files with the Bulk Export Tool:

1. From the Tools menu, select Bulk File Export and then Select Files to Export ...
2. In the Select Files to Export dialog, select the files you wish to export and click Continue.



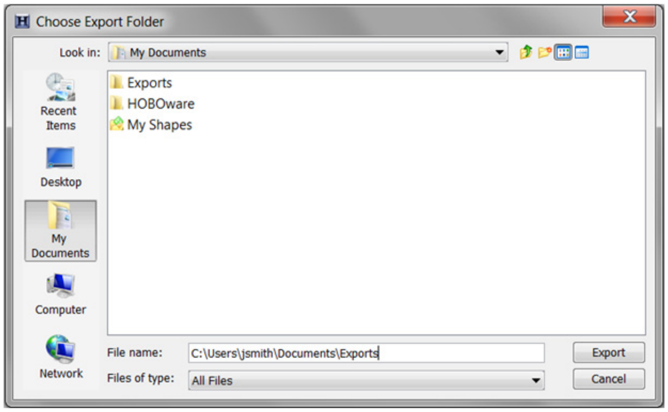
Select Files to Export

Look in: Sample Datafiles

File name: 'ator Door.hobo" "Well_Log_Baro.hobo" "Well_Log_Downwell.hobo"

Files of type: HOBOware Data Files

3. In the Choose Exports Folder dialog, navigate to the directory where you want the files to be exported and click Export.



Choose Export Folder

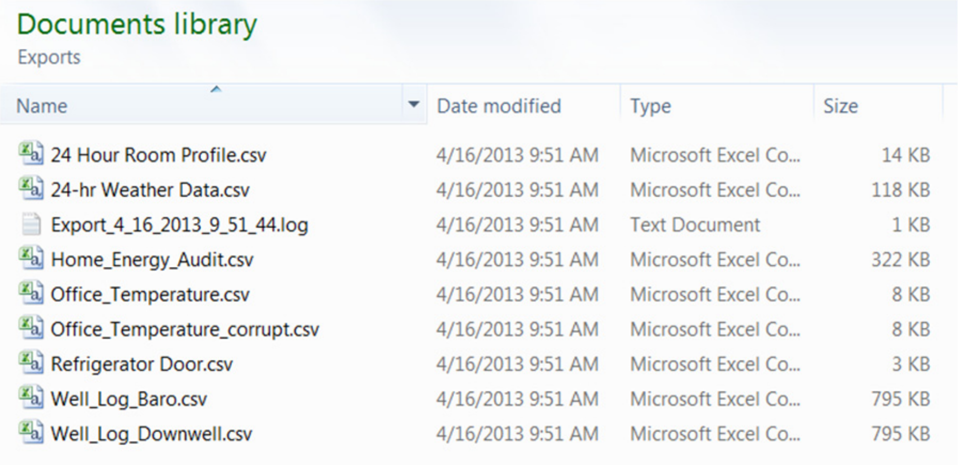
Look in: My Documents

File name: C:\Users\jsmith\Documents\Exports

Files of type: All Files

4. A progress bar indicates the status of the export (if this happens very quickly, you may not see the bar). A message appears when the export is complete. Click OK.

The exported files are saved to the specified directory.



Documents library
Exports

Name	Date modified	Type	Size
24 Hour Room Profile.csv	4/16/2013 9:51 AM	Microsoft Excel Co...	14 KB
24-hr Weather Data.csv	4/16/2013 9:51 AM	Microsoft Excel Co...	118 KB
Export_4_16_2013_9_51_44.log	4/16/2013 9:51 AM	Text Document	1 KB
Home_Energy_Audit.csv	4/16/2013 9:51 AM	Microsoft Excel Co...	322 KB
Office_Temperature.csv	4/16/2013 9:51 AM	Microsoft Excel Co...	8 KB
Office_Temperature_corrupt.csv	4/16/2013 9:51 AM	Microsoft Excel Co...	8 KB
Refrigerator Door.csv	4/16/2013 9:51 AM	Microsoft Excel Co...	3 KB
Well_Log_Baro.csv	4/16/2013 9:51 AM	Microsoft Excel Co...	795 KB
Well_Log_Downwell.csv	4/16/2013 9:51 AM	Microsoft Excel Co...	795 KB

The native file extension is removed and appended with the file type selected in the export preferences (.txt, .csv, or .xls). For example, if the Export File Type preference is set to Excel, then exportfile.hobo is renamed exportfile.xls. If a file name already exists, new files will be appended with "_0", "_1" etc. For example:

exportfile.xls

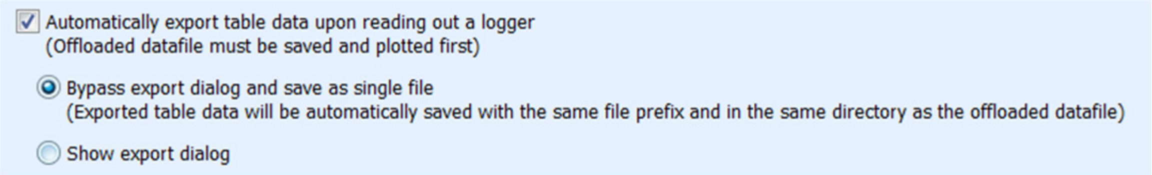
exportfile_0.xls

exportfile_1.xls

A log file showing the result of each exported file is also saved to the same directory. The log file lists either the successful export with the resulting file names or an error message if there was a problem. The log file has the date and time of the export in its file name like this:

Export_<day>_<month>_<year>_<hour>_<minute>_<second>.log

Important: The Bulk Export Tool will not export files properly if the "Show export dialog" setting is selected in the export preferences. To disable this setting, select Preferences from the File menu in Windows or the HOBOware menu in Macintosh. In the General category, select Export Settings. Make sure "Show export dialog" is not selected. Even if the "Automatically export table data upon readout of logger" option is disabled, the "Show export dialog" must not be selected for the Bulk Export Tool to export files properly. Your preferences must look like this:

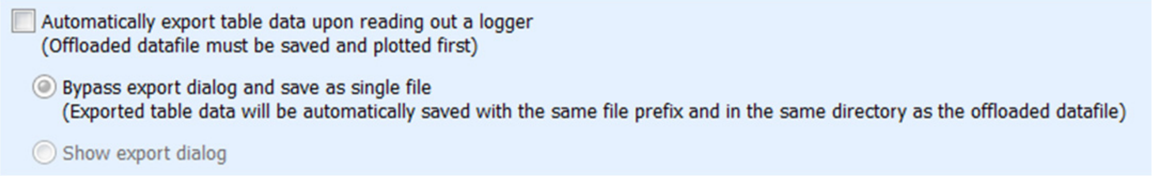


☑ Automatically export table data upon reading out a logger
(Offloaded datafile must be saved and plotted first)

● Bypass export dialog and save as single file
(Exported table data will be automatically saved with the same file prefix and in the same directory as the offloaded datafile)

○ Show export dialog

or this:

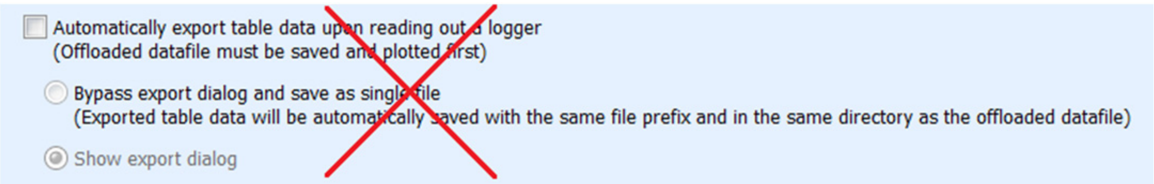


☐ Automatically export table data upon reading out a logger
(Offloaded datafile must be saved and plotted first)

● Bypass export dialog and save as single file
(Exported table data will be automatically saved with the same file prefix and in the same directory as the offloaded datafile)

○ Show export dialog

but not like this:



☐ Automatically export table data upon reading out a logger
(Offloaded datafile must be saved and plotted first)

○ Bypass export dialog and save as single file
(Exported table data will be automatically saved with the same file prefix and in the same directory as the offloaded datafile)

● Show export dialog

for files to export correctly.

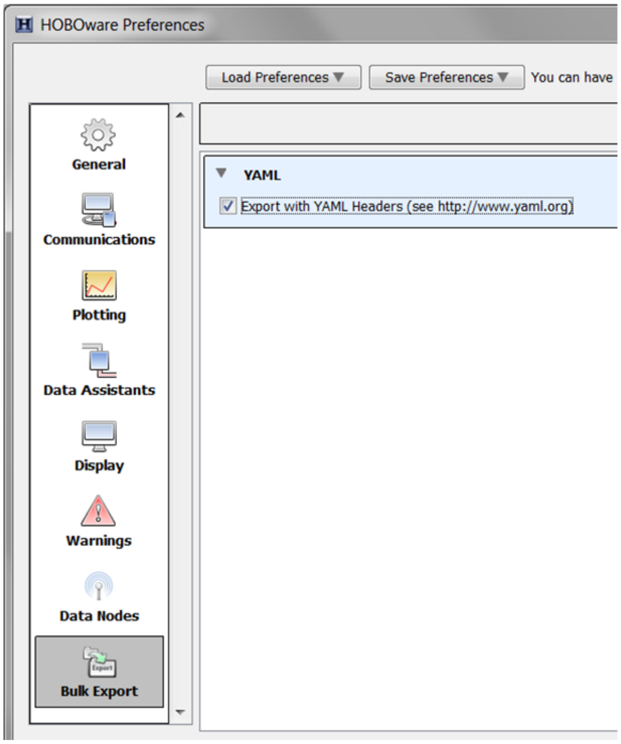
YAML

You can choose to have YAML ("YAML Ain't a Markup Language") headers added to the exported files (they are not inserted by default). If enabled, YAML headers are inserted at the front end of the file. You can remove the YAML header using any text editor.

YAML™ (rhymes with “camel”) is a human-friendly, cross language; Unicode based data serialization language designed around the common native data structures of agile programming languages. For more information see yaml.org.

To enable YAML headers:

1. Go to the File menu in Windows or the HOBOware menu in Macintosh and select Preferences.
2. Scroll down to the Bulk Export category and select YAML.
3. Check the Export with YAML Headers box.



☑ Export with YAML Headers (see http://www.yaml.org)

Importing Text Files

You can plot non-HOBOware data by importing data from certain text files including:

- Text files that were created by Onset’s Alarm & Readout Tool version 2.0 or higher.
- Text files that were exported from Onset's BoxCar Pro 4.3 software using the default BoxCar export settings. This allows you to view data from legacy Onset loggers that cannot be read out using HOBOware Pro.
- With some adjustments, you can open text files that were exported from other software or that you create. See Importing Text File Requirements for more details.

Note: This feature is only available in HOBOware Pro.

To import data from a properly formatted text file:

1. From the File menu, select Import Text Data.
2. Select a text file (.txt) and click Open.
3. If the text file was created by the Alarm & Readout Tool, go to step 8. Otherwise, HOBOware Pro attempts to parse the text file and displays the Text Import Information window. To conserve system resources, it displays only the first several records in the file.
4. Check the Delimiter Preview area to be sure the date, time, and data columns are separated correctly. If they are not, use the Data Separator, Date/Time Separator, and Decimal Separator pull-down menus to choose other delimiters until the data looks correct. You can resize the columns by clicking and dragging the dividers between the column headers.

   For text files that were not exported in BoxCar's default format, click the Edit Date/Time Format button and ensure that the import function is interpreting incoming date, time, and year formats and separators correctly. Use the current date and time displayed in the Sample panel as a guide.
5. When the Delimiter Preview is correct, click OK.
6. Depending on the file's contents, the Plot Setup window may be displayed at this time. If so, go to step 8.

   Otherwise, the Text File Information window is displayed. This window allows you to add optional information and change units, if needed.

   - Type a description, which will become the plot title and be included in the Details pane.
   - Select a model from the list. If you select Other/3rd Party, you can enter a description (up to 20 characters) of the logger or other data source in the next field.
   - Type the logger's serial number, if applicable.
   - Verify the units are correct for the data in the file.
7. Click OK.
8. The Plot Setup window opens. Select the series you wish to view in the plot and click Plot. The plot is displayed. You may want to save your work in a project (.hproj) file for quick viewing later.

Import Text Files Requirements

When you import a text file, the file must meet certain requirements. You can view or edit text files in a text editor or word processor. To delete, rearrange, or reformat columns of data, you may need to use a spreadsheet program. Remember to save the corrected file in text (.txt) format. This feature is only available in HOBOware Pro.

Serial Number

The file can contain an optional header for serial number information located at the beginning of the file, before the column headings. The header must have the phrase "Serial Number:" followed by a space, then the serial number, then two dashes:

Serial Number: 733329 --

Note: Text files originating from HOBOlink and the Alarms & Readouts Tool may also contain YAML headers at the top of the file.

Contents

Below the header (if any), there should be the data, starting with column headings. There must be no other text in the file other than the optional header, column headings, and data. The first column must be date, the next must be time, and the rest must be data.

Delimiters

Valid delimiters for separating date and time and other data are commas, tabs, and semicolons. The delimiter used to separate the date from the time may be different from the delimiter used to separate the data. Do not use a space as a delimiter; there cannot by any spaces in the data.

Date

The date column must have the heading, "Date" and date values should be formatted as mm/dd/yy. If they are in a different format, remember to indicate the correct format in the Edit Date/Time Format window when you import the file.

Date
12/31/04
12/31/04
01/01/05
01/01/05

Time

The time column must have the heading, "Time" and time values should be formatted in 24-hour format as hh:mm:ss.sss (decimals are optional). If they are in a different format, remember to indicate the correct format in the Edit Date/Time Format window when you import the file. UTC offset is assumed to be the same as your computer's current time zone.

Time
23:59:59
23:59:59.5
00:00:00
00:00:00.5

- No thousands separator can be used.
- Rows of data must be separated with a paragraph return.
- There must be a last blank row.

Measurements

Data column headings must have the format "Measurement (Units)". Additional information (such as channel number or serial number) can follow, but is optional. Only spaces can be used between the end of the measurement name and the opening parenthesis. An example is "RH (%)".

RH (%)
38.7
38.9
39.0
39.0

If the column header and units of an imported series exactly matches the text in the table below, HOBOware will recognize the measurement and be able to perform unit conversions, apply data assistants, etc. to that series.

Measurements listed below that either have only one unit type, or can be any unit type, cannot have their units converted, but may still be used with applicable data assistants.

Measurement Type	Column Header	Units
Acceleration	x accel, y accel, z accel	g, m/s2, ft/s2
Carbon Dioxide	co2	ppm
Conductivity	low range, full range, high range	µS/cm, mS/cm
Counts	counts	*[any units]*

Dew Point	dew point	F, C
Gust Speed	gust speed	m/s, km/hr, mph, knots
Leaf Wetness	leaf wetness	*[any units]*
Light Intensity	intensity	lux, lum/ft2
PAR	par	*[any units]*
Pressure	pres	kPa, Pa, mbar, mm Hg, psi, in Hg
Rain	rain	mm, in
Relative Humidity	rh	%
Salinity	salinity	ppt
Soil Moisture	soil moisture	*[any units]*
Specific Conductance	conductance	µS/cm, mS/cm
Sum Vector	sum vector	g, m/s2, ft/s2
Temperature	temp	F, C
Tilt	x tilt, y tilt, z tilt	deg, rad
Wind Speed	wind speed	m/s, km/hr, mph, knots
Wind Direction	wind dir	*[any units]*

Measurements that are not listed in the table (or do not exactly match the text below) can be exported, but without any units conversions or use of Data Assistants. These include:

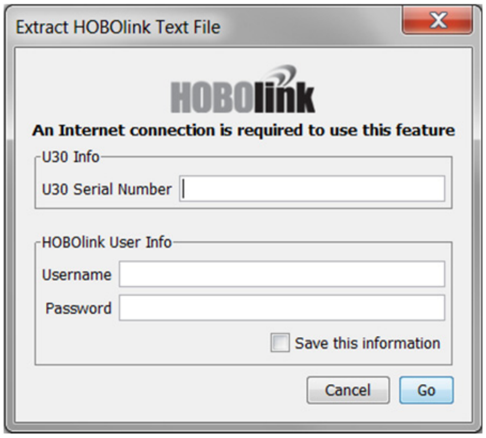
- Air Velocity
- Battery
- Compressed Airflow
- Conductance
- Current
- Gauge Pressure
- Power
- Solar Radiation
- Temperature for Thermocouples
- Water Flow
- Volatile Organic Compound
- Voltage
- Asynchronous Events/Readings
- State
- Runtime

Importing Files from HOBOlink

This feature allows you to import the current data file for a remote HOBO U30 Station from HOBOlink directly into HOBOware for analysis. **Note:** This feature is only available in HOBOware Pro.

To import a file from HOBOlink into HOBOware:

1. From the File menu, select Import Data File from HOBOlink.



2. Type the serial number for the HOBO U30 Station.
3. Type the Username and Password for the HOBOlink account.
4. Select the "Save this information" checkbox if you want to HOBOware to retain the username and password for future use.
5. Click Go to import the file into HOBOware.

Chapter 5
Hardware Reference

Refer to the following topics for more information on using HOBOware with specific devices:

- Working with the HOBO U30 Station
- Configuring FlexSmart Modules/Analog Sensor Ports
- Working with a Shuttle
- Configuring Loggers with the E50B2 Power and Energy Meter
- Checking Dates for the HOBO U26 Dissolved Oxygen logger Sensor Cap
- Using the Lab Calibration Tool with the HOBO U26 Dissolved Oxygen Logger
- Updating UX Series Logger Firmware
- Fixing "Read Header Failed" Error

Working with the HOBO U30 Station

There are four models of the HOBO U30 Station: USB, cellular, ethernet, and wi-fi. The USB model works with HOBOware Pro only. The cellular, ethernet, and wi-fi models are designed primarily for use with internet-based HOBOlink software, but can also work with HOBOware for specific tasks. This section describes when to use each of the four U30 Station models with HOBOware.

HOBO USB U30 Station (U30-NRC)

Use HOBOware Pro for all tasks with the USB model, including launching, reading out, and checking status. You can also configure alarms, control the relay, configure excitation power, and set the scaling parameters.

HOBO Cellular (U30-GSM), Ethernet (U30-ETH), and Wi-Fi (U30-WIF) U30 Stations

Use HOBOlink to launch, read out, check status, configure alarms, and set up sensor scaling for cellular, ethernet, and wi-fi models. Although it is possible to perform these tasks with HOBOware Pro, any parameters set in HOBOware Pro will be overridden by the settings in HOBOlink. If you do attempt to launch, read out, or check the status using HOBOware Pro, you may see a message indicating there is already a live HOBOlink session underway. You can choose to override the HOBOlink connection and use HOBOware Pro instead. Alternatively, you may see a message indicating the HOBO U30 Station is busy and a HOBOware Pro session cannot begin. Try again in a few minutes.

These models connect to HOBOlink on a schedule that you determine. Data is automatically read out from the U30 Station and uploaded to HOBOlink. There may be circumstances in which you want to override this schedule and contact HOBOlink immediately. For example, if you moved the HOBO U30 Station to a different location and you want to make sure it can still connect to HOBOlink, but you don't want to wait until the next connection. To force an immediate connection to HOBOlink, connect the U30 Station to a USB port. Click the Contact HOBOlink button in the Status window.

HOBOlink displays data read out from the HOBO U30 Station in line graphs and shows the readings from the last connection. The data is also saved in datafiles that can be downloaded and opened in HOBOware Pro for additional analysis.

While most tasks should be done using HOBOlink, the following tasks can only be completed in HOBOware:

- Configuring the analog sensor port. This can only be done in HOBOware Pro and is accessed through the Launch window. See Configuring FlexSmart Modules and Analog Sensor Ports for details.
- Changing the default relay setting or testing the relay. The default relay setting for the HOBO U30 Station is normally open and can only be changed in HOBOware Pro. You can also use HOBOware Pro to test the relay. See Controlling the Relay on the HOBO U30 Station for details.
- Testing the accuracy of individual smart sensors. Unplug all the sensors when the logger is not logging. Plug one sensor back in and check the current reading for the sensor in the Launch Logger window. Repeat this for the remaining sensors. **Note:** Sensors are listed in ascending order by serial number, regardless of their physical position in the logger.
- Checking cellular signal strength. Open the Status window in HOBOware Pro to check the cellular signal for the HOBO U30 Station in its current location. This will help you determine if you need to reposition the station for optimal signal strength.

Controlling the Relay on the HOBO U30 Station

The U30 Station relay contact is a latching relay that can be configured as either Normally Open or Normally Closed. The factory-default setting is Normally Open. **Note:** This is a HOBOware Pro feature.

To change the relay from the Device menu:

1. Connect the HOBO U30 Station to the computer with the USB cable.
2. From the Device menu, select Manage U30.
3. Select Control U30 Relay.
4. Select "Set default (deactivated) state."
5. Select either Open or Closed.

To conduct an immediate test of the relay from the Device menu:

1. Connect the HOBO U30 Station to the computer with the USB cable.
2. From the Device menu, select Manage U30.
3. Select Control U30 Relay.
4. Select "Activate (close) relay." You should hear a click in the HOBO U30 Station.
5. Select "Deactivate (open) relay." You should hear the click again.

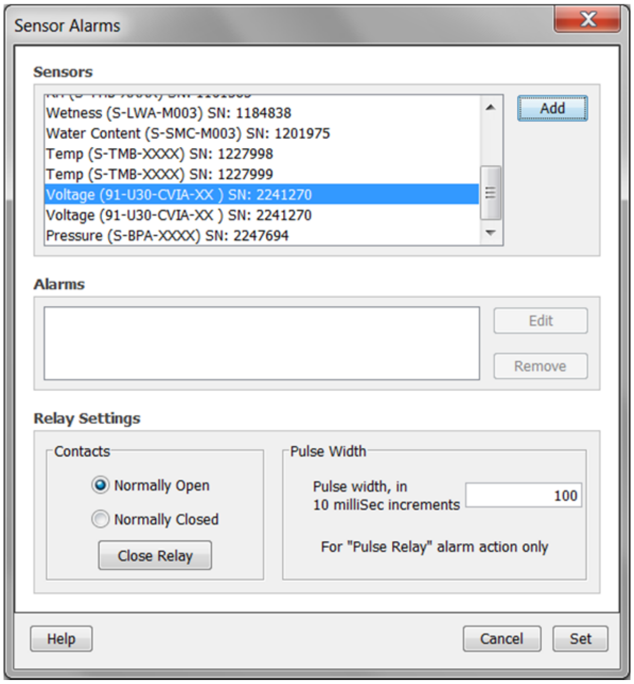
To change the relay and test it using the Sensor Alarms window:

1. From the Device menu, select Manage U30.
2. Select Configure U30 Alarms and select Configure Alarms to open the Sensor Alarms window.
3. In the Relay Contacts section, select Normally Open or Normally Closed.
4. If you are setting an Alarm Action of Pulse Relay, you can set the Relay Pulse Width in milliseconds.
5. To test the relay, click the Close Relay or Open Relay button in the Sensor Alarms window. You should hear a click in the HOBO U30 Station. Click the button again to return to the default state. Use a digital multimeter to check for continuity to confirm that the relay is opened and closed as expected.
6. Click Set to send the alarm configuration to the U30 Station.

Setting Alarms on a HOBO U30 Station

You can set alarm to trip for individual sensors on a HOBO USB 30 Station (U30-NRC). **Note:** This is a HOBOware Pro feature.

1. From the Device menu, select Manage U30 > Configure U30 Alarms > Configure Alarms.
2. Select a sensor and click Add.



Wetness (S-LWA-M003) SN: 1184838
Water Content (S-SMC-M003) SN: 1201975
Temp (S-TMB-XXXX) SN: 1227998
Temp (S-TMB-XXXX) SN: 1227999
Voltage (91-U30-CVIA-XX) SN: 2241270
Voltage (91-U30-CVIA-XX) SN: 2241270
Pressure (S-BPA-XXXX) SN: 2247694

● Normally Open
○ Normally Closed

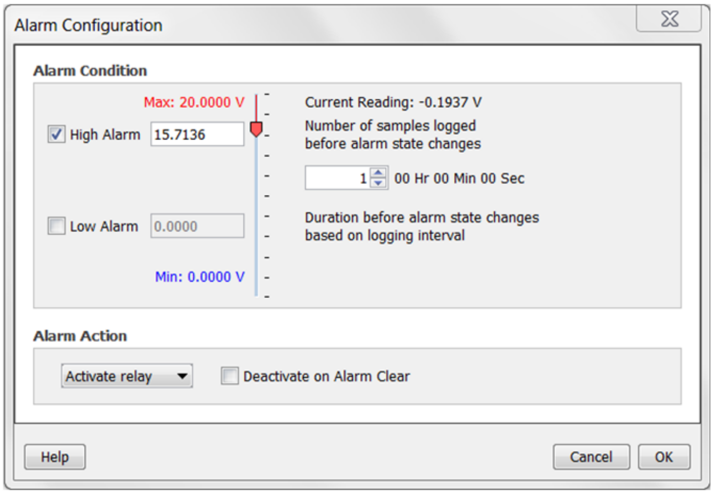
Pulse width, in 10 milliSec increments: 100

For "Pulse Relay" alarm action only

3. In the Alarm Configuration window, select the High Alarm checkbox if you want an alarm to trip when the sensor reading goes above a value you specify. Type a High Alarm value or drag the top slider to set a value. and/or the Low Alarm checkboxes. Type a value for the alarm in the box(es) or use the sliders.

   Select the Low Alarm checkbox if you want an alarm to trip when the sensor reading goes below a value you specify. Type a Low Alarm value or drag the bottom slider to set a value.

   Note: If you type a High or Low Alarm value, the software may adjust them slightly to the nearest values supported by the logger.



Max: 20.0000 V

☑ High Alarm 15.7136

☐ Low Alarm 0.0000

Min: 0.0000 V

Current Reading: -0.1937 V

Number of samples logged before alarm state changes: 1 00 Hr 00 Min 00 Sec

Duration before alarm state changes based on logging interval

Activate relay ☐ Deactivate on Alarm Clear

4. Set the number of samples that will be logged before the alarm trips. **Note:** To avoid unintended activation of the relay contact, set the number of samples to allow for anticipated breaches of the alarm threshold. If the measurement is still out of range when the number of samples is reached, the relay contact will be activated.
5. Select an action to occur when the alarm is triggered: Activate Relay (Open/Close), Deactivate, Pulse, Toggle, Open, Close.
6. Select the Deactivate on Alarm Clear checkbox if you want the alarm action to stop automatically once the alarm condition clears.
7. Click OK to save the changes. The alarm will now appear in the Sensor Alarms window. Select the alarm and click Edit if you need to make changes or click Delete to remove an alarm.
8. Click Set in the Sensor Alarms window when finished configuring alarms.

Configuring FlexSmart Modules/Analog Sensor Ports

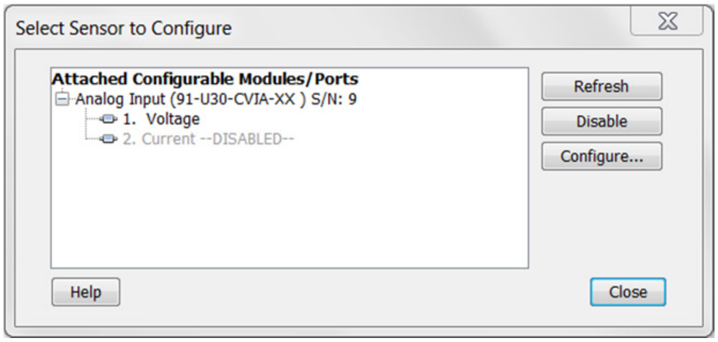
You can configure HOBO Energy Logger FlexSmart modules and the HOBO U30 Station analog sensor port to accommodate a wide range of Onset and third-party sensors. You can set up these modules/ports while selecting launch settings or you can create and save different configurations to be loaded into the modules/ports whenever needed.

Notes:

- Modules, ports, and sensors are listed in ascending order by serial number regardless of their physical position in the logger.
- This procedure is for creating a new configuration and sending it to a port. To send an already saved configuration to a port, see Loading a Saved Configuration.
- This is a HOBOware Pro feature.

To configure an analog module or port, perform the following steps:

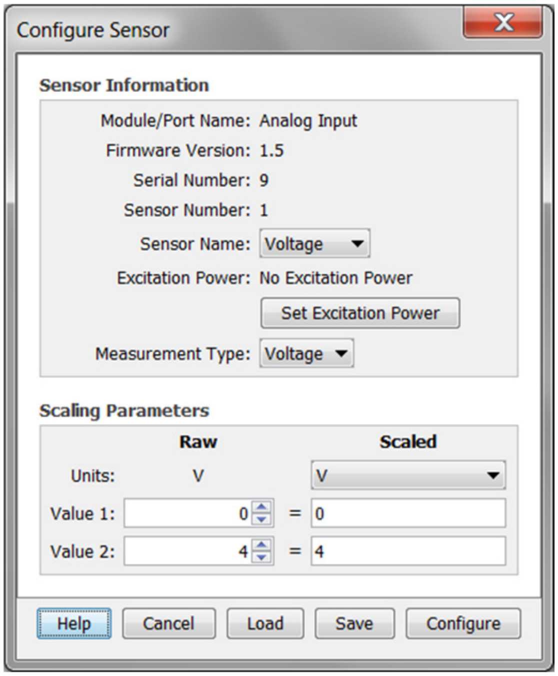
1. From the the Device menu, choose Configure Modules/Ports.
2. In the Select Sensor to Configure window, click the + sign to see the available modules/ports. If you are using the HOBO Energy Logger, you can attach additional modules while viewing this window. Click Refresh to update the module list. **Note:** The default channel names Voltage and Current can both be configured to measure voltage or current. For example, both channels can be used to monitor sensors with 4-20 mA output.



Attached Configurable Modules/Ports
Analog Input (91-U30-CVIA-XX) S/N: 9
1. Voltage
2. Current --DISABLED--

3. Select a sensor and then click the Configure button to open the Configure Sensor window. **Note:** You can also access this window from the Launch Logger window. Select the sensor and double-click the module/port name to expand it. Click the sensor name to select it and then click the Configure button.

4. In the Configure Sensor window, select the Sensor Name. Choose either a default name or select Custom and enter your own 16-character name, which you can also save to the list for future use. Note that a saved name is stored as a preference and removed when you restore preference defaults.



Module/Port Name: Analog Input
Firmware Version: 1.5
Serial Number: 9
Sensor Number: 1
Sensor Name: Voltage
Excitation Power: No Excitation Power
Measurement Type: Voltage

	Raw		Scaled
Units:	V		V
Value 1:	0	=	0
Value 2:	4	=	4

5. Set the excitation power, measurement type, and scaling as desired (options may vary depending on the sensor). For details on excitation power, see Configuring Excitation Power. If the module/port offers more than one type of input, select the correct the measurement type for the sensor. For details on scaling, see Setting Voltage Ranges and Scaling Parameters.

6. Although you do not have to save the configuration if you are going to send it to the module/port right away, you may find it convenient to save it for future use, especially if you have defined custom sensor settings. Click Save, type a name for the configuration file, and click Save again.

   By default, the file is saved to the following location with an extension of .hcfg.

   Windows: My Documents\HOBOware\Configs

   Mac: Users/<username>/Library/Application Support/HOBOware/Configs

7. Click Configure to send the currently displayed configuration to the module/port. The module/port will remain in this configuration until you send it a different configuration.

Configuring Excitation Power

You can configure sensor excitation power and warm up on the Analog Sensor Ports. Sensor excitation is a voltage output provided by the HOBO U30 Station to power a sensor that is connected to it. This power may be needed because the sensor is not self-powered or because the sensor's power capacity cannot support a long deployment. **Note:** This is only available in HOBOware Pro.

When sensor excitation is required, the logger can provide 12 V DC sensor excitation voltage up to 200 mA total for transducers that require external power for proper operation. The excitation voltage has a programmable warm up time and is controlled by the Analog Sensor Port.

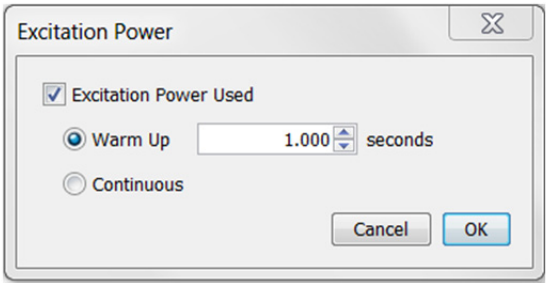
A warm up time can be up to 120 seconds. If the warm up required is longer than 120 seconds, or if you are not concerned with battery life, you may choose the Continuous option, which will power the sensor for the entire deployment.

Providing excitation power drastically decreases the logger's battery life (consult the logger manual for more information). To save battery power, you may specify the minimum time needed to power the sensor before taking a measurement. For example, if you specify a Warm Up of one second and set the logging interval in the logger to one minute, the logger will power the external sensor for one second, log data and then turn off the excitation power for the next 59 seconds.

Always enable the logger's internal battery channel when logging with excitation power. If the battery becomes too low to provide excitation power, excitation power is turned off, but logging continues as long as the battery can power the logger. This will cause the further readings on that channel to become inaccurate. If you are logging the internal battery channel when this happens, an Excitation Off event will be shown in your datafile to mark the point at which excitation power was disabled.

To configure excitation power:

1. From the Configure Sensor window, click the Set Excitation Power button. For information on accessing the Configure Sensor window, see Configuring FlexSmart Modules/Analog Sensor Ports.
2. Select the Excitation Power Used checkbox.



Excitation Power

☑ Excitation Power Used

● Warm Up 1.000 seconds

○ Continuous

3. Select either Warm Up or Continuous mode. If you select Warm up, select the warm up time in seconds.

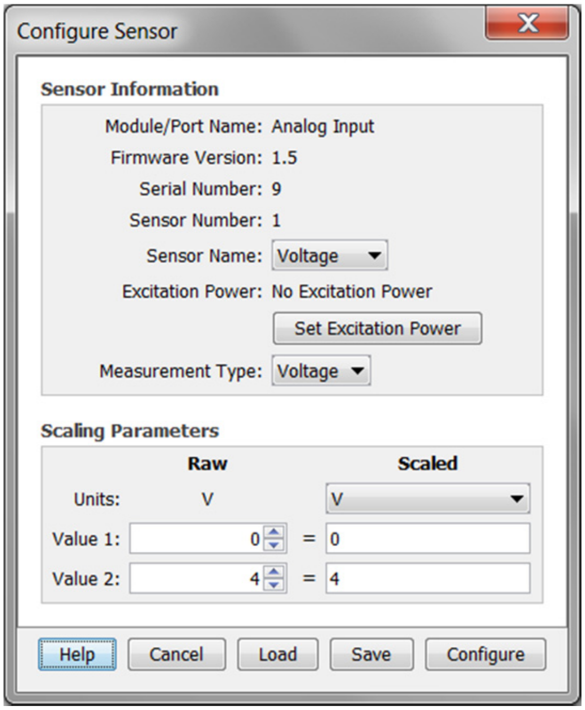
   In Warm up mode, the logger supplies excitation power for a brief period prior to each measurement. This mode allows you to select the minimum warm up time needed to allow for sensor stabilization, while conserving battery power. For example, if you specify a warm up of one second and set the Logging Interval to one minute, the HOBO U30 Station will power the external sensor for one second, log a measurement, and then turn off the excitation power for the next 59 seconds. The warm up time can be up to 120 seconds. If the warm up time selected is greater than the logging interval selected, the logger will interpret the excitation mode as continuous.

   In Continuous mode, the logger supplies constant excitation power to the sensor for the entire duration of the deployment. This mode will result in reduced battery life. Continuous mode is required if the sensor needs more than two minutes of warm up time.

4. Click OK.
5. Select Save to save these settings in a configuration for future use. Click Configure to send this configuration to the port immediately.

Setting Voltage Ranges and Scaling Parameters

You can set voltage ranges and scaling parameters for the HOBO Energy Logger FlexSmart modules and the HOBO U30 Station in the Scaling Parameters panel of the Configure Sensor window. For information on accessing this window, see Configuring FlexSmart Modules/Analog Sensor Ports. **Note:** This is only available in HOBOware Pro.


Configure Sensor

Sensor Information

Module/Port Name: Analog Input
Firmware Version: 1.5
Serial Number: 9
Sensor Number: 1
Sensor Name: Voltage
Excitation Power: No Excitation Power
Measurement Type: Voltage

Scaling Parameters

	Raw		Scaled
Units:	V		V
Value 1:	0	=	0
Value 2:	4	=	4

To set the scaling or voltage range:

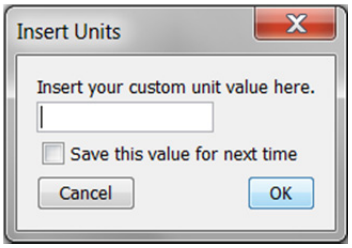
1. Check the Raw Units. This is the type of output the sensor has; either V or mA, corresponding to the type of sensor selected. Raw Value 1 and Raw Value 2 should be input in these units. For example, if the external sensor has an output of 4 – 20 mA, the raw units would be in mA.
2. Set Raw Value 1, which is the low raw value given by the external sensor. In the previous example, this would be 4 mA.
3. Set Raw Value 2, which is the high raw value given by the external sensor. In the previous example, this would be 20 mA.

Important: The number entered for Raw Value 2 determines the voltage range the analog port will use. Use this table to determine what the range will be depending on the number entered in the Value 2 field.

If the raw voltage entered in the Value 2 field is:	**The voltage range for the analog port will be:**
Less than 2.5	2.5V
Greater than 2.5 and less than or equal to 5	5V
Greater than 5 and less than or equal to 10	10V
Greater than 10 and less than or equal to 20	20V

4. Select the Scaled Units. Choose one of the predefined units from the pull-down list or select Custom to define units for other types of sensors. If you select Custom, type up to eight characters of the units

associated with the sensor. For example, if you are using a flow meter, you could specify CFS (Cubic Feet per Second) as the scaled unit. If you want to see data in particular SI or US units, you need to enter the appropriate scaling values in the next steps. Select the "Save this value for next time" checkbox to add this name to the Scale Units drop-down menu for future use. Note that a saved unit name is stored as a preference and removed when you restore preference defaults. Custom unit values do not allow for conversion between SI to US units. It is only a reference used to indicate how the module is configured and how the resulting data should be labeled. Click OK to save the changes and return to the Configure Sensor window.



5. Set Scaled Value 1, which is the value that will be displayed on the graph when the sensor reports a raw value equal to Raw Value 1. This value should be entered based on the Scaled Units selected in the previous step.
6. Set Scaled Value 2, which is the value that will be displayed on the graph when the sensor reports a raw value equal to Raw Value 2. This value should be entered based on the Scaled Units selected in Step 4.
7. Click the Save button to save this configuration for future use or click Configure to send these settings to the module/port immediately.

Loading a Saved Configuration

If you have created and saved a sensor configuration for a HOBO Energy Logger FlexSmart modules and the HOBO U30 Station analog sensor port, you can load it into any module/port of the same type. For example, a configuration for a FlexSmart TRMS module can be loaded into any other FlexSmart TRMS module, but not into a FlexSmart Analog module. **Note:** This is only available in HOBOware Pro.

To load a saved configuration:

1. From the Device menu, select Configure Modules/Ports.
2. Click the Load button to see a list of all defined configurations in the currently selected folder that are compatible with the module/port.
3. Choose a configuration. To use one of the defined configurations, click the button next to Use Configuration File, then click the button next to the name of the configuration file you want to use. To get a file from a different location, click Choose Folder and browse to the desired directory. If you are experiencing problems with the module, you can reset the channel to its default configuration. Select Use Default Module Configuration.
4. Click Continue.
5. To send the currently displayed configuration to the module/port, click Configure. The module/port will remain in this configuration until you send it a different one.

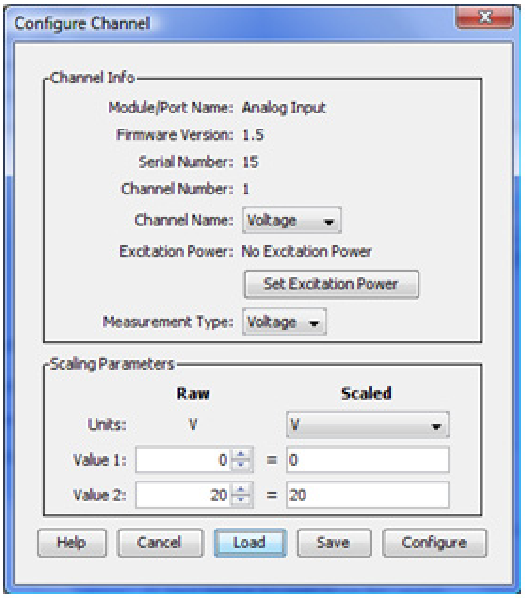
Resetting a Module to the Default Configuration

If you are experiencing problems with a module, you can reset it to the default configuration.

1. From the Device menu, select Configure Modules/Port.

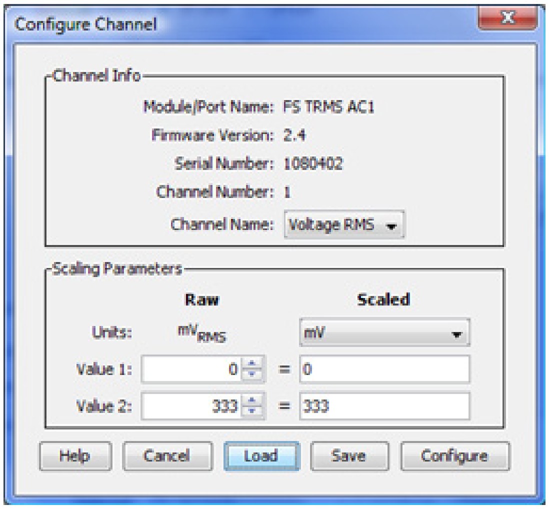
2. Select a sensor and click Configure.
3. In the Configure Sensor window, click the Load button to view a list of all defined configurations in the currently selected folder that are compatible with the module/port.
4. Select Use Default Module Configuration and click Continue.
5. To send the currently displayed configuration to the module/port, click Configure. The module/port will remain in this configuration until you send it a different one.

The following examples show the default configuration for the analog modules. The configuration is the same for both channels.



Module/Port Name: Analog Input
Firmware Version: 1.5
Serial Number: 15
Channel Number: 1
Channel Name: Voltage
Excitation Power: No Excitation Power
Measurement Type: Voltage
Units: V = V
Value 1: 0 = 0
Value 2: 20 = 20

CVIA Module



Module/Port Name: FS TRMS AC1
Firmware Version: 2.4
Serial Number: 1080402
Channel Number: 1
Channel Name: Voltage RMS
Units: mV_{RMS} = mV
Value 1: 0 = 0
Value 2: 333 = 333

TRMS Module

Working with a Shuttle

HOBO shuttles provide a convenient way to read out and relaunch loggers in the field. The HOBO U-Shuttle features a text display and is compatible with all loggers that can be used with HOBOware Pro. The HOBO Waterproof Shuttle communicates with optic loggers. **Note:** To use a U-Series logger (other than the HOBO U30 Station) with a shuttle, the logger must first be launched with HOBOware version 2.2 or higher at least once. Consult the shuttle user guide for details.

After you read out a logger to the shuttle, you can then connect the shuttle to the computer and offload and save the files to view in HOBOware Pro. From the Device menu, select Manage Shuttle to open the Shuttle Management window to check the status and work with the shuttle. See Offloading and Saving Files from a Shuttle and Deleting shuttle files for more information on using the shuttle.

Note: While the Shuttle Management window is displayed, the U-Shuttle remains on battery power for up to an hour. After one hour, or any time the U-Shuttle's main battery level becomes low, the window closes and the shuttle powers down. To further conserve the shuttle's battery life, you should close the window, disconnect the shuttle, and turn the shuttle off as soon as you finish working with it.

U-Shuttle Firmware Updates

Occasionally, a firmware update may be available for the U-Shuttle. To check whether an update is available or if you are directed to update the firmware from Onset Technical Support:

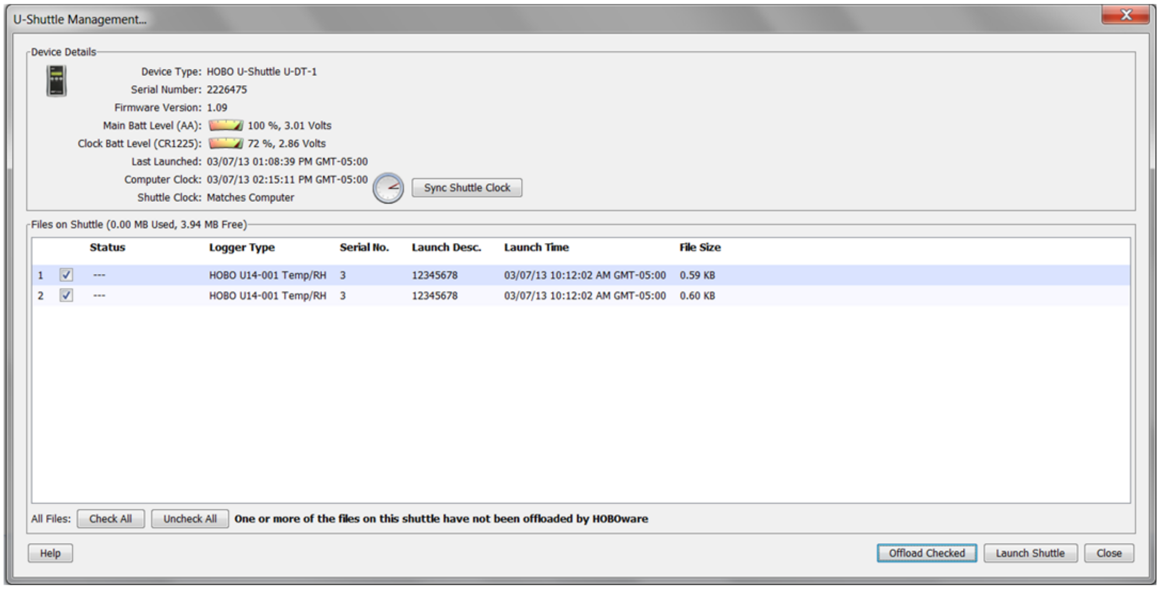
1. Connect the U-Shuttle to the computer.

2. From the Help menu, select Update Device Firmware and then select U-DT-1/U-DT-2 from the submenu.
3. Follow the instructions on the screen to complete the upgrade process.

Offloading and Saving Shuttle Files

To offload datafiles from a shuttle to a compute:

1. Connect the shuttle to the computer. **Note:** HOBO Shuttles require HOBOware Pro.
2. From the Device menu, select Manage Shuttle. Or, to quickly offload all the new datafiles on the shuttle, select Readout from the Device menu.
3. In the Shuttle Management window, choose files to offload.
    - On the U-Shuttle, all files are selected by default if the shuttle has not been offloaded before. To deselect all files, click the Uncheck All button. To deselect individual files, click the checkbox next to each file.
    - On the Waterproof Shuttle, only the files that have not been offloaded AND saved previously are selected by default. To select or deselect individual files, click the chexbox next to each file. Use the Check All and Uncheck All buttons next to Previously Offloaded Files and New Files (Not Offloaded) to control the selection of these groups of files. To automatically delete files after you offload and save them, select the Delete Contents Upon Offload checkbox.

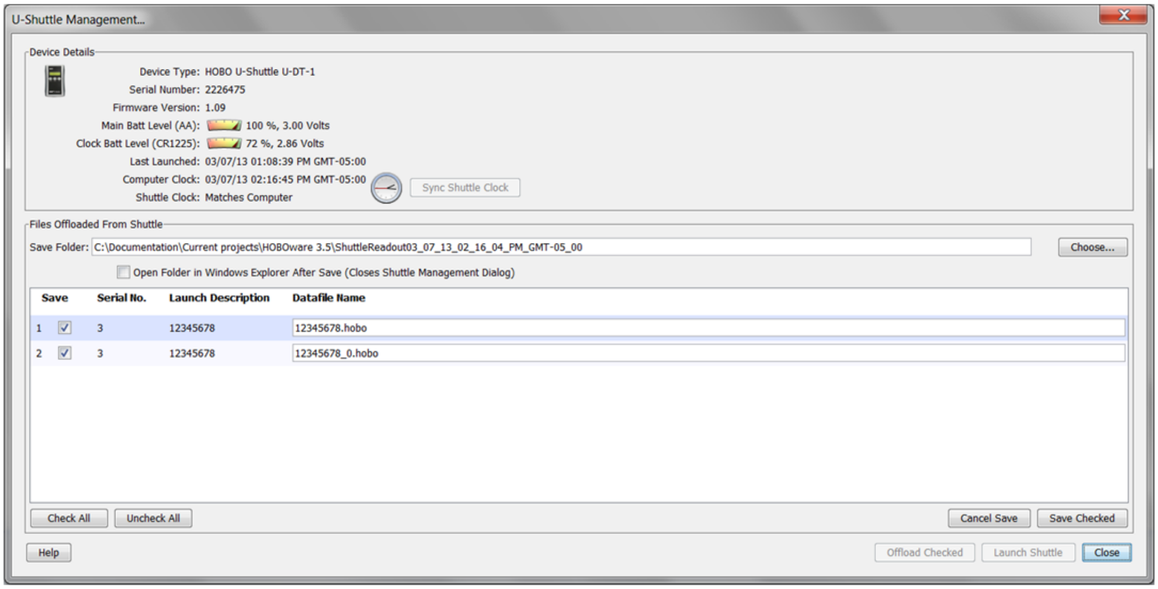


Device Type: HOBO U-Shuttle U-DT-1
Serial Number: 2226475
Firmware Version: 1.09
Main Batt Level (AA): 100 %, 3.01 Volts
Clock Batt Level (CR1225): 72 %, 2.86 Volts
Last Launched: 03/07/13 01:08:39 PM GMT-05:00
Computer Clock: 03/07/13 02:15:11 PM GMT-05:00
Shuttle Clock: Matches Computer

		Status	Logger Type	Serial No.	Launch Desc.	Launch Time	File Size
1	☑	---	HOBO U14-001 Temp/RH	3	12345678	03/07/13 10:12:02 AM GMT-05:00	0.59 KB
2	☑	---	HOBO U14-001 Temp/RH	3	12345678	03/07/13 10:12:02 AM GMT-05:00	0.60 KB

One or more of the files on this shuttle have not been offloaded by HOBOware

4. Click the Offload Checked button when you are ready to begin offloading the files from the shuttle. Once offloading begins, the Offload Checked button will change to Cancel Offload. When offloading is complete, the Files on Shuttle panel in the Shuttle Management window will change to a Files Offloaded From Shuttle panel.



Device Type: HOBO U-Shuttle U-DT-1
Serial Number: 2226475
Firmware Version: 1.09
Main Batt Level (AA): 100 %, 3.00 Volts
Clock Batt Level (CR1225): 72 %, 2.86 Volts
Last Launched: 03/07/13 01:08:39 PM GMT-05:00
Computer Clock: 03/07/13 02:16:45 PM GMT-05:00
Shuttle Clock: Matches Computer

Save Folder: C:\Documentation\Current projects\HOBOware 3.5\ShuttleReadout03_07_13_02_16_04_PM_GMT-05_00

☐ Open Folder in Windows Explorer After Save (Closes Shuttle Management Dialog)

	Save	Serial No.	Launch Description	Datafile Name
1	☑	3	12345678	12345678.hobo
2	☑	3	12345678	12345678_0.hobo

5. The Save Folder indicates where the offloaded files will be saved. To change the location where these files are saved, click Choose and browse to another folder.
6. To open the folder automatically after they are saved, select the Open Folder in Windows Explorer after Save checkbox on Windows or the Open Folder in Finder after Save checkbox on Macintosh.
7. Select the files to save. By default, all the offloaded files are selected for saving. To deselect individual files, click the checkbox next to each file. To deselect all files, click the Uncheck All button. To save all files if you already deselected a few, click the Check All button.
8. Make any changes to the listed datafile names if desired for the files you are saving.
9. Click the Save Checked buttons to save all selected files in the folder specified in step 5.
10. Click the Launch Shuttle to reset the shuttle clock and delete all files from the shuttle. See Deleting Files from a Shuttle for more information.

The Shuttle Management Window

Use the Shuttle Management window to work with the HOBO U-Shuttle and Waterproof Shuttle.

Notes:

- HOBO Shuttles require HOBOware Pro.
- While the Shuttle Management window is displayed, the U-Shuttle remains on battery power for up to an hour. After one hour, or any time the U-Shuttle's main battery level becomes low, the window closes and the shuttle powers down. To further conserve the shuttle's battery life, you should close the window, disconnect the shuttle, and turn the shuttle off as soon as you finish working with it.
- The Waterproof Shuttle is powered by the USB port, and does not need to be turned off.

The Device Details panel displays the following information about the shuttle:

- **Device Type.** The shuttle model and description.
- **Serial Number.** Serial number of the shuttle.
- **Firmware Version.** Version number of the shuttle's firmware.
- **Main Batt Level (AA) (U-Shuttle only).** The condition of the shuttle's main batteries. Consult the U-Shuttle manual for specifics on battery capacity.

- **Clock Batt Level (CR1225) (U-Shuttle only).** The condition of the battery that provides backup power to the shuttle's clock. Consult the U-Shuttle manual for details.
- **Battery Level (Waterproof Shuttle only).** Condition of the shuttle's batteries when you opened the Waterproof Shuttle Management window. If the batteries are low, remember to change them before going into the field. Consult the Waterproof Shuttle manual for specifics on battery capacity.
- **Last Launched.** Date, time, and offset to Greenwich Mean Time (GMT, also known as UTC) when the shuttle was last launched.
- **Computer clock.** Time reported by the computer's clock.
- **Shuttle clock.** Status of the shuttle's clock in relation to the computer's clock. If the difference is more than five seconds, the shuttle clock label and icon will flash red. The shuttle's clock is synchronized to the computer when you launch the shuttle. Click the Sync Shuttle Clock button to synchronize the shuttle's clock to the computer clock without launching the shuttle. (Exit HOBOware Pro if you need to update the computer's clock first. **Important:** If the difference between the shuttle's clock and the computer's clock is more than 59 minutes, the Sync Shuttle Clock button is not available. You must launch the shuttle to correct the time difference

The Files on Shuttle panel lists the logger datafiles that are available to be offloaded from the shuttle. If the shuttle is empty, this panel displays "No Files Available on Shuttle." Use the Check All/Uncheck All buttons to select or deselect all files. The details for each file are:

- **Status.** The message that describes the state of the datafile on the shuttle. The status message is replaced by a progress bar while the file is actively being offloaded. For the U-Shuttle, the status message "Awaiting Offload" appears when HOBOware Pro is offloading files from the shuttle and "Finished" after each file is offloaded. For the Waterproof Shuttle, files have the status message "Offloaded" only if the file has been offloaded from the shuttle and saved as a datafile. If the files has not been offloaded, or it has been offloaded but not saved, its status is listed as "Not Offloaded."
- **Logger Type.** Model and description of the logger where the datafile originated.
- **Serial No.** Serial number of the logger where the datafile originated.
- **Launch Desc.** Description in place when the logger was launched. This description will be the default datafile name.
- **Launch Time.** Date, time, and offset to Greenwich Mean Time (GMT, also known as UTC) when the shuttle was last launched.
- **File Size.** Actual size of the datafile.

After clicking the Offload Checked button, the Files on Shuttle panel will change to a Files Offloaded from Shuttle panel. This panel lists the folder where the files will be saved (or click Choose to select a different directory). You can also select to a checkbox to automatically open the folder in Windows Explorer or Finder (Macintosh) after the files are saved. The serial number, Launch Description, and default file name is listed for each datafile. Click the Save Checked button to save all the selected files.

Use the Launch Shuttle button to delete all files (whether saved or not) from the shuttle and to reset the clock. Launching the shuttle also repairs a corrupted header.

Deleting Files from a Shuttle

You can delete files from a shuttle after they have been offloaded and saved. **Note:** HOBO Shuttles require HOBOware Pro.

To delete files from a shuttle:

1. From the Device menu, select Manage Shuttle.

2. Offload and save any files if necessary. You must at least offload all files before deleting (click Cancel Save if you do not want to save the files). If you are offloading a Waterproof Shuttle, select the Delete Contents Upon Offload checkbox to automatically delete all files after you offload and save them.
3. To delete ALL files regardless of whether they have been offloaded and saved, click the Launch Shuttle button. This will reset the shuttle's clock and its Last Launched time.

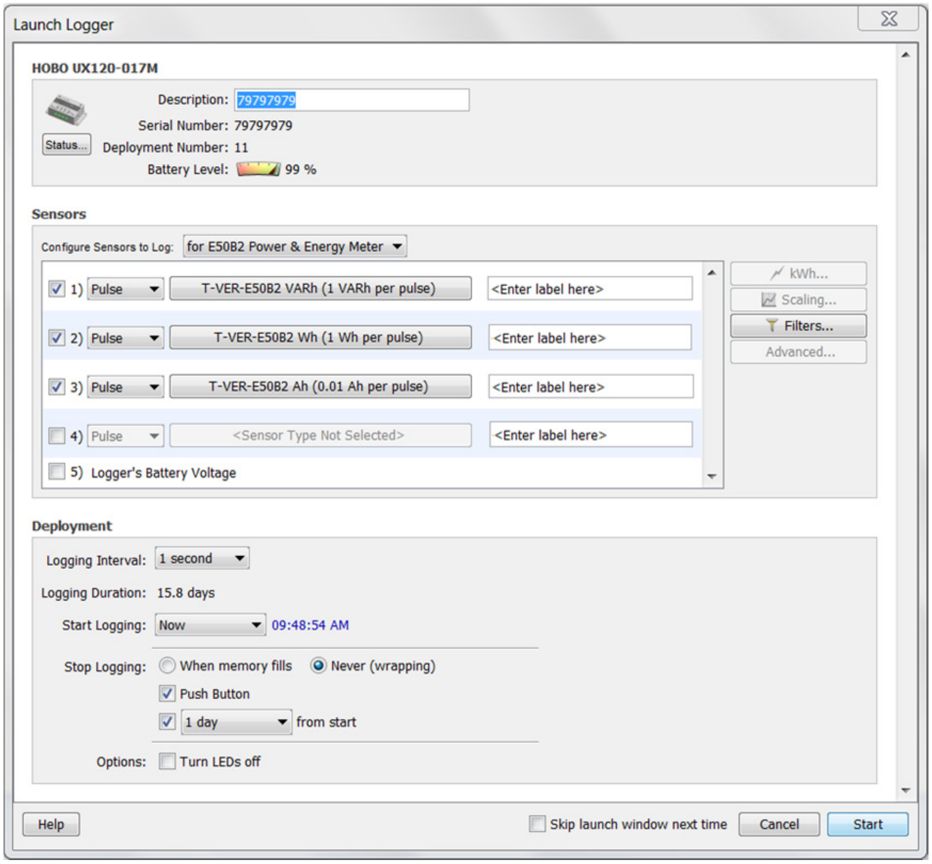
   To delete individual files from a Waterproof shuttle (you cannot delete individual files from a U-Shuttle), click the checkbox for each unwanted file. To select all files that have already been offloaded, click the Check All button next to Previously Offloaded Files. Click Delete Checked after you have selected all the files you want to delete.

Note: The maximum amount of free memory available on a U-Shuttle is 3.94 MB because the header information on a HOBO U-Shuttle occupies 64 KB.

Configuring Loggers with the E50B2 Power & Energy Meter

When the E50B2 Power & Energy Meter (T-VER-E50B2) is combined with a supported logger, there is a custom setting available to quickly configure the applicable channels or sensor types. To access this setting:

1. Connect a logger to the computer that supports the meter, such as the HOBO 4-Channel Pulse Input Data Logger (UX120-017x), and select Launch from the Device menu.
2. In the Launch Logger window, select "for E50B2 Power & Energy Meter" in the Configure Sensors drop-down list. The first three sensors, or data channels, listed will automatically be updated to display the appropriate settings for the E50B2 Power & Energy Meter as shown below.



HOBO UX120-017M

Description: 79797979
Serial Number: 79797979
Deployment Number: 11
Battery Level: 99 %

Sensors

Configure Sensors to Log: for E50B2 Power & Energy Meter

☑ 1) Pulse T-VER-E50B2 VARh (1 VARh per pulse) <Enter label here>
☑ 2) Pulse T-VER-E50B2 Wh (1 Wh per pulse) <Enter label here>
☑ 3) Pulse T-VER-E50B2 Ah (0.01 Ah per pulse) <Enter label here>
☐ 4) Pulse <Sensor Type Not Selected> <Enter label here>
☐ 5) Logger's Battery Voltage

Deployment

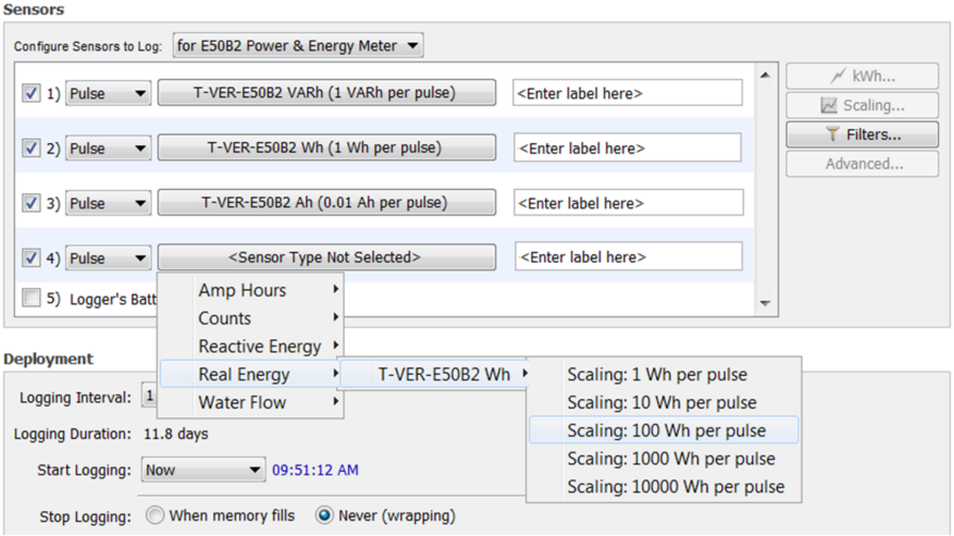
Logging Interval: 1 second
Logging Duration: 15.8 days
Start Logging: Now 09:48:54 AM
Stop Logging: ○ When memory fills ● Never (wrapping)
☑ Push Button
☑ 1 day from start
Options: ☐ Turn LEDs off

☐ Skip launch window next time

When these settings are selected, the logger will record the default values from the Onset Power Meter. This means that when you read out the logger, the first three data channels will record the following by default:

- Reactive energy, at a rate of 1 pulse equal to 1 VARh
- Real energy, at a rate of 1 pulse equal to 1 Wh
- Amp hours, at a rate of 1 pulse equal to 0.01 Ah

You can change the scaling for these three channels. Click one of the channel or sensor buttons and select the measurement type, sensor name, and then scaling factor. The example below shows changing scaling on channel 2 after clicking the "T-VER-E50B2 Wh (1000 Wh per pulse)" button. **Note:** The scaling factor must be the same for VARh and Wh channels. WARNING: If you change the default scaling parameters, you must also change the settings on the Onset Power Meter. Similarly, if you change the scaling on the device itself, you must also change the scaling in the software to match. Refer to the *Compact Power and Energy Meter (T-VER-E50B2) Full Install Guide* for details on how to change the settings on the device.



Sensors

Configure Sensors to Log: for E50B2 Power & Energy Meter

☑ 1) Pulse T-VER-E50B2 VARh (1 VARh per pulse) <Enter label here>

☑ 2) Pulse T-VER-E50B2 Wh (1 Wh per pulse) <Enter label here>

☑ 3) Pulse T-VER-E50B2 Ah (0.01 Ah per pulse) <Enter label here>

☑ 4) Pulse <Sensor Type Not Selected> <Enter label here>

☐ 5) Logger's Batt

Deployment

Logging Interval: 1

Logging Duration: 11.8 days

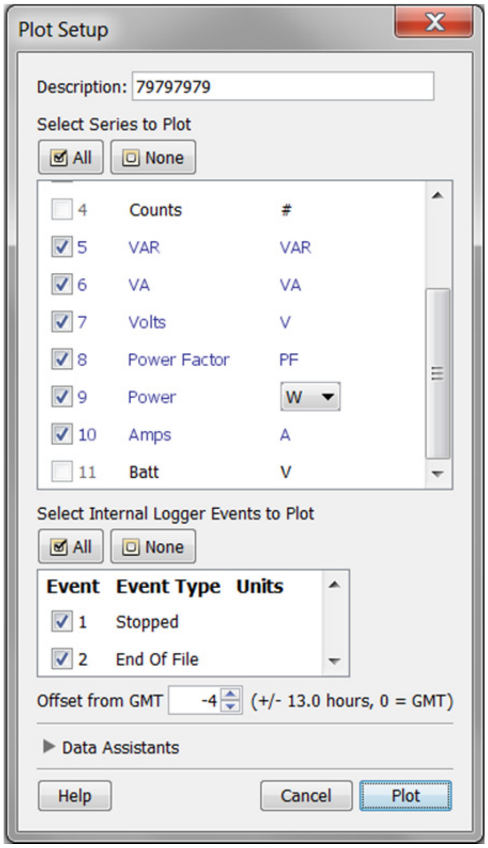
Start Logging: Now 09:51:12 AM

Stop Logging: ○ When memory fills ● Never (wrapping)

3. Select any other Launch settings as desired and then click Start to launch the logger with the Onset Power Meter settings (note that the Start button name changes depending on when you chose to begin logging).

Additional Series for Plot Setup

Datafiles from a logger with Onset Power Meter settings not only list logged sensor data, but they also contain additional derived series automatically calculated in relevant units. HOBOware uses the logged data from each of the three enabled sensors (reactive energy, real energy, and amp hours) to derive, or calculate, up to six additional data series that you can plot. These derived series are numbers 9 through 14 in the Plot Setup dialog box example below. Select the series you wish to view and then click Plot. These series are always available for plotting any time you open the datafile.



Description: 79797979

Select Series to Plot

☐	4	Counts	#
☑	5	VAR	VAR
☑	6	VA	VA
☑	7	Volts	V
☑	8	Power Factor	PF
☑	9	Power	W
☑	10	Amps	A
☐	11	Batt	V

Select Internal Logger Events to Plot

Event	Event Type	Units
☑ 1	Stopped	
☑ 2	End Of File	

Offset from GMT -4 (+/- 13.0 hours, 0 = GMT)

The following table lists the calculations for all derived series. It also specifies which of the three Onset Power Meter sensors/channels must be enabled at launch time for these series to be available upon readout.

Derived Series Name	**Calculated By**	**Requires these Channel(s) to be Enabled at Launch**
VAR	VARh / (logging interval in seconds / 3600)	Reactive Energy (VARh)
VA	VAh / (logging interval in seconds / 3600), where VAh = SQRT (Wh² + VARh²)	Reactive Energy (VARh) and Real Energy (Wh)
Volts (V)	VAh / Ah, where VAh = SQRT (Wh² + VARh²)	Reactive Energy (VARh) and Amp Hours (Ah)
Power Factor (PF)	Wh / VAh, where VAh = SQRT (Wh² + VARh²)	Reactive Energy (VARh) and Real Energy (Wh)
Power (W)	Wh / (logging interval in seconds / 3600)	Real Energy (Wh)
Power (kW)	Wh / (logging interval in seconds / 3600) / 1000 OR W / 1000	Real Energy (Wh)
Amps (A)	Ah / (logging interval in seconds / 3600)	Amp Hours (Ah)

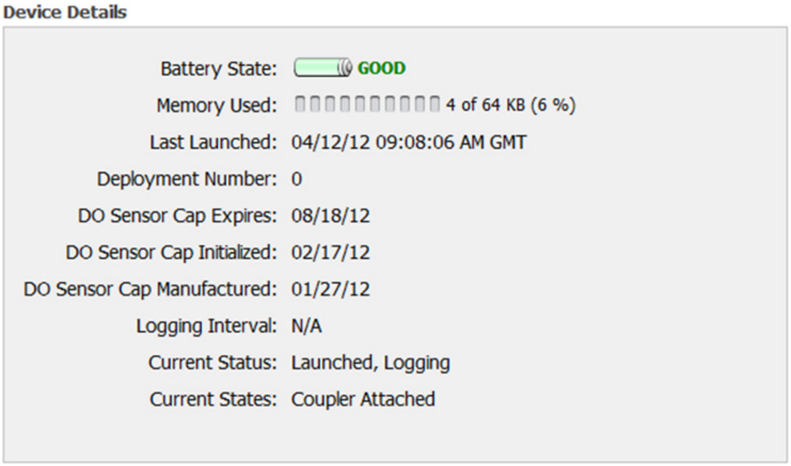
Checking Dates for the HOBO U26 Dissolved Oxygen Logger Sensor Cap

The HOBO U26 Dissolved Oxygen logger has a replaceable DO sensor cap intended for six months of use plus a one-month grace period. Once the cap is initialized, an internal clock within the logger will count down to the seven-month expiration date.

A new sensor cap can be initialized several ways:

- When the logger is launched, it will automatically be initialized when logging begins.
- You will be prompted to initialize it when checking the Status.
- You will be prompted to initialize it when using the Lab Calibration tool.
- If you replace an existing sensor cap while the logger is logging, it will automatically be initialized.

Once the 7-month countdown begins, you can see information about the sensor cap in the Status window as shown below.



Device Details

Battery State: GOOD
Memory Used: 4 of 64 KB (6 %)
Last Launched: 04/12/12 09:08:06 AM GMT
Deployment Number: 0
DO Sensor Cap Expires: 08/18/12
DO Sensor Cap Initialized: 02/17/12
DO Sensor Cap Manufactured: 01/27/12
Logging Interval: N/A
Current Status: Launched, Logging
Current States: Coupler Attached

In the Device Details pane, three key DO sensor cap dates are displayed:

- Expiration date, at which time you'll need to replace it with a new cap. **Important:** The logger will not collect any data after the cap has expired.
- Initialization date, which is the date the cap was initialized and the date the 7-month countdown began.
- Manufactured date; the cap has a shelf life and must be used within two years of this date.

For details on installing or replacing the DO sensor cap, see the logger manual.

Using the Lab Calibration Tool with the HOBO U26 Dissolved Oxygen Logger

Lab calibration is available for HOBO Dissolved Oxygen (U26-001) loggers. Use this tool when you need to calibrate the logger before deploying it or after replacing an expired sensor cap. The tool sets the gain and offset adjustment values for the logger by:

- Restoring logger calibration values to the factory defaults,
- Using your own gain and offset adjustment values, or
- Calculating the values with a three-step calibration procedure.

In the three-step procedure, the logger is first calibrated to 100% saturation by placing it in water-saturated air. Then, you can calibrate the logger to 0% saturation by placing it in sodium sulfite or another 0% oxygen environment (recommended if the logger will be deployed in water with DO levels of 4 mg/L or less).

Important: Lab calibration only affects future launches; any data saved in the logger will be based on the previous calibration values.

To complete these steps, you will need fresh water, the calibration boot and sponge supplied with the logger, and a source for current barometric pressure at your current location. You will also need sodium sulfite solution and a 3 inch beaker if you will be calibrating to 0% saturation.

The fresh water, logger, and sodium sulfite (if applicable) should be left out in the lab where the calibration is being done long enough so that they are at room temperature. If the logger had been deployed previously, make sure the sensor is clean and dry (see the logger manual for more details).

To use the Lab Calibration tool:

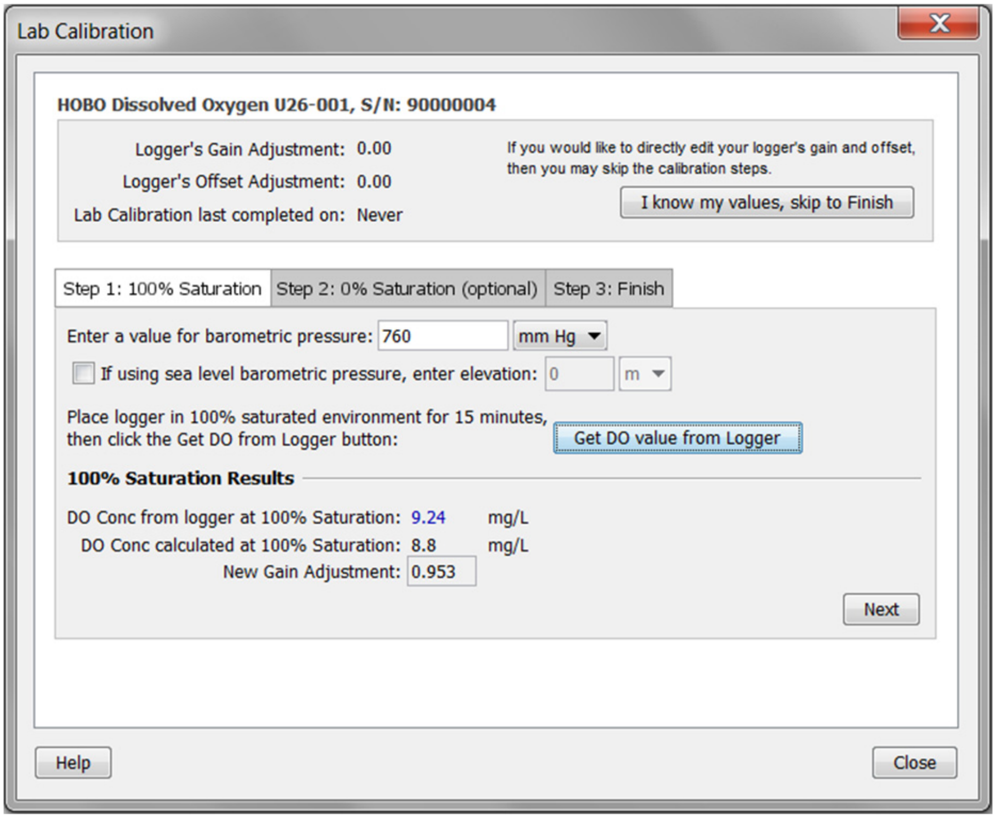
1. Connect a HOBO Dissolved Oxygen logger to the computer. Stop the logger if it is currently logging or awaiting a coupler or delayed start.
2. From the Device menu, click Lab Calibration. **Note:** If the sensor cap is installed and it has not yet been initialized, you will be prompted to do so. Follow the instructions on the screen. The sensor cap will expire in seven months once initialized.
3. The current gain and offset adjustments are displayed in the top pane of the window, along with the date and time the last lab calibration was completed (if applicable). Completing Steps 1 through 3 in this window will result in new gain and offset adjustment values based on the current logger conditions. Continue to the next section for details on how to complete these steps.

If you already know what the gain and offset values should be (for example, the values from a previous calibration that you want to use again) or want to return to the default factory values, click the "I know my values, skip to Finish" button. This will automatically move you to "Step 3: Finish." Either click the "Reset to Factory Defaults" button or type in new gain adjustment and new offset adjustment values and click the "Send Calibration to the Logger" button. **Note:** If you decide you do not need to change the calibration, click Close to cancel the calibration and revert back to the last saved logger values.

Step 1: 100% Saturation

1. Enter the barometric pressure for your current location in one of five available units. If the barometric pressure reading has been adjusted for sea level (such as a reading taken from the National Weather Service weather station), select the "If using sea level barometric pressure, enter elevation" checkbox and enter your elevation in either meters or feet.
2. Make sure the logger either has the protective guard or the anti-fouling guard installed (whichever guard you plan to use in the deployment) so that the sensor is covered.
3. Wet the small sponge that shipped with the logger with fresh water. Squeeze out any excess water.
4. Place the sponge in the end of the calibration boot.
5. Insert the logger in the calibration boot so that there is approximately a 1 cm (0.5 inch) overlap between the end of the boot and the body of the logger. This will ensure there is enough space between the end of the logger and the sponge (the logger should not be pressed up tightly against the sponge).
6. Wait for approximately 15 minutes until the logger reaches temperature equilibrium. **Important:** The logger will "go to sleep" if there is no activity for 30 minutes. To avoid this, click the "Get DO value from the logger" button as described next in step 7 well before 30 minutes have passed. If the logger does go to sleep, a message will appear indicating that there was a communication failure. You may need to close and reopen the Lab Calibration window to reactivate the logger. Follow the instructions on your screen.
7. Click the "Get DO value from the logger" button to display the 100% saturation results. You can click this button as often as needed. The results are updated each time you click the button. To check for equilibrium, click the "Get DO value from the logger" button several times in a row to check the current "DO Conc from logger at 100% Saturation" value. If the value remains the same or varies very little with each button click, then temperature equilibrium has likely been reached.

8. When you are satisfied with the results displaying, click the Next button to proceed to "Step 2: 0% Saturation."



HOBO Dissolved Oxygen U26-001, S/N: 90000004

Logger's Gain Adjustment: 0.00
Logger's Offset Adjustment: 0.00
Lab Calibration last completed on: Never

If you would like to directly edit your logger's gain and offset, then you may skip the calibration steps.

Enter a value for barometric pressure: 760 mm Hg
☐ If using sea level barometric pressure, enter elevation: 0 m

Place logger in 100% saturated environment for 15 minutes, then click the Get DO from Logger button:

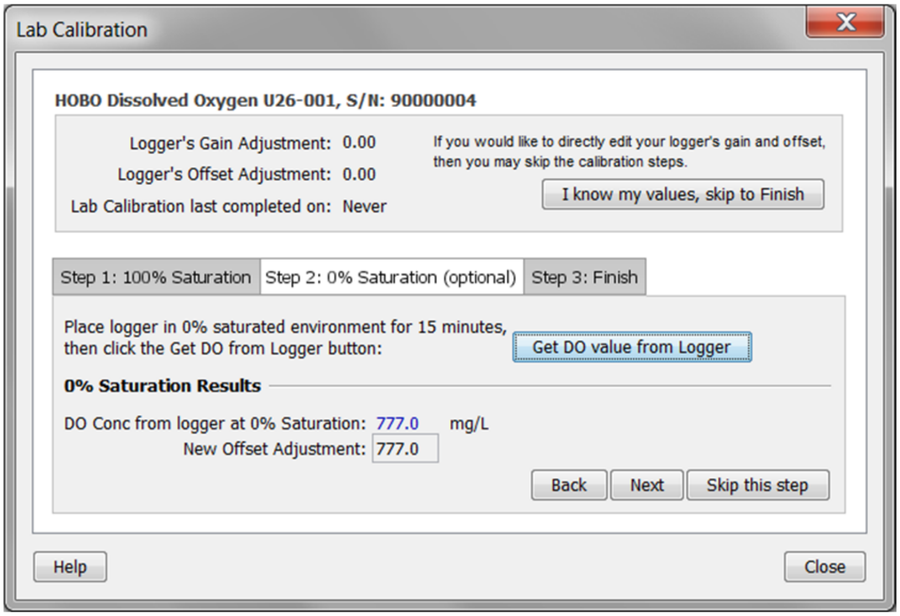
100% Saturation Results

DO Conc from logger at 100% Saturation: 9.24 mg/L
DO Conc calculated at 100% Saturation: 8.8 mg/L
New Gain Adjustment: 0.953

Step 2: 0% Saturation (optional)

If the logger will be deployed in water with DO levels greater than 4 mg/L, click the “Skip this Step” button. Otherwise, continue with the following procedure.

1. Make sure the logger either has the protective guard or the anti-fouling guard installed (whichever guard you plan to use in the deployment) so that the sensor is covered.
2. Pour the sodium sulfite into the beaker so that it is about two-thirds full.
3. Place the sensor end of the logger into the solution so that the entire protective cap or anti-fouling guard and at least 2.5 cm (1 inch) of the logger body are submerged in the beaker. Allow it to rest on the bottom of the beaker.
4. Wait a few minutes until the logger reaches temperature equilibrium. **Important:** The logger will "go to sleep" if there is no activity for 30 minutes. If this happens, you will need to close and reopen the Lab Calibration window to reactivate the logger and, as a result, repeat the calibration for 100% saturation. To avoid this, click the "Get DO value from the logger" button as described next in step 5 well before 30 minutes have passed.
5. Click the “Get DO value from the logger” button to display the 0% saturation results. As with the 100% calibration, you can click this button as often as needed. The results are automatically updated each time you click the button. If the value remains the same or varies very little with each button click, then temperature equilibrium has likely been reached.
6. When you are satisfied with the results displaying in the Step 2: 0% Saturation tab, click the Next button to proceed to "Step 3: Finish."



HOBO Dissolved Oxygen U26-001, S/N: 90000004

Logger's Gain Adjustment: 0.00
Logger's Offset Adjustment: 0.00
Lab Calibration last completed on: Never

If you would like to directly edit your logger's gain and offset, then you may skip the calibration steps.

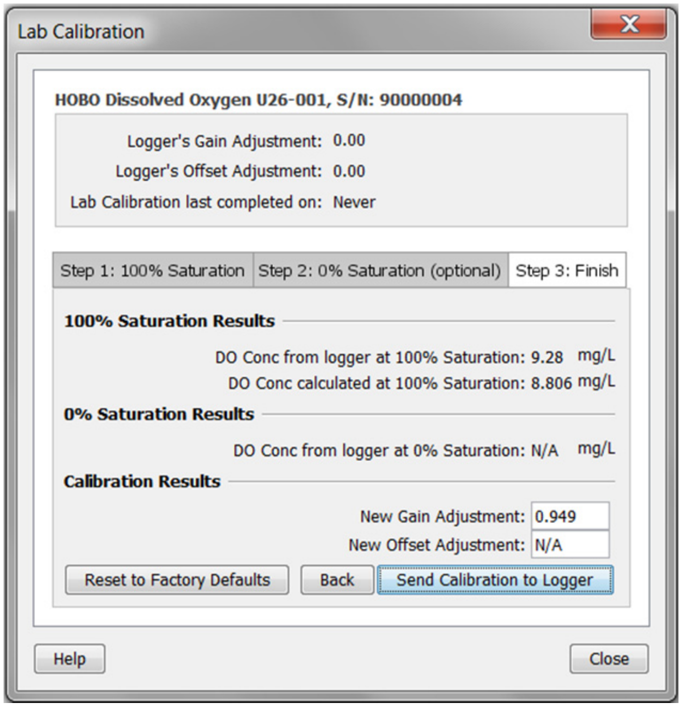
Place logger in 0% saturated environment for 15 minutes, then click the Get DO from Logger button:

0% Saturation Results

DO Conc from logger at 0% Saturation: 777.0 mg/L
New Offset Adjustment: 777.0

Step 3: Finish

The results from the first two steps are displayed as well as the overall calibration results and the new gain and offset adjustment values. If you are satisfied with the results, click the "Send Calibration to Logger" button. The logger will then be calibrated based on the new values. Click the Back button to return to a previous step if you wish to repeat Step 1 or Step 2. These values will not take effect until the logger is launched. If you do not want to save these values, click Close to cancel the calibration and revert back to the last saved logger values. Or, click "Reset to Factory Defaults" to return to the original values. If you performed Step 2, then remove the logger from the solution and thoroughly rinse it with fresh water to remove any excess sodium sulfite. See the logger manual for additional details on cleaning the logger.



HOBO Dissolved Oxygen U26-001, S/N: 90000004

Logger's Gain Adjustment: 0.00
Logger's Offset Adjustment: 0.00
Lab Calibration last completed on: Never

100% Saturation Results

DO Conc from logger at 100% Saturation: 9.28 mg/L
DO Conc calculated at 100% Saturation: 8.806 mg/L

0% Saturation Results

DO Conc from logger at 0% Saturation: N/A mg/L

Calibration Results

New Gain Adjustment: 0.949
New Offset Adjustment: N/A

Updating UX Series Logger Firmware

You can update the firmware in a UX series logger as needed with HOBOware. You may see that an update is available when opening the Launch Logger or Status window, or Onset Technical Support will notify you when this is necessary.

To update UX series logger firmware:

1. Connect a UX series logger to the computer.
2. **Important: Stop and read out the logger and save the file before updating the firmware.** The update process will delete all existing data in the logger so be sure to stop and read out the logger before continuing with the next step.
3. From the Help menu, select Update Logger Firmware and then select Update UX Series Logger Firmware. **Note:** This is not necessary if a message indicates that a firmware update is available after opening the Launch Logger or Status window. Continue with the next step instead.
4. If there is a newer firmware version available than the version currently installed in the logger, a message appears indicating a firmware update is available. Click Yes to continue.

   If a newer firmware version is not detected, then a message appears indicating there are no updates available for this logger. There may be instances where you have downloaded a firmware .hex file from the Onset website and need to locate this file. If so, click Yes when this message appears to find the file. Otherwise, click No to close the message and exit the update process.
5. In the Update UX Series Logger Firmware window, the suggested firmware file for use with the current logger is displayed. The logger model number will be listed within the file name for you to double-check that it is the correct version for the logger you are updating. If the file listed is the one you wish to use, then click Continue. If it is not the correct file or you wish to locate a different file based on instructions from Onset Technical Support, click Select Firmware and locate the appropriate file. **Note:** If you click Cancel, you may still be prompted for an additional firmware update in some instances. Click Cancel again to completely exit the procedure.
6. A message appears warning you not to disconnect the logger until the update process is complete. The update process should take a couple of minutes. If you have not already read out the logger and saved the data, then click No to cancel the update and return to step 2. Otherwise, if you are ready to update the firmware in the logger, click Yes to continue.
7. As the firmware update process takes place, "Boot" will display on the logger LCD screen. Do not disconnect the logger during this process. Once the update is complete, a message will appear indicating the update was successful. UX100 series loggers require an additional firmware update. A message will appear automatically if a second update is necessary. Repeat steps 4–7 if another firmware update is available. **Note:** If "Boot" remains on the logger LCD screen after this is complete, the device may need to be reset. From the Device menu, select Utilities, and then select Reset UX Logger. If "Boot" still remains on the LCD screen, contact Onset Technical Support.
8. After the firmware update process is complete, you will need to launch the logger before you can use it again. If you'd like to launch the logger immediately, click Yes. Otherwise click No to close the message and click Launch from the Device menu to launch the logger at a later time.

Note: Selecting the preference "Only show Select Device window if a device has not been selected" (available within Preferences > General > Selecting Devices) can prevent auto-update notifications. If this occurs, access the firmware update from the Help menu as described in step 3.

Fixing "Read Header Failed" Error

Occasionally, when trying to launch, check status, or read out a U-Series logger (other than a HOBO U30 Station), HOBO Waterproof Shuttle, or HOBO U Shuttle, you may receive the following error: "Read Header Failed." These messages occur when a device's header cannot be read, usually because of a communication error or corrupted header. Disconnect the device from the computer, then reconnect it and try to launch, check status, or read out again.

If you receive the message again, the header has probably become corrupted. The most common cause of header corruption is a communication problem during launch, such as the USB cable coming loose or an optical logger slipping out of its base station/coupler while the Launching Logger progress bar is displayed. In that case, there is a possibility that valid data has been logged, but cannot be read out.

You can restore the header by launching the logger or shuttle. This will reset the device's launch options to factory defaults. However, it will also cause any logged data or offloaded data from a shuttle to be lost. If you receive a "Read Header Failed" message and are unable to read out the logger or offload a shuttle, please contact the vendor that sold you the device. It may be possible to retrieve the logged data.

Chapter 6
HOBOnode Manager

HOBOnode Manager is the software tool within HOBOware Pro for setting up and managing a ZW wireless data network, which consists of a receiver, data nodes, and router nodes.

For information about setting up a network, refer to the ZW Series Wireless Network Quick Start Guide available on www.onsetcomp.com.

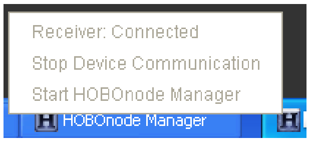
For help with deploying a network in your facility, refer to the HOBO Data Node Deployment Guide also available at www.onsetcomp.com.

To open HOBOnode Manager for the first time, select the Device menu and choose Manage HOBO Data Node Network.

Notes about operating HOBOnode Manager:

- When HOBOnode Manager is open, two HOBOware icons appear in the Windows taskbar.
- You cannot access HOBOnode Manager if a HOBOware window, such as Logger Launch or Status, is open.
- You can close HOBOnode Manager and leave HOBOware running, but you cannot close HOBOware and leave HOBOnode Manager running. If you close both HOBOnode Manager and HOBOware, device communication can continue to run, which allows incoming data from the network to be uploaded to the computer. A HOBOware icon appears in your system tray when device communication is running. Note that the next time you open HOBOnode Manager, it could take several minutes for the real-time plots to reflect all the stored data.

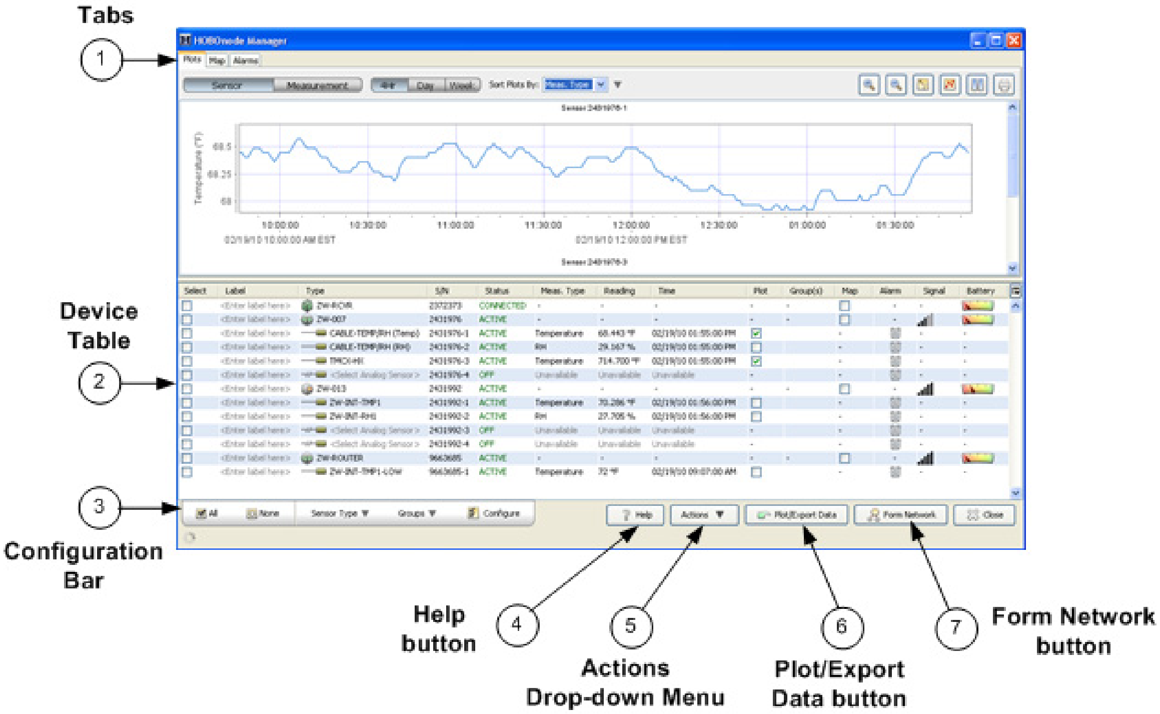
  To stop device communication, right-click (or left-click on a Mac) the system tray HOBOware icon to access the Device Communication menu, which shows the receiver status and has options for stopping device communication and starting HOBOnode Manager. Device communication must be stopped when updating HOBOware software.



- An icon appears in the status bar at the bottom of the main HOBOware window to show whether the receiver is currently connected. If the receiver is connected, you'll see this  No devices connected in the bottom right corner of the HOBOware window. If the receiver is disconnected, you'll see this  No devices connected instead. The "No devices connected" message next to the receiver icon does not refer to devices within your data node network; it indicates that other devices, such as loggers and shuttles, are not currently connected. If you were to connect a logger or a shuttle, that message is updated independently of the receiver icon.

A Tour of HOBOnode Manager

This topic provides a description of the elements in HOBOnode Manager.



1. Tabs. Click the tabs to toggle between the Plots, Map, and Alarms pages.
2. Device Table. The Device Table displays information about the receiver and each node and configured sensor in your network. Use the Device Table to:
    - Select a device by checking the appropriate box in the Select column.
    - Double-click the <Enter label here> field to assign a name, or label, to the node or sensor. Type in the name and press Enter.
    - See a list of all network devices in the Type column, which lists the device by part number, followed by sensor part number as applicable.
    - View the serial number for the device in the S/N column.
    - Check the current status of the device, listed in the Status column. Data nodes and router nodes are listed as either Active (communicating with the receiver) or Missing (not communicating with the receiver). As with data notes and router nodes, sensor status can be Active or Missing, but it also be listed as Off if it is an external sensor that has not been configured. Receiver status is either listed as Connected or Not Connected.
    - See what the sensor is configured to measure in the Meas. type column. The measurement type is automatically filled in for internal sensors. The measurement type listed for external sensors is determined by the selections in the Configure Sensor dialog.
    - Check the latest reading for each sensor in the Reading column, and the time that reading was taken in the Time column.
    - View device readings in a real-time plot. Check the box in the Plot column to generate a real-time plot for that device.
    - See what group(s) the sensor has been assigned to in the Group column.

- Add the device to a map. Check the box in the Map column to add that device to the map. Drag the icon to the desired location on the map click the mouse button.
- Check whether an alarm has tripped for a specific device in Alarm column. A grey alarm icon means an alarm has not been set up for the device. A green alarm icon means an alarm has been set up, but has not tripped as of the latest reading. A red alarm indicates the alarm for that sensor has tripped.
- Check the signal strength between the device and receiver or the device and the nearest router in the Signal column. If the signal is low, there may be obstructions or other interference preventing the device from communicating to the receiver or router.
- Check the battery level for a specific device in the Battery column.

You can change the sort order in a column by clicking the column header. Right-click anywhere in the Device Table to restore the sort order. You can also show or hide individual columns by clicking the icon above the vertical scroll bar in the Device Table.

3. Configuration Bar. Use the Configuration Bar to select all or none of the devices, to quickly change the sensor type for external sensors, to assign sensors to groups, or to open the Configure window for additional sensor settings.
4. Help button. Click this button to access HOBOnode Manager help. Click the *Open topic with navigation* link to open the full Help table of contents.
5. Actions button. From the Actions button, you can print a copy of the device table, edit preferences, or create a new deployment.
6. Plot/Export Data button. Click this button to open the Plot/Export Wireless Data window, from which you can select sensor data to plot in HOBOware or export to a .csv or .txt file for use in another program.
7. Form Network button. Click this button to create a network and add data nodes and router nodes to it.

Viewing Real-Time Plots

In the plots window, you can view sensor data in real-time plots. You can plot a maximum of 20 sensors at once.

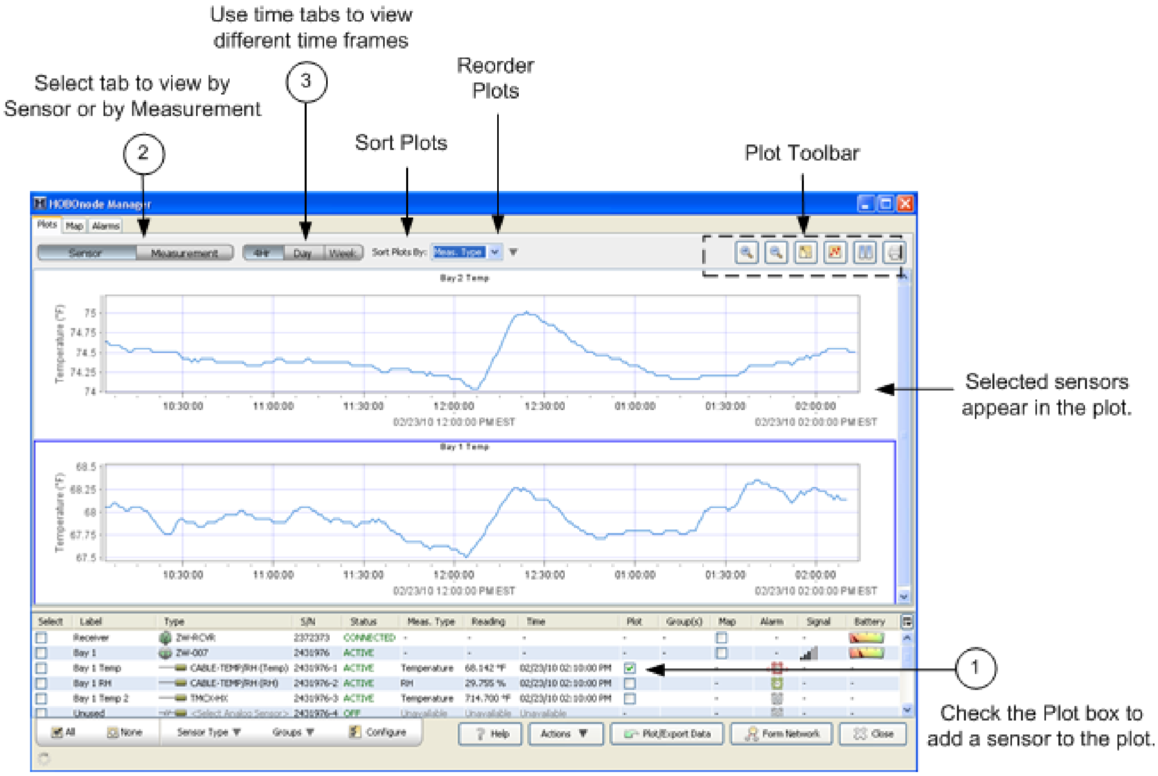
To view the real-time plot for sensors:

1. Select the Plot box in the Device Table for each sensor you want to view.
2. Select Sensor or Measurement view tab.

   In Sensor View, there is a separate plot for each sensor.

   In Measurement View, there is one plot for each Measurement Type (such as temperature), which may contain separate entries for multiple sensors.

3. Change the time frame of the plot using the Time Frame tabs.



Select	Label	Type	S/N	Status	Meas. Type	Reading	Time	Plot	Group(s)	Map	Alarm	Signal	Battery
☐	Receiver	ZW-RCVR	2372373	CONNECTED	-	-	-	-	-	☐	-	-	
☐	Bay 1	ZW-007	2431976	ACTIVE	-	-	-	-	-	☐	-		
☐	Bay 1 Temp	CABLE-TEMP/RH (Temp)	2431976-1	ACTIVE	Temperature	68.142 °F	02/23/10 02:10:00 PM	☑		-		-	-
☐	Bay 1 RH	CABLE-TEMP/RH (RH)	2431976-2	ACTIVE	RH	29.755 %	02/23/10 02:10:00 PM	☐		-		-	-
☐	Bay 1 Temp 2	TMCX-HX	2431976-3	ACTIVE	Temperature	714.700 °F	02/23/10 02:10:00 PM	☐		-		-	-
☐	Unused	<Select Analog Sensor>	2431976-4	OFF	Unavailable	Unavailable	Unavailable	-		-		-	-

- Use the Sort Plots By drop-down list to change the order of the plots.
- Use the Reorder Plots arrow to reverse the order of plots.
- Use the Plot Toolbar to zoom in or out, pause the plot, or print the plot.

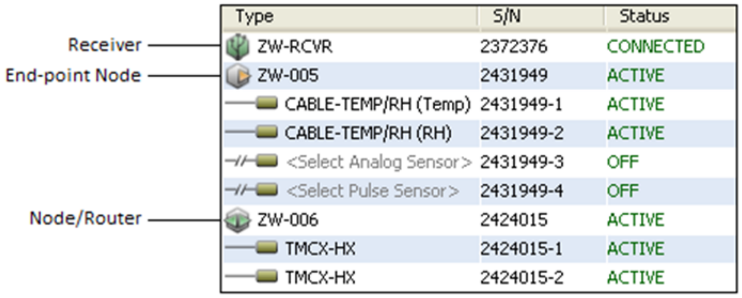
Plotting Preferences

To change preferences that apply to real-time plots only, see Setting HOBOnode Manager Preferences.

Use the general HOBOware Plotting Preferences to change the appearance of plots. To apply changes to real-time plots, re-start HOBOnode Manager or uncheck the sensor Plot box and then re-check. To open the Plotting Preferences, from the main HOBOware menu select File > Preferences and then click the Plotting tab.

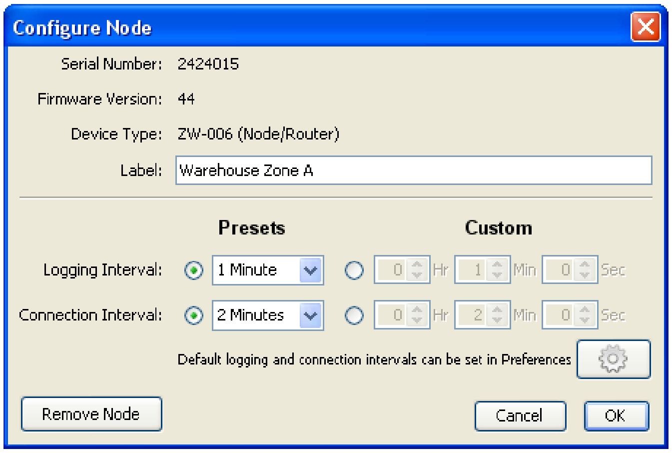
Determining Data Node Type

There are three types of devices displayed within HOBOnode Manager: the data receiver (ZW-RCVR), end-point data nodes (ZW-0xx), and node/routers. A node/router can be either a data node (ZW-0xx) that was initially powered by an AC adapter instead of batteries or a router node (ZW-ROUTER) that routes data only and does not have recording capability. Use the icons in the device table to identify data node types. This is particularly helpful if you need to verify whether a data node (ZW-0xx) is acting as a data node only or if it also has routing abilities.



Type	S/N	Status
ZW-RCVR	2372376	CONNECTED
ZW-005	2431949	ACTIVE
CABLE-TEMP/RH (Temp)	2431949-1	ACTIVE
CABLE-TEMP/RH (RH)	2431949-2	ACTIVE
<Select Analog Sensor>	2431949-3	OFF
<Select Pulse Sensor>	2431949-4	OFF
ZW-006	2424015	ACTIVE
TMCX-HX	2424015-1	ACTIVE
TMCX-HX	2424015-2	ACTIVE

For another way to see whether the device is a data node only or a data node/router, double-click the device to open the Configure Node dialog. Check the Device Type for the device part number and description. In the example below, the device is operating as a both a data node and a router so the Device Type is listed as "ZW-006 (Node/Router)." If this device was powered by batteries only, then it would be operating as a data node and not a router, and listed as "ZW-006 (Node)."



Serial Number: 2424015

Firmware Version: 44

Device Type: ZW-006 (Node/Router)

Label: Warehouse Zone A

	Presets	Custom
Logging Interval:	● 1 Minute	○ 0 Hr 1 Min 0 Sec
Connection Interval:	● 2 Minutes	○ 0 Hr 2 Min 0 Sec

Default logging and connection intervals can be set in Preferences

Changing Logging and Connection Intervals

There are two types of intervals associated with data nodes:

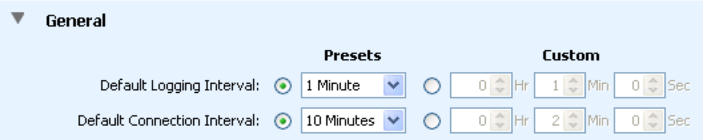
- the logging interval, which is how often the node records data and
- the connection interval, which is how often the node transmits data to the receiver.

When a data node joins a network, it uses the default logging and connection intervals that are set within the general preferences (upon installation of the software, the default logging interval is 1 minute and the default connection interval is 10 minutes). However, you can also define logging and connection intervals on a per-node basis, which gives you the flexibility of having data nodes logging and transmitting data at different rates.

Changing Default Values in Preferences

To change the default logging and connection intervals, click the Actions button in HOBOnode Manager and select Edit HOBO Data Node Preferences. Or, within HOBOware, select File > Preferences on Windows or HOBOware > Preferences on Macintosh and click Data Nodes. The default logging and connection intervals are under the General category of the data node preferences.

Select a preset value or set a custom interval. The minimum logging interval is 1 minute, and the minimum connection interval is 2 minutes.



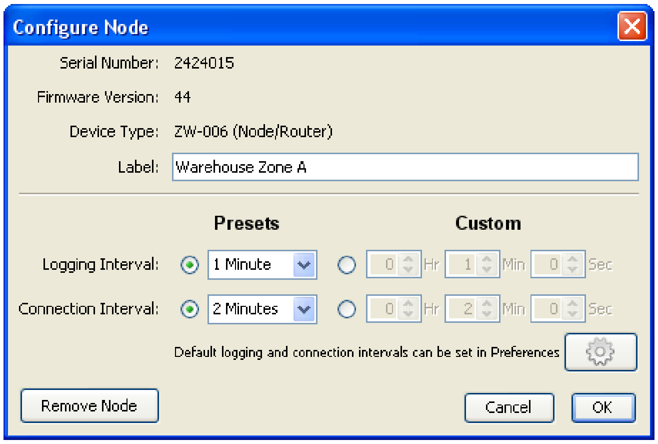
	Presets	Custom
Default Logging Interval:	● 1 Minute	○ 0 Hr 1 Min 0 Sec
Default Connection Interval:	● 10 Minutes	○ 0 Hr 2 Min 0 Sec

These default values will only be used for new data nodes that join the network. Changes to these default intervals will not affect data nodes that are already logging or that have been previously configured with their own individual logging or connection interval.

Changing Intervals for Individual Data Nodes

To change the logging and connection intervals on an individual data node:

1. Double-click the data node entry in the Device Table to open the Configure Device window.



Serial Number: 2424015

Firmware Version: 44

Device Type: ZW-006 (Node/Router)

Label: Warehouse Zone A

	Presets	Custom
Logging Interval:	● 1 Minute	○ 0 Hr 1 Min 0 Sec
Connection Interval:	● 2 Minutes	○ 0 Hr 2 Min 0 Sec

Default logging and connection intervals can be set in Preferences

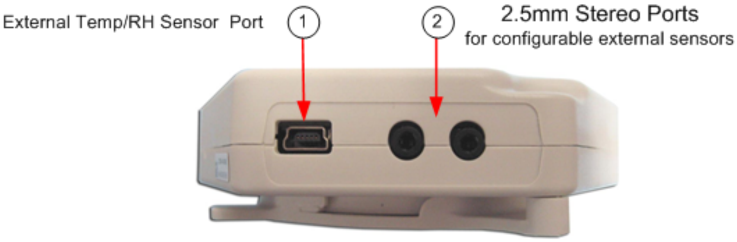
2. Change the logging interval and connection interval as required.
3. Click OK.

The changes will take effect the next time the data node connects to the receiver; they will only apply to that particular data node and its sensors. All other data nodes in the network will continue logging and connecting at their current intervals.

Setting up External Sensors

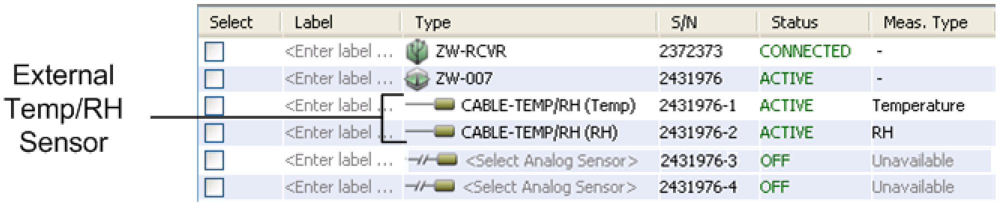
Important: Refer to the documentation that came with your sensor for specific connection and wiring information.

Data nodes support various external sensors that plug into one of two kinds of ports:



Most external sensors are not automatically configured. You must assign a sensor type for any external sensors connected to the data node (except for the External Temp/RH sensor). If you do not assign a sensor type, the device will not record any data for that sensor.

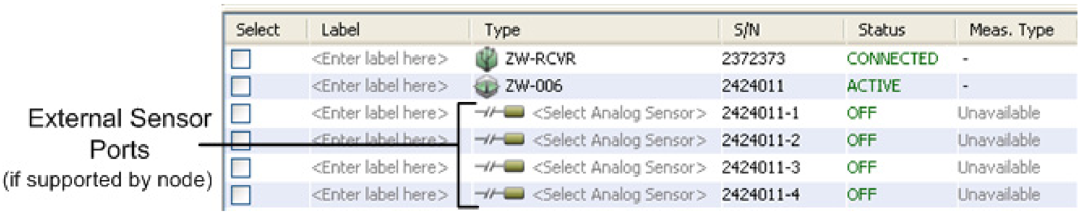
The ZW-005 and the ZW-007 support the External Temp/RH sensor (Part # CABLE-TEMP/RH), which plugs into the External Temp/RH Sensor Port (#1 in the photo above). This sensor is preconfigured and you do not have to select a sensor type. Separate rows appear under the node for the Temperature and RH channels with corresponding entries in the Type column.



Select	Label	Type	S/N	Status	Meas. Type
☐	<Enter label ...	ZW-RCVR	2372373	CONNECTED	-
☐	<Enter label ...	ZW-007	2431976	ACTIVE	-
☐	<Enter label ...	CABLE-TEMP/RH (Temp)	2431976-1	ACTIVE	Temperature
☐	<Enter label ...	CABLE-TEMP/RH (RH)	2431976-2	ACTIVE	RH
☐	<Enter label ...	<Select Analog Sensor>	2431976-3	OFF	Unavailable
☐	<Enter label ...	<Select Analog Sensor>	2431976-4	OFF	Unavailable

Some data nodes support up to four configurable external sensors, which plug into one of the 2.5mm Stereo Ports shown (#2 in the photo above).

You must select a Sensor Type in HOBOnode Manager for these sensors. When the data node appears in the Device Table, configurable external sensors will not have an entry in the Type column.



Select	Label	Type	S/N	Status	Meas. Type
☐	<Enter label here>	ZW-RCVR	2372373	CONNECTED	-
☐	<Enter label here>	ZW-006	2424011	ACTIVE	-
☐	<Enter label here>	<Select Analog Sensor>	2424011-1	OFF	Unavailable
☐	<Enter label here>	<Select Analog Sensor>	2424011-2	OFF	Unavailable
☐	<Enter label here>	<Select Analog Sensor>	2424011-3	OFF	Unavailable
☐	<Enter label here>	<Select Analog Sensor>	2424011-4	OFF	Unavailable

To select a Sensor Type for an external sensor:

1. Double-click the row for the sensor in the Device Table.
2. Select the Sensor Type from the drop-down list.
3. Add a label for the sensor (optional).
4. Click OK.

Once you select a sensor type, the Status will change to ACTIVE and the appropriate measurement type will appear in the Measurement Type column.

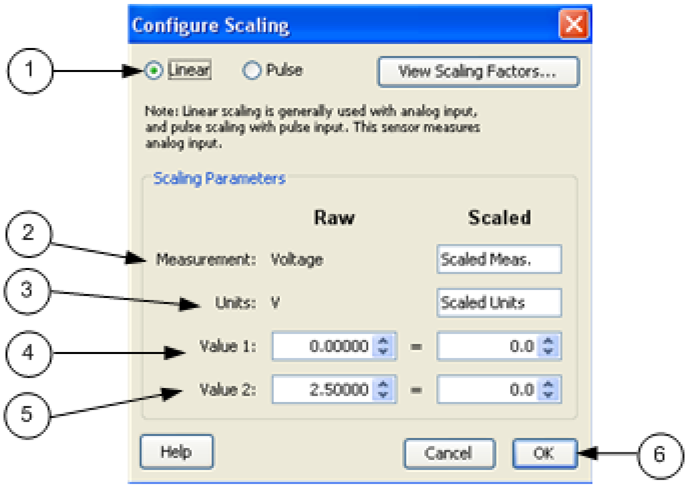
Some sensors must be scaling to give you meaningful data. Refer to Configuring Scaling on a Sensor for more details.

Configuring Scaling on a Sensor

Some sensors need to be scaled to provide meaningful data. Scaling is set through the Configure Scaling window. To open this window:

1. Double-click the sensor in the Device Table to open the Configure Sensor window.
2. Select the Sensor Type if not already selected.
3. Click the Configure button.

To set scaling for the sensor:



Note: Linear scaling is generally used with analog input, and pulse scaling with pulse input. This sensor measures analog input.

Measurement: Voltage — Scaled Meas.

Units: V — Scaled Units

Value 1: 0.00000 = 0.0

Value 2: 2.50000 = 0.0

1. Check the scaling type is correct. The scaling type is automatically selected based on the type of sensor selected. Linear scaling is enabled for analog sensors; pulse scaling is enabled for pulse sensors. Note: Click the View Scaling Factors button to see scaling factors by sensor.
2. Enter the scaled measurement type. The Raw Measurement is the source measurement type, such as Current, Voltage, or Counts.

3. Enter the scaled units. The Raw Units is the type of output the sensor uses, either V or mA, corresponding to the type of sensor selected. Raw Value 1 and Raw Value 2 should be entered using these units.
4. Type in the Raw and Scaled numbers for Value 1. For Raw Value 1, enter the low raw value given by the external sensor. For Scaled Value 1, enter the value in the same units that were specified in the Scaled Units box. The Scaled Value 1 is the value that will appear on the plot when the sensor reports a raw value equal to Raw Value 1.
5. Type in the Raw and Scaled numbers for Value 2. For Raw Value 2, enter the high raw value given by the external sensor. For Scaled Value 2, enter the value in the same units that were specified in the Scaled Units box. The Scaled Value 2 is the value that will appear on the plot when the sensor repors a raw value equal to Raw Value 2.
6. Click OK when done.

Once scaling is configured on a sensor, the scaled icon will appear in the Meas. Type column in the Device Table.

Scaling Factors

Click the link below to see the scaling factors for your sensor model.

- Wattnode: T-WNB-3Y-208/ T-WNB-3D-240 / T-WNB-3D-480
- Veris: T-VER-8051-300/ T-VER-8053-800
- Veris: T-VER-H970-200
- Veris: T-VER-971BP-200
- Veris: T-VER-PXU-L/ T-VER-PXU-X
- Ion: T-ION-TVOC

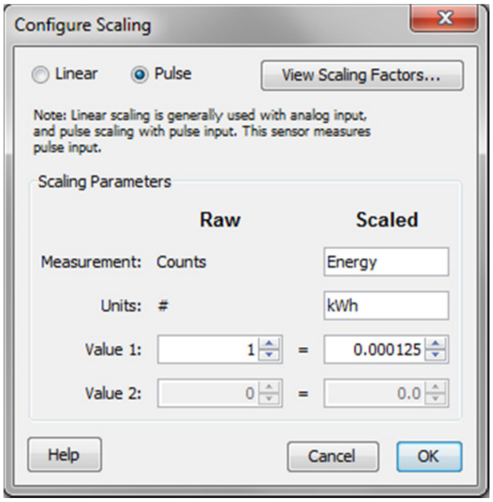
Wattnode Scaling Factors: T-WNB-3Y-208/T-WNB-3D-240/ T-WNB-3D-480

Use the table below to find the Kilowatt-hours per pulse for your CT Size and WattNode model and enter it in the Scaled Value 1 box.

Cable Required/Sensor Type: CABLE-2.5-STEREO

Example

This example shows the values you would enter in the Configure Scaling window for a Wattnode 3Y-208 with a 5 amp CT. Pulse should be selected automatically. In the Scaled column, type "Energy" for Measurement and "kWh" for Units. For this example, the Raw Value 1 is "1" and the Scaled Value 1 is "0.000125."



Note: Linear scaling is generally used with analog input, and pulse scaling with pulse input. This sensor measures pulse input.

Scaling Parameters

	Raw		Scaled
Measurement:	Counts		Energy
Units:	#		kWh
Value 1:	1	=	0.000125
Value 2:	0	=	0.0

Kilowatt-hours per pulse

	Kilowatt-hours per pulse	
CT Size (amps)	Model #: 3Y-208/3D-240	Model #: 3D-480
5	0.000125	0.0002885
15	0.000375	0.0008656
20	0.0005	0.0011541
30	0.00075	0.0017313
50	0.00125	0.0028854
60	0.0015	0.0034625
70	0.00175	0.0040396
100	0.0025	0.0057708
150	0.00375	0.0086563
200	0.005	0.011542
250	0.00625	0.014427
300	0.0075	0.017313
400	0.01	0.023083
600	0.015	0.034625
800	0.02	0.046167
1000	0.025	0.057708
1200	0.03	0.06925
1500	0.0375	0.086563
2000	0.05	0.11542
3000	0.075	0.17313

Veris Scaling Factors: T-VER-8051-300/T-VER-8053-800

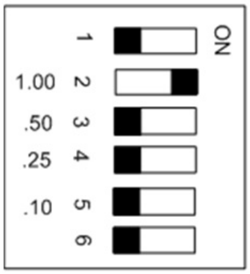
The consumed energy in kilowatt-hours (kWh) per pulse for these sensors is determined by the DIP switch setting on the transducer. The default is “1.00” kWh / pulse, at which the scaling factor is 1 = 1. If you change the default DIP switch settings, adjust your scaling factors accordingly, as shown below.

The data recorded by the data node will be the number of counts (pulses) per sampling interval.

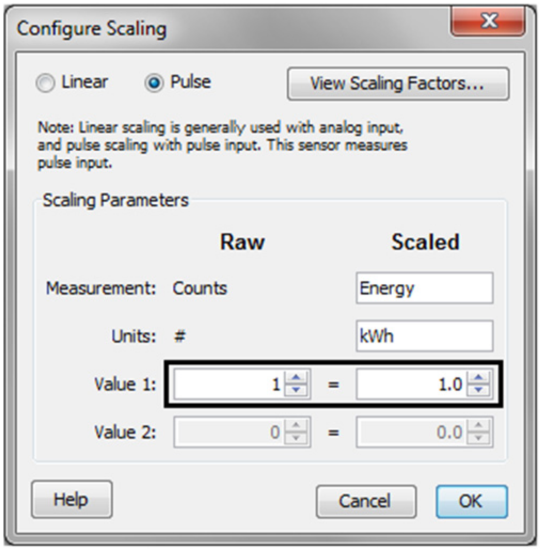
Cable Required/Sensor Type: CABLE-2.5-STEREO

1.0 kWh Per Pulse (Default)

DIP Switch Setting
on Transducer



Values in Configure
Scaling Window


Configure Scaling

○ Linear ● Pulse

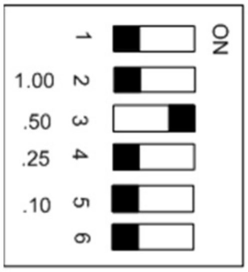
Note: Linear scaling is generally used with analog input, and pulse scaling with pulse input. This sensor measures pulse input.

Scaling Parameters

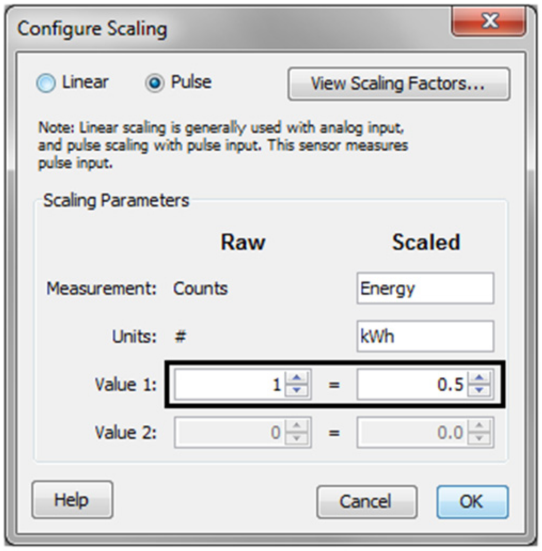
	Raw		Scaled
Measurement:	Counts		Energy
Units:	#		kWh
Value 1:	1	=	1.0
Value 2:	0	=	0.0

0.5 kWh Per Pulse

DIP Switch Setting
on Transducer



Values in Configure
Scaling Window


Configure Scaling

○ Linear ● Pulse

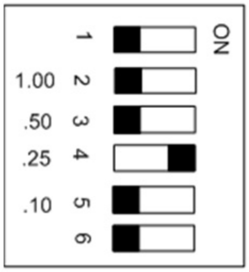
Note: Linear scaling is generally used with analog input, and pulse scaling with pulse input. This sensor measures pulse input.

Scaling Parameters

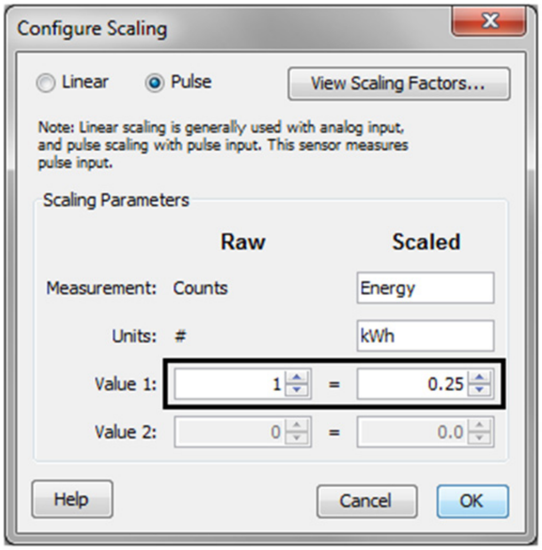
	Raw		Scaled
Measurement:	Counts		Energy
Units:	#		kWh
Value 1:	1	=	0.5
Value 2:	0	=	0.0

0.25 kWh Per Pulse

DIP Switch Setting
on Transducer



Values in Configure
Scaling Window



○ Linear ● Pulse

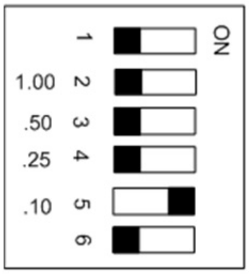
Note: Linear scaling is generally used with analog input, and pulse scaling with pulse input. This sensor measures pulse input.

Scaling Parameters

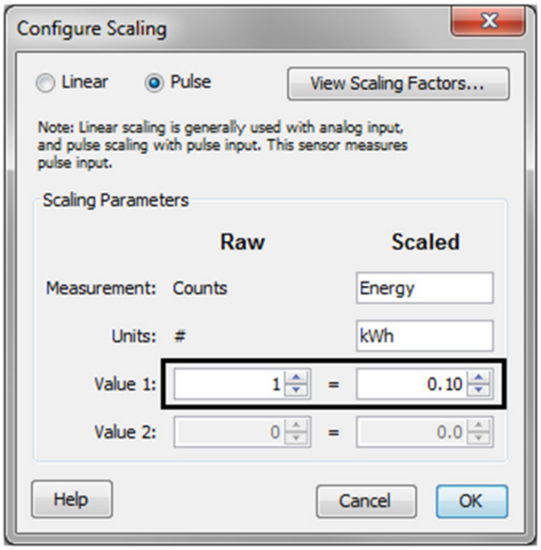
	Raw		Scaled
Measurement:	Counts		Energy
Units:	#		kWh
Value 1:	1	=	0.25
Value 2:	0	=	0.0

0.10 kWh per Pulse

DIP Switch Setting
on Transducer



Values in Configure
Scaling Window



○ Linear ● Pulse

Note: Linear scaling is generally used with analog input, and pulse scaling with pulse input. This sensor measures pulse input.

Scaling Parameters

	Raw		Scaled
Measurement:	Counts		Energy
Units:	#		kWh
Value 1:	1	=	0.10
Value 2:	0	=	0.0

Veris Scaling Factors: T-VER-H970-200

The T-VER-H970-200 has a selectable range for Linear Scaling: mA or Volts -> Amps. An AC-DC power adapter with a minimum of 6W @ 35mA is required for excitation power.

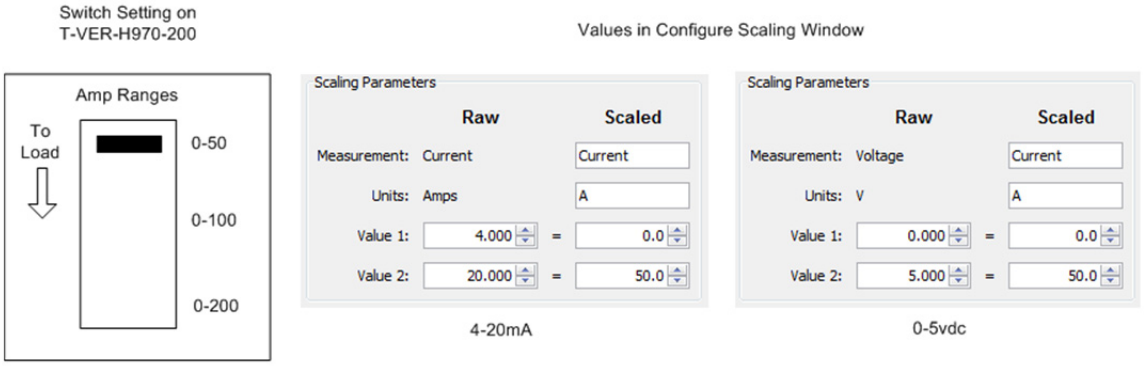
Cable Required/Sensor Type

Use the appropriate cable to connect the sensor to the data node and select the corresponding cable in the Sensor Type drop-down when configuring the External Sensor in HOBOnode Manager.

- For 4-20mA output, use CABLE-4-20mA.

- For 0-5vdc output, use CABLE-ADAP5.

0-50 Amps



Scaling Parameters

	Raw		Scaled
Measurement:	Current		Current
Units:	Amps		A
Value 1:	4.000	=	0.0
Value 2:	20.000	=	50.0

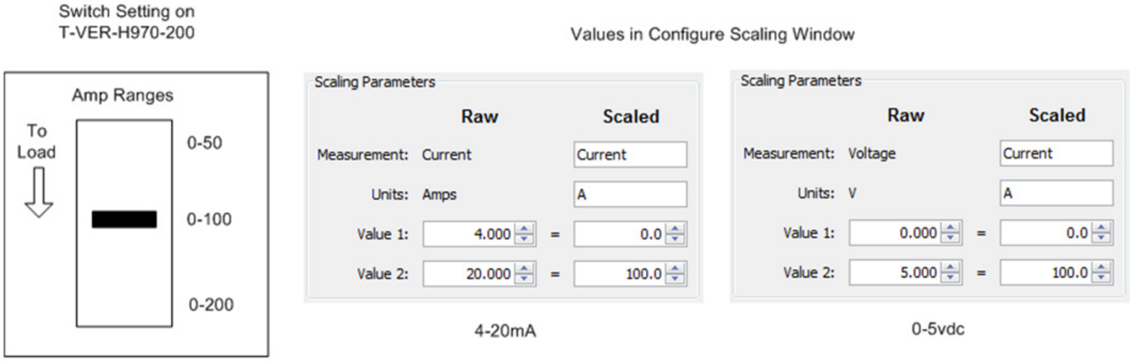
4-20mA

Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Current
Units:	V		A
Value 1:	0.000	=	0.0
Value 2:	5.000	=	50.0

0-5vdc

0-100 Amps



Scaling Parameters

	Raw		Scaled
Measurement:	Current		Current
Units:	Amps		A
Value 1:	4.000	=	0.0
Value 2:	20.000	=	100.0

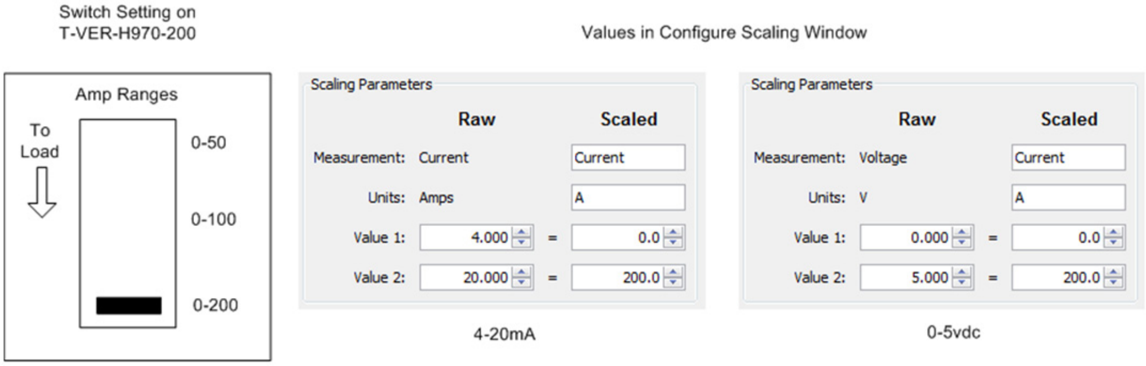
4-20mA

Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Current
Units:	V		A
Value 1:	0.000	=	0.0
Value 2:	5.000	=	100.0

0-5vdc

0-200 Amps



Scaling Parameters

	Raw		Scaled
Measurement:	Current		Current
Units:	Amps		A
Value 1:	4.000	=	0.0
Value 2:	20.000	=	200.0

4-20mA

Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Current
Units:	V		A
Value 1:	0.000	=	0.0
Value 2:	5.000	=	200.0

0-5vdc

Veris Scaling Factors: T-VER-971BP-200

The T-VER-971BP-200 has a selectable range for Linear Scaling of mA to Amps for current flow in both directions.

Cable Type/Sensor Type

Use a CABLE-4-20mA to connect the sensor to the data node and select CABLE-4-20mA in the Sensor Type drop-down when configuring the External Sensor in HOBOnode Manager.

Notes:

- Requires 12-24VDC @ 35 to 110 mA excitation power depending on DC current load.
- An AC-DC power adapter with a minimum of 6W @ 65mA is required.
- For currents over 120 Amps, supply voltage to CT must be at least 15V to maintain accuracy.
- Minimum Warm-up Time is 8-10 seconds.

Span Setting

The H971 comes preset at the maximum (0-200A) span. To adjust the H971 to a different span, locate the potentiometer on the top of the device. This potentiometer is a multi-turn device, taking about 23 turns to adjust the span from ±20A to ±200A. Use the potentiometer to adjust the maximum amperage range used by the sensor.

The smallest amperage range (0 to ±20 A) is set by turning the potentiometer fully counterclockwise; the greatest amperage range (0 to ±200 A) is set by turning the potentiometer fully clockwise.

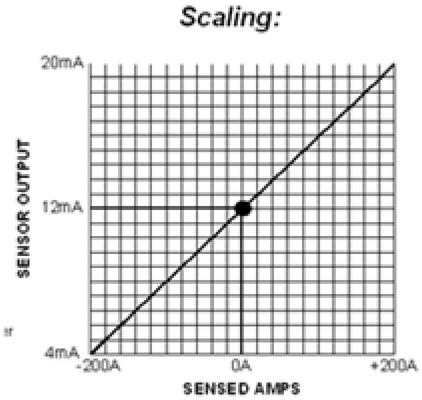
To determine the best amperage range for an application, first set the load to the maximum amperage that will be used. Use the LED as a guide to adjust the potentiometer to its optimum setting. Verify the measured output current matches the load current using a current clamp meter.

LED Activity	Potentiometer Adjustment
Steady green blink	Turn CCW until LED blinks rapidly, then slowly turn CW just until blink returns to steady rate.
Rapid green blink	Turn CW until LED blinks at a steady rate.

For an alternate method, see the Veris Installation Manual:

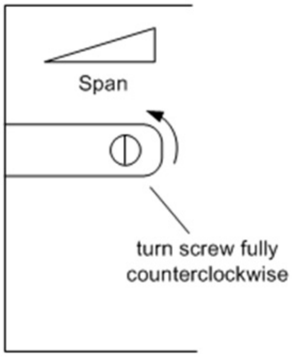
http://www.veris.com/docs/Installs/h971_971SP_i0d2.pdf

Scaling Graph

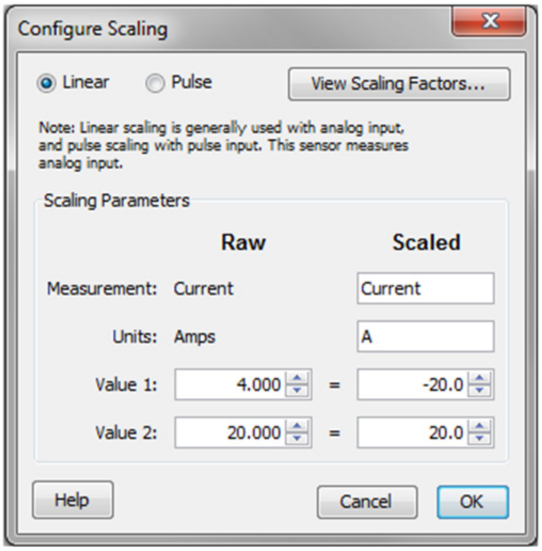


0-20mA

Potentiometer on transducer



Values in Configure Scaling Window



● Linear ○ Pulse

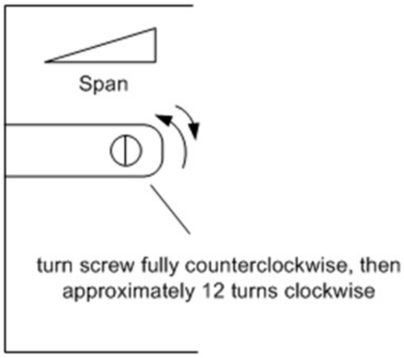
Note: Linear scaling is generally used with analog input, and pulse scaling with pulse input. This sensor measures analog input.

Scaling Parameters

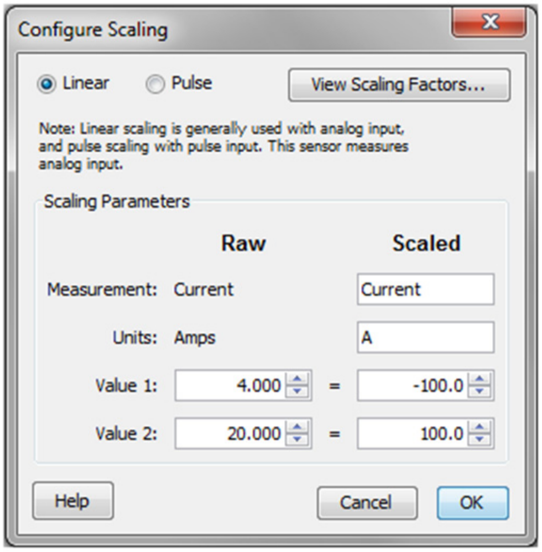
	Raw		Scaled
Measurement:	Current		Current
Units:	Amps		A
Value 1:	4.000	=	-20.0
Value 2:	20.000	=	20.0

0-100mA

Potentiometer on transducer



Values in Configure Scaling Window



● Linear ○ Pulse

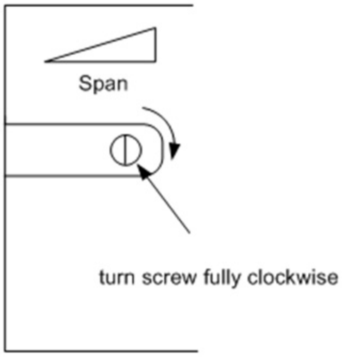
Note: Linear scaling is generally used with analog input, and pulse scaling with pulse input. This sensor measures analog input.

Scaling Parameters

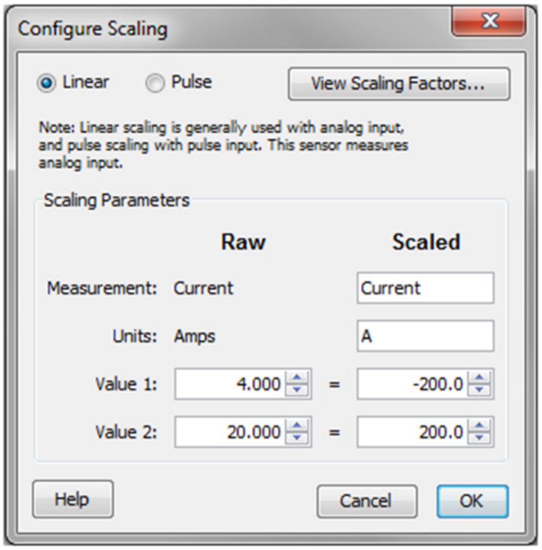
	Raw		Scaled
Measurement:	Current		Current
Units:	Amps		A
Value 1:	4.000	=	-100.0
Value 2:	20.000	=	100.0

0-200mA

Potentiometer on transducer



Values in Configure Scaling Window



● Linear ○ Pulse

Note: Linear scaling is generally used with analog input, and pulse scaling with pulse input. This sensor measures analog input.

Scaling Parameters

	Raw		Scaled
Measurement:	Current		Current
Units:	Amps		A
Value 1:	4.000	=	-200.0
Value 2:	20.000	=	200.0

Veris Scaling Factors: T-VER-PXU-L/T-VER-PXU-X

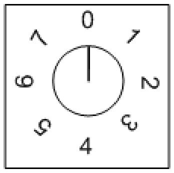
These Veris differential pressure transducers use Linear Scaling, mA or Volts -> "WC".

The analog output for these Veris sensors is determined by which screw terminals are connected either to a CABLE-4-20mA or to CABLE-ADAP5 or to CABLE-ADAP10. See the documentation that came with the hardware for details.

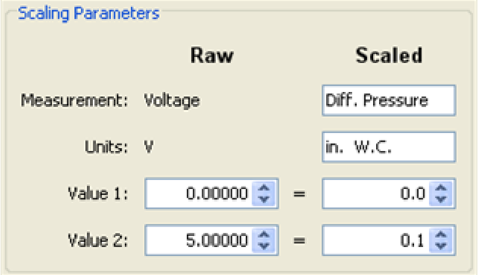
Both models have switch-selectable ranges and scales. The examples below show the scaling parameters you enter in the Configure Scaling window for the supported output ranges and raw values.

0 - 0.1 in. W.C.

Range Setting on Sensor



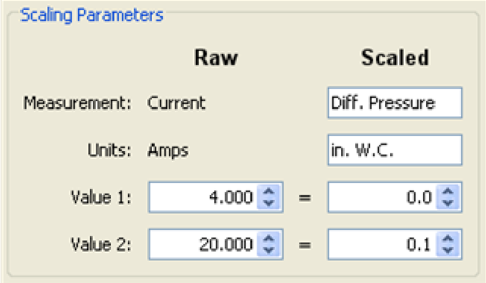
0 = 0 - 0.1 in. W.C.



Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	5.00000	=	0.1

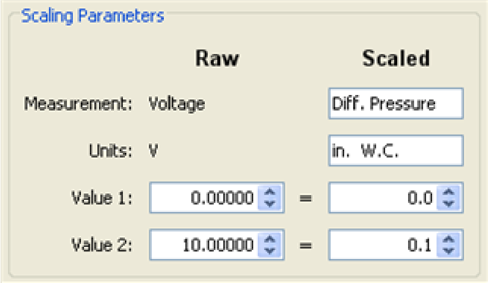
Voltage: 0 - 5 V



Scaling Parameters

	Raw		Scaled
Measurement:	Current		Diff. Pressure
Units:	Amps		in. W.C.
Value 1:	4.000	=	0.0
Value 2:	20.000	=	0.1

Current: 4 - 20mA



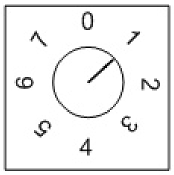
Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	10.00000	=	0.1

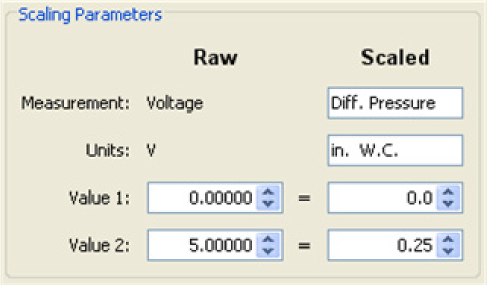
Voltage: 0 - 10 V

0 - 0.25 in. WC

Range Setting on Sensor



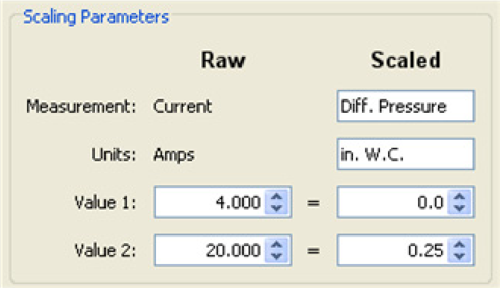
1 = 0 - 0.25 in. W.C.



Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	5.00000	=	0.25

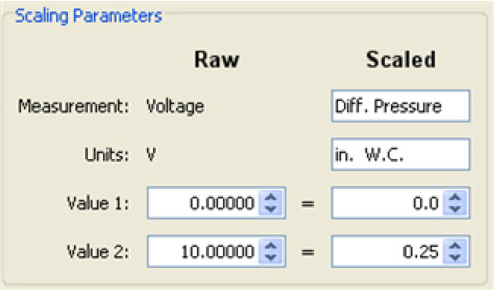
Voltage: 0 - 5 V



Scaling Parameters

	Raw		Scaled
Measurement:	Current		Diff. Pressure
Units:	Amps		in. W.C.
Value 1:	4.000	=	0.0
Value 2:	20.000	=	0.25

Current: 4 - 20mA



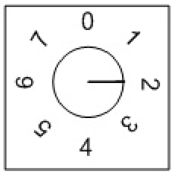
Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	10.00000	=	0.25

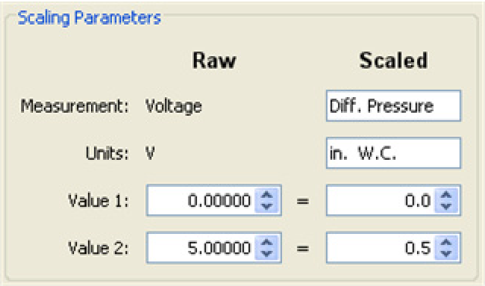
Voltage: 0 - 10 V

0 - 0.5 in. WC

Range Setting on Sensor



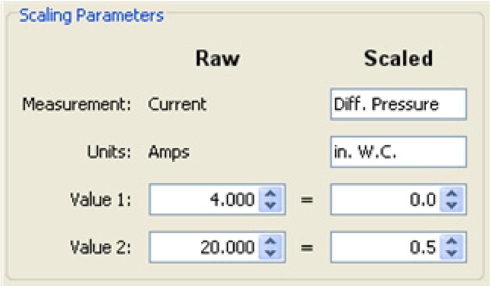
2 = 0 - 0.5 in. W.C.



Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	5.00000	=	0.5

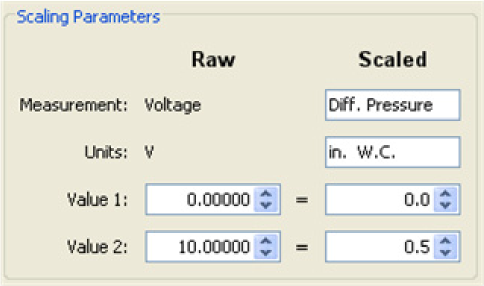
Voltage: 0 - 5 V



Scaling Parameters

	Raw		Scaled
Measurement:	Current		Diff. Pressure
Units:	Amps		in. W.C.
Value 1:	4.000	=	0.0
Value 2:	20.000	=	0.5

Current: 4 - 20mA



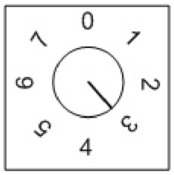
Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	10.00000	=	0.5

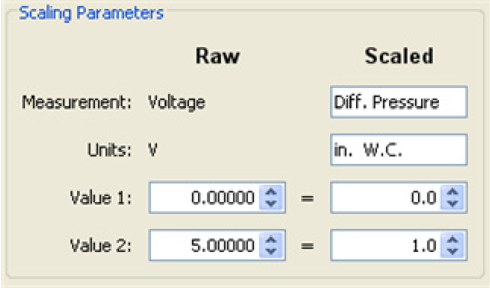
Voltage: 0 - 10 V

0 - 1.0 in. WC

Range Setting on sensor



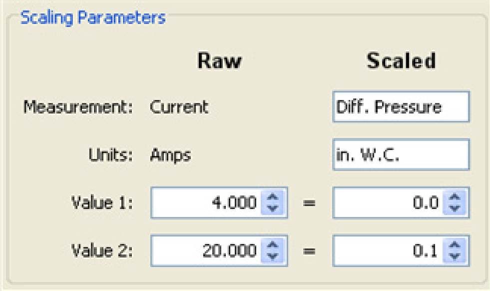
3 = 0 - 1.0 in W.C.



Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	5.00000	=	1.0

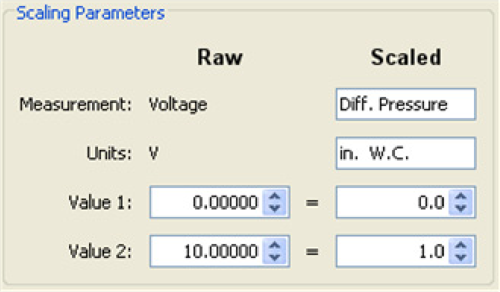
Voltage: 0 - 5 V



Scaling Parameters

	Raw		Scaled
Measurement:	Current		Diff. Pressure
Units:	Amps		in. W.C.
Value 1:	4.000	=	0.0
Value 2:	20.000	=	0.1

Current: 4 - 20mA



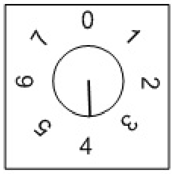
Scaling Parameters

	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	10.00000	=	1.0

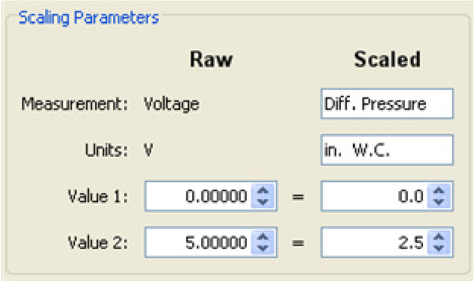
Voltage: 0 - 10 V

0 - 2.5 in. WC

Range Setting on sensor

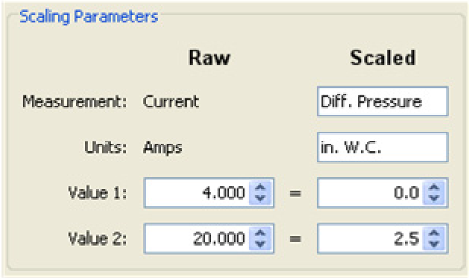


4 = 0 - 2.5 in. W.C.



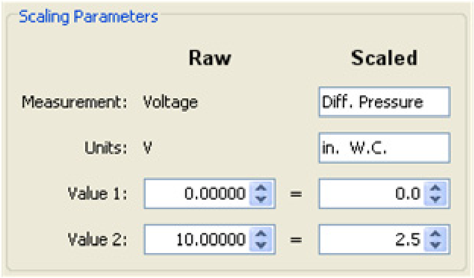
	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	5.00000	=	2.5

Voltage: 0 - 5 V



	Raw		Scaled
Measurement:	Current		Diff. Pressure
Units:	Amps		in. W.C.
Value 1:	4.000	=	0.0
Value 2:	20.000	=	2.5

Current: 4 - 20mA

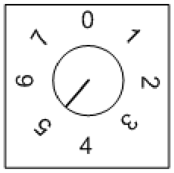


	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	10.00000	=	2.5

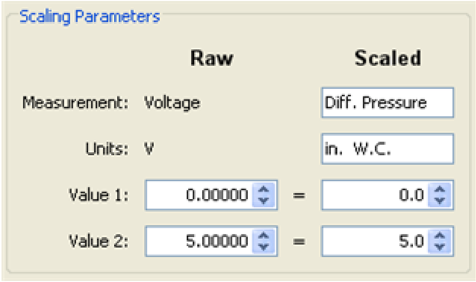
Voltage: 0 - 10 V

0 - 5.0 in. WC

Range Setting on sensor

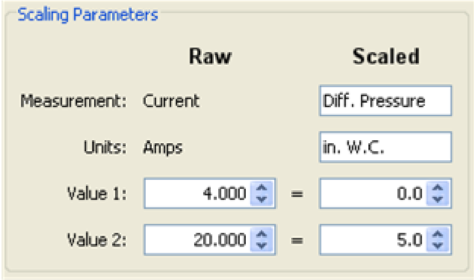


5 = 0 - 5.0 in. W.C.



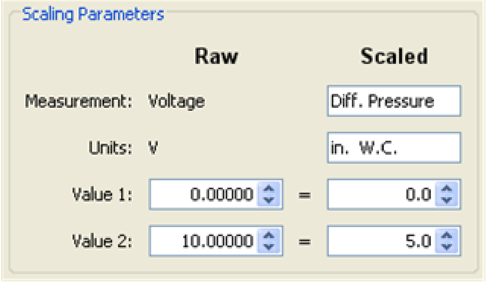
	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	5.00000	=	5.0

Voltage: 0 - 5 V



	Raw		Scaled
Measurement:	Current		Diff. Pressure
Units:	Amps		in. W.C.
Value 1:	4.000	=	0.0
Value 2:	20.000	=	5.0

Current: 4 - 20mA

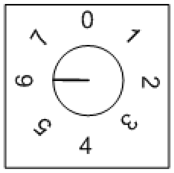


	Raw		Scaled
Measurement:	Voltage		Diff. Pressure
Units:	V		in. W.C.
Value 1:	0.00000	=	0.0
Value 2:	10.00000	=	5.0

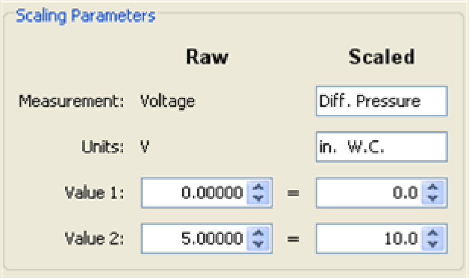
Voltage: 0 - 10 V

0 - 10.0 in. WC

Range Setting on sensor

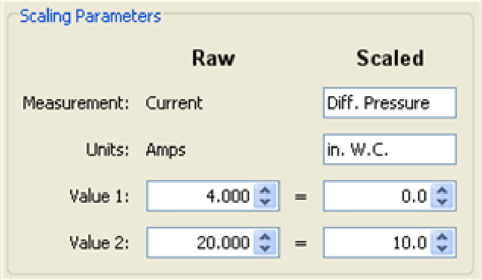


6 = 0 - 10.0 in. W.C.



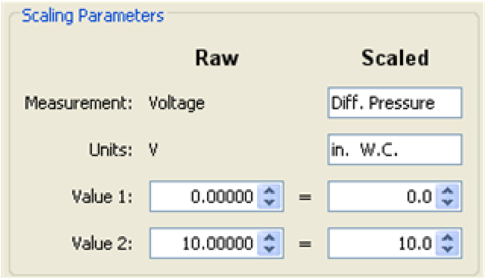
	Raw	Scaled
Measurement:	Voltage	Diff. Pressure
Units:	V	in. W.C.
Value 1:	0.00000	= 0.0
Value 2:	5.00000	= 10.0

Voltage: 0 - 5 V



	Raw	Scaled
Measurement:	Current	Diff. Pressure
Units:	Amps	in. W.C.
Value 1:	4.000	= 0.0
Value 2:	20.000	= 10.0

Current: 4 - 20mA



	Raw	Scaled
Measurement:	Voltage	Diff. Pressure
Units:	V	in. W.C.
Value 1:	0.00000	= 0.0
Value 2:	10.00000	= 10.0

Voltage: 0 - 10 V

Ion Scaling Factors: ION-TVOC

The ION-TVOC uses Linear Scaling, mA -> ppm.

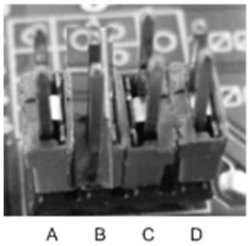
Cable Required/Sensor Type: CABLE-4-20mA

NOTES

- Requires Loop power of 22 mA. Lamp and electronics require 65 mA.
- An AC-DC power adapter with a minimum of 6W @ 35mA is required for excitation power.

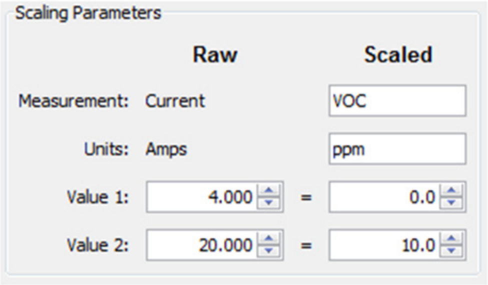
0-10 ppm

Hardware Setting



pin B removed = 10 ppm

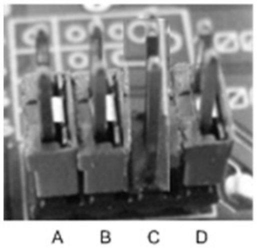
Configure Scaling values



	Raw	Scaled
Measurement:	Current	VOC
Units:	Amps	ppm
Value 1:	4.000	= 0.0
Value 2:	20.000	= 10.0

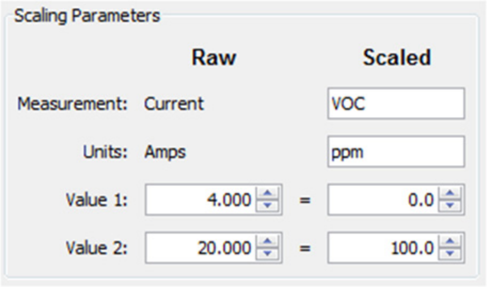
0-100 ppm

Hardware Setting



pin C removed = 100 ppm

Configure Scaling values

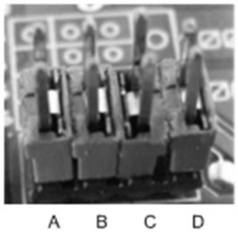


Scaling Parameters

	Raw		Scaled
Measurement:	Current		VOC
Units:	Amps		ppm
Value 1:	4.000	=	0.0
Value 2:	20.000	=	100.0

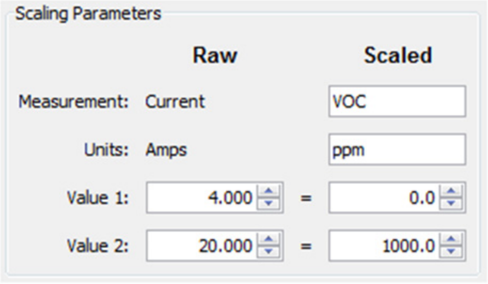
0-1000 ppm

Hardware Setting



all pins installed = 1000 ppm

Configure Scaling values



Scaling Parameters

	Raw		Scaled
Measurement:	Current		VOC
Units:	Amps		ppm
Value 1:	4.000	=	0.0
Value 2:	20.000	=	1000.0

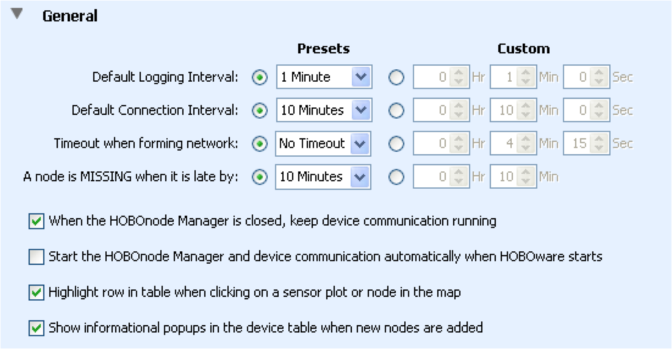
Setting HOBOnode Manager Preferences

You can change preferences for several features within HOBOnode Manager. You can access HOBOnode Manager preferences one of two ways:

- In HOBOware, select File > Preferences on Windows or HOBOware > Preferences on Macintosh and click Data Nodes.
- At the bottom of the HOBOnode Manager window, click the Actions button and select Edit HOBO Data Node Preferences.

General Preferences

The following general preferences are available:



General

	Presets	Custom
Default Logging Interval:	● 1 Minute	○ 0 Hr 1 Min 0 Sec
Default Connection Interval:	● 10 Minutes	○ 0 Hr 10 Min 0 Sec
Timeout when forming network:	● No Timeout	○ 0 Hr 4 Min 15 Sec
A node is MISSING when it is late by:	● 10 Minutes	○ 0 Hr 10 Min

☑ When the HOBOnode Manager is closed, keep device communication running

☐ Start the HOBOnode Manager and device communication automatically when HOBOware starts

☑ Highlight row in table when clicking on a sensor plot or node in the map

☑ Show informational popups in the device table when new nodes are added

- **Default Logging Interval.** This is how often data nodes will log data. The default is 1 minute.

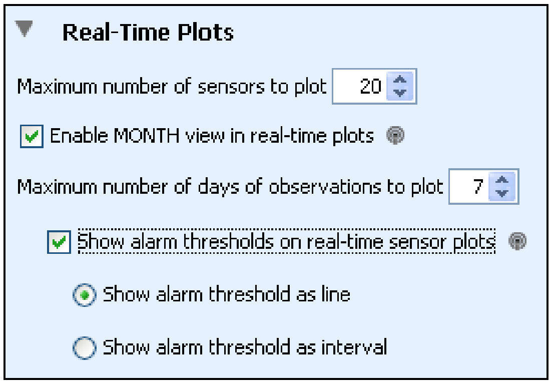
- **Default Connection Interval.** This is how often data nodes will send data to the receiver. The default is 10 minutes.
- **Timeout when forming network.** This is the amount of time that you can add a data node to the network after you click the Form Network button. By default, Form Network mode will remain active until you click the X on the Form Network progress indicator.
- **A node is MISSING when it is late by.** This is how long a node must go without sending data to HOBOnode Manager for it to be marked as missing. When a data node is missing, its status in the Device Table will be MISSING, and a MISSING NODE alarm will be tripped (if configured). The default is 10 minutes.
- **When the HOBOnode Manager is closed, keep device communication running.** This controls whether device communication automatically remains running when you exit HOBOnode Manager. The default is to keep it running.
- **Start the HOBOnode Manager and device communication automatically when HOBOware starts.** This controls whether HOBOnode Manager and the device communication automatically starts immediately upon opening HOBOware. The default is to not automatically open HOBOnode Manager and the device communication when HOBOware is opened.
- **Highlight row in table when clicking on a sensor or data node in the map.** This controls whether the corresponding row in the device table is automatically highlighted when you select a device in the HOBOnode Manager map. This is enabled by default.
- **Show informational popups in the device table when new nodes are added.** This controls whether a message is displayed every time a new device is added to the device table. This is enabled by default.

Alarms Preferences

See Setting Alarms Preferences.

Real-Time Plots Preferences

You can customize the plots that appear in HOBOnode Manager by increasing the number of sensors you can plot at one time, adding the ability to view monthly data, displaying alarm thresholds, and more. These preferences are specific to real-time plots only. See Plotting Preferences for details on how to change general plot appearance, such as changing font type and size, adding gridlines, or modifying axis details.



Real-Time Plots

Maximum number of sensors to plot: 20

☑ Enable MONTH view in real-time plots

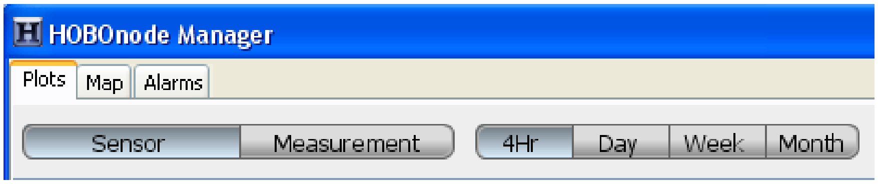
Maximum number of days of observations to plot: 7

☑ Show alarm thresholds on real-time sensor plots

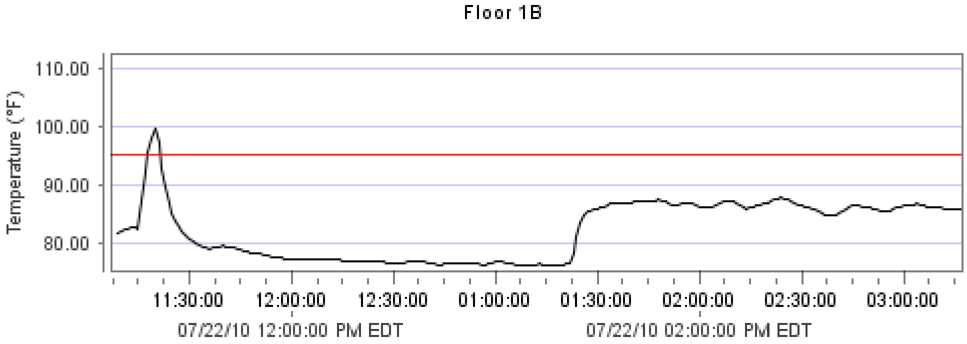
● Show alarm threshold as line

○ Show alarm threshold as interval

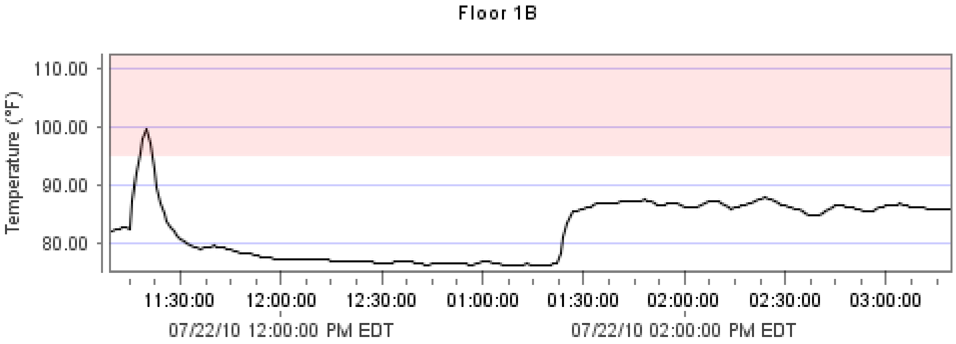
- Maximum number of sensors to plot. Select how many data node sensors you want to be able to plot at one time within HOBOnode Manager. You can select from 1 sensor to 100, with a default of 20.
- Enable MONTH view in real-time plots. Select this checkbox to add a Month button to the Plots tab in HOBOnode Manager. You can then plot data by hour (4 hours), day, week, or month. The Month view is disabled by default.



- Maximum number of days of observations to plot. Select how many days worth of data you want to view in the plot, up to 31. The default is 7 days.
- Show alarm thresholds on real-time sensor plots. Select this checkbox to add a visual indicator, or reference point, when a sensor alarm has tripped.
    - Select Show alarm threshold as line to display the alarm threshold on the real time plots as a horizontal line. An example of this type of reference point is the red line in the following plot where an alarm was configured to trip at above 95 degrees Fahrenheit.



    - Select Show alarm threshold as interval to display the alarm threshold as a shaded area: red when the alarm is above the specified threshold and blue when it is below. Using the same example, there is a red shaded area from above 95 degrees on the following plot instead of a single red line.



Data Storage

This lists the current location of the HOBOnode Manager database. For more information, see Data Storage Location.

Sharing

This provides options for sharing HOBOnode Manager data via HOBOnode Viewer or automatic data delivery. See Enabling HOBOnode Viewer and Setting up Data Delivery.

Working with HOBOnode Manager Data

There are several ways you can analyze data gathered in HOBOnode Manager. In addition to the viewing the real-time plots and information in the Device Table, you can:

- Plot or export data for use in HOBOware or external programs
- Set up groups to organize data
- Set up a HOBOnode Viewer web page for viewing on a local area network
- Automatically send data to others via email or FTP, or save it to a computer on a local area network

Plotting or Exporting Wireless Data

With HOBOnode Manager, you can view data and plots from your HOBO data node wireless network in real time, but you also have the ability to plot or export previously logged data. Using the Plot/Export Wireless Data capability, you can plot data directly in HOBOware or you can export it to a text or .csv file to open in another program for further analysis. You can pinpoint the exact data you wish to plot or export, allowing you to view data from:

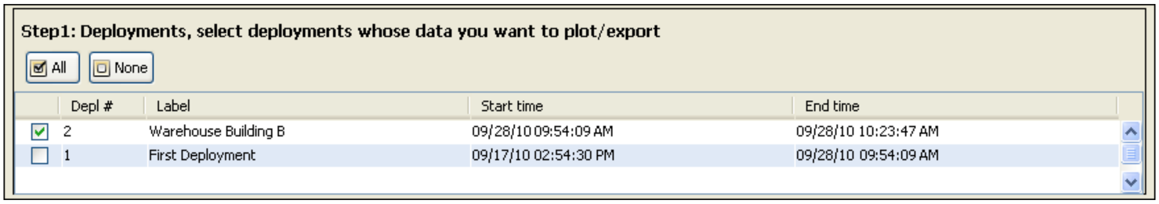
- Current and/or previous network deployments,
- Specific data nodes,
- A subset of certain sensors from selected data nodes,
- Groups of data nodes as configured in HOBOnode Manager, and
- A specific date range or timeframe.

In addition, you can save frequently used settings for quick plotting and exporting in the future and for use with data delivery, which allows you to share data automatically via email, FTP, or saved to a drive on a regular schedule.

To open the Plot/Export Wireless Data tool, click the Plot/Export Data button in HOBOnode Manager (or from the File menu in HOBOware, select Plot/Export Wireless Data).

To use the Plot/Export Wireless Data tool:

1. Select the deployment that contains the data you wish to plot or export.

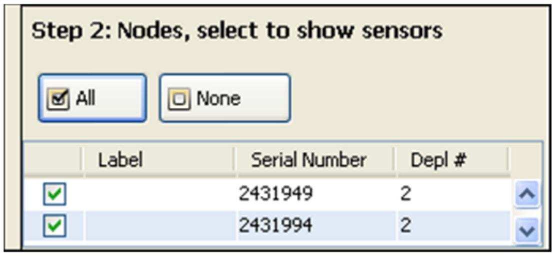


Step1: Deployments, select deployments whose data you want to plot/export

☑ All ☐ None

	Depl #	Label	Start time	End time
☑	2	Warehouse Building B	09/28/10 09:54:09 AM	09/28/10 10:23:47 AM
☐	1	First Deployment	09/17/10 02:54:30 PM	09/28/10 09:54:09 AM

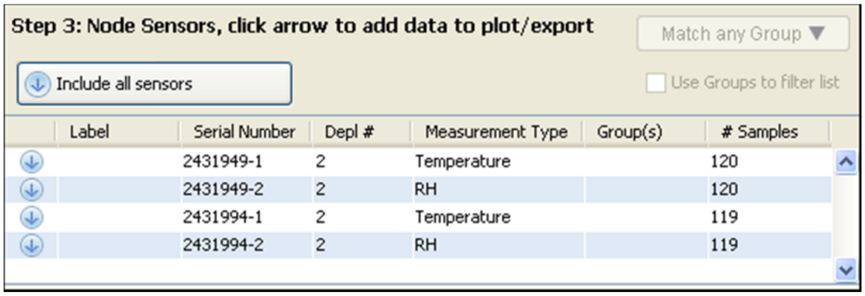
2. Select the data nodes with the sensors whose data you wish to plot or export.



Step 2: Nodes, select to show sensors

	Label	Serial Number	Depl #
☑		2431949	2
☑		2431994	2

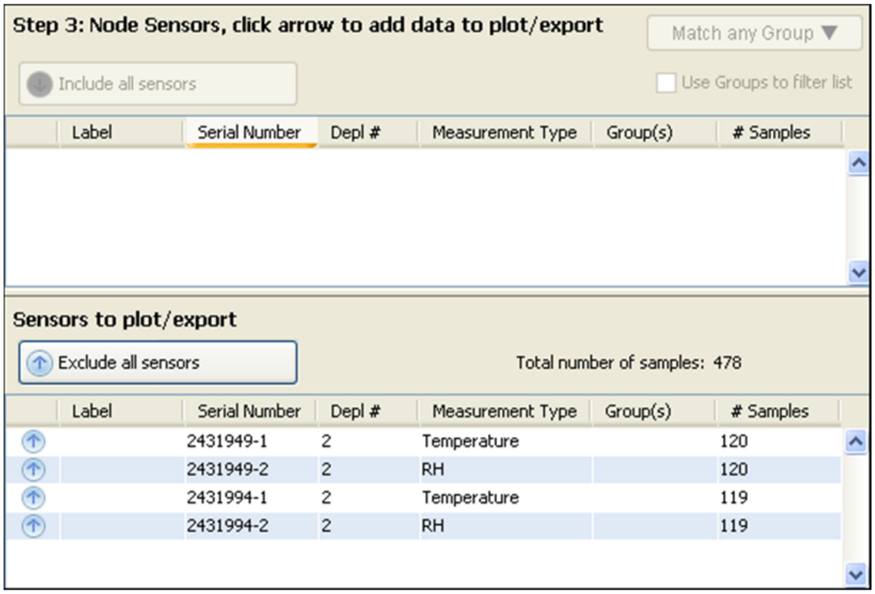
3. Each sensor for the data node that you selected in Step 2 will appear in a list as shown below. Click the down arrow icon for each sensor you wish to plot or export, or click the Include All Sensors button if you want to plot or export data from all sensors in the list. **Note:** If you have set up groups in HOBOnode Manager, you can also sort and select sensors within those groups. See Using Groups in the Plot/Export window.



Step 3: Node Sensors, click arrow to add data to plot/export

	Label	Serial Number	Depl #	Measurement Type	Group(s)	# Samples
↓		2431949-1	2	Temperature		120
↓		2431949-2	2	RH		120
↓		2431994-1	2	Temperature		119
↓		2431994-2	2	RH		119

The sensors that you selected will move from the top half of the Step 3 pane to the bottom half as shown below. In this example, all sensors were included and are now shown in the "Sensors to plot/export" list. If you wish to make changes, you can either click the up arrow icon remove a specific sensor from the list, or click the Exclude all sensors button to move all the sensors back to the top (you'll then need to select the sensors you wish to plot or export again).



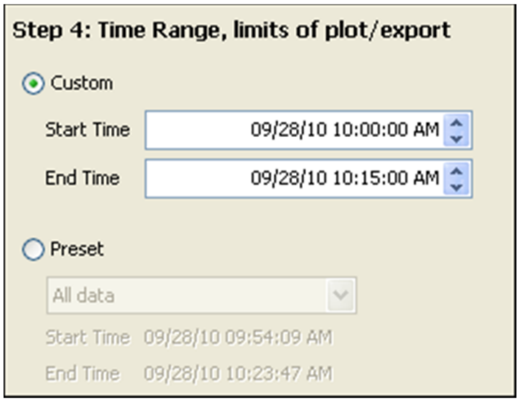
Step 3: Node Sensors, click arrow to add data to plot/export

Sensors to plot/export

Total number of samples: 478

	Label	Serial Number	Depl #	Measurement Type	Group(s)	# Samples
↑		2431949-1	2	Temperature		120
↑		2431949-2	2	RH		120
↑		2431994-1	2	Temperature		119
↑		2431994-2	2	RH		119

4. Choose the time range for the data you wish to plot or export. Select Custom and specify your own start and end time, or select Preset and choose one of several pre-defined ranges from the drop-down list.



Step 4: Time Range, limits of plot/export

● Custom

Start Time 09/28/10 10:00:00 AM

End Time 09/28/10 10:15:00 AM

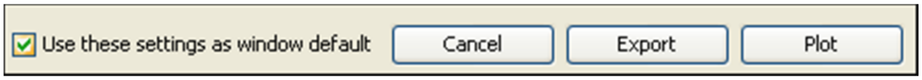
○ Preset

All data

Start Time 09/28/10 09:54:09 AM

End Time 09/28/10 10:23:47 AM

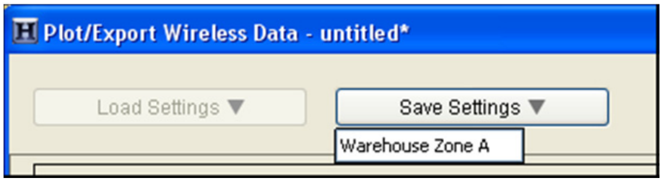
5. Once you have all the settings selected, click the Export or Plot button. Clicking the Export button will open the Export window. Clicking the Plot button opens the Plot Setup window, where you can select the series that will appear in the graph in HOBOware.



☑ Use these settings as window default

Notes:

- If you want the current settings to always appear in the Plot/Export Wireless Data window, then select the "Use these settings as window default" checkbox.
- You can save different combinations of settings to a configuration file in the Plot/Export Wireless Data window for future use, or for use by the data delivery feature. Click the Save Settings button, type a name, and press Enter. Then click the Load Settings button and choose the configuration file you wish to use for the current plot or export.

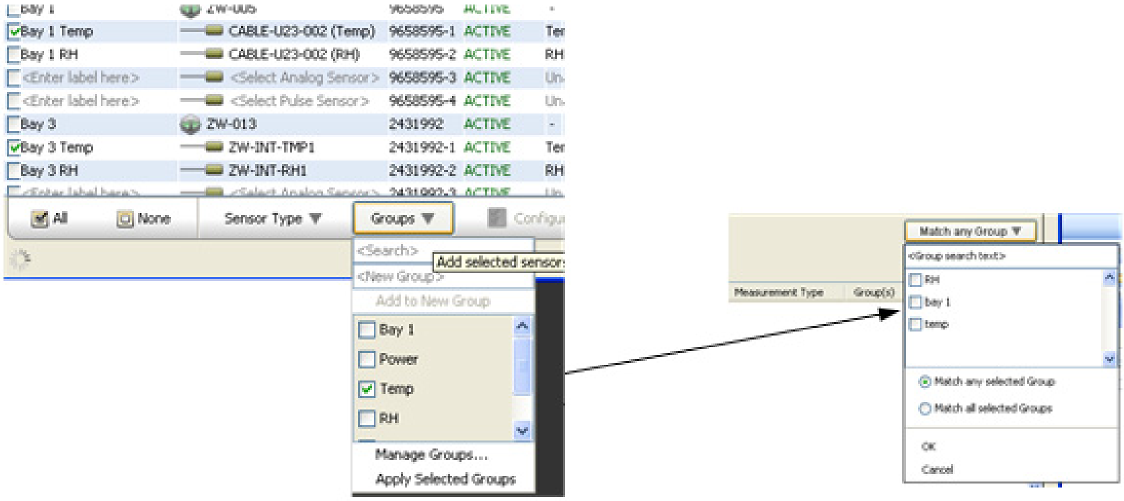


Plot/Export Wireless Data - untitled*

Warehouse Zone A

Using Groups to Sort Sensors

You can assign sensors to groups in the Device Table and then use them to sort rows in the table, or to refine a list of sensors in the Plot/Export Wireless Data window.



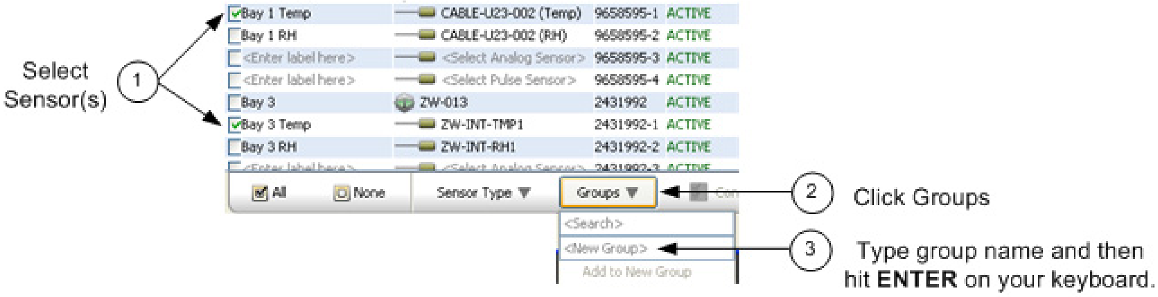
☐ Bay 1	ZW-005	9658595	ACTIVE	-
☑ Bay 1 Temp	CABLE-U23-002 (Temp)	9658595-1	ACTIVE	Ter
☐ Bay 1 RH	CABLE-U23-002 (RH)	9658595-2	ACTIVE	RH
☐ <Enter label here>	<Select Analog Sensor>	9658595-3	ACTIVE	Un
☐ <Enter label here>	<Select Pulse Sensor>	9658595-4	ACTIVE	Un
☐ Bay 3	ZW-013	2431992	ACTIVE	-
☑ Bay 3 Temp	ZW-INT-TMP1	2431992-1	ACTIVE	Ter
☐ Bay 3 RH	ZW-INT-RH1	2431992-2	ACTIVE	RH

Apply Groups in the Device Table

Use Groups sort sensors in the Plot/Export Data Window

Creating Groups and Adding Sensors

1. In the Device Table, select the sensor(s) you want to add to a group.
2. Click Groups.
3. In the <New Group> box, enter a name for the group and press Enter.



☑ Bay 1 Temp	CABLE-U23-002 (Temp)	9658595-1	ACTIVE
☐ Bay 1 RH	CABLE-U23-002 (RH)	9658595-2	ACTIVE
☐ <Enter label here>	<Select Analog Sensor>	9658595-3	ACTIVE
☐ <Enter label here>	<Select Pulse Sensor>	9658595-4	ACTIVE
☐ Bay 3	ZW-013	2431992	ACTIVE
☑ Bay 3 Temp	ZW-INT-TMP1	2431992-1	ACTIVE
☐ Bay 3 RH	ZW-INT-RH1	2431992-2	ACTIVE

① Select Sensor(s)

② Click Groups

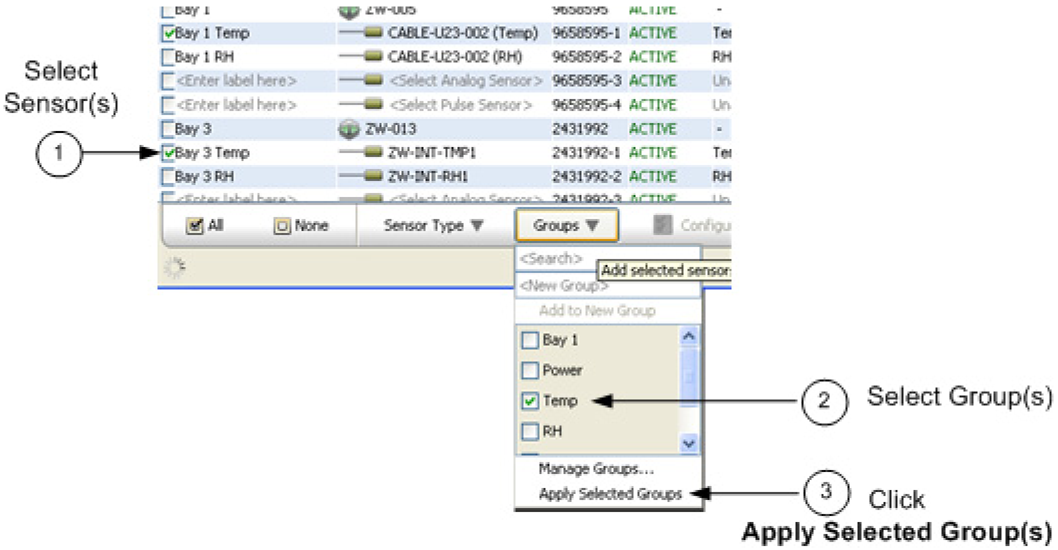
③ Type group name and then hit **ENTER** on your keyboard.

The Group Name appears in the table for each sensor selected.

Adding Sensors to a Group

To add a sensor to an existing group:

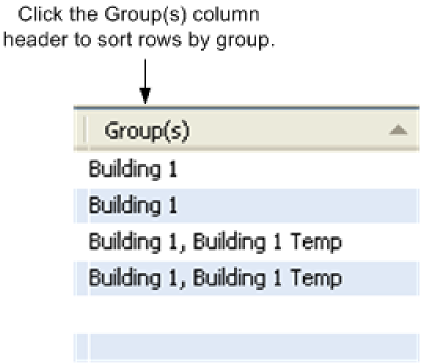
1. Select the sensor(s).
2. Click **Groups**.
3. Check desired groups(s).
4. Click Apply Selected Groups.



See Using Groups in the Plot/Export Data Window.

Sorting by Group

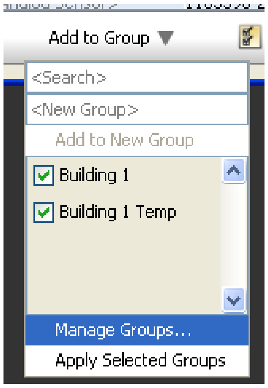
Click the Group(s) column header to sort rows by groups.



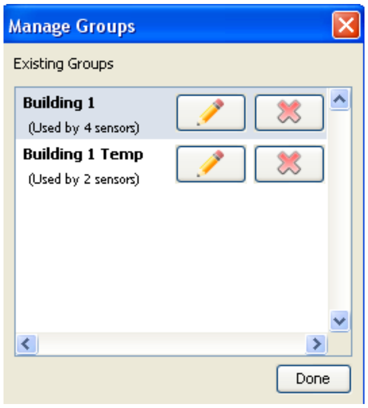
Group(s)
Building 1
Building 1
Building 1, Building 1 Temp
Building 1, Building 1 Temp

Deleting or Renaming a Group

Select Manage Groups from the Groups drop-down.



The Manage Groups window appears.

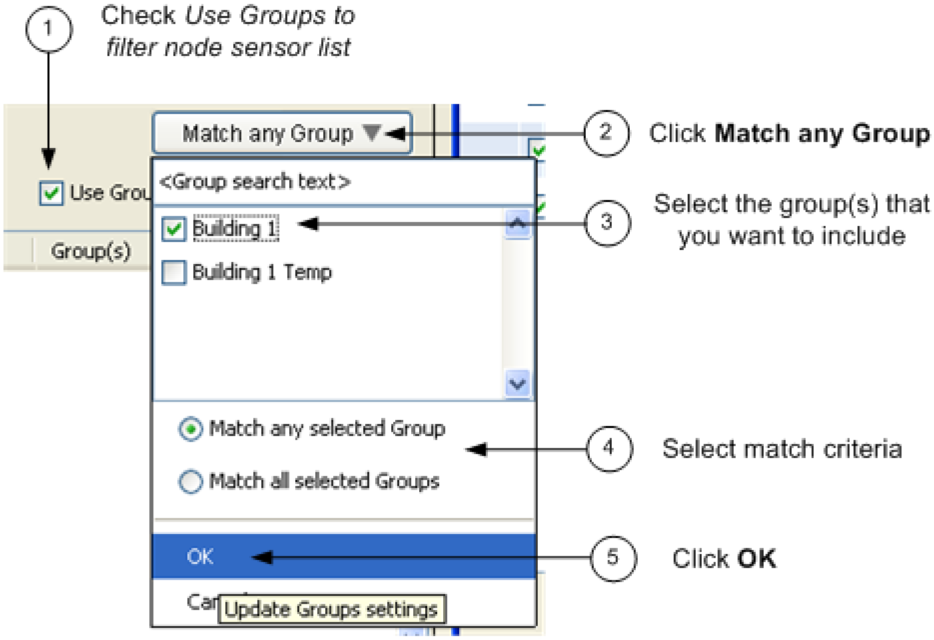


- To change the name of the group click the Edit icon and enter the new name.
- To delete a group, click the X.

Using Groups in the Plot/Export Wireless Data Window

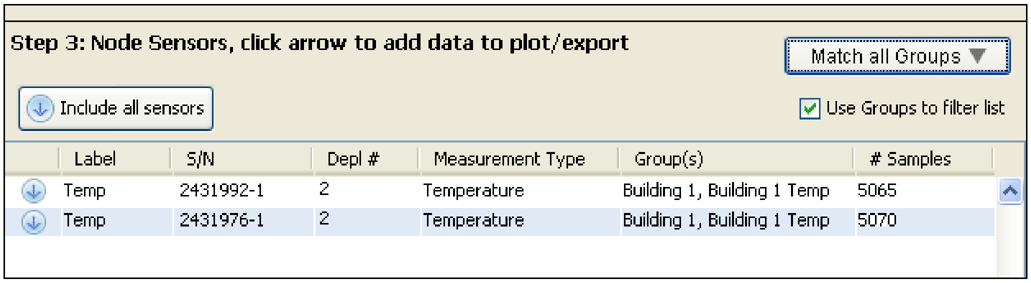
Once you have set up groups in the Device Table, you can use them to refine the list of available sensors in the Plot/Export Wireless Data window.

To set up groups, see Using Groups to Sort Sensors.



1. Check the "Use Groups to filter list" box.
2. Click the Match any Group button.
3. Select Groups. Select the groups you want to include in the list.
4. Select the Match Criteria. Select "Match any selected Group" and any sensors that are a member of any of the groups selected will appear. Select "Match all selected Groups" and only sensors that are a member of all of the groups selected will appear.
5. Select **OK**.

Only the sensors that match the group criteria will appear in the Node Sensors list.

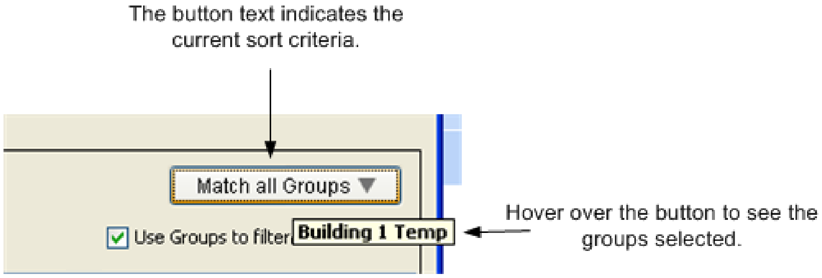


Step 3: Node Sensors, click arrow to add data to plot/export

☑ Use Groups to filter list

	Label	S/N	Depl #	Measurement Type	Group(s)	# Samples
↓	Temp	2431992-1	2	Temperature	Building 1, Building 1 Temp	5065
↓	Temp	2431976-1	2	Temperature	Building 1, Building 1 Temp	5070

Viewing Current Sort Criteria



The button text indicates the current sort criteria.

Hover over the button to see the groups selected.

Enabling HOBOnode Viewer

You can view plots and data from your HOBO data node network on your local area network with HOBOnode Viewer. While HOBOnode Manager requires a direct connection on a dedicated PC to monitor your network, HOBOnode Viewer gives you the flexibility to see data node plots and network status anywhere. This allows you to:

- Look at real-time data from your local area network with any browser
- Check on the data node network remotely to make sure it is running properly and that no devices are missing or alarms have tripped
- Share data with others by sending them a link to HOBOnode Viewer

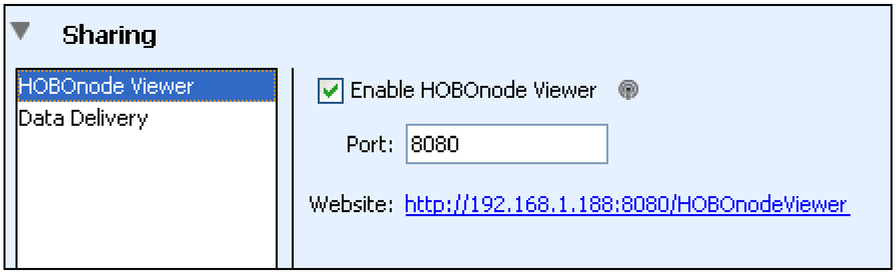
HOBOnode Viewer is a locally hosted website easily configured within HOBOware preferences. Once HOBOnode Viewer is enabled, HOBOware will create a link for your own web page that displays the real-time plots and data for your data node network. The HOBOnode Viewer web page will always be available as long as HOBOnode Manager remains open on the computer with your HOBOnode database.

To access HOBOnode Viewer, you must first enable that feature within HOBOware preferences on the computer running a data node network. This will create a link to a HOBOnode Viewer web page that you can use and share with others. If you have not already set up a data node network using HOBOnode Manager, you must do that first and then you will be able to activate HOBOnode Viewer from the same computer.

Windows note: If Windows Firewall is enabled on your computer, you may need to adjust the security settings to allow access to HOBOware before enabling HOBOnode Viewer. To check this, open Control Panel, go to Security, and select Allow a program through Windows Firewall (or click Windows Firewall and click the Exceptions tab on some versions of Windows). Make sure HOBOware is selected in the allowed access/exceptions list. Note that you must be administrator to make these changes.

To enable HOBOnode Viewer:

1. Open the preferences for data nodes. From HOBOnode Manager, click the Actions button and select Edit HOBO Data Node Preferences. Or, to access preferences within HOBOware, select File > Preferences on Windows or HOBOware > Preferences on Macintosh and click Data Nodes.
2. Click Sharing within the Data Nodes preferences, and then click HOBOnode Viewer.
3. Select the Enable HOBOnode Viewer checkbox.



☑ Enable HOBOnode Viewer

Port: 8080

Website: http://192.168.1.188:8080/HOBOnodeViewer

4. By default, the port number assigned for HOBOnode Viewer is 8080. You may use this one or change it to any other available port. In most cases, the default 8080 port number will be available. However, if this number is already in use by another web service application on the same computer, then you can change it to any other available port. There are 0 to 65,535 ports. Port numbers 0 to 1023 are restricted ports reserved for use by system services, such as FTP, Telnet, and HTTP. You may use any other available port number from 1024 to 65,535 for HOBOnode Viewer.
5. Click OK in preferences and then restart HOBOnode Manager (close HOBOnode Manager and then from the Device menu in HOBOware, select Manage HOBO Data Node Network to reopen it). HOBOnode Viewer will not be fully enabled until you restart HOBOnode Manager.
6. After HOBOnode Manager has restarted, return to the HOBOnode Viewer preferences. Click the link, or URL, to go to your HOBOnode Viewer web page.

The URL has the following structure:

htttp://<IP address>:<port number>/HOBOnodeViewer

where <IP address> is the IP address for the computer where your data node network is running and <port number> is the port assigned for the HOBOnode Viewer in preferences.

To share the URL with others, click the link and then copy the URL from your browser and paste it an email message to send to others who would like to view your data node network.

Note: HOBOnode Viewer is only available while HOBOnode Manager is running. If you close HOBOnode Manager and then attempt to access HOBOnode Viewer, the web page will not open. Also note that the HOBOnode Viewer will not be available outside your local area network unless you expose that computer outside of the network. Contact your IT department if you would like to expose the HOBOnode Viewer.

To disable HOBOnode Viewer:

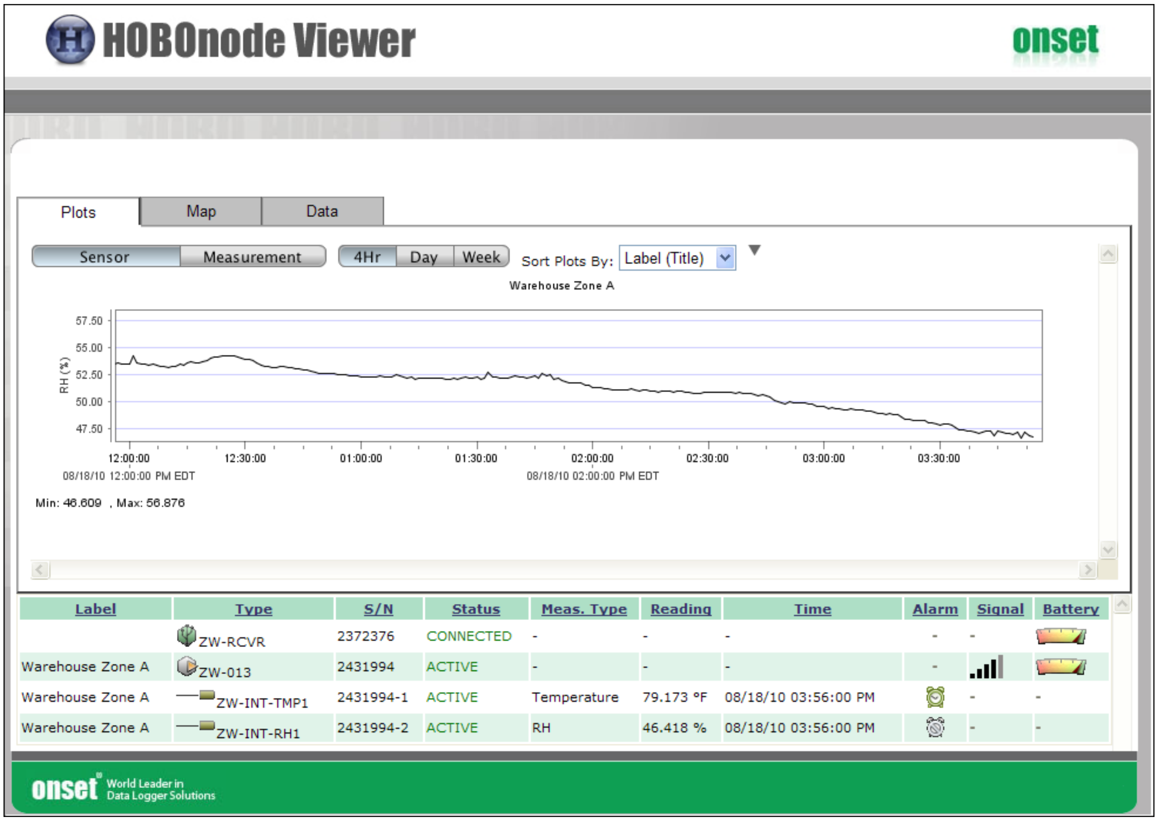
1. Open the preferences for data nodes. From HOBOnode Manager, click the Actions button and select Edit HOBO Data Node Preferences. Or, to access preferences within HOBOware, select File > Preferences on Windows or HOBOware > Preferences on Macintosh and click Data Nodes.
2. Click Sharing within the Data Nodes preferences, and then click HOBOnode Viewer.
3. Deselect the Enable HOBOnode Viewer checkbox.
4. Click OK in preferences and restart HOBOnode Manager.

Using HOBOnode Viewer

Many of the elements in HOBOnode Viewer are the same as HOBOnode Manager. Specifically, you can do the following with HOBOnode Viewer just as you would with HOBOnode Manager:

- Organize plots by sensor or by measurement type
- View plot data hourly, by day, by week, or by month (the month view must be enabled in the preferences for real-time plots)
- Sort the plots several ways, including by serial number, current reading, and alarm state

- View a map of your network devices
- Check the device table for details on each device in your network
- Change the device table view by sorting the columns

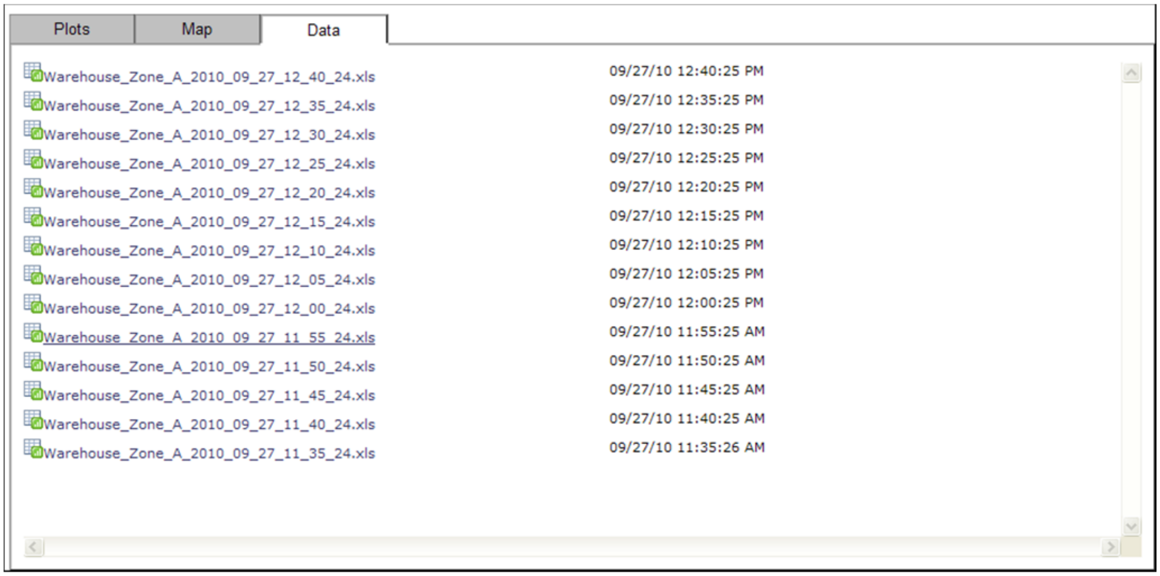


Min: 46.609 , Max: 56.876

Label	Type	S/N	Status	Meas. Type	Reading	Time	Alarm	Signal	Battery
	ZW-RCVR	2372376	CONNECTED	-	-	-	-	-	🔋
Warehouse Zone A	ZW-013	2431994	ACTIVE	-	-	-	-	📶	🔋
Warehouse Zone A	ZW-INT-TMP1	2431994-1	ACTIVE	Temperature	79.173 °F	08/18/10 03:56:00 PM	⏰	-	-
Warehouse Zone A	ZW-INT-RH1	2431994-2	ACTIVE	RH	46.418 %	08/18/10 03:56:00 PM	⏰	-	-

There are, however, some key differences between HOBOnode Manager and HOBOnode Viewer.

- HOBOnode Viewer, as its name implies, is a viewer only. Any changes you wish to make to your network, including updates to alarms or modifications to the map, need to be done directly in HOBOnode Manager.
- With HOBOnode Manager, you can see all available sensor channels on all devices, including those without a sensor type selected. HOBOnode Viewer displays enabled sensor channels only. If a device in HOBOnode Manager has a channel listed as "OFF," then that channel will not appear in HOBOnode viewer.
- There may be some minor differences in plot appearance if you are comparing the plots in HOBOnode Viewer to HOBOnode Manager. In general, plots are nearly identical, but there could be slight differences in scaling.
- If you set up data delivery and chose to have files saved to your computer or a network drive, then a Data tab will be visible in HOBOnode Viewer with a list of all files delivered through that service as shown below. Click a file name to open or save the file.



Warehouse_Zone_A_2010_09_27_12_40_24.xls	09/27/10 12:40:25 PM
Warehouse_Zone_A_2010_09_27_12_35_24.xls	09/27/10 12:35:25 PM
Warehouse_Zone_A_2010_09_27_12_30_24.xls	09/27/10 12:30:25 PM
Warehouse_Zone_A_2010_09_27_12_25_24.xls	09/27/10 12:25:25 PM
Warehouse_Zone_A_2010_09_27_12_20_24.xls	09/27/10 12:20:25 PM
Warehouse_Zone_A_2010_09_27_12_15_24.xls	09/27/10 12:15:25 PM
Warehouse_Zone_A_2010_09_27_12_10_24.xls	09/27/10 12:10:25 PM
Warehouse_Zone_A_2010_09_27_12_05_24.xls	09/27/10 12:05:25 PM
Warehouse_Zone_A_2010_09_27_12_00_24.xls	09/27/10 12:00:25 PM
Warehouse_Zone_A_2010_09_27_11_55_24.xls	09/27/10 11:55:25 AM
Warehouse_Zone_A_2010_09_27_11_50_24.xls	09/27/10 11:50:25 AM
Warehouse_Zone_A_2010_09_27_11_45_24.xls	09/27/10 11:45:25 AM
Warehouse_Zone_A_2010_09_27_11_40_24.xls	09/27/10 11:40:25 AM
Warehouse_Zone_A_2010_09_27_11_35_24.xls	09/27/10 11:35:26 AM

Note: If you change the file directory location in the data delivery settings, then you must restart HOBOnode Manager before you can access the files from the Data tab in HOBOnode Viewer.

Any changes you make to your network with HOBOnode Manager will be reflected in the HOBOnode Viewer upon the next refresh, or update. HOBOnode Viewer refreshes every 30 seconds. You can also use your browser's refresh feature if you want to see a change immediately.

Important: HOBOnode Viewer is only available while HOBOnode Manager is running. If you close HOBOnode Manager and then attempt to access HOBOnode Viewer, the web page will not open. Always keep HOBOnode Manager running to ensure anyone accessing HOBOnode Viewer can see the real-time plots and data.

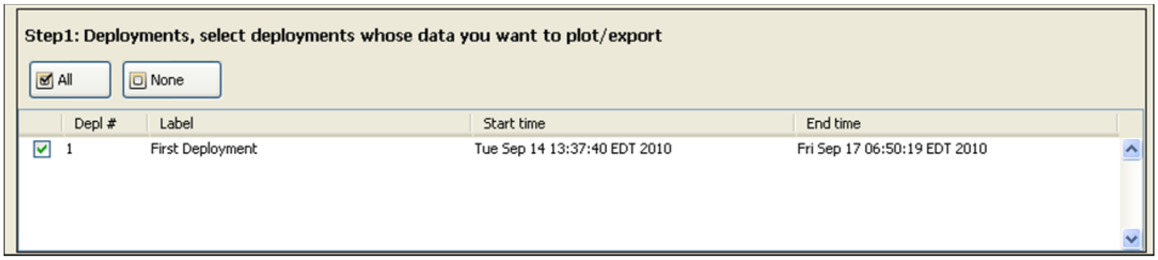
Setting up Data Delivery

With data delivery, you can automatically save recorded sensor data from nodes in your network to a single .txt, .csv, or .xls file on a regular schedule. This allows you to:

- Store data from your current data node network deployment for future reference and analysis,
- Access data remotely when you are away from the network, and
- Share data with others in a file that is distributed automatically via FTP or email, or saved to a computer or network drive.

Before you can set up data delivery, you must first select which nodes and sensors you wish to include in the file by saving the configuration settings. To do this:

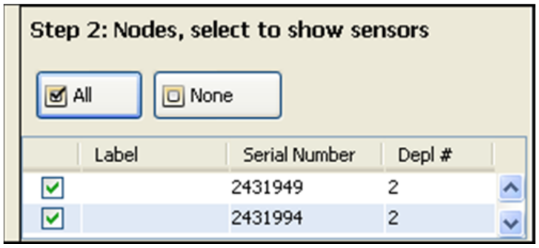
1. From HOBOnode Manager, click the Plot/Export Data button.
2. Select the deployment name from the list.



Step1: Deployments, select deployments whose data you want to plot/export

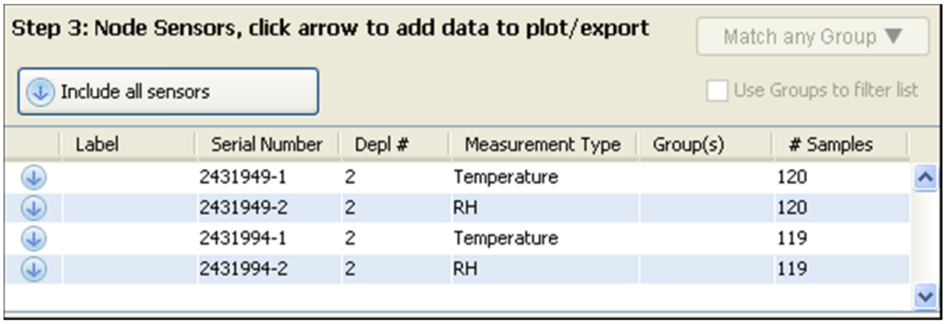
	Depl #	Label	Start time	End time
☑	1	First Deployment	Tue Sep 14 13:37:40 EDT 2010	Fri Sep 17 06:50:19 EDT 2010

3. Select the individual nodes you would like to include in the file or click the All button to select all nodes.



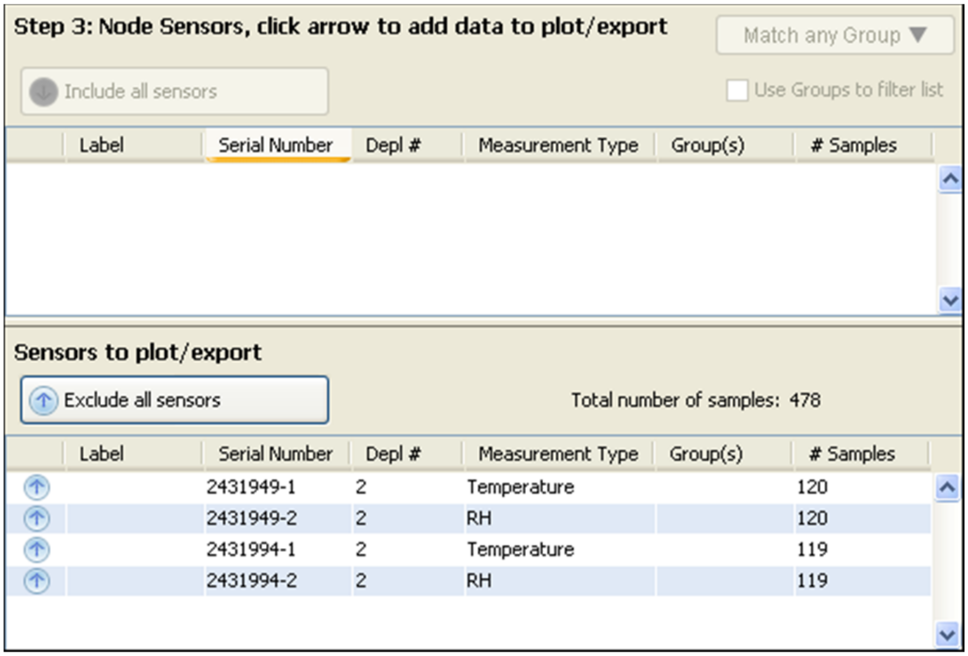
	Label	Serial Number	Depl #
☑		2431949	2
☑		2431994	2

4. Select the sensors you would like to include in the file or click the Include all sensors button.



	Label	Serial Number	Depl #	Measurement Type	Group(s)	# Samples
↓		2431949-1	2	Temperature		120
↓		2431949-2	2	RH		120
↓		2431994-1	2	Temperature		119
↓		2431994-2	2	RH		119

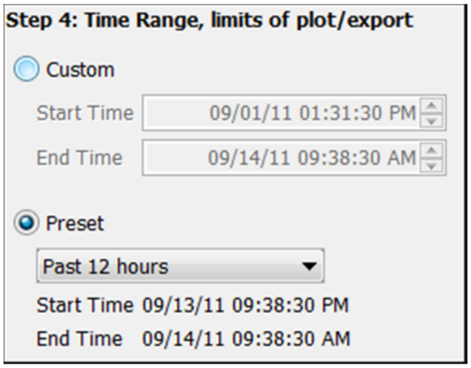
5. Make sure all the sensors you wish to share in your datafile appear in the Sensors to plot/export list.



Total number of samples: 478

	Label	Serial Number	Depl #	Measurement Type	Group(s)	# Samples
↑		2431949-1	2	Temperature		120
↑		2431949-2	2	RH		120
↑		2431994-1	2	Temperature		119
↑		2431994-2	2	RH		119

6. Select Preset and choose a preset time range to determine how much data will be exported each time data delivery runs. In this example, we chose "Past 12 hours," which means only data from the past 12 hours will be exported via data delivery. The most recent 12 hours worth of data is shown for reference. **Note**: Do not choose a custom time range. This is for immediate exports only. If you choose a custom time range for data delivery, then data from that custom time-range only will be exported every time data delivery runs.



Step 4: Time Range, limits of plot/export

○ Custom

Start Time 09/01/11 01:31:30 PM

End Time 09/14/11 09:38:30 AM

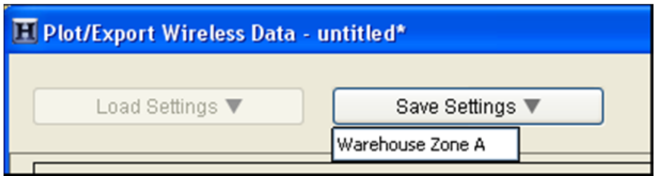
● Preset

Past 12 hours

Start Time 09/13/11 09:38:30 PM

End Time 09/14/11 09:38:30 AM

7. Click the Save Settings button and type a name, which will also be used for the data delivery file name, and press Enter. Your configuration settings will be saved.

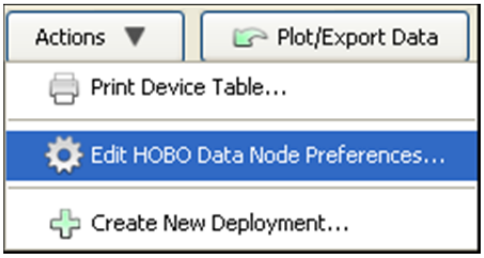


Warehouse Zone A

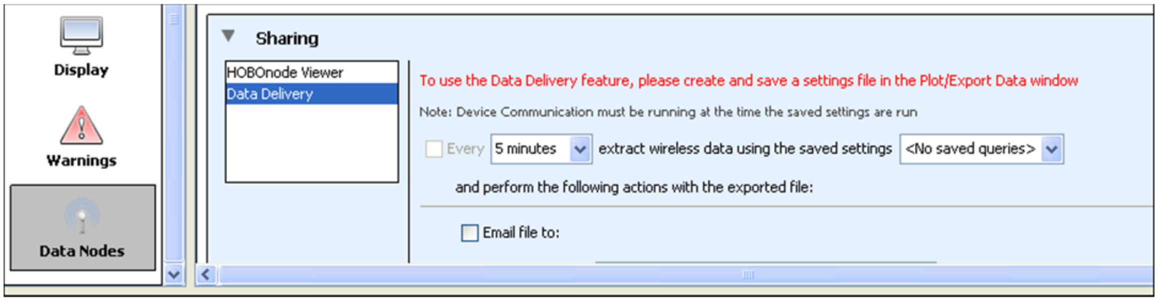
After you have selected the sensors you wish to include in the shared data file, you can then set up data delivery within Preferences.

To do this:

1. Open HOBOnode Manager.
2. Click the Actions button and select Edit HOBO Data Node Preferences.



3. Select Sharing, and then select Data Delivery.



To use the Data Delivery feature, please create and save a settings file in the Plot/Export Data window

Note: Device Communication must be running at the time the saved settings are run

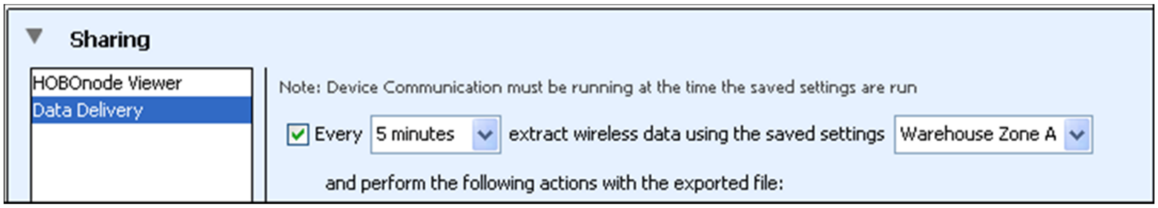
☐ Every 5 minutes extract wireless data using the saved settings <No saved queries>

and perform the following actions with the exported file:

☐ Email file to:

Note: If you have not yet selected the sensors you wish to export, then you will see a message indicating you need to create and save a settings file. You must select the sensors in Plot/Export Wireless Data before continuing.

4. Select how often you want to save the data from your network, from 1 minute to 7 days. This will determine what schedule you use to share the data.



Sharing

HOBOnode Viewer
Data Delivery

Note: Device Communication must be running at the time the saved settings are run

☑ Every 5 minutes extract wireless data using the saved settings Warehouse Zone A

and perform the following actions with the exported file:

5. Select the name of the saved settings that you created in Plot/Export Wireless Data, such as "Warehouse Zone A" in the example above.
6. Select how you would like to share the file: via email, FTP, or saved to a computer or network location. You may select more than one method of sharing the file.

Email:

Type the email address where you want to send the file and select the checkbox if you want to compress the file before emailing it. **Note:** Data delivery uses the same email settings configured for alarm email notifications. If you have never configured an alarm email, you must do that first, even if you don’t plan on setting any alarms.

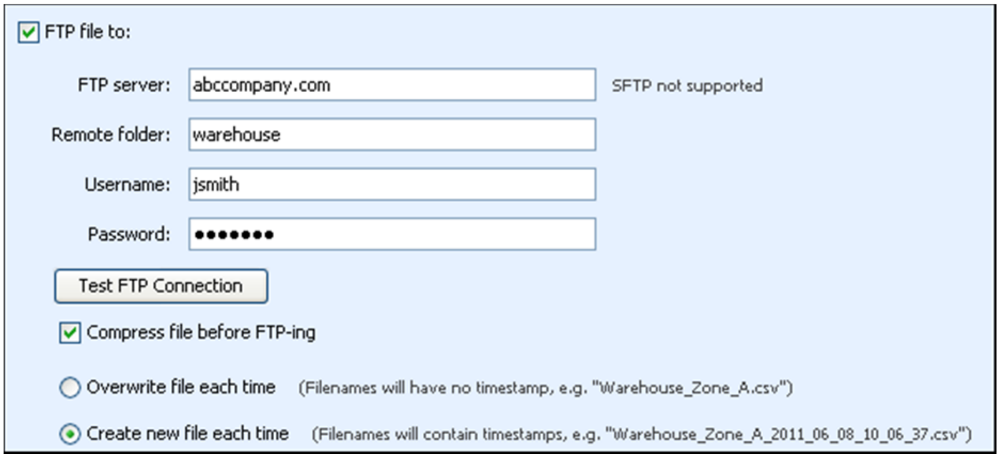
☑ Email file to:

Email address: jsmith@abccompany.com Uses SMTP settings from Alarms panel above

☑ Compress file before emailing

FTP:

Enter the FTP server name, the directory name (remote folder), username, and password for the FTP location where you want to place the file. Test the FTP Connection to make sure it successfully delivers the file to the specified location. Select the checkbox if you want to compress the file before delivering it via FTP. Choose whether you want to overwrite the existing file at that FTP location each time a new file is transferred, or if you want to create a new time-stamped file each time.



☑ FTP file to:

FTP server: abccompany.com SFTP not supported

Remote folder: warehouse

Username: jsmith

Password: •••••••

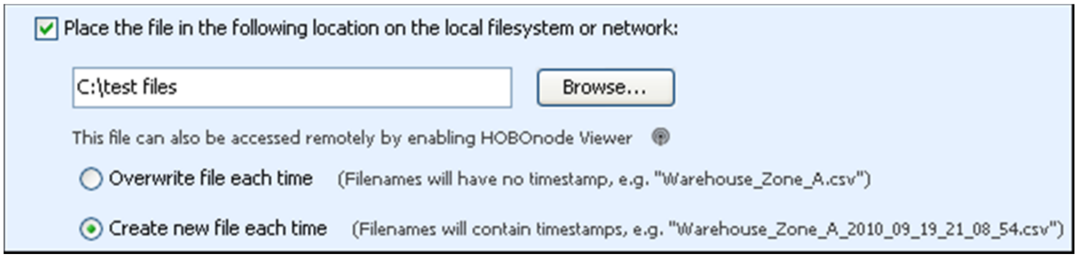
☑ Compress file before FTP-ing

○ Overwrite file each time (Filenames will have no timestamp, e.g. "Warehouse_Zone_A.csv")

● Create new file each time (Filenames will contain timestamps, e.g. "Warehouse_Zone_A_2011_06_08_10_06_37.csv")

Saving it to a hard drive or network:

Select the directory where you want to save the files. Choose whether you want to overwrite the file each time a file is saved, or if you want to create a new file each time.



☑ Place the file in the following location on the local filesystem or network:

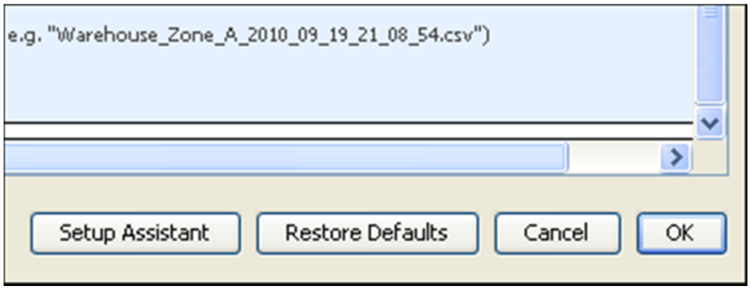
C:\test files

This file can also be accessed remotely by enabling HOBOnode Viewer

○ Overwrite file each time (Filenames will have no timestamp, e.g. "Warehouse_Zone_A.csv")

● Create new file each time (Filenames will contain timestamps, e.g. "Warehouse_Zone_A_2010_09_19_21_08_54.csv")

When you are done configuring your data delivery settings, click **OK** in the main Preferences window.



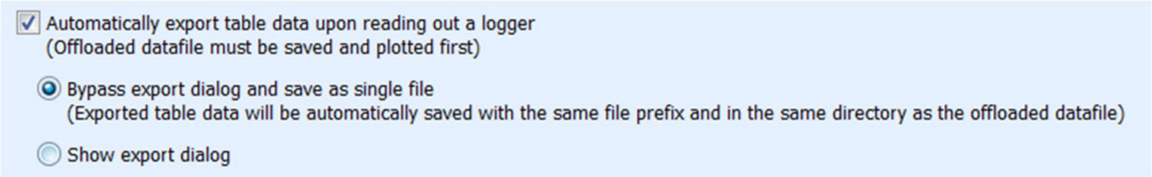
e.g. "Warehouse_Zone_A_2010_09_19_21_08_54.csv")

The sensor data from your data network will then be saved and shared on the schedule that you selected. The data will be saved as a .txt, .csv, or .xls file that you can import into HOBOware, Microsoft Excel, and other programs for analysis. The file type is determined by the export settings in Preferences.

Notes:

- Data delivery will not run unless device communication is also running. This means if you opt to stop device communication when you close HOBOnode Manager, then data delivery will also stop. Once you restart the device communication, then data delivery will commence again on the previously configured schedule.
- The preferences for data delivery may include the names of settings files from old network deployments. If you enable data delivery and use the saved settings from an old deployment, you will see a message indicating "No data found for selected sensors." Choose a settings file from the current deployment, or create a new one with Plot/Export Wireless Data.

Important: Data Delivery will not work properly if the "Show export dialog" setting is selected in the export preferences. To disable this setting, select Preferences from the File menu in Windows or the HOBOware menu in Macintosh. In the General category, select Export Settings. Make sure "Show export dialog" is not selected. Even if the "Automatically export table data upon readout of logger" option is disabled, the "Show export dialog" must not be selected for Data Delivery to work properly. Your preferences must look like this:

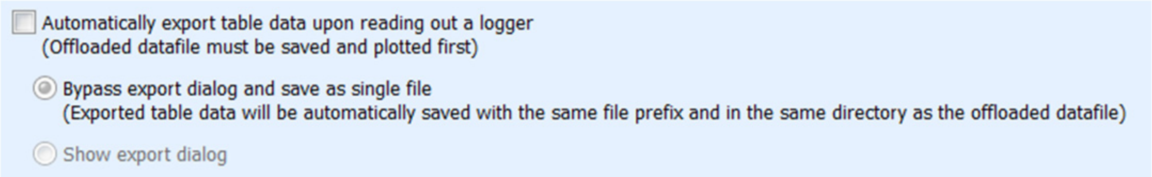


☑ Automatically export table data upon reading out a logger
(Offloaded datafile must be saved and plotted first)

● Bypass export dialog and save as single file
(Exported table data will be automatically saved with the same file prefix and in the same directory as the offloaded datafile)

○ Show export dialog

or this:

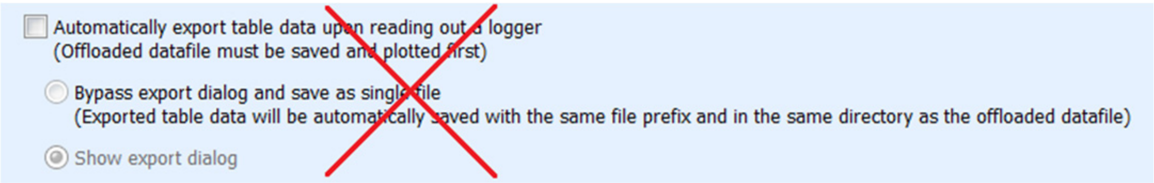


☐ Automatically export table data upon reading out a logger
(Offloaded datafile must be saved and plotted first)

● Bypass export dialog and save as single file
(Exported table data will be automatically saved with the same file prefix and in the same directory as the offloaded datafile)

○ Show export dialog

but not like this:



☐ Automatically export table data upon reading out a logger
(Offloaded datafile must be saved and plotted first)

○ Bypass export dialog and save as single file
(Exported table data will be automatically saved with the same file prefix and in the same directory as the offloaded datafile)

● Show export dialog

for Data Delivery to work correctly.

Tip: You can also share data from your HOBO data node network by enabling a HOBOnode Viewer webpage. When data delivery is configured to save files to your computer or a network drive, the files will also be available on the

Data tab in HOBOnode Viewer. Note that if you change the file directory used for data delivery when HOBOnode Viewer is enabled, you will need to restart HOBOnode Manager before you can access the files from the Data tab.

Data Storage Location

The HOBOnode Manager database is stored in the directory shown in the Data Storage Location field. This database includes all data recorded by the data nodes, settings for all deployments, alarm information, and other details related to your data node network.

Onset recommends that you periodically back up the database to secure your data in case of a database or computer failure. You can back up the database to an external hard drive or network server using third-party backup software. You will also be asked to back up your database before running the HOBOnode Manager Database Upgrade Utility in HOBOware 3.2.2 or later.

Important: The database must be closed during a backup or restore. Before copying or restoring a database, close HOBOware, HOBOnode Manager, and Device Communication. Right-click (Windows) or left-click (Macintosh) the HOBOware system tray icon and select Stop Device Communication.

The database is stored at the following location, as shown in the Data Storage Location field:

- Windows 7 and Windows 8

  C:\Users\<user name>\AppData\Local\OnsetComputerCorporation\cosmos\db

- Windows XP

  C:\Documents and Settings\<user name>\Application Data\Local\OnsetComputerCorporation\cosmos\db

- Macintosh OS 10.5 and 10.6

  /Users/<user name>/Documents/OnsetComputerCorporation/cosmos/db

Be sure to back up the entire "db" directory.

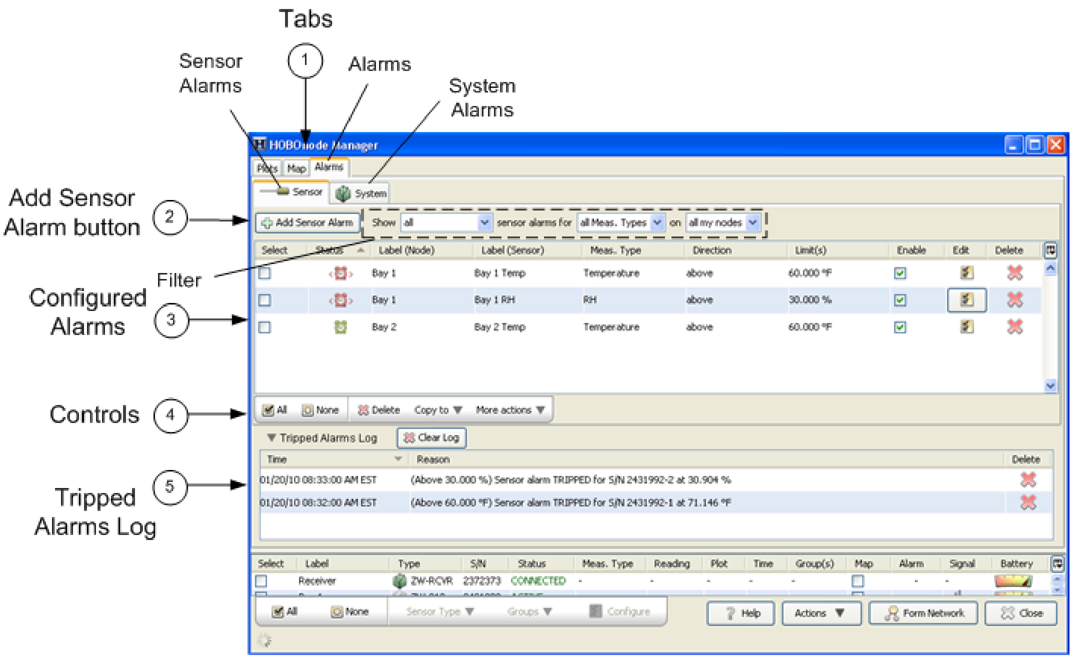
To restore the database:

1. Obtain the "db" directory from your backup source.
2. Replace the "db" directory as shown in the Data Storage Location field with the backup copy.

Alarms

There are two types of alarms in HOBOnode Manager: sensor alarms and system alarms. With sensor alarms, you can set an alarm to trip when a sensor reading is out of a range you specify. With system alarms, you can set an alarm to trip when a node is missing from the network or has a low battery. You can also configure a heartbeat alarm, which periodically notifies you the receiver is active and communicating with the nodes in the network. You can also set alarm actions, or notifications, to alert you via email, text, and/or audible/visual cue on your computer when an alarm trips. **Note:** When an alarm trips, HOBOnode Manager is opened, if it is not already.

Click the Alarms tab to access the following:



Show all sensor alarms for all Meas. Types on all my nodes

Select	Status	Label (Node)	Label (Sensor)	Meas. Type	Direction	Limit(s)	Enable	Edit	Delete
☐		Bay 1	Bay 1 Temp	Temperature	above	60.000 °F	☑		
☐		Bay 1	Bay 1 RH	RH	above	30.000 %	☑		
☐		Bay 2	Bay 2 Temp	Temperature	above	60.000 °F	☑		

Time	Reason	Delete
01/20/10 08:33:00 AM EST	(Above 30.000 %) Sensor alarm TRIPPED for S/N 2431992-2 at 30.904 %	
01/20/10 08:32:00 AM EST	(Above 60.000 °F) Sensor alarm TRIPPED for S/N 2431992-1 at 71.146 °F	

Select	Label	Type	S/N	Status	Meas. Type	Reading	Plot	Time	Group(s)	Map	Alarm	Signal	Battery
☐	Receiver	ZW-RCVR	2372373	CONNECTED	-	-	-	-	-	☐	-	-	

1. Tabs. Click the Sensor tab to set or view sensor alarms. Click the System tab to set Missing Node, Heartbeat, and Low Battery alarms.

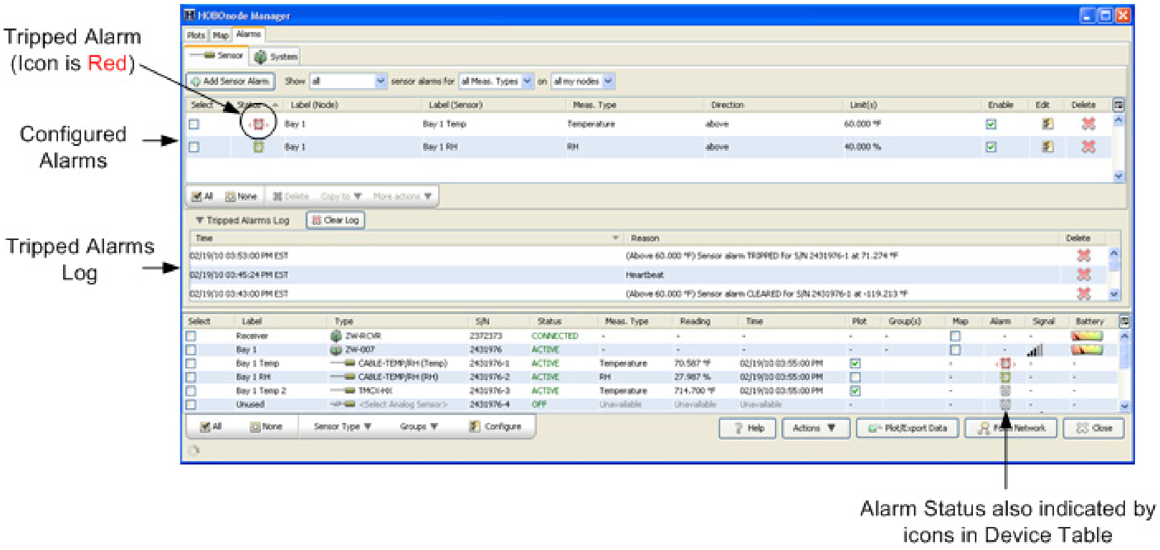
2. Add Sensor Alarm button (Sensor tab only). Click this button to go to the Add Sensor Alarms window.

3. Configured Alarms. Configured sensor alarms appear here. Use the filter to control what alarms shown in the sensor alarms pane. **Note:** If an alarm you configured is not appearing in the Alarms window, make sure the filter is set to show all.

4. Controls (Sensor tab only). Use the controls to apply an action to multiple alarms, including delete, copy, enable/disable, and apply default actions.

5. Tripped Alarms Log. All tripped alarms appear here. Click the Clear Log button to delete all tripped alarms.

Alarms that have been configured, but not tripped, display as green alarm clock icons in both the Sensor and Systems tab as well as the Device Table (sensor alarms only). Once the alarm is tripped, the alarm clock icon changes to red.



Show all sensor alarms for all Meas. Types on all my nodes

Select	Status	Label (Node)	Label (Sensor)	Meas. Type	Direction	Limit(s)	Enable	Edit	Delete
☐		Bay 1	Bay 1 Temp	Temperature	above	60.000 °F	☑		
☐		Bay 1	Bay 1 RH	RH	above	40.000 %	☑		

Time	Reason	Delete
02/19/10 03:53:00 PM EST	(Above 60.000 °F) Sensor alarm TRIPPED for S/N 2431976-1 at 71.274 °F	
02/19/10 03:45:24 PM EST	Heartbeat	
02/19/10 03:43:00 PM EST	(Above 60.000 °F) Sensor alarm CLEARED for S/N 2431976-1 at -119.213 °F	

Select	Label	Type	S/N	Status	Meas. Type	Reading	Time	Plot	Group(s)	Map	Alarm	Signal	Battery
☐	Receiver	ZW-RCVR	2372373	CONNECTED	-	-	-	-	-	☐	-	-	
☐	Bay 1	ZW-007	2431976	ACTIVE	-	-	-	-	-	☐	-		
☐	Bay 1 Temp	CABLE-TEMP/RH (Temp)	2431976-1	ACTIVE	Temperature	70.587 °F	02/19/10 03:55:00 PM	☑		-		-	-
☐	Bay 1 RH	CABLE-TEMP/RH (RH)	2431976-2	ACTIVE	RH	27.987 %	02/19/10 03:55:00 PM	☐		-		-	-
☐	Bay 1 Temp 2	TMCX-HX	2431976-3	ACTIVE	Temperature	714.700 °F	02/19/10 03:55:00 PM	☑		-		-	-
☐	Unused	<Select Analog Sensor>	2431976-4	OFF	Unavailable	Unavailable	Unavailable	-		-		-	-

Adding a Sensor Alarm

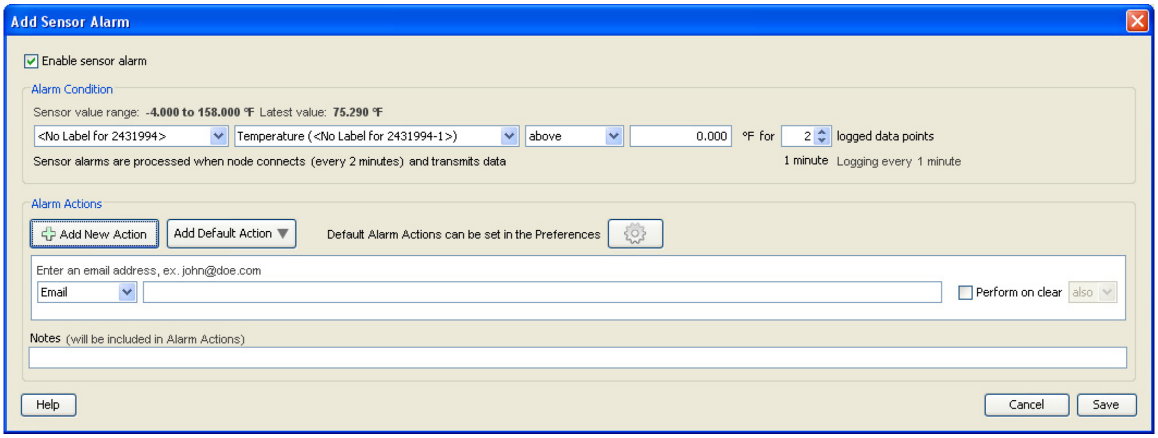
A sensor alarm trips when a sensor reading is outside a threshold that you configure. You can set up actions so that you are notified by email, text message, or by an audio or visual alarm in HOBOnode Manager when a sensor alarm trips. Once you create an alarm, you can copy it to multiple sensors of the same measurement type or the same measurement type and group.

Note: Sensor data is sent to the receiver periodically (based on the Connection Interval) and not continuously. Therefore, there is a delay between the time the alarm condition occurs and is recorded by the sensor and when you are alerted by any notifications you have configured. The default Connection Interval is 10 minutes. For critical applications, you may want to decrease the Connection Interval so that you are alerted to alarm conditions more frequently. See Changing the Logging Interval and Connection Interval.

Opening the Add Sensor Alarm window

The first time you add an alarm for a sensor, you can click the alarm icon for the sensor in the Device Table. This will open the Add Sensor Alarm window with the sensor already selected.

Otherwise, click the Alarms tab, then the Sensor tab, and then the Add Sensor Alarm button. With this method you will then need to select the sensor from a drop-down list.



☑ Enable sensor alarm

Sensor value range: **-4.000 to 158.000 °F** Latest value: **75.290 °F**

<No Label for 2431994> Temperature (<No Label for 2431994-1>) above 0.000 °F for 2 logged data points

Sensor alarms are processed when node connects (every 2 minutes) and transmits data

1 minute Logging every 1 minute

Default Alarm Actions can be set in the Preferences

Enter an email address, ex. john@doe.com

Email

☐ Perform on clear also

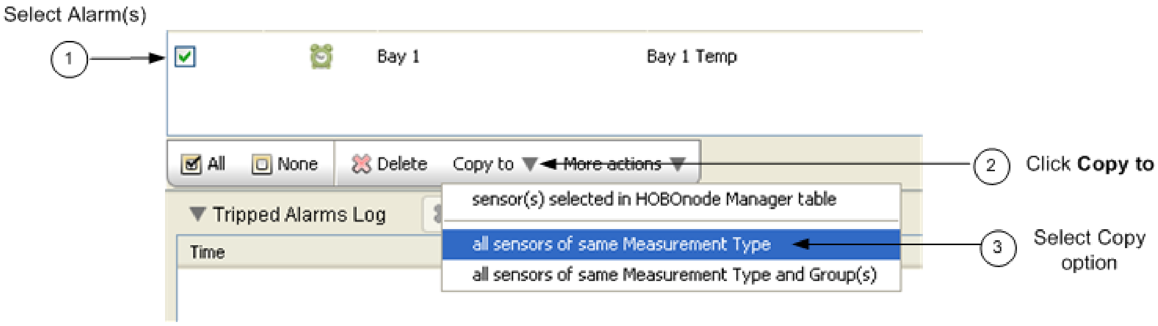
Notes (will be included in Alarm Actions)

1. Make sure the "Enable sensor alarm" checkbox is selected.
2. Select the sensor (if not already selected). If you accessed the Add Sensor Alarm window by clicking on the alarm icon in the Device Table, the sensor will automatically be populated. Otherwise, select the sensor you want to add the alarm to.
3. Configure Alarm Parameters.
   a. Select the threshold: Above, Below, or Outside Range.
   a. Enter the value for the alarm.
   b. Enter the Number of Data points. This is the number of readings that must be outside of the limits for the alarm to be tripped or cleared.
4. Configure Alarm Actions (Notifications).
5. Click Save.

Note: Any time you edit an existing alarm, the alarm state is reset to untripped and the logged data points are reset to zero.

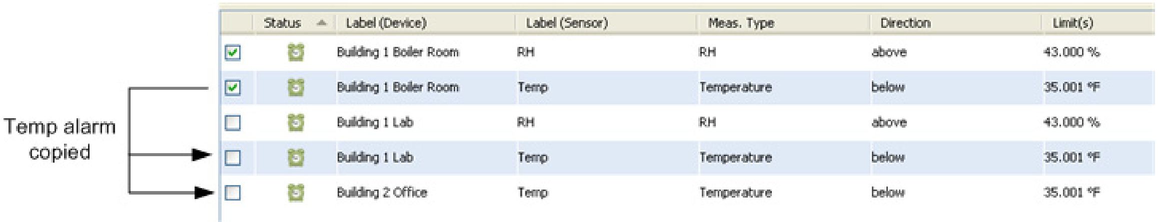
Copying an Alarm to Other Sensors

To copy an alarm to other sensors:



1. Select Alarm(s). Select the alarms you want to copy. You can select alarms for multiple measurement types and each alarm will only be copied for sensors of that type.
2. Click the **Copy to** button.
3. Select the copy option. You can copy the alarm to all sensors of the same Measurement Type, or to Measurement Type and Group(s).

The alarms are copied to the sensors, as shown below.



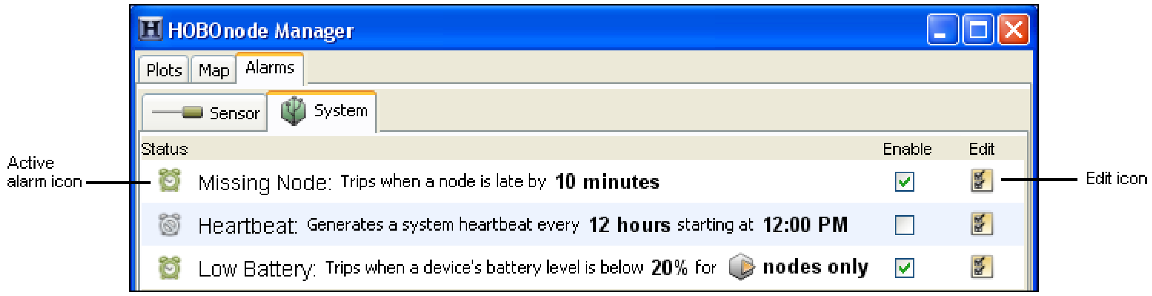
	Status	Label (Device)	Label (Sensor)	Meas. Type	Direction	Limit(s)
☑		Building 1 Boiler Room	RH	RH	above	43.000 %
☑		Building 1 Boiler Room	Temp	Temperature	below	35.001 °F
☐		Building 1 Lab	RH	RH	above	43.000 %
☐		Building 1 Lab	Temp	Temperature	below	35.001 °F
☐		Building 2 Office	Temp	Temperature	below	35.001 °F

Enabling a Missing Node Alarm

A Missing Node alarm trips when a data node has not connected to the receiver within the specified timeframe. The default period to determine that a node is missing is 10 minutes. You can change this in the Preferences.

To enable a missing node alarm:

1. Click the Alarms tab.
2. Click the System tab and select the checkbox in the Enable column for Missing Node. If alarm actions have already been configured by a previous edit, then the Status icon for Missing Node will change to an active alarm icon (green) as shown below. This means the alarm is enabled. If an Edit Missing Node Alarm dialog box appears or you wish to make additional changes to this alarm, then proceed to next step.

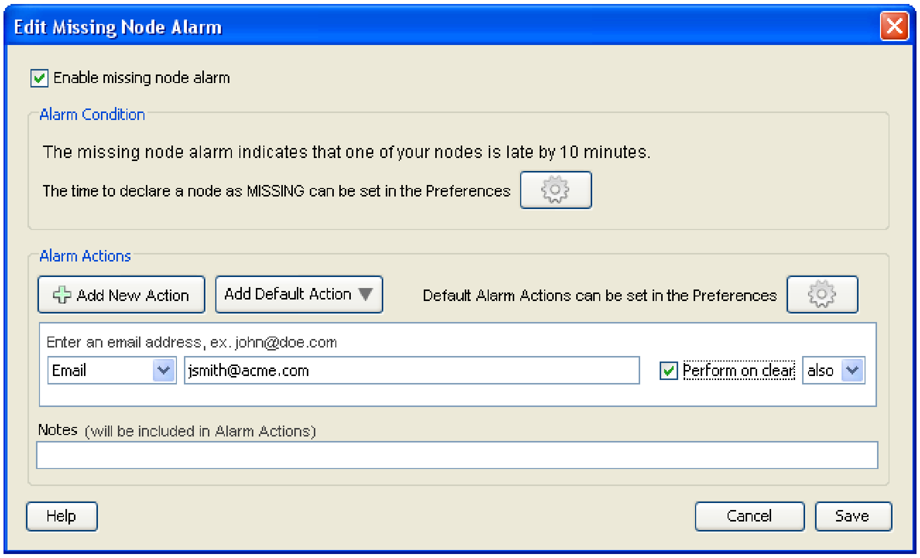


Missing Node: Trips when a node is late by **10 minutes** ☑

Heartbeat: Generates a system heartbeat every **12 hours** starting at **12:00 PM** ☐

Low Battery: Trips when a device's battery level is below **20%** for **nodes only** ☑

3. An Edit Missing Node Alarm dialog box may open automatically. If it does not and you wish to change the settings, then click the Edit icon for Missing Node as shown above.



☑ Enable missing node alarm

The missing node alarm indicates that one of your nodes is late by 10 minutes.

The time to declare a node as MISSING can be set in the Preferences

Default Alarm Actions can be set in the Preferences

Enter an email address, ex. john@doe.com

Email jsmith@acme.com ☑ Perform on clear also

Notes (will be included in Alarm Actions)

4. Make sure the "Enable missing node alarm" checkbox is selected.
5. By default, the alarm will trip after the node is missing for 10 minutes. Click the Preferences button if you wish to change the default time period.
6. Add one or more alarm actions, which is how you will be notified when the alarm trips. You can be notified via email or text, or by a visual cue or audible sound on the computer where HOBOnode Manager is running.
7. Click **Save**. The changes you made to the missing node alarm are displayed on the System tab.

Note: Nodes may temporarily go missing after upgrading their firmware as described in Upgrading the Firmware for a Receiver or Single Data Node or Updating the Firmware for Multiple Data Nodes. In most instances, the node will not be reported as missing after upgrading its firmware. However, depending on how long the upgrade process takes and the length of the connection interval, the node may occasionally be reported as missing. If a node is reported as missing after updating its firmware, wait one or two connection intervals for the node to reappear. For example, if the connection interval is set to 20 minutes, wait for 40 minutes to make sure the node reappears. If the node is then still reported as missing, add it back to the network by following these steps:

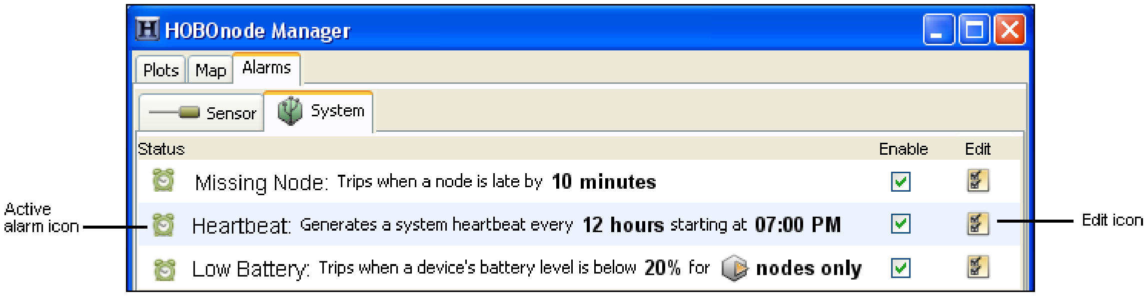
1. Click the Form Network button in HOBOnode Manager.
2. Press the reset button with a quick 1-second push to reactivate the data node.
3. Verify that the data node appears in the HOBOnode Manager table and is identified as a router or data node as expected (see Determining Data Node Type). To change the type of data node, see Converting an End-Point Node to a Router Node or Converting a Router Node to an End-Point Node.

Enabling a Heartbeat Alarm

If you enable a Heartbeat alarm, a heartbeat is generated every 12 hours (configurable) to let you know that the system is up and running. If you do not receive a heartbeat notification, check the status of your receiver and restart HOBOware if necessary.

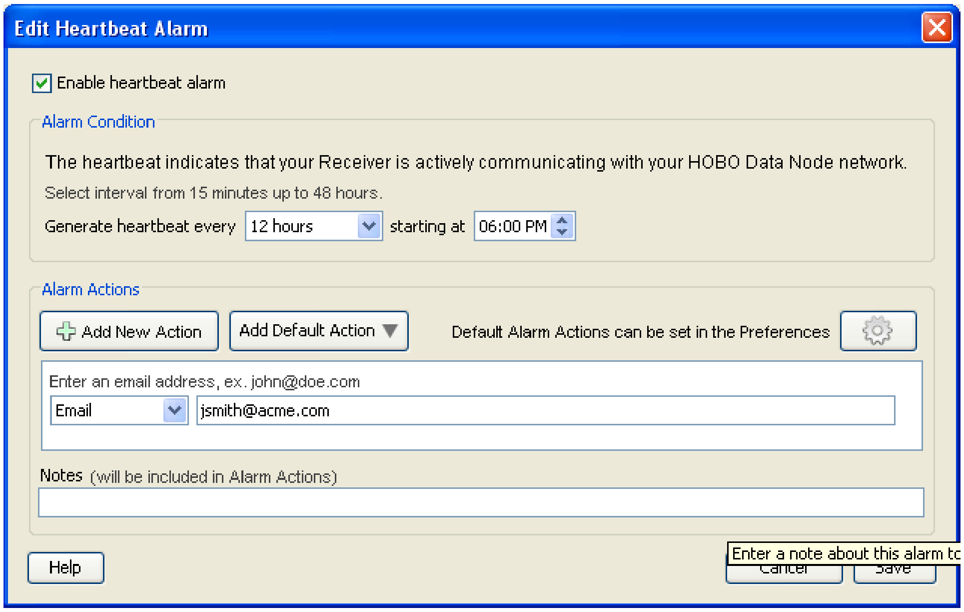
To configure a heartbeat alarm:

1. Click the Alarms tab.
2. Click the System tab and select the checkbox in the Enable column for Heartbeat. If alarm actions have already been configured by a previous edit, then the Status icon for Heartbeat will change to an active alarm icon (green) as shown below. This means the alarm is enabled. If an Edit Heartbeat dialog box appears or you wish to make additional changes to this alarm, then proceed to next step.



Status	Enable	Edit
Missing Node: Trips when a node is late by **10 minutes**	☑	
Heartbeat: Generates a system heartbeat every **12 hours** starting at **07:00 PM**	☑	
Low Battery: Trips when a device's battery level is below **20%** for **nodes only**	☑	

3. An Edit Heartbeat dialog box may open automatically. If it does not and you wish to change the settings, then click the Edit icon for Heartbeat as shown above.



☑ Enable heartbeat alarm

The heartbeat indicates that your Receiver is actively communicating with your HOBO Data Node network.

Select interval from 15 minutes up to 48 hours.

Generate heartbeat every 12 hours starting at 06:00 PM

Default Alarm Actions can be set in the Preferences

Enter an email address, ex. john@doe.com

Email jsmith@acme.com

Notes (will be included in Alarm Actions)

Enter a note about this alarm tc

4. Make sure the "Enable heartbeat alarm" checkbox is enabled.

5. Select how often you want to generate a heartbeat and what time you want to start.

6. Add one or more alarm actions, which is how you will be notified when the alarm trips. You can be notified via email or text, or by a visual cue or audible sound on the computer where HOBOnode Manager is running.

7. Click Save. The changes you made to the heartbeat alarm are displayed on the System tab.

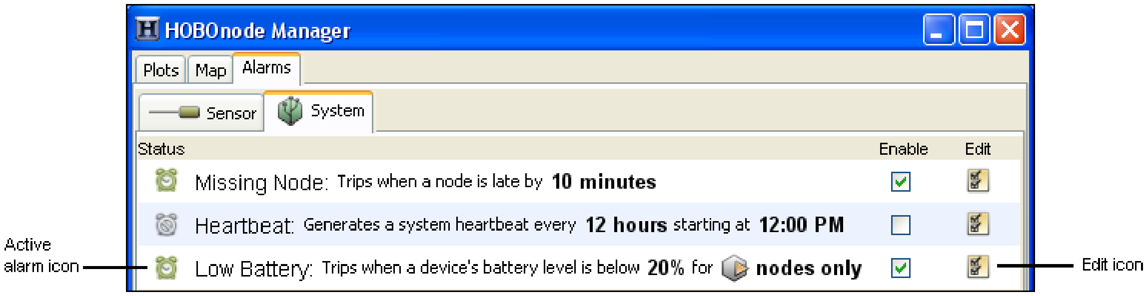
Enabling a Low Battery Alarm

You can set an alarm to trip when the battery level in a data node or a router drops below a specific threshold. This can help you determine when it is time to change the batteries for devices in your network. The low battery alarm is a system-wide alarm, which means it applies to all devices (either all nodes or all nodes and routers) in the network. You cannot set a low battery alarm for some nodes and not others.

To configure a low battery alarm:

1. Click the Alarms tab.

2. Click the System tab and select the checkbox in the Enable column for Low Battery. If alarm actions have already been configured by a previous edit, then the Status icon for Low Battery will change to an active alarm icon as shown below. This means the alarm is enabled. If an Edit Low Battery dialog box appears or you wish to make additional changes to this alarm, then proceed to next step.

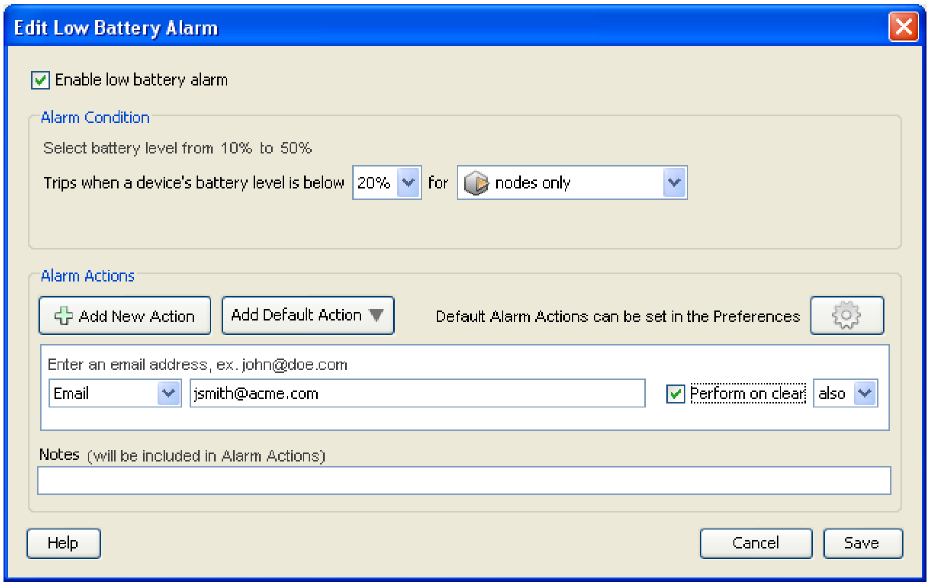


Missing Node: Trips when a node is late by **10 minutes** ☑

Heartbeat: Generates a system heartbeat every **12 hours** starting at **12:00 PM** ☐

Low Battery: Trips when a device's battery level is below **20%** for **nodes only** ☑

3. An Edit Low Battery dialog box may open automatically. If it does not and you wish to change the settings, then click the Edit icon for Low Battery as shown above.



☑ Enable low battery alarm

Select battery level from 10% to 50%

Trips when a device's battery level is below 20% for nodes only

Default Alarm Actions can be set in the Preferences

Enter an email address, ex. john@doe.com

Email jsmith@acme.com ☑ Perform on clear also

Notes (will be included in Alarm Actions)

4. Make sure the "Enable low battery alarm" checkbox is enabled.

5. Select the battery level at which you want the alarm to trip, from 10 to 50%. For example, if you choose 20%, then the alarm will trip once the device's remaining battery power drops below 20%.

6. Select whether the battery alarm should trip for nodes only or for both nodes and routers. **Notes:** You cannot set a low battery alarm for a receiver because it should always be powered by an AC adapter. In addition,you should not set a low battery alarm for routers that do not have batteries installed. If your routers are powered by AC adapters only and do not have backup batteries installed, then you should set the battery alarm for nodes only.

7. Add one or more alarm actions, which is how you will be notified when the alarm trips. You can be notified via email or text, or by a visual cue or audible sound on the computer where HOBOnode Manager is running.

8. Click Save. The changes you made to the low battery alarm are displayed on the System tab. **Note:** If the low battery alarm was previously configured and had tripped, then clicking Save will clear the tripped state. If the newly saved settings result in an alarm condition, then the alarm will trip at the next connection interval.

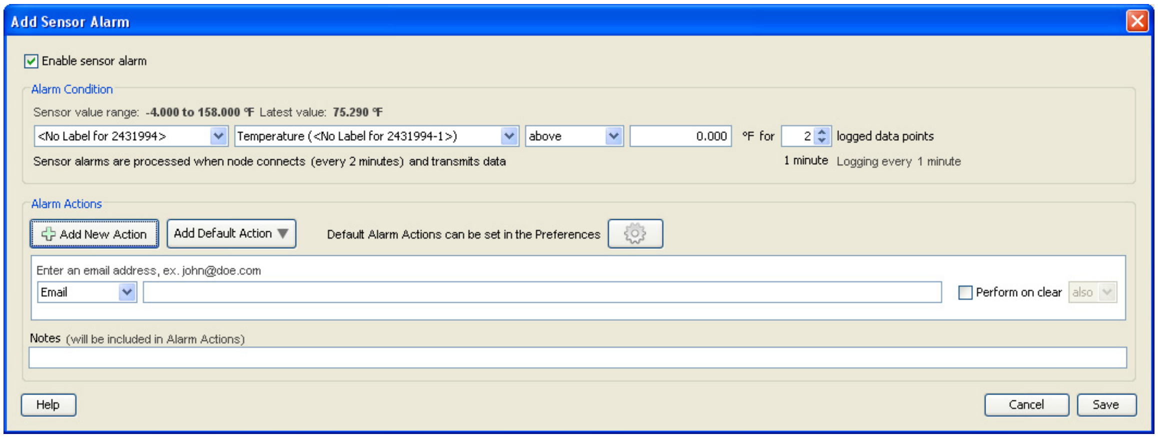
Adding Alarm Actions (Notifications)

An alarm action is a notification when an alarm trips or and/or clears. You can configure the alarm action to notify you in four ways:

- Via email

- Via text message
- With a visible message on your computer
- With a sound on your computer

Before you set up email or text notifications, you must configure your SMTP settings. See Setting Alarm Preferences.



☑ Enable sensor alarm

Alarm Condition

Sensor value range: **-4.000 to 158.000 °F** Latest value: **75.290 °F**

<No Label for 2431994> Temperature (<No Label for 2431994-1>) above 0.000 °F for 2 logged data points

Sensor alarms are processed when node connects (every 2 minutes) and transmits data

1 minute Logging every 1 minute

Alarm Actions

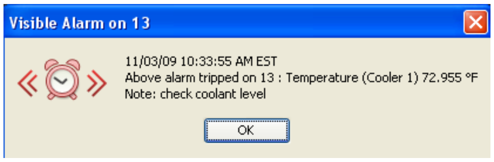
Default Alarm Actions can be set in the Preferences

Enter an email address, ex. john@doe.com

Email ☐ Perform on clear also

Notes (will be included in Alarm Actions)

1. Click the Add New Action button. A new action is added. **Tip:** To save time, you can configure default alarm actions. See Setting Alarm Preferences for information.
2. Select the type of notification: Email, Text Message, Visible, or Audible.
3. Enter information or make a selection depending on the type of notification. **Note:** If you add an email or text notification and you have not already set up your SMTP settings, you will be prompted to do so.
    - Email: Enter the email address where you want the alarm notification sent.
    - Text Message: Enter the email address where you want the alarm notification sent.
    - Visible: No further configuration required. A pop-up window will appear in HOBOnode Manager if the alarm trips.



11/03/09 10:33:55 AM EST
Above alarm tripped on 13 : Temperature (Cooler 1) 72.955 °F
Note: check coolant level

    - Audible: Select the sound that you want to play when an alarm trips. Click the Play icon to hear the alarm.

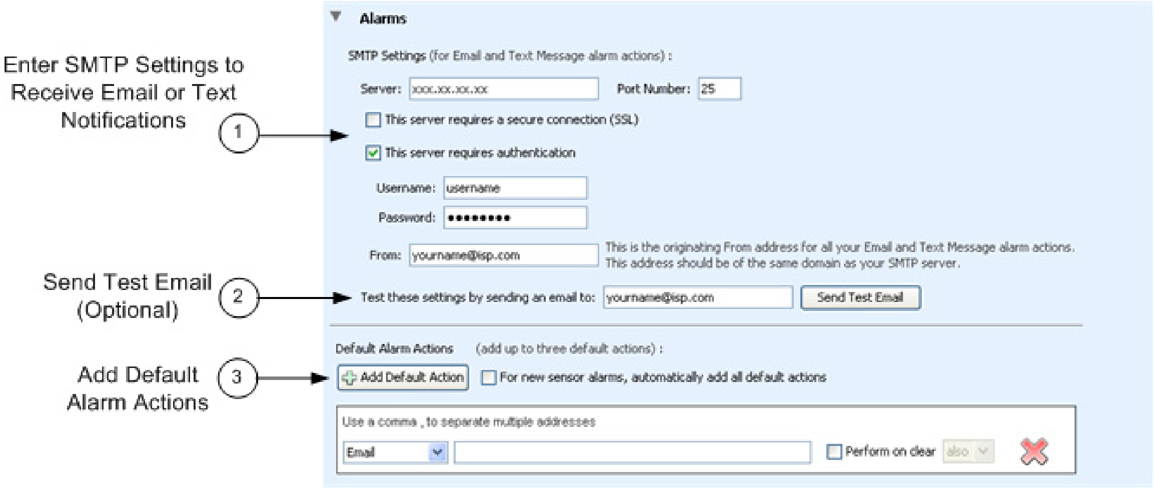
   Note: If multiple audible alarms are set, only the most recent will play. Any other actions configured for the alarm will be sent.

4. Check the "Perform on clear" box if you want a notification when the alarm clears. If you only want a notification when the alarm clears and not when it is tripped, change the drop-down selection to "only."
5. Add Notes to be included in the alarm notification (optional).
6. Click Save.

To add another action, repeat the procedure.

Setting Alarm Preferences

Before you add sensor alarms, set up your Alarm Preferences for email notifications and create default actions (notifications). To open the Preferences window, click Actions at the bottom of the HOBOnode Manager window and select Edit Data Node Preferences.



SMTP Settings (for Email and Text Message alarm actions) :

Server: xxx.xx.xx.xx Port Number: 25

☐ This server requires a secure connection (SSL)

☑ This server requires authentication

Username: username

Password: ••••••••

From: yourname@isp.com This is the originating From address for all your Email and Text Message alarm actions. This address should be of the same domain as your SMTP server.

Test these settings by sending an email to: yourname@isp.com

Default Alarm Actions (add up to three default actions) :

☐ For new sensor alarms, automatically add all default actions

Use a comma , to separate multiple addresses

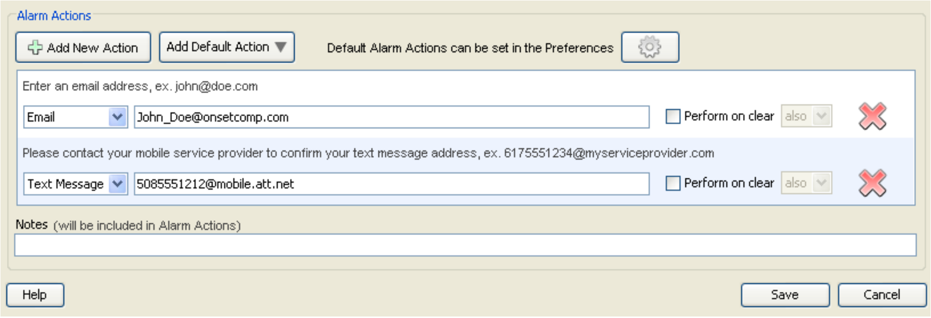
Email ☐ Perform on clear also

1. Enter SMTP settings for email or text notifications. To receive email or text message alarm notifications, enter the Server IP Address for your mail server, and enable SSL or authentication if required by your network. See your Network Administrator or your Internet Service Provider for information; see also Alarm Email/Text Configuration for more information.

2. Send a test email. Enter your email address and click the Send Test Email button to verify that your settings are correct. Make sure you check your Junk Mail or Spam folder for the email if it is not in your email inbox.

3. Add default alarm actions (optional). Entering default alarm actions simplifies alarm configuration. For example, instead of entering the same email address for every alarm, you can select an address from a list of drop-down entries when you add the alarm action. For more details on alarm actions, see Adding Alarm Actions.

If you check "For new sensor alarms, automatically add all default actions" when you click the Add Sensor Alarm button, the alarm actions you configured are automatically added, as shown below. This is helpful if you want the same actions for every alarm.



Default Alarm Actions can be set in the Preferences

Enter an email address, ex. john@doe.com

Email John_Doe@onsetcomp.com ☐ Perform on clear also

Please contact your mobile service provider to confirm your text message address, ex. 6175551234@myserviceprovider.com

Text Message 5085551212@mobile.att.net ☐ Perform on clear also

Notes (will be included in Alarm Actions)

Alarm Email/Text Configuration

You must configure the SMTP Settings to allow email from the data node network to get to your email recipients. If your data node network is within a corporate network environment, you should contact your Network Administrator (IT/MIS dept.) for this information. Also, they may need to add the receiver to a White List to allow it to relay email through the corporate email server.

If you use a private mail account such as Yahoo or Google, or if you do not know your corporate information, you can get the outgoing mail parameters from your mail provider. The following are links to this information for some providers. For other providers, search the Internet for "SMTP Settings for <provider name>."

- Gmail

  http://mail.google.com/support/bin/answer.py?hl=en&answer=13287

- Hotmail

  http://liveunplugged.spaces.live.com/blog/cns!F92775FC46A390CA!422.entry

Sending an Alarm to a Cell Phone

To send an email to your cell phone when an alarm occurs, enter the email address for your cell phone. These are the formats for some cell phone providers. For others, contact your provider.

Alltel

[10-digit phone number]@message.alltel.com

Example: 2125551212@message.alltel.com

AT&T

[10-digit phone number]@txt.att.net

Example: 2125551212@txt.att.net

Boost Mobile

[10-digit phone number]@myboostmobile.com

Example: 2125551212@myboostmobile.com

Nextel (now part of Sprint Nextel)

[10-digit telephone number]@messaging.nextel.com

Example: 7035551234@messaging.nextel.com

Sprint PCS (now Sprint Nextel)

[10-digit phone number]@messaging.sprintpcs.com

Example: 2125551234@messaging.sprintpcs.com

T-Mobile

[10-digit phone number]@tmomail.net

Example: 4251234567@tmomail.net

Verizon

[10-digit phone number]@vtext.com

Example: 5552223333@vtext.com

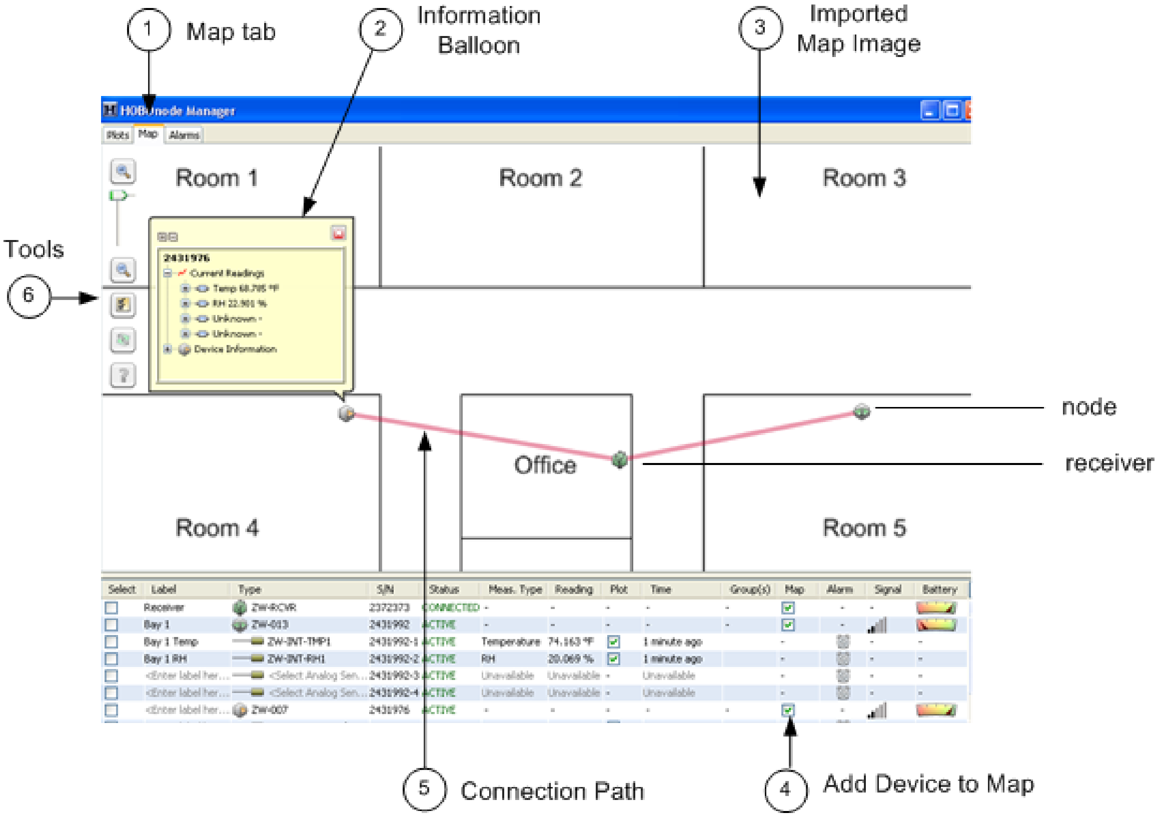
Virgin Mobile USA

[10-digit phone number]@vmobl.com

Example: 5551234567@vmobl.com

The Network Map

Place icons on the Network Map to help you keep track of your devices. You can expand Information Balloons on the device to view status information and sensor readings. You can also import a custom background image, such as a floor plan.



Select	Label	Type	S/N	Status	Meas. Type	Reading	Plot	Time	Group(s)	Map	Alarm	Signal	Battery
☐	Receiver	ZW-RCVR	2372373	CONNECTED	-	-	-	-	-	☑	-	-	
☐	Bay 1	ZW-013	2431992	ACTIVE	-	-	-	-	-	☑	-		
☐	Bay 1 Temp	ZW-INT-TMP1	2431992-1	ACTIVE	Temperature	74.163 °F	☑	1 minute ago		-		-	-
☐	Bay 1 RH	ZW-INT-RH1	2431992-2	ACTIVE	RH	20.069 %	☑	1 minute ago		-		-	-
☐	<Enter label her…	<Select Analog Sen…	2431992-3	ACTIVE	Unavailable	Unavailable	-	Unavailable		-		-	-
☐	<Enter label her…	<Select Analog Sen…	2431992-4	ACTIVE	Unavailable	Unavailable	-	Unavailable		-		-	-
☐	<Enter label her…	ZW-007	2431976	ACTIVE	-	-	-	-	-	☑	-		

1. Map Tab. To view the Network Map, click the Map tab.

2. Information Balloons. Click a device in the Network Map to open a pop-up that shows current readings and other device information. To have pop-ups appear automatically, click the Configure Map icon and select "Show Information Balloon when adding new data nodes and on startup." You can also adjust how much information is included in the balloon. See Configuring the Network Map for more information.

3. Imported Map Image. To customize your map background image, see Customizing the Network Map Background.

4. Add Device to Map. To add a device to the map, check the Map box in the Device Table and then click in the map where you want to place the icon.

5. Connection Path. Lines on the map show the path each device takes to the receiver. You can monitor the communication between a data node and the data receiver by checking the connection paths between devices. If a device has missed a scheduled connection, the path will become a dotted line. To change the path color, see Configuring the Network Map.

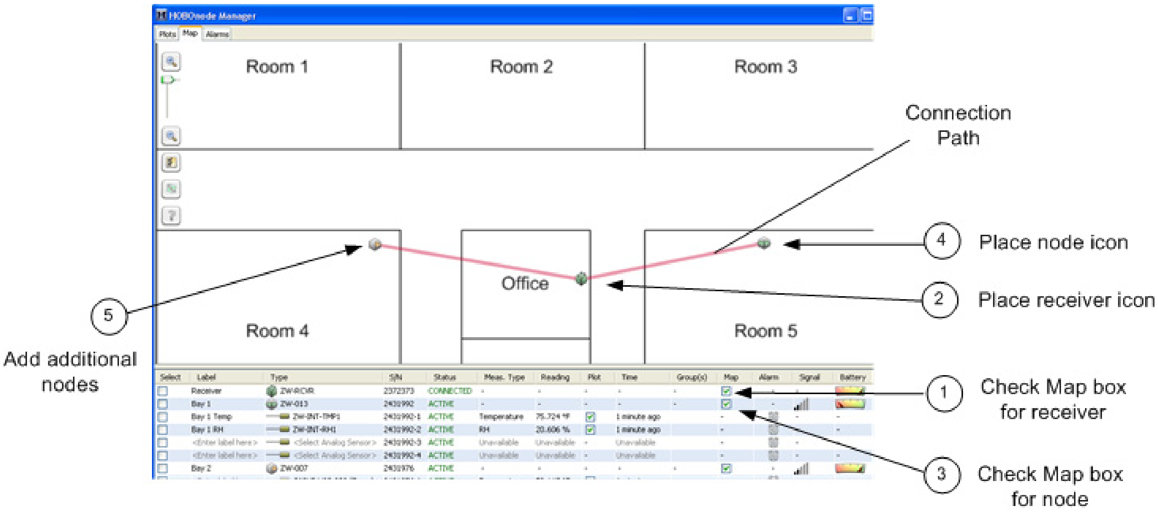
6. Tools. Use the Zoom tools to zoom in and out of the map. Click the Configure Map button to access additional map settings. Use the Refresh Network Paths button to see the latest path that the devices are taking to get to the receiver. Paths can change if a data node is moved or because the original path was obstructed.

Note that if an alarm has tripped on a node, the node icon on the network map will have a red ring around it like this:

Adding a Device to the Network Map

To add a device to Network Map.

1. In the Device Table, check the Map box for the receiver to add it to the map.
2. Move the icon to the location of the receiver and click the left mouse button.
3. Check the Map box for a node to add it to the map.
4. Move the icon to the location of the device and click the left mouse button.
5. Repeat steps 3 and 4 for each node you want to add to the map.

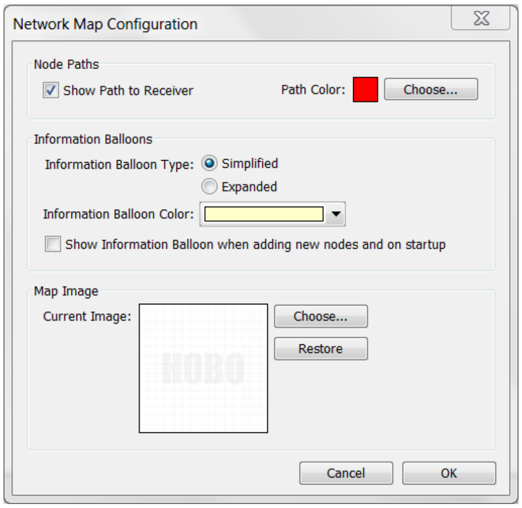


Select	Label	Type	S/N	Status	Meas. Type	Reading	Plot	Time	Group(s)	Map	Alarm	Signal	Battery
☐	Receiver	ZW-RCVR	2372373	CONNECTED	-	-	-	-	-	☑	-	-	
☐	Bay 1	ZW-013	2430992	ACTIVE	-	-	-	-	-	☑	-		
☐	Bay 1 Temp	ZW-INT-TMP1	2430992-1	ACTIVE	Temperature	75.724 °F	☑	1 minute ago		-		-	-
☐	Bay 1 RH	ZW-INT-RH1	2430992-2	ACTIVE	RH	20.606 %	☑	1 minute ago		-		-	-
☐	<Enter label here>	<Select Analog Sensor>	2430992-3	ACTIVE	Unavailable	Unavailable	-	Unavailable		-		-	-
☐	<Enter label here>	<Select Analog Sensor>	2430992-4	ACTIVE	Unavailable	Unavailable	-	Unavailable		-		-	-
☐	Bay 2	ZW-007	2430976	ACTIVE	-	-	-	-	-	☑	-		

Configuring the Network Map

You can customize the paths and information balloons on the Network Map, and you can use your own

Click the Configure icon in the top left of the Network Map to open the Network Map Configuration window.



Node Paths

☑ Show Path to Receiver

Path Color: 🟥

Information Balloons

Information Balloon Type: ● Simplified ○ Expanded

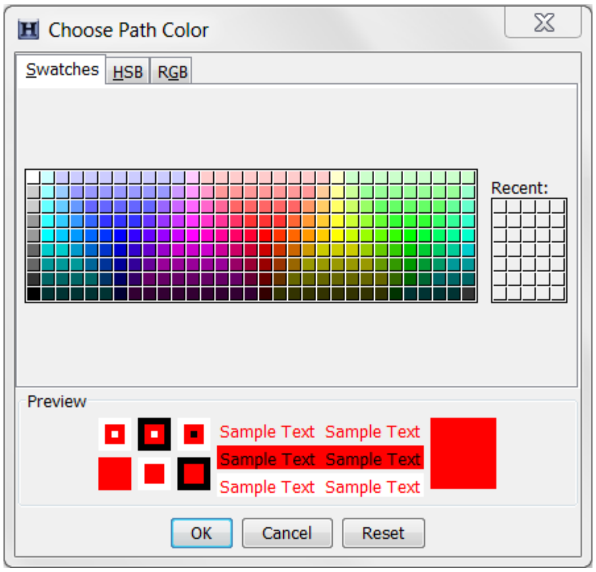
Information Balloon Color:

☐ Show Information Balloon when adding new nodes and on startup

Map Image

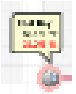
Current Image:

In the Node Paths pane, select the Show Path to Receiver checkbox Paths to show or hide connection paths between nodes. To change the path color, click the Choose button. Select a new color from the Swatches tab, or enter HSB or RGB values and click OK.

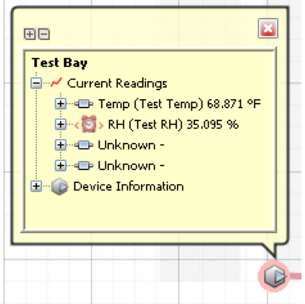


In the Information Balloons pane, select the Information Balloon Type, as either:

- Simplified to show only label and readings, or

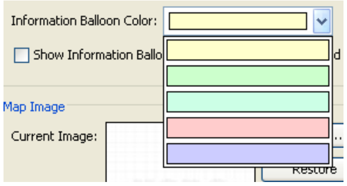


- Expanded to show all device information.



Test Bay
Current Readings
Temp (Test Temp) 68.871 °F
RH (Test RH) 35.095 %
Unknown -
Unknown -
Device Information

To change the background color on the balloon, click the Information Balloon Color drop-down arrow and select a color.

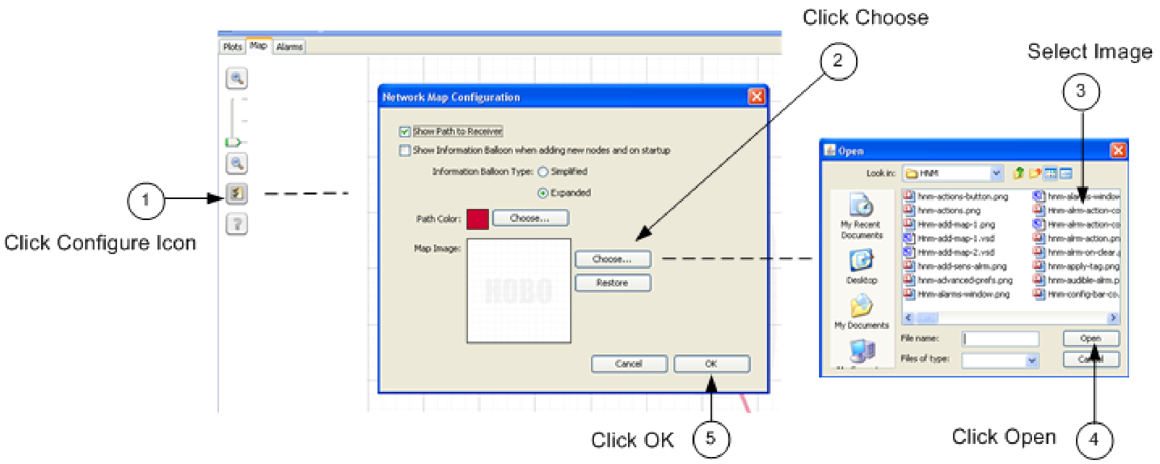


Select the "Show Information Balloon when adding new data nodes and on startup" checkbox to automatically display the balloons any time you open HOBOnode Manager or add a new icon to the map.

To change the map image, see Customizing the Network Map Background.

Customizing the Network Map Background

You can upload a custom image to the Network Map to represent your floor plan.



☑ Show Path to Receiver

☐ Show Information Balloon when adding new nodes and on startup

Information Balloon Type: ○ Simplified ● Expanded

Path Color:

Map Image:

1. Click the Configure icon in the top left corner of the map.
2. Click the Choose button in the Network Map Configuration window.
3. Select the image file from the Open window.
4. Click Open.
5. Click OK to close the Network Map Configuration window and display the new image.

To revert to the default image, click Restore.

If you don't have an image to upload, you can create one using any drawing program following these guidelines:

- There are 3 scale levels available for an image in the Network Map, depending on the size of the image you upload. The larger the size, the more zoom levels you will have.
  - 1,000 x 1,000 (minimum size) - 1 zoom level
  - 2,000 x 2,000 - 2 zoom levels
  - 3,000 x 3,000 (maximum size) - 3 zoom levels
- All images are converted to squares in the Network Map, so for best results your overall image should be a square.
- Inside the main square, add a smaller square or rectangle to roughly represent your building.
- Add squares or rectangles to represent rooms in your building where you will place nodes. Add descriptive labels to each room such as "Office," "Cooler," or "Boiler Room." Some programs will also have other images you can add to the room such as desks and computers to help you narrow the location of the node.
- Set the properties of the image to your desired resolution. For best results enter 4,000 x 4,000 pixels.

Maintenance & Troubleshooting

Once your ZW Wireless Data Node Network is running, refer to the following topics for maintenance and troubleshooting tips:

- Changing External Sensor Type
- Moving or Removing a Data Node
- Converting a Router Node to an End-Point Node (Switching from AC Power to Battery Power)
- Converting an End-Point Node to a Router Node (Switching from Battery Power to AC Power)

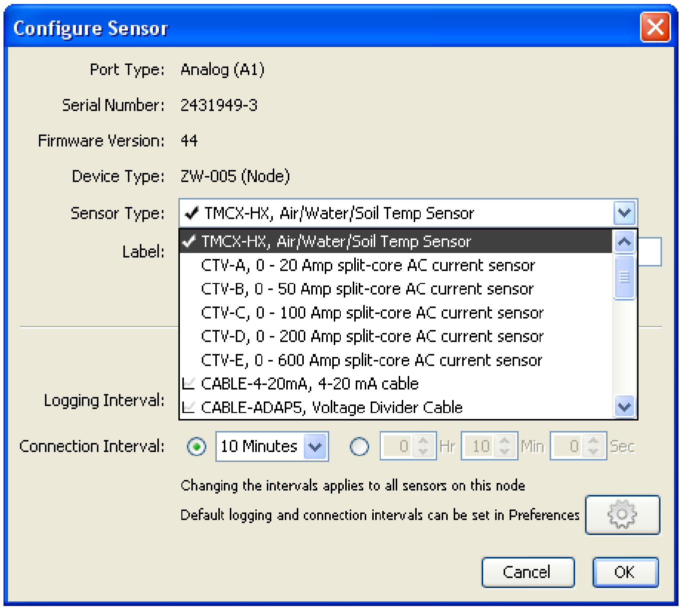
- Database Backup and Restore
- HOBOnode Manager Database Upgrade Utility
- Creating a New Deployment
- Updating Firmware for a Receiver or Single Data Node
- Updating Firmware for Multiple Data Nodes
- Troubleshooting

Changing External Sensor Type

Many types of HOBO data nodes can be configured with external sensors. One of the benefits of using external sensors is that you can swap them out when necessary for different ones if you want to modify your wireless network. Or, you can disable the external sensor channel if you don't need it for your current network deployment.

To change the type of external sensor associated with a data node:

1. Double-click the external sensor you wish to change in the HOBOnode Manager device table.
2. Select the sensor from the Sensor Type drop-down list.



Configure Sensor

Port Type: Analog (A1)

Serial Number: 2431949-3

Firmware Version: 44

Device Type: ZW-005 (Node)

Sensor Type: ✓ TMCX-HX, Air/Water/Soil Temp Sensor

✓ TMCX-HX, Air/Water/Soil Temp Sensor
CTV-A, 0 - 20 Amp split-core AC current sensor
CTV-B, 0 - 50 Amp split-core AC current sensor
CTV-C, 0 - 100 Amp split-core AC current sensor
CTV-D, 0 - 200 Amp split-core AC current sensor
CTV-E, 0 - 600 Amp split-core AC current sensor
CABLE-4-20mA, 4-20 mA cable
CABLE-ADAP5, Voltage Divider Cable

Label:

Logging Interval:

Connection Interval: ● 10 Minutes ○ 0 Hr 10 Min 0 Sec

Changing the intervals applies to all sensors on this node

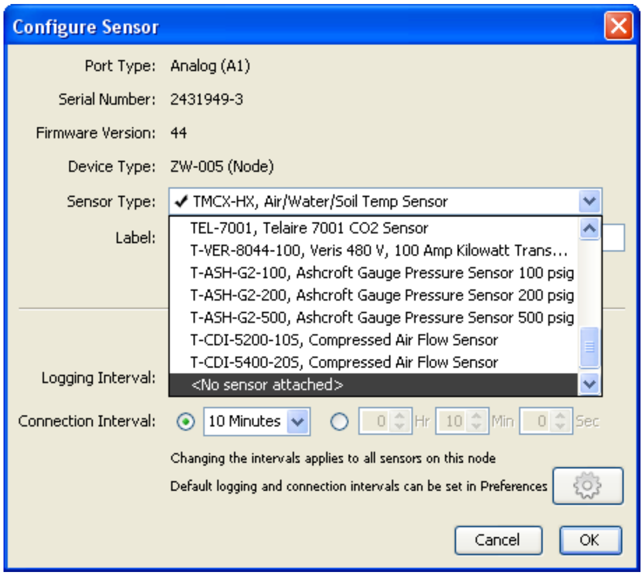
Default logging and connection intervals can be set in Preferences

3. Make any other changes as necessary and click OK.

Note: While the HOBOnode Manager device table will display the change to the sensor type immediately, data for the new sensor will not display until the next connection interval .

To deselect, or turn off, an external sensor:

1. Double-click the external sensor you wish to change in the HOBOnode Manager device table.
2. Scroll to the end of the Sensor Type drop-down list and select <No sensor attached>.



Configure Sensor

Port Type: Analog (A1)

Serial Number: 2431949-3

Firmware Version: 44

Device Type: ZW-005 (Node)

Sensor Type: ✓ TMCX-HX, Air/Water/Soil Temp Sensor

Label:

- TEL-7001, Telaire 7001 CO2 Sensor
- T-VER-8044-100, Veris 480 V, 100 Amp Kilowatt Trans…
- T-ASH-G2-100, Ashcroft Gauge Pressure Sensor 100 psig
- T-ASH-G2-200, Ashcroft Gauge Pressure Sensor 200 psig
- T-ASH-G2-500, Ashcroft Gauge Pressure Sensor 500 psig
- T-CDI-5200-10S, Compressed Air Flow Sensor
- T-CDI-5400-20S, Compressed Air Flow Sensor
- <No sensor attached>

Logging Interval:

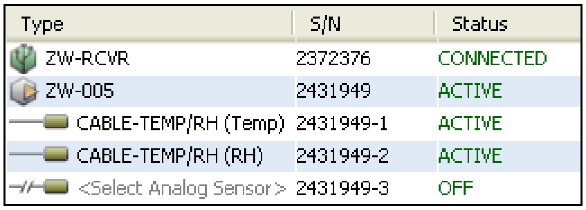
Connection Interval: ● 10 Minutes ○ 0 Hr 10 Min 0 Sec

Changing the intervals applies to all sensors on this node

Default logging and connection intervals can be set in Preferences

3. Make any other changes as necessary and click OK.

The HOBOnode Manager device table will then change the status for that external sensor to OFF as shown below. Any plots and alarms associated with that sensor will also be removed from HOBOnode Manager.



Type	S/N	Status
ZW-RCVR	2372376	CONNECTED
ZW-005	2431949	ACTIVE
CABLE-TEMP/RH (Temp)	2431949-1	ACTIVE
CABLE-TEMP/RH (RH)	2431949-2	ACTIVE
<Select Analog Sensor>	2431949-3	OFF

Shortcut: In the device table, click the checkbox next to the external sensor, then click the Sensor Type button and select the sensor from the list. This can be done for many sensors at once by selecting more than one sensor at a time in the device table.

For details on setting up a HOBO data node with an external sensor for the first time, see Setting Up an External Sensor. For details on scaling sensor data, see Configuring Scaling on a Sensor.

Moving or Removing a Data Node

If you will not be using a data node for an extended period of time, you may want to deactivate it to stop measurements and save batteries. To deactivate a data node, use a paper clip to press the Activate button as shown in the photo below for 5 seconds until the red LED starts flashing.

To later reactivate the data node, select Form Network from HOBOnode Manager and briefly depress the Activate button on the node.

If you do not want a data node to appear in HOBOnode Manager, double-click the device row in the Device Table and then click Remove Node in the Configure Node window.

If you move a data node to a new location, make sure the green LED is still blinking once per 10 seconds to indicate that the node still has a connection to the receiver. If the red LED is blinking, the connection path is broken. Try adjusting the orientation of the data node or moving it closer to the receiver to minimize obstructions. You may need to add a router to re-establish a connection.

If moving a data node changes the primary power source, see the following:

- Switching from AC Power to Battery Power
- Switching from Battery Power to AC Power

Converting a Router Node to an End-Point Node (Switching from AC Power to Battery Power)

If you initially power up a node using an AC adapter, it will operate as a router node. If you need to convert the router node into an end-point node that operates on battery power only, follow this procedure.

1. Deactivate the data node by pressing the reset button on the data node with a paper clip until the red LED starts flashing repeatedly (about 5 seconds).
2. Disconnect the data node from AC power.
3. If batteries are installed, remove them.
4. Wait at least 30 seconds to clear the memory.
5. Reinstall the batteries. Do not plug in the AC adapter.
6. Click Form Network in HOBOnode Manager.
7. Press the reset button with a quick 1-second push to reactivate the data node.
8. Verify that the data node appears in the HOBOnode Manager table and is identified as a node (no routing capabilities). See Determining Data Node Type.

Converting an End-Point Node to a Router Node (Switching from Battery Power to AC Power)

If you initially power up a node using batteries, it will operate as an end-point node with no routing capabilities. If you need to convert the end-point node into a router node that operates on AC power, follow this procedure so that HOBOnode Manager recognizes the data node as having routing capabilities.

1. Deactivate the data node by pressing the reset button on the data node with a paper clip until the red LED starts flashing repeatedly (about 5 seconds).
2. Remove the batteries from the data node.
3. Wait at least 30 seconds to clear the memory.
4. Plug the data node into an AC power outlet.
5. Click Form Network in HOBOnode Manager.
6. Press the reset button with a quick 1-second push to reactivate the data node.
7. Verify that the data node appears in the HOBOnode Manager table and is identified as a router. See Determining Data Node Type.
8. Reinstall the batteries for backup purposes.

Database Backup and Restore

It is recommended that you periodically back up your database to secure your data in case of a database failure. You can back up your database to an external hard drive or network server using third-party backup software.

If you should ever need to restore your database, simply replace the primary database with the backup.

Important: The database must be closed during a backup or restore. Before copying or restoring a database, close HOBOware, HOBOnode Manager, and Device Communication. Right-click (Windows) or left-click (Macintosh) the HOBOware system tray icon and select Stop Device Communication.

The database is stored at the following location:

- Windows 7 and Windows 8

c:\Users\<user name>\AppData\Local\OnsetComputerCorporation\cosmos\db

- Windows XP

c:\Documents and Settings\<user name>\Application Data\OnsetComputerCorporation\cosmos\db

- Mac OS 10.5 and 10.6

/Users/<user name>/Documents/OnsetComputerCorporation/cosmos/db

To rename the database, modify the name of the db folder by adding the deployment location or the date (example: "db-11-10"). **Note:** HOBOnode Manager will be empty after renaming the database. You will need to form a new network.

HOBOnode Manager Database Upgrade Utility

HOBOnode Manager databases created in HOBOware 3.2.1 or earlier must be upgraded with the HOBOnode Manager Database Upgrade Utility to improve performance and response time. This utility is automatically opened the first time you access the HOBOnode Manager database in HOBOware 3.2.2 or later.

Before you can upgrade the database with the utility, you must first go to the data storage location to back up the database (and the entire db directory). After the backup is complete, click Start in the utility to begin the upgrade process. Progress will be displayed while the upgrade takes place.

Important: The larger your database, the longer it will take the upgrade to complete. Please be prepared for the utility to run for an hour or more. You will not be able to access any features in HOBOnode Manager or HOBOware while the utility is running. Any data recorded while the upgrade is running will be saved and available in HOBOnode Manager once the upgrade is complete. In addition, this utility requires free disk space equivalent to double the size of the current database. For example, if your database is 450 MB, then you will need at least 900 MB free disk space on the computer for the utility to complete its process. Once the upgrade is complete, the database will be close to its original size.

Creating a New Deployment

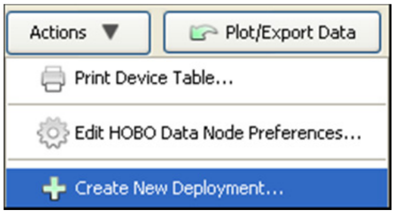
The first time you form a HOBO data node wireless network, the initial deployment, or network configuration, is created automatically for you. This first deployment can continue indefinitely. However, you also have the option to create a new deployment if you need to move your current network to a new location or if you'd like to configure a different set of sensors in a new network, for example. This allows you to more easily distinguish between two separate networks or deployments of nodes when they are plotted or exported from HOBOware.

You have the option of either creating a new deployment that is an exact copy of the previous one (all devices, alarms, and settings will be copied as currently configured) or consists of a new network (only system alarms and alarm logs are copied).

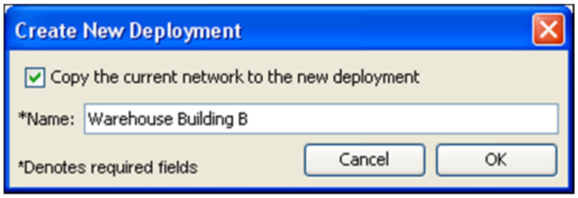
Note: Creating a new deployment does not create a new database. All data recorded in the previous deployment is saved and can be accessed through Plot/Export Data.

To create a new deployment:

1. Click the Actions button in HOBOnode Manager and select Create New Deployment.



2. Type a name for the new deployment. Select the Copy the current network to the new deployment checkbox if you want to use the current deployment as the basis for the new deployment (HOBOnode Manager will automatically be filled in with your current network devices, alarms, and settings). If you do not copy the current network, then you will need to form a new network (only system alarms and alarm logs will appear in HOBOnode Manager). Click OK.



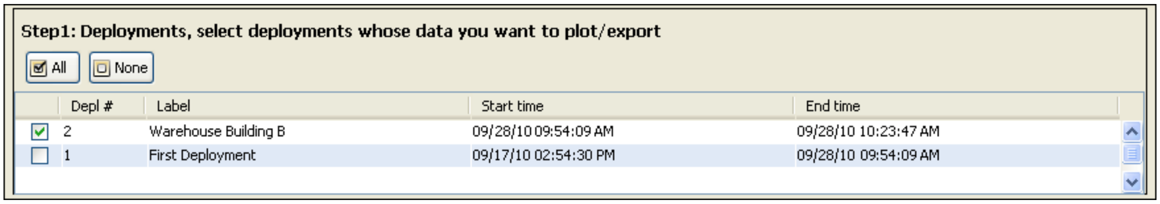
☑ Copy the current network to the new deployment

*Name: Warehouse Building B

*Denotes required fields

3. A message appears indicating that the current network deployment will end and a new deployment will be started. Click Yes to continue, or click No to return to the Create New Deployment dialog.
4. From the Device menu in HOBOware, select Manage HOBO Data Node Network to restart HOBOnode Manager.
5. If you chose to copy the current network to the new deployment, then HOBOnode Manager opens with all devices listed. Plots will begin displaying the new network data at the next scheduled connection interval. If you did not copy the old network, then you will be prompted to form a new network.

Both the newly created deployment and the previous deployment are listed in the Plot/Export Wireless Data window. Click the Plot/Export button in HOBOnode Manager to see the deployment list as shown in the example below.



Step1: Deployments, select deployments whose data you want to plot/export

	Depl #	Label	Start time	End time
☑	2	Warehouse Building B	09/28/10 09:54:09 AM	09/28/10 10:23:47 AM
☐	1	First Deployment	09/17/10 02:54:30 PM	09/28/10 09:54:09 AM

Deployments are listed from newest to oldest. The initial deployment is labeled "First Deployment" by default. Any subsequent deployments are listed with the name you entered in the Create New Deployment dialog.

The start time for the current deployment (the deployment at the top of the list) is the time the new deployment was created, which is also the end time for the previous deployment on the list.The end time for the current deployment is the current time.

Updating Firmware for a Receiver or Single Data Node

Occasional firmware updates may be necessary for the devices in your network. Follow these steps if you are directed by Onset Computer to upgrade the firmware in the receiver or a single data node. To update several data nodes in the network at once, see Updating Firmware for Multiple Data Nodes.

Important Notes Before you Begin:

- Updating the firmware generally takes two to three minutes for a receiver and four to six minutes for a data node. You cannot cancel the update process once it starts.
- If you need to update both the receiver and data nodes, update the receiver first to provide the best network performance. After the receiver update is complete, wait for HOBOnode Manager to display the latest data from all the nodes. Once each node has communicated with the newly updated receiver and the latest data appears in the device table, then you can continue with updating the firmware in the nodes.
- When updating the receiver firmware, the entire network will automatically shut down and restart.
- A data node should be powered the same way as it was when it was originally configured to ensure it remains a part of the network once the update is complete. This means a router node must be plugged into an AC adapter and an end-point data node must have batteries installed and not be plugged into an AC adapter. See Determining Data Node Type for details on identifying routers and end-point nodes in HOBOnode Manager.

To update firmware:

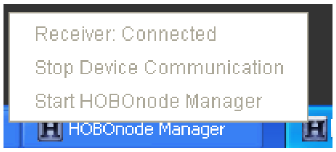
1. Place the firmware .hex file(s) in the appropriate directory. Do not rename the files.

   For Windows 7 and Windows 8: C:\Users\Public\Documents\HOBOware Public Files\FWUpdates

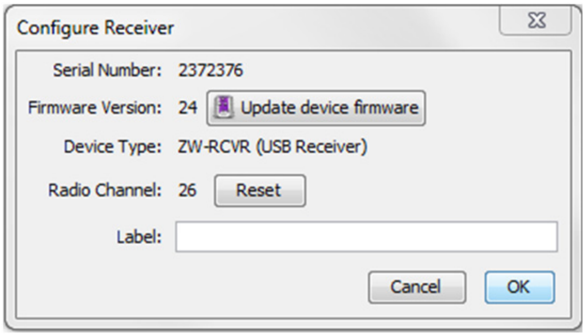
   For Windows XP: C:\Documents and Settings\All Users\Shared Documents\HOBOware Public Files\FWUpdates

   For Macintosh: /Users/<user>/Documents/HOBOware/FWUpdates

2. HOBOware, HOBOnode Manager, and ZW Device Communication must be restarted to correctly identify the firmware files. Close HOBOware and HOBOnode Manager if open. If prompted to leave the device communication running in the background, click No. If HOBOware and HOBOnode Manager were already closed, but device communication was running, right-click (or left-click on a Mac) the HOBOware icon in the system tray select Stop Device Communication.



3. Open HOBOware and HOBOnode Manager again. Wait for new data to be updated in HOBOnode Manager.
4. In HOBOnode Manager, double-click the receiver (ZW-RCVR) or node you want to update in the Device Table (or select the receiver or node and click Configure).
5. Click the "Update device firmware" button in the Configure Receiver or Configure Node window (Configure Receiver is shown in the following example).


Configure Receiver

Serial Number: 2372376

Firmware Version: 24

Device Type: ZW-RCVR (USB Receiver)

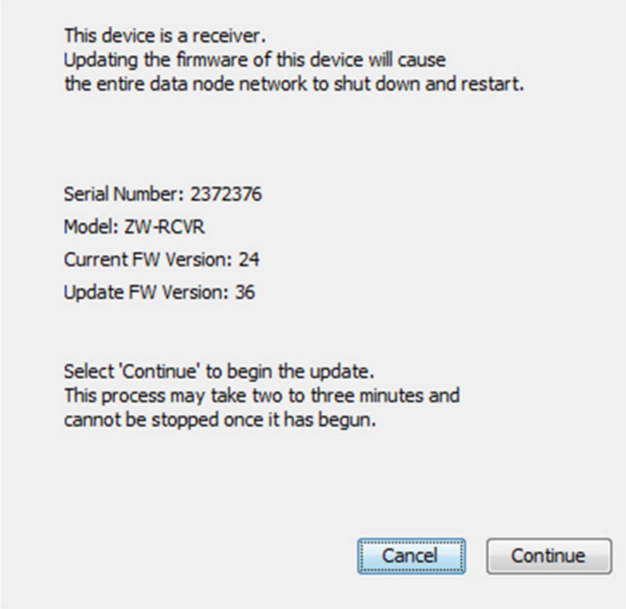
Radio Channel: 26

Label:

Notes:

- If the "Update device firmware" button is disabled, HOBOnode Manager is still being updated after its restart. Keep the Configure window open and wait for a few more minutes for the button to become enabled.
- If the "Update device firmware" button does not appear, double-check that the firmware .hex file is in the correct directory as described in Step 1.
- A battery-powered end-point node with a current firmware version of 64 must be temporarily converted to an AC-powered router node before you can update the firmware. If a message displays indicating you cannot complete the update, follow the steps in Converting an End-Point Node to a Router Node first and then repeat Steps 2 and 3 again.

6. A message appears listing details about the device and any notes about the update process. Click Cancel if you do not want to update the device at this time. Otherwise, click Continue.

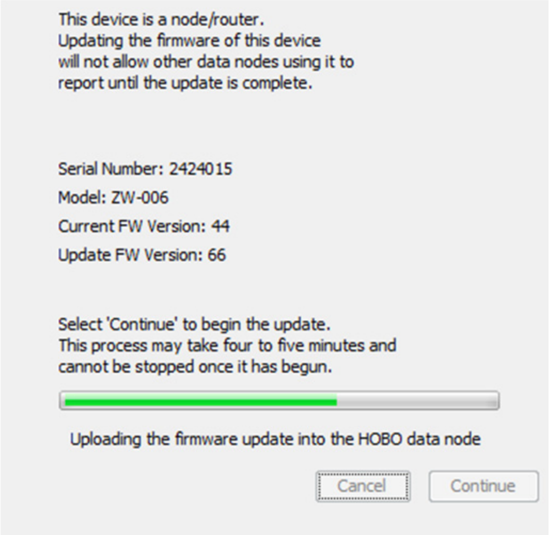


This device is a receiver.
Updating the firmware of this device will cause
the entire data node network to shut down and restart.

Serial Number: 2372376
Model: ZW-RCVR
Current FW Version: 24
Update FW Version: 36

Select 'Continue' to begin the update.
This process may take two to three minutes and
cannot be stopped once it has begun.

7. The firmware is updated in the device; check the progress on the screen during the update as shown in the following example of a node being updated.



This device is a node/router.
Updating the firmware of this device
will not allow other data nodes using it to
report until the update is complete.

Serial Number: 2424015
Model: ZW-006
Current FW Version: 44
Update FW Version: 66

Select 'Continue' to begin the update.
This process may take four to five minutes and
cannot be stopped once it has begun.

Uploading the firmware update into the HOBO data node

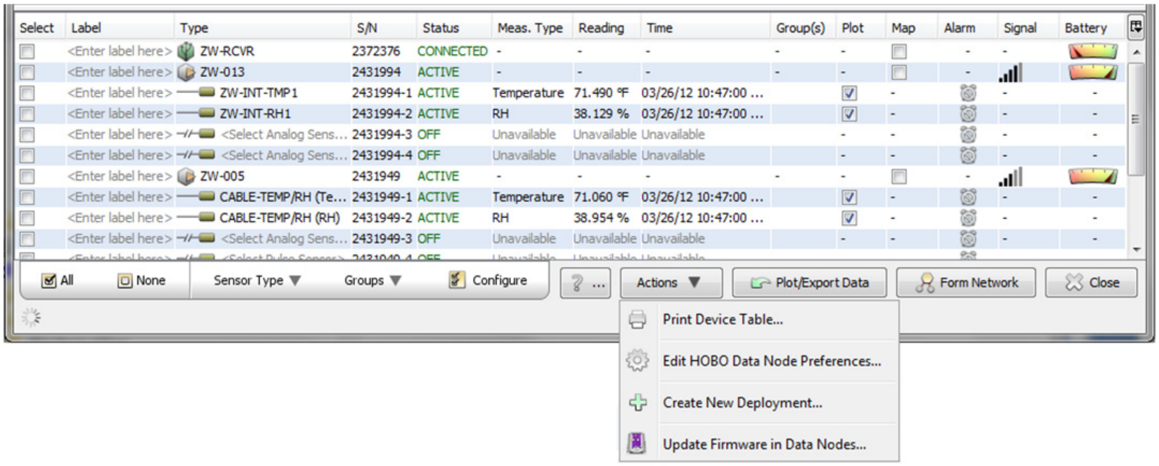
When the firmware is saved to the device, the LED will flash red on the receiver and green on a data node. A message appears at the end when the update is successfully completed.

Notes:

- After a data node has been updated, it may to take one or two connection intervals before new data is displayed in HOBOnode Manager. For example, if the connection interval is set for 10 minutes, it may take two connection intervals, or about 20 minutes, for new data to appear. If new data still isn't appearing after two connection intervals have passed, power cycle the data node (unplug the adapter and/or remove the batteries then plug the adapter back in and/or reinstall the batteries).
- If HOBOnode Manager still is not displaying data after power cycling the data node as described above or if the data node is listed as missing in HOBOnode Manager after updating the firmware, add it back to the network by following these steps:
    1. Click the Form Network button in HOBOnode Manager.
    2. Press the reset button with a quick 1-second push to reactivate the data node.
    3. Verify that the data node appears in the HOBOnode Manager table and is identified as a router or data node as expected (see Determining Data Node Type). To change the type of data node, see Converting an End-Point Node to a Router Node or Converting a Router Node to an End-Point Node.

Updating Firmware for Multiple Data Nodes

Occasional firmware updates may be necessary for the data nodes in your network. If new versions of firmware files are detected in the HOBOware FWUpdates directory (exact location described below), then an Update Firmware in Data Nodes option appears in the Actions drop-down menu in HOBOnode Manager as shown below.



Select	Label	Type	S/N	Status	Meas. Type	Reading	Time	Group(s)	Plot	Map	Alarm	Signal	Battery
☐	<Enter label here>	ZW-RCVR	2372376	CONNECTED	-	-	-	-	-	☐	-	-	🔋
☐	<Enter label here>	ZW-013	2431994	ACTIVE	-	-	-	-	-	☐	-	📶	🔋
☐	<Enter label here>	ZW-INT-TMP1	2431994-1	ACTIVE	Temperature	71.490 °F	03/26/12 10:47:00 ...		☑	-	⏰	-	-
☐	<Enter label here>	ZW-INT-RH1	2431994-2	ACTIVE	RH	38.129 %	03/26/12 10:47:00 ...		☑	-	⏰	-	-
☐	<Enter label here>	<Select Analog Sens...	2431994-3	OFF	Unavailable	Unavailable	Unavailable		-	-	⏰	-	-
☐	<Enter label here>	<Select Analog Sens...	2431994-4	OFF	Unavailable	Unavailable	Unavailable		-	-	⏰	-	-
☐	<Enter label here>	ZW-005	2431949	ACTIVE	-	-	-	-	-	☐	-	📶	🔋
☐	<Enter label here>	CABLE-TEMP/RH (Te...	2431949-1	ACTIVE	Temperature	71.060 °F	03/26/12 10:47:00 ...		☑	-	⏰	-	-
☐	<Enter label here>	CABLE-TEMP/RH (RH)	2431949-2	ACTIVE	RH	38.954 %	03/26/12 10:47:00 ...		☑	-	⏰	-	-
☐	<Enter label here>	<Select Analog Sens...	2431949-3	OFF	Unavailable	Unavailable	Unavailable		-	-	⏰	-	-

Follow these steps if you are directed by Onset Computer to upgrade the firmware in multiple data nodes. To update the firmware in the receiver or in a single data node at a time, see Updating Firmware for a Receiver or Single Data Node.

Important Notes Before you Begin:

- Firmware .hex files must be present in the appropriate directory. (Do not rename the files.)

  For Windows 7 and Windows 8: C:\Users\Public\Documents\HOBOware Public Files\FWUpdates

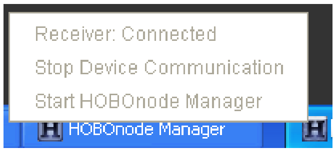
  For Windows XP: C:\Documents and Settings\All Users\Shared Documents\HOBOware Public Files\FWUpdates

  For Macintosh: /Users/<user>/Documents/HOBOware/FWUpdates

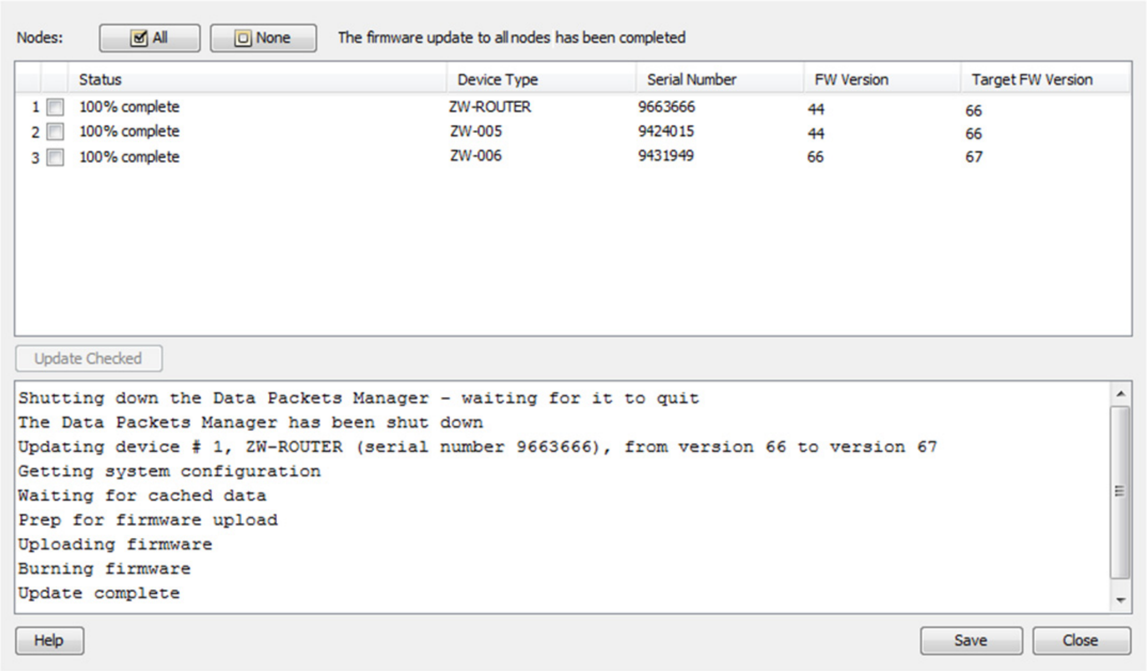
- If you need to update the firmware in both the receiver and data nodes, update the receiver first for best network performance. Follow the steps in Updating Firmware for a Receiver or Single Data Node. After the receiver update is complete, wait for HOBOnode Manager to display the latest data from all the nodes. Once each node has communicated with the newly updated receiver and the latest data appears in the device table, then you can continue with updating the firmware in data nodes.
- A data node should be powered the same way as it was when it was originally configured to ensure it remains a part of the network once the update is complete. This means a router node must be plugged into an AC adapter and an end-point data node must have batteries installed and not be plugged into an AC adapter.
- A battery-powered end-point node with a current firmware version of 64 must be temporarily converted to an AC-powered router node before you can update the firmware. These nodes will not be displayed in the list of data nodes waiting for an update. Follow the steps in Converting an End-Point Node to a Router Node first, then update the firmware in each of these nodes one at time as described in Updating Firmware for a Receiver or Single Data Node.
- Although data will continue to be transmitted and stored in the receiver while this upgrade takes place, it will not be available in HOBOnode Manager until after the upgrade is complete. Therefore, select a time to perform the upgrade when you do not need real-time access to your data.
- Nodes may be temporarily reported as missing after being upgraded. If you have enabled the Missing Node alarm for any nodes in your network, consider only upgrading a few nodes at a time to minimize the potential for nodes to be reported as missing and the Missing Node alarm to trip.

Steps

1. Once the firmware .hex files are in the correct location as described in the Important Notes Before you Begin, you must restart HOBOware, HOBOnode Manager, and Device Communication. Close HOBOware and HOBOnode Manager if open. If prompted to leave the device communication running in the background, click No. If HOBOware and HOBOnode Manager were already closed, but device communication was running, right-click (or left-click on a Mac) the HOBOware icon in the system tray select Stop Device Communication.



2. Open HOBOware and HOBOnode Manager again. Wait for new data to be updated in HOBOnode Manager.
3. From the Actions menu in HOBOnode Manager, click Update Firmware in Data Nodes. If this option does not appear in the menu, wait for a few more minutes for HOBOnode Manager to finish updating in Step 2. If it still does not display, double-check that the firmware .hex files are in the correct directory and repeat Steps 1 through 3 again.
4. A list of all nodes waiting to be updated is displayed. Click the checkbox next to each node you want to update or click Select All to choose all the nodes in the list.
5. Click the Updated Checked button to start the update process for all the nodes selected in the list. Each node will be updated one by one, with the progress displayed next to the node and a detailed progress listed in the bottom pane of the window. **Important:** Clicking Cancel will not immediately stop all updating. When you click Cancel, the node update in progress will continue until finished. The Cancel button will also change to read "Cancel requested." Once the update is complete for that node, the update for the remaining nodes will be canceled. Click the Update button to restart the update process for the remaining nodes.



The firmware update to all nodes has been completed

	Status	Device Type	Serial Number	FW Version	Target FW Version
1 ☐	100% complete	ZW-ROUTER	9663666	44	66
2 ☐	100% complete	ZW-005	9424015	44	66
3 ☐	100% complete	ZW-006	9431949	66	67

```
Shutting down the Data Packets Manager - waiting for it to quit
The Data Packets Manager has been shut down
Updating device # 1, ZW-ROUTER (serial number 9663666), from version 66 to version 67
Getting system configuration
Waiting for cached data
Prep for firmware upload
Uploading firmware
Burning firmware
Update complete
```

6. Once the update is complete, click the Save button to save the log detailing the update procedure to a text file called "FirmwareUpdateLog.txt" (saved in C:\Users\<User Name>\Documents on Windows and in the <User Name> folder on Mac). Click Close to return to HOBOnode Manager.

Notes:

- After a data node has been updated, it may to take one or two connection intervals before new data is displayed in HOBOnode Manager. For example, if the connection interval is set for 10 minutes, it may take two connection intervals, or about 20 minutes, for new data to appear. If new data still isn't appearing after two connection intervals have passed, power cycle the data node (unplug the adapter and/or remove the batteries then plug the adapter back in and/or reinstall the batteries).
- If HOBOnode Manager still is not displaying data after power cycling the data node as described above or if the data node is listed as missing in HOBOnode Manager after updating the firmware, add it back to the network by following these steps:
  1. Click the Form Network button in HOBOnode Manager.
  2. Press the reset button with a quick 1-second push to reactivate the data node.
  3. Verify that the data node appears in the HOBOnode Manager device table and is identified as a router or data node as expected (see Determining Data Node Type). To change the type of data node, see Converting an End-Point Node to a Router Node or Converting a Router Node to an End-Point Node.

Troubleshooting

General Network Connection Issues

If you are having problems connecting data nodes to the receiver, or they are losing a connection after they have been joined to the network, you may be experiencing issues with a conflicting wireless device. To reset the radio channel, double-click the receiver row in the Device Table and in the Configure Receiver window click the Reset button. You will then need to form the network again.

Receiver Will Not Connect to HOBOnode Manager

Make sure the USB plug is secure on both ends. Try unplugging and plugging the receiver back in.

Data Node Cannot Join Network

Positioning: If you are having trouble getting a data node to join the network, try repositioning the node within the space. Move the data node away from any obstacles (such as metal walls, stairwells, elevator shafts) that may exist between it and the receiver.

Distance: The data node may be too far from the receiver to obtain a signal. Try moving the data node closer to the receiver, or add a router or router/node between the data node and the receiver.

Make sure the receiver is in Form Network mode (RED and GREEN LEDs alternating).

Make sure you have pressed the button on the bottom of the node and that the RED and GREEN LEDs are alternating. Try pressing the button again.

Debugging

There are a number of debugging and logging options in HOBOnode Manager. If you are working with Onset Technical Support on an issue, you may be asked to enable debugging options and send a log file to Onset.

No readings for a sensor

For external sensors, make sure the connection to the data node is secure and that you have assigned a Sensor Type (does not apply to the External Temp/RH Sensor).

No Plot Appears for a Sensor

Make sure you have checked the Plot box in the Device Table for the sensor.

Extreme Sensor Readings

If you are seeing extreme sensor readings, make sure the sensor cable is securely plugged into the node.

Alarms

If an alarm you configured is not appearing in the Alarms window, make sure the filter is set to Show all.

Security Connection Messages on Macintosh

If the firewall setting is enabled in the security system preferences on a Macintosh, you may encounter a security warning message every time you open HOBOnode Manager. To turn off this message, go to System Preferences, select Security, and turn off the firewall. **Note:** Keeping the firewall turned on and adjusting the advanced settings to allow all incoming connections for HOBOware does not resolve the problem.

Firewall Messages on Windows

Windows Firewall must allow access to HOBOware.exe for HOBOnode Viewer to run properly. To allow HOBOware access, open Control Panel, go to Security, and select Allow a program through Windows Firewall (or click Windows Firewall and click the Exceptions tab on some versions of Windows). Make sure HOBOware is selected in the allowed access/exceptions list.

Changing Locale

The language in use at the time the original HOBO data node network database was created is the only language that can be used for that database. You cannot switch to another language. If you need to change the locale on the computer that contains your HOBO data node network database, you will need to:

1. Back up and then move or rename the database.
2. Change the locale on the computer.
3. Form a new network to create a database that operates in the new locale.

Chapter 7

Reference

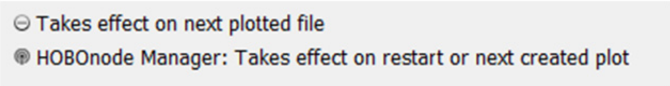
- Setting Preferences
- Menus
- The Toolbar
- Tips for Working with Multiple Loggers
- Setting the Language Format on Your Computer
- Alarm & Readout Tool

Setting Preferences

You can change the default behavior of HOBOware in the categories listed below. Preference settings are unique for each user login on your computer. The following categories are available:

- **General**. Set preferences for Launch Time-Savings Options, Readout Time-Savings Options, Open File Time-Saving Options, Export Settings, Selecting Devices, File Associations, Startup, Data Verification, and Data Encoding.
- **Communications**. Set preferences for Device Types , Serial Ports, Device Speeds, and Other Options.
- **Plotting**. Set preferences for Fonts, Lines, Value Axis, Layout, Points Table and Details Pane, Gridlines, Plot Setup, Other Options, Undo & Redo.
- **Data Assistants**. Set show/hide preferences for HOBOware Pro Data Assistants.
- **Display**. Set preferences for Default Unit System, Date/Time, and Series.
- **Warnings**. Set preferences for various warning types.
- **Data Nodes**. Set preferences for HOBOnode Manager, including General, Alarms, Real-Time Plots, Data Storage, and Sharing (HOBOware Pro only).
- **Alarms**. Set preferences for the Alarms & Readout Tool, including Alarm Conditions, Readouts, Notifications, Messages, and Warnings (HOBOware Pro only). **Important:** The Alarm & Readout Tool is no longer installed with HOBOware as of version 3.4. Information in the help system is included for reference only for existing Alarm & Readout Tool users.
- **Bulk Export**. Set YAML preference for Bulk Export Tool (HOBOware Pro only).

Some preferences have one of the following icons next to them, indicating a difference in behavior between HOBOware and HOBOnode Manager (HOBOware Pro only).



⊖ Takes effect on next plotted file

● HOBOnode Manager: Takes effect on restart or next created plot

You can save preference settings and reload them as needed (HOBOware Pro only). Click the Save Preferences button at the top of the Preferences window and type a name in the pop-up field to save all currently selected preferences. You can then click the Load Preferences button and select the name you typed in to load those preference settings back into the Preferences window.

See also:

- Restoring Default Preferences

General Preferences

Use the General category within Preferences to control a variety of HOBOware behavior, including launching, reading out, opening files, exporting, selecting devices, and more.

To change these settings:

1. From the File menu on Windows or the HOBOware menu on Macintosh, select Preferences.
2. Select the General category on the left and then click the subcategory you wish to change.
3. Adjust any of the settings described below and then click OK.

Launch Time-Saving Options (HOBOware Pro only)

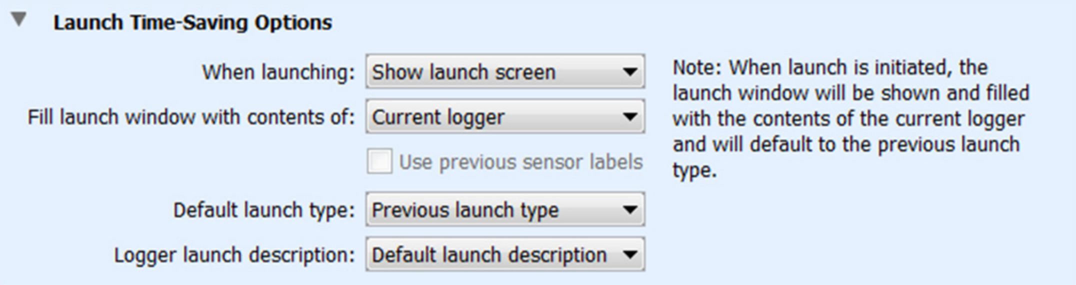
- **When launching.** Select "Show launch screen" to display the Launch Logger window when you select Launch from the Device menu or click the Launch icon on the toolbar, or select "Automatically launch" to bypass this window and launch the logger with the default settings. Selecting "Automatically launch" is particularly useful if you want to launch several loggers quickly without changing any settings. The default settings are determined by the "Fill launch window with contents of" preference.

  For HOBOware Pro only: If you select "Automatically launch" and also set the Default Action from the Device menu to Launch, this feature allows you to launch several U-Series loggers in a row simply by connecting and disconnecting each logger to the computer.

- **Fill launch window with contents of.** Select "Current logger" to show the logger's most recent launch settings (as stored in the logger memory) in the Launch Logger window. Select "Previous launch" to show the same settings used in the most recent launch. This is helpful if you want to launch several loggers of the same type with similar settings or if you want to set up several loggers to start at the same time with the same logging interval. An indicator on the Launch Logger window will remind you when this preference is use. Note that "Previous launch" does not apply if you are launching different types of loggers; instead the settings in the logger's memory will be used. When "Previous launch" is selected, you also can select the "Use previous sensor labels" checkbox to automatically fill any sensor label fields with the labels from the previous launch.

- **Default launch type.** This preference controls what displays by default in the "Start logging" field in the Launch Logger window"Previous launch type" is selected, then the "Start logging" field will display the same setting used for the logger's last launch. For example, if the logger was last configured to start logging "Now" selected, then the "Start logging" field will default to "Now" for the next launch. Note that if the previous launch was set to start "At interval," the "Start logging" field will default to start "On Date/Time." If "Launch now," "Launch at interval," "On specified date/time," or "Button or coupler start" is selected, then that launch type will automatically be selected in the "Start logging" field in the Launch Logger window regardless of how the logger was previously launched. Note that if you choose "Button or coupler start" and the logger does not support that feature, then the "Start logging" field will default to "Now." **Important:** If you set the "Fill launch window with contents of" preference to "Previous launch," then the "Default launch type" preference will be ignored in favor of the "Start logging" setting used in the last launch.

- **Logger launch description.** This preference controls what displays by default in the Description field in the Launch Logger window. If you select "Default launch description," then the Description field will display the description used the last time the logger was launched. If you select "Logger S/N," then the logger serial number will automatically be listed in the Description field. Selecting "Logger S/N" can help to easily differentiate files when launching and reading out several loggers of the same type. Note that whatever is listed in the Description field is also used as the default file name when reading out and saving the logger data.



When launching: Show launch screen

Fill launch window with contents of: Current logger

☐ Use previous sensor labels

Default launch type: Previous launch type

Logger launch description: Default launch description

Note: When launch is initiated, the launch window will be shown and filled with the contents of the current logger and will default to the previous launch type.

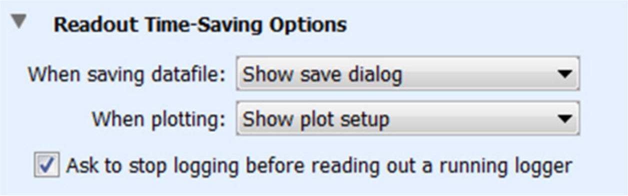
Readout Time-Saving Options (HOBOware Pro only)

- **When saving datafile.** This preference controls whether the Save window displays automatically when reading out a file. Select "Show save dialog" if you want the Save window to display every time you read out a logger and specify a location and name for the file, or accept the default file name. Select "Automatically save" if you do not want to display the Save window during the readout process. The file will automatically be saved with the default name (the description in the Launch Logger window) and in the default location (as described in Reading Out the Logger).

- **When plotting.** This preference controls the default plot behavior when reading out a logger. Select "Show plot setup" to display the Plot Setup window after reading out and saving the file. Select "Automatically plot" if you want to bypass the Plot Setup window and instead automatically plot the data after reading out and saving the file. This option is not recommended if you will be using Data Assistants, which are accessed through the Plot Setup window. Select "Do not plot" if you do not want to plot the data at all. This is useful if you are reading out several loggers and prefer to look at the plots later. You can always open the saved datafile and plot it at that time.

  For HOBOware Pro only: You can adjust the Readout Time-Saving Options and set the Default Action from the Device menu to Readout to quickly read out several U-Series loggers in a row by connecting and disconnecting each logger to the computer. To do this choose "Automatically save" for "When saving datafile," choose "Do not plot" for "When plotting," and deselect the "Ask to stop logging before reading out a running logger" checkbox.

- **Ask to stop logging before reading out a running logger.** When this checkbox is selected, a message appears every time you read out a logger that is still recording data. The message asks whether you want to stop the logger or let it continue logging data during the readout process. If you deselect this checkbox, a logger that is still recording data will automatically continue logging during readout.



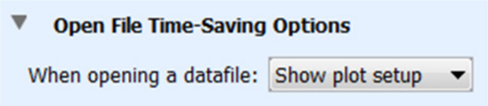
When saving datafile: Show save dialog

When plotting: Show plot setup

☑ Ask to stop logging before reading out a running logger

Open File Time-Saving Options (HOBOware Pro only)

This preference controls whether the Plot Setup window is automatically displayed when opening a file. Select "Show plot setup" if you want the Plot Setup window to display every time you open a file. Select "Automatically plot" if you want to bypass the Plot Setup window and automatically generate the plot each time you open the file. This is not recommended if you will be using Data Assistants, which are accessed through the Plot Setup window.



Open File Time-Saving Options

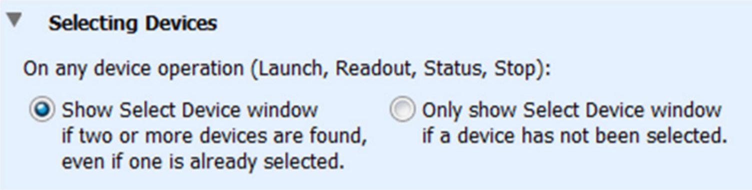
When opening a datafile: Show plot setup

Export Settings

See Export Settings for details on the preferences in this subcategory.

Selecting Devices

This preference controls when the Select Device window is displayed. If you select "Show Select Device window if two or more devices are found, even if one is already selected," then the Select Device window will display any time more than one device is connected to the computer. This allows you to choose the device you want to work with any time you select Launch, Readout, Status, or Stop from the Device menu. If you select "Only show Select Device window if a device has not been selected," then the Select Device window will only display the first time you select Launch, Readout, Status, or Stop. That device will then remain selected until you change it with the Select Device icon on the toolbar.



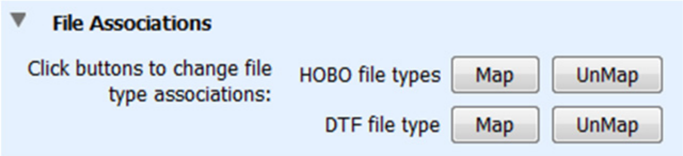
Selecting Devices

On any device operation (Launch, Readout, Status, Stop):

● Show Select Device window if two or more devices are found, even if one is already selected.

○ Only show Select Device window if a device has not been selected.

File Associations



File Associations

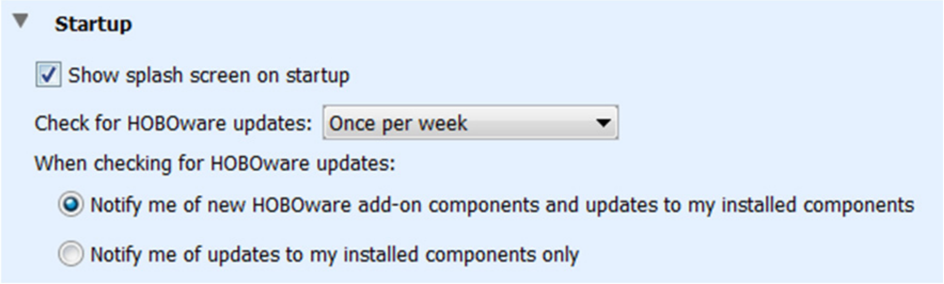
Click buttons to change file type associations:

Use this preference to control the association of HOBOware file types on Windows. **Note:** You must have administrator privileges on the computer to change file type associations. To temporarily run HOBOware as an Administrator, right-click the HOBOware icon and select Run as Administrator. Enter the Administrator name and password as prompted.

By default, files with the extensions of .hobo, .hsec, and .hproj (HOBO files) and .dtf and .dsec (DTF files; HOBOware Pro only) are automatically associated with HOBOware. This means that these files are identified by a HOBOware icon and can be opened by double-clicking them. Click the Map or UnMap buttons to change the file type associations.

Startup

- **Show splash screen on startup.** This preference controls whether the HOBOware graphic, or splash screen, appears every time you open the software.
- **Check for HOBOware updates.** This setting controls how frequently, if it all, HOBOware automatically checks the Onset website for any software updates. The default setting is once per week.
- **When checking for HOBOware updates (HOBOware Pro only).** These settings control whether you are notified about all new software updates or only those that affect the currently installed components. The default is to check for any new updates.



☑ Show splash screen on startup

Check for HOBOware updates: Once per week

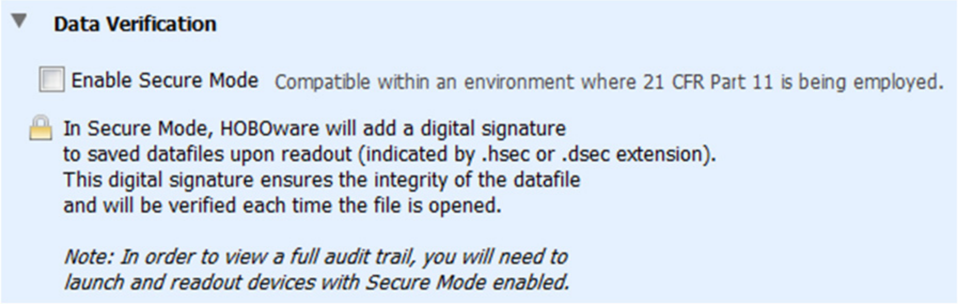
When checking for HOBOware updates:

● Notify me of new HOBOware add-on components and updates to my installed components

○ Notify me of updates to my installed components only

Data Verification (HOBOware Pro Only)

Select this option to enable Secure Mode and have HOBOware Pro add a digital signature to new datafiles when you read out loggers (for environments where 21 CFR Part 11 is being employed). The digital signature is indicated by a filename extension of .hsec for hobo files and .dsec for dtf files. The signature will be verified each time you open the datafile to ensure its integrity. This option is disabled off by default.



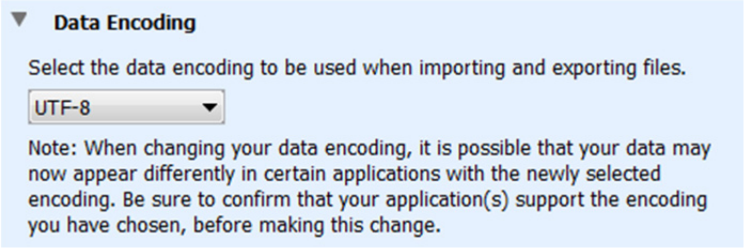
☐ Enable Secure Mode Compatible within an environment where 21 CFR Part 11 is being employed.

In Secure Mode, HOBOware will add a digital signature to saved datafiles upon readout (indicated by .hsec or .dsec extension). This digital signature ensures the integrity of the datafile and will be verified each time the file is opened.

Note: In order to view a full audit trail, you will need to launch and readout devices with Secure Mode enabled.

Data Encoding

Data encoding controls how special characters are displayed in files that are imported into and exported from HOBOware. The default is to use UTF-8, a common character encoding protocol for software. Select "Windows default" if characters are not displaying correctly in imported and exported files in Windows.



Select the data encoding to be used when importing and exporting files.

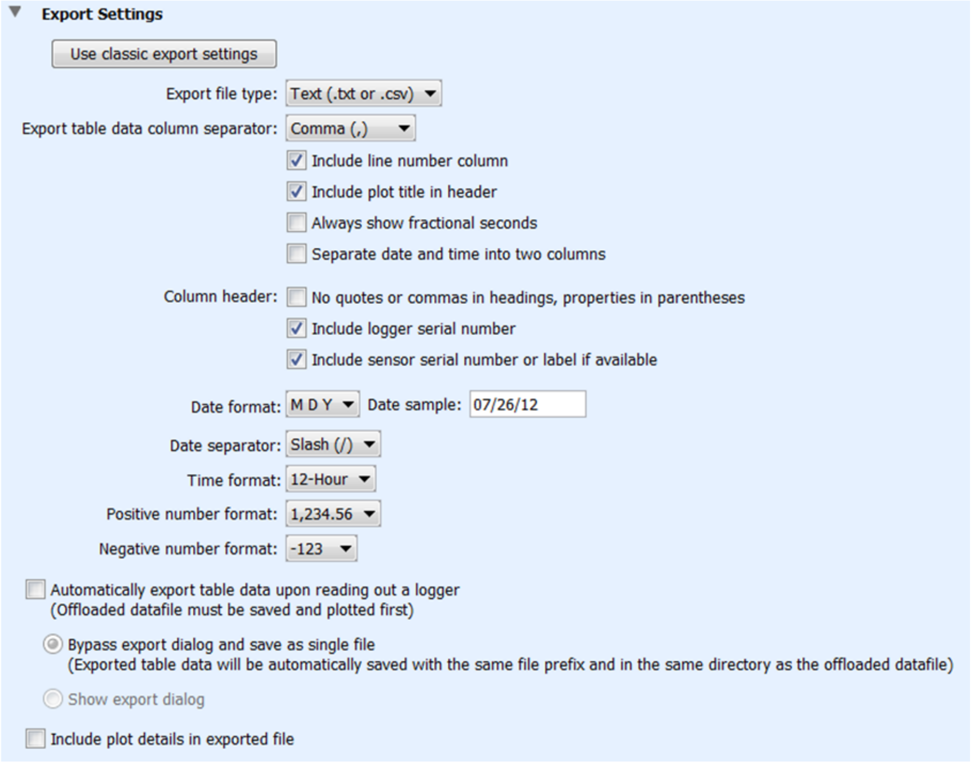
UTF-8

Note: When changing your data encoding, it is possible that your data may now appear differently in certain applications with the newly selected encoding. Be sure to confirm that your application(s) support the encoding you have chosen, before making this change.

Export Settings

Use the Export Settings preferences to customize how data is formatted when you export the table data from a plotted HOBOware file, to set up automatic export upon readout, to include plot details in an exported file, and to set export ordering rules. To access these settings:

1. From the File menu on Windows or the HOBOware menu on Macintosh, select Preferences.
2. Select the General category and then click Export Settings.
3. Adjust any of the settings described below and then click OK.



Export file type: Text (.txt or .csv)

Export table data column separator: Comma (,)

☑ Include line number column

☑ Include plot title in header

☐ Always show fractional seconds

☐ Separate date and time into two columns

Column header: ☐ No quotes or commas in headings, properties in parentheses

☑ Include logger serial number

☑ Include sensor serial number or label if available

Date format: M D Y Date sample: 07/26/12

Date separator: Slash (/)

Time format: 12-Hour

Positive number format: 1,234.56

Negative number format: -123

☐ Automatically export table data upon reading out a logger
(Offloaded datafile must be saved and plotted first)

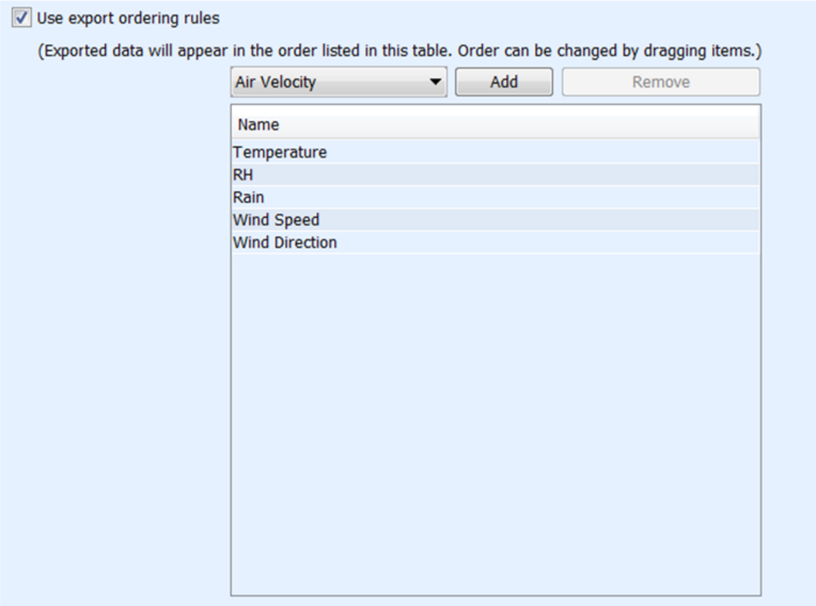
● Bypass export dialog and save as single file
(Exported table data will be automatically saved with the same file prefix and in the same directory as the offloaded datafile)

○ Show export dialog

☐ Include plot details in exported file

- **Use classic export settings.** Click this button to change the export settings to the default settings used with BoxCar Pro software, which is Onset legacy software released before HOBOware.
- **Export file type.** Select how you want exported data to be saved: either to a text file (.csv or .txt) or a Microsoft Excel file (.xls).
- **Export table data column separator.** This setting controls the column separator for exported text files. (If you selected Excel for the export file type, then this option is disabled.) Select Comma, Tab, or Semicolon. When Comma is selected as the column separator, the data will be saved to a .csv file that can be imported into Excel. When Tab or Semicolon is selected, the data will be saved to a .txt file.
- **Include line number column.** By default, exported files include line numbers. Uncheck this box if you do not want line numbers in the file (for example, to export in BoxCar Pro software format).
- **Include plot title in header.** Uncheck this box if you do not want the plot title included in the header of the exported file. This option is primarily for compatibility with the BoxCar Pro software format.
- **Always show fractional seconds.** Check this box to show fractional seconds in the time-stamped data points. This is primarily for compatibility with the BoxCar Pro software format.
- **Separate date and time into two columns.** By default, the date and time of a logged data point is exported as a single column to facilitate graphing in spreadsheet programs. Check this box to split the date and time into two columns.
- **No quotes or commas in headings, properties in parenthesis.** Check this box if you do not want quotations marks and commas in the exported file's column headers. Sensor properties, or units, (such as °F or RH) will be listed in parenthesis instead of quotation marks when this setting is enabled. This option is primarily for compatibility with the BoxCar Pro software format.
- **Include logger serial number.** When this setting is enabled, the logger's serial number will be listed in each column header in the exported file. This is useful if you are exporting data series that were copied and pasted from plots that originally came from different loggers.

- **Include sensor serial number, or label (if available) (HOBOware Pro only).** When this setting is enabled, each sensor's serial number or label (if available) will be listed in each column header in the exported file. This is especially useful when exporting data from multiple sensors recording the same measurement type (for example, three temperature sensors). **Note:** If "No quotes or commas in headings, properties in parenthesis" is selected, the label (if available) will be added to the column header instead of the sensor serial number.
- **Date format.** Select the format in which you want the date to be shown (Month, Day, Year; Day, Month, Year; or Year, Month, Day).
- **Date separator.** Select either a slash (/) or a dash (-) to separate the months, day, and year in the date format.
- **Time format.** Select whether to show the time in a 12-hour or 24-hour format.
- **Positive number format.** Select the format in which positive numbers are displayed (for example: 1,234.56; 1 234,56; 1.234,56; or 1.234 56).
- **Negative number format.** Select the format in which negative numbers are displayed (for example: -123, 123-, or (123).
- **Automatically export table data upon reading out a logger.** Select this option if you want HOBOware to automatically create an export file each time you read out a logger (note that you must save and plot the data before the exported file will be created). When this setting is enabled, the default option is to export the data to a single file (as controlled by "Bypass export dialog and save as single file"). This will result in an exported file saved in the same directory as the datafile offloaded from the logger. Both files will also have the same prefix. If you do not want to save it to the default directory or use the default name, then select "Show export dialog" instead to select your own directory or name.
- **Include plot details in exported file.** When this setting is enabled, the information that appears to the left of the plot in the Details pane (series information, the type of logger, deployment information, etc.) will be included in the exported file along with the sensor data. This option only applies to text (.txt or .csv) file type exports, not Excel. It also requires that the file is saved and plotted before exporting. Therefore, it is not compatible with exports done via the Bulk Export Tool or HOBOnode Manager's Data Delivery and Plot/Export Wireless Data features. Finally, select a tab or semicolon for the "export table data column separator" when using this option. If you choose a comma separator, then details may span multiple cells.
- **Use export ordering rules.** Select this option to define the order that series are listed in the Export window by default. Select the measurement type from the drop-down list and then click Add to add it to the ordering rules list. In this example, we have set the order to temperature, RH, rain, wind speed, and then wind direction. This means the Export window will always show any temperature, RH, rain, wind speed, and then wind direction series first in the list, in that order, followed by any series that were not defined in the rules. (You can override this order as needed in the Export window by clicking the column header or dragging a row.) To delete an item from the ordering rules, click the measurement type and then click Remove. To change the order of items, drag them up or down.


☑ Use export ordering rules

(Exported data will appear in the order listed in this table. Order can be changed by dragging items.)

Name
Temperature
RH
Rain
Wind Speed
Wind Direction

Communications Preferences

Use the Communications category within Preferences to set the default device type, serial port, device speed, and status window operation.

To change these settings:

1. From the File menu on Windows or the HOBOware menu on Macintosh, select Preferences.
2. Select the Communications category on the left and then click the subcategory you wish to change.
3. Adjust any of the settings described below and then click OK.

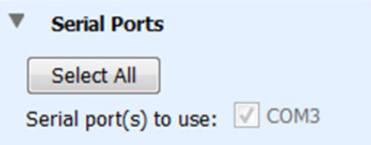
Device Types (HOBOware Pro Only)

This preference controls the type of devices HOBOware recognizes when connected to the computer: USB, serial, or both. If you only use USB loggers or serial loggers, select the corresponding preference. This will save time as HOBOware will only check the USB or serial port(s) for a connected device when selecting Launch, Readout, Status, or Stop from the Device menu. If you use both USB and serial loggers regularly, select "USB and serial devices." You can also quickly change this preference by using the pull-down menu next to the Select Device icon on the toolbar.

Select device type: ○ USB devices only
○ Serial devices only
● USB and serial devices

Serial Ports (HOBOware Pro Only)

This preference controls which serial ports you want HOBOware to check for a connected device. Click Select All to check all serial ports displayed in this list or choose specific serial ports. Note that if you want to use only one port, you can have only one serial logger connected at a time. Alternatively, checking multiple serial ports can cause slow performance even when no loggers are connected.

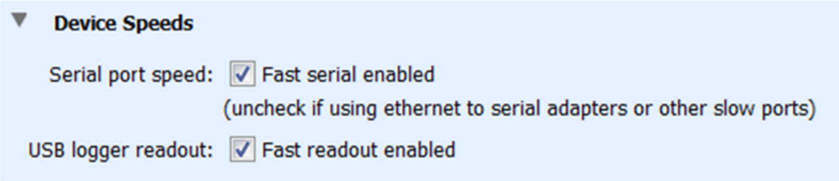


Serial port(s) to use: ☑ COM3

Device Speeds

- **Serial port speed.** Select "Fast serial enabled" (HOBOware Pro only) to read out a serial logger at a speed appropriate for most systems. Disable this option only if you are having communication problems with the logger, such as when the logger is connected via a slow serial-to-LAN bridge device. Communication between the computer and the logger is slower when this option is disabled.

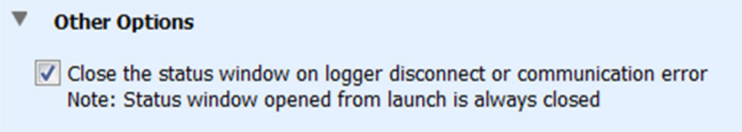
- **USB logger readout.** Select "Fast readout enabled" to read out a USB logger quickly. Disable this option only if you are having communication problems with the logger. Communication between the computer and the logger is slower when this option is disabled.



Serial port speed: ☑ Fast serial enabled
(uncheck if using ethernet to serial adapters or other slow ports)
USB logger readout: ☑ Fast readout enabled

Other Options

Select "Close the status window on logger disconnect or communication error" if you want the Status window to close automatically (on the next refresh) if it is open when you remove the interface cable, base station, or coupler from the logger, or if communication is interrupted for another reason. Deselect this option if you want to leave it open. Note that if the Status window was opened from the Launch Logger window, it will close automatically even if this option is not selected.



☑ Close the status window on logger disconnect or communication error
Note: Status window opened from launch is always closed

Plotting Preferences

Use the Plotting Preferences to control fonts, series lines, Y-axis, and several other plot elements.

To change these settings:

1. From the File menu on Windows or the HOBOware menu on Macintosh, select Preferences.
2. Select the Plotting category on the left and then click the subcategory you wish to change.
3. Adjust any of the settings described below and then click OK.

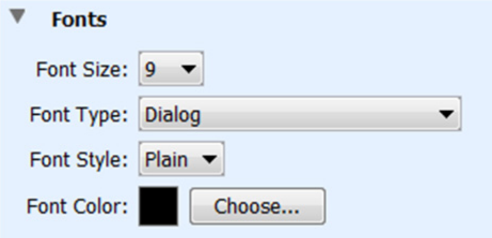
Notes:

- To apply certain preferences to a single series, double-click the series to open the Series Properties window.

- To apply changes to real-time plots in HOBOnode Manager, restart HOBOnode Manager or remove the plot for the sensor and then add it back (deselect the Plot checkbox for the sensor to remove it and then select the Plot checkbox again to add it back.

Fonts

Use the Fonts Preferences to control the font size, type, style, and color for most text on the graph (HOBOware Lite has font preferences for size only). Note that the plot title font will be two points larger than the selected font size.



Fonts

Font Size: 9

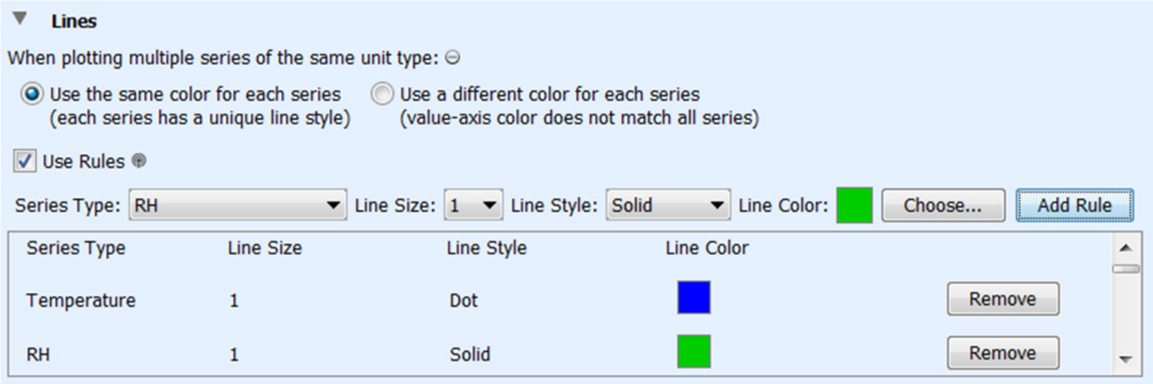
Font Type: Dialog

Font Style: Plain

Font Color: ⬛

Lines (HOBOware Pro only)

Use the lines preferences to define the appearance of lines in the plot for a specific series type. Rules added will appear in the panel at the bottom. Only one rule can be added per series type. To delete a rule, click the delete button on the row.



Lines

When plotting multiple series of the same unit type:

● Use the same color for each series (each series has a unique line style)

○ Use a different color for each series (value-axis color does not match all series)

☑ Use Rules

Series Type: RH Line Size: 1 Line Style: Solid Line Color: 🟩

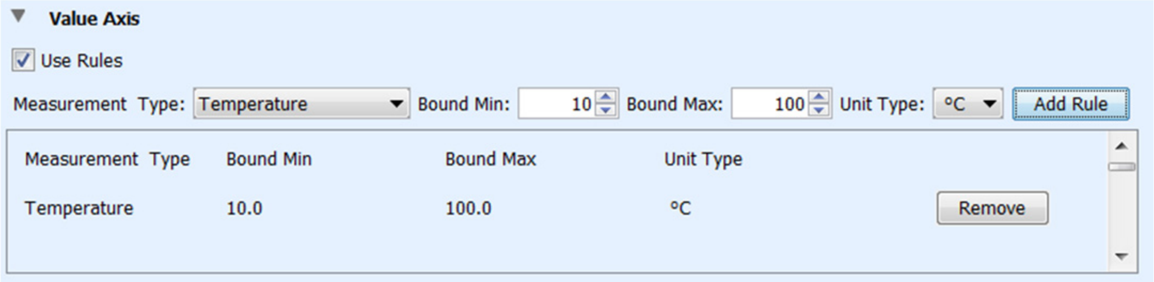
Series Type	Line Size	Line Style	Line Color	
Temperature	1	Dot	🟦	Remove
RH	1	Solid	🟩	Remove

- **When plotting multiple rules of the same type.** If "Use the same color for each series" is selected, then multiple series of the same unit type (for example, multiple temperature series) are plotted with the same color, but with different line styles (solid, dashed, dotted, etc) to differentiate them. If "Use a different color for each series" is selected, then multiple series of the same unit type will be plotted in different colors. The series will still be attached to a single, common Y-axis, but only one series will match the axis color.

- **Use Rules.** Select this box to set up rules for series lines on the plots. Then select the series type for the rule you want to set up. Select the size and style of the series line. Click the Choose button to select a line color. Click the Add Rule button to create the rule. Line size, style, and color will be applied on series lines, the corresponding Y-axis (value axis), and its corresponding representation in the legend. This rule will be overridden by any changes you make in the Series or Axis Properties window. To add another rule, select a different Series Type, choose the settings, and then click Add Rule. To delete a rule, select it and click the Remove button.

Value Axis (HOBOware Pro only)

Select the Use Rules box to set up rules about the minimum and maximum values used on the Y-axis (value axis) for a specific measurement type. Select the measurement type and then type in the minimum (Bound Min) and maximum (Bound Max) you want to use. Select the Unit Type and then click Add Rule to create the rule. This rule can be overridden by any changes you make in the Axis Properties window. To add another rule, select a different measurement type, choose the settings, and then click Add Rule. To delete a rule, select it and click the Remove button.



Value Axis

☑ Use Rules

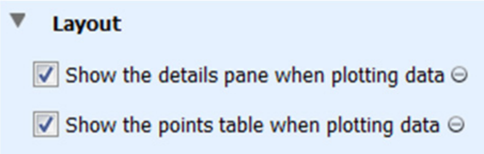
Measurement Type: Temperature Bound Min: 10 Bound Max: 100 Unit Type: °C

Measurement Type	Bound Min	Bound Max	Unit Type
Temperature	10.0	100.0	°C

Layout

- **Show the details pane when plotting data.** Select this preference to automatically display the details pane with the plot.

- **Show the points table when plotting data.** Select this preference to automatically display the points table with the plot.



Layout

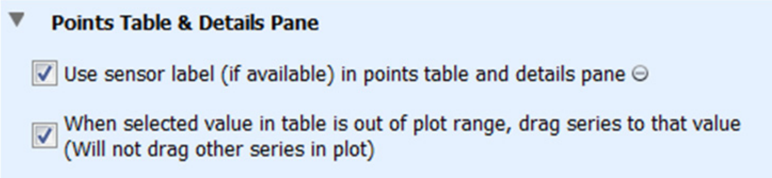
☑ Show the details pane when plotting data

☑ Show the points table when plotting data

Points Table & Details Pane

- **Use sensor Label (if available) in points table and details pane (HOBOware Pro Only).** Select this preference to display the sensor label (if available) as added in the Launch Logger window with corresponding column header in the points table and in the details pane. This is especially useful if there are multiple sensors of the same measurement type in the same file (for example, a HOBO Micro Station datafile with three temperature sensors).

- **When selected value in table is out of plot range, drag series to that value.** Normally, if the plot is zoomed in and you select a point in the Points table that is outside the zoom area, the plot will scroll so the marked point is in view, while retaining your zoom factor. Clear this box if you do not want to scroll to points outside of the current view.



Points Table & Details Pane

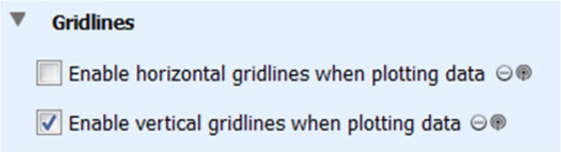
☑ Use sensor label (if available) in points table and details pane

☑ When selected value in table is out of plot range, drag series to that value (Will not drag other series in plot)

Gridlines

- **Enable horizontal gridlines when plotting data.** By default, horizontal gridlines are not displayed when you open a plot. Enable this option if you always want a new plot to display gridlines for all value axes.

- **Enable vertical gridlines when plotting data.** By default, vertical gridlines are always displayed when you open a plot. Clear this checkbox if you never want a new plot to display gridlines for the time axis.



Gridlines

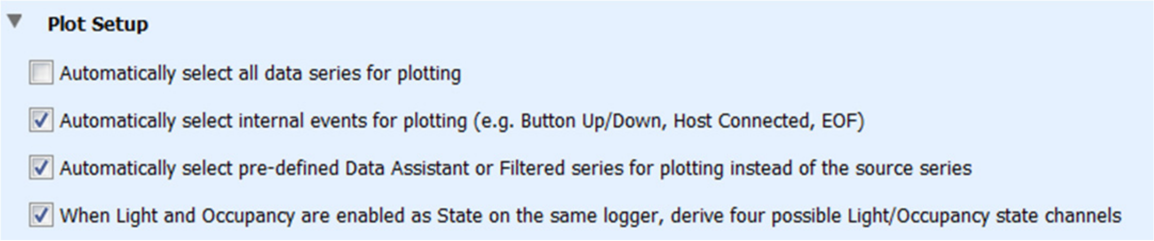
☐ Enable horizontal gridlines when plotting data

☑ Enable vertical gridlines when plotting data

Plot Setup

- **Automatically select all data series for plotting.** By default, some series (such as Dew Point) are not selected for display in the Plot Setup window. Enable this option if you want every series to be selected automatically in the Plot Setup window.
- **Automatically select internal events for plotting (e.g. Button Up/Down, Host Connected, EOF).** By default, all internal events are selected for display in the Plot Setup window. Disable this option if you do not want these events to be selected automatically in the Plot Setup window.
- **Automatically select pre-defined Data Assistants or Filtered series for plotting instead of the source series.** This option controls whether any series from Data Assistants and filters that you configured in the Launch Logger window are automatically selected in the Plot Setup window. Disable this option if you do not want these series selected automatically in the Plot Setup window.
- **When Light and Occupancy are enabled as State on the same logger, derive four possible Light/Occupancy state channels.** For UX90-005x and -006x series loggers, this option controls whether four additional data series are automatically calculated and available for plotting. These series are:
    - Lights on & occupied (Light On & Occ)
    - Lights on & unoccupied (Light On & Unocc)
    - Lights off & occupied (Light Off & Occ)
    - Lights off & unoccupied (Light Off & Unocc)

Disable this option if you do not want these series to be generated when plotting data.



Plot Setup

☐ Automatically select all data series for plotting

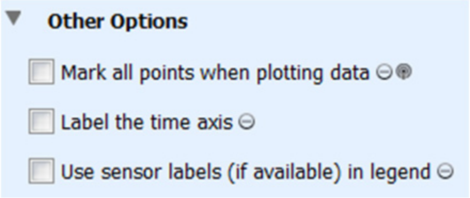
☑ Automatically select internal events for plotting (e.g. Button Up/Down, Host Connected, EOF)

☑ Automatically select pre-defined Data Assistant or Filtered series for plotting instead of the source series

☑ When Light and Occupancy are enabled as State on the same logger, derive four possible Light/Occupancy state channels

Other Options

- **Mark all points when plotting data.** This preference controls whether each data point is marked on the series. Point markers are not displayed by default (except for events and for a series with only one data point) to avoid cluttering the plot. Enable this option if you want all points to be marked on every series whenever you display a plot. Keep in mind, however, that marking all points on a large plot takes longer and consumes more system memory.
- **Label the time axis.** Select this option if you want the default label "Time" to be displayed with the time axis (X-axis).
- **Use sensor labels (if available) in legend.** Select this option if you want any available sensor labels as added in the Launch Logger window to appear in the legend with the series name.



Other Options

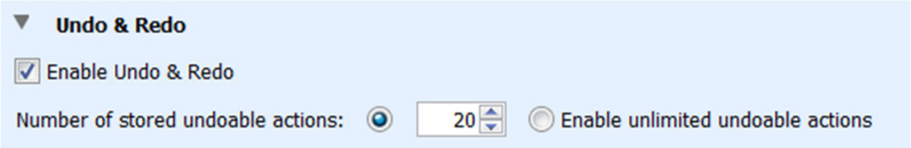
☐ Mark all points when plotting data

☐ Label the time axis

☐ Use sensor labels (if available) in legend

Undo & Redo

This preference controls whether you can undo and redo the changes you make to plots. When the Undo & Redo preference is enabled, you can specify how many changes to plots will be stored within HOBOware. If you select "Number of stored undoable actions," then there will be a limit to the number of changes to the plots that you can undo. For example, if you choose to store 25 undoable actions, then you will be able to undo the last 25 changes that you made to the plots, but not the 26th. You can configure HOBOware to store from 1 to 50 undoable actions (changes to the plot) with this setting. If you select "Enable unlimited undoable actions," then there will be no limit to the number of changes to the plots that you can undo. Note that storing an unlimited number of actions can impact HOBOware performance on slower computers.



☑ Enable Undo & Redo

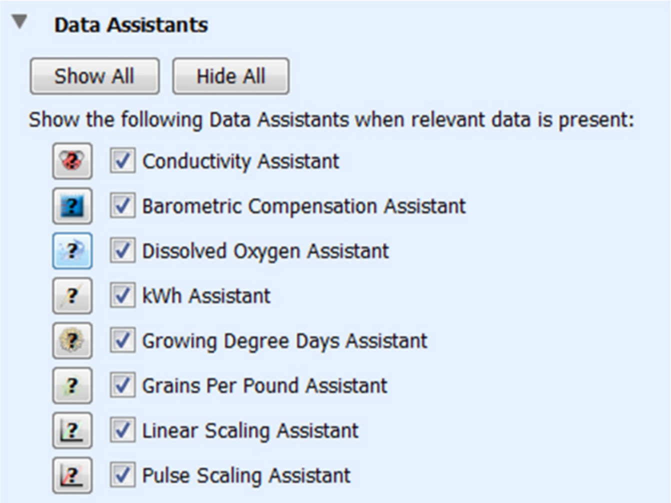
Number of stored undoable actions: ● 20 ○ Enable unlimited undoable actions

Data Assistant Preferences

Use the Data Assistant category within Preferences to control which Data Assistants are displayed in the Plot Setup window.

To change these settings:

1. From the File menu on Windows or the HOBOware menu on Macintosh, select Preferences.
2. Select the Data Assistant category on the left and then click the Data Assistants subcategory.
3. Adjust any of the settings described below and then click OK.



Show the following Data Assistants when relevant data is present:

- ☑ Conductivity Assistant
- ☑ Barometric Compensation Assistant
- ☑ Dissolved Oxygen Assistant
- ☑ kWh Assistant
- ☑ Growing Degree Days Assistant
- ☑ Grains Per Pound Assistant
- ☑ Linear Scaling Assistant
- ☑ Pulse Scaling Assistant

When you read out a logger or open a datafile, all compatible Data Assistants are listed in the Plot Setup window by default. Deselect the checkboxes for any assistants that you do not want to display in the Plot Setup window. Or, click Show All to display all compatible assistants in the Plot Setup window or Hide All to display none of them.

Display Preferences

Use the Display category within Preferences to control the default units, date/time format, and series options displayed in plots.

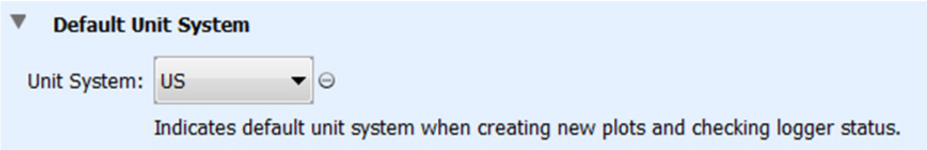
To change these settings:

1. From the File menu on Windows or the HOBOware menu on Macintosh, select Preferences.

2. Select the Display category on the left and then click the subcategory you wish to change.
3. Adjust any of the settings described below and then click OK.

Default Units

This preference controls the units used throughout HOBOware: either US or SI (Metric). This will change the units shown on the axis, legend, points, and details the next time you display a plot. This will also change the current readings the next time you open the Status window.



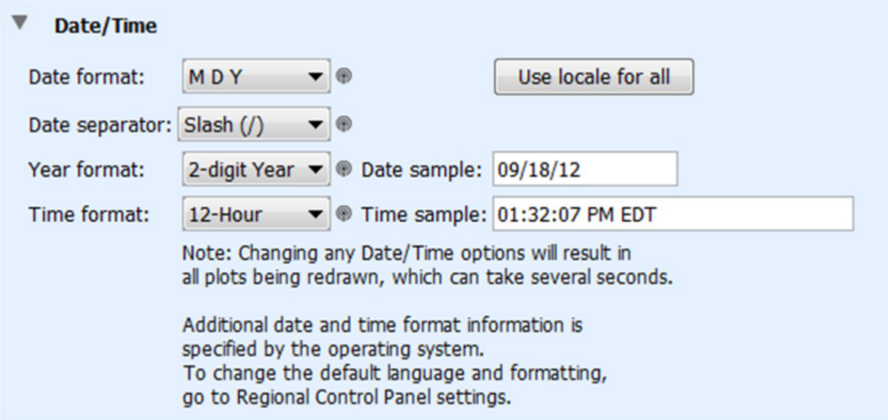
Default Unit System

Unit System: US

Indicates default unit system when creating new plots and checking logger status.

Date/Time

These settings control how the date and time appears in HOBOware. Changes you make are shown in the date and time sample. Any plots that may be open when you make changes to the date and time display will require the plots to be redrawn, which may take several seconds. As noted in the preferences, date and time formatting beyond what is specified in these settings are determined by the computer operating system. **Note:** When you export a file, the date and time are exported as determined by the Export Settings in Preferences (except for year format, which is only controlled by these Date/Time settings in the Display category. If you open the file in Excel, the dates and times may be automatically reformatted to Excel's default date and time format, which you may customize within Excel.



Date/Time

Date format: M D Y

Date separator: Slash (/)

Year format: 2-digit Year

Date sample: 09/18/12

Time format: 12-Hour

Time sample: 01:32:07 PM EDT

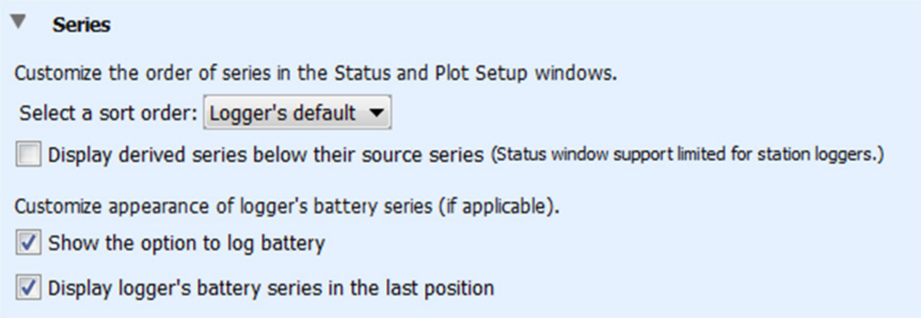
Note: Changing any Date/Time options will result in all plots being redrawn, which can take several seconds.

Additional date and time format information is specified by the operating system. To change the default language and formatting, go to Regional Control Panel settings.

- **Date format.** This controls how the date is displayed: Month, Day, Year; Day, Month, Year; or Year, Month, Day.
- **Date separator.** This controls what character is displayed between the month, day, and year: a slash (/) or a dash (-).
- **Year format.** This controls whether the year is listed as two of four digits.
- **Time format.** This controls whether the time is shown in 12- or 24-hour format.
- **Use locale for all.** Click this button to use the default settings for the current locale as configured in the operating system.

Series

Use the Series preferences to customize how data series are sorted in the Status and Plot Setup windows and to set battery series options.



Series

Customize the order of series in the Status and Plot Setup windows.

Select a sort order: Logger's default

☐ Display derived series below their source series (Status window support limited for station loggers.)

Customize appearance of logger's battery series (if applicable).

☑ Show the option to log battery

☑ Display logger's battery series in the last position

- **Select a sort order.** Choose one of the following four ways to sort the series displayed in the Status and Plot Setup windows:
  - Logger's default: Series are sorted the same way they were listed in the Launch Logger window.
  - Enabled: All series selected, or enabled, for logging are displayed at the top of the list.
  - Label: Series are sorted by their label name, if available. Labels can be sorted in ascending or descending order (alphabetically or numerically depending on the label entered).
  - Measurement: Series are sorted by measurement type alphabetically in ascending or descending order.
- **Display derived series below their source series.** A derived series is one that is calculated rather than recorded by a sensor. Some loggers have the capability to create datafiles that not only have logged sensor data, but also additional derived series automatically calculated in relevant units. One example is a logger with a temperature/RH sensor. The logger records a data series for temperature and another for humidity (two source series), which are used to calculate a dew point data series (the derived series). In addition, some loggers support filtering at launch time and using data assistants before or after launch, which also results in derived series. Select this option if you want any derived series to be displayed immediately following its source series in the Status and Plot Setup windows. By default, this option is disabled, which means all derived series are displayed at the bottom of the data series list. Note that status window support is limited for station loggers, such as the U30 Station.
- **Show the option to log battery.** This setting controls whether you have the option to enable or disable the battery series in the Launch Logger window when applicable. You can configure some loggers to record the battery voltage at every logging interval. When this option is selected, you can choose whether to record the battery voltage at launch time. If this setting is not selected, then you cannot record the battery voltage and it will not be shown in the Launch Logger window. This setting is enabled by default.
- **Display logger's battery series in the last position.** This setting controls whether the optional battery series is displayed at the bottom of the data series list in the Launch Logger, Status, and Plot Setup windows regardless of any other series settings. If this setting is not enabled, the position of the battery series in the data series list will vary based on other preferences. This setting is enabled by default.

Warnings Preferences

Use the Warnings Preferences to disable warning pop-ups that you do not want to appear. Before you do so, however, keep in mind that the warnings are intended to help prevent mistakes and inadvertent data loss. Review each warning carefully before disabling it. To re-enable a warning, re-select the check box.

To disable all of the warnings in a group, click the **Select None** button for that group.

To enable all of the warnings in a group, click the **Select All** button for that group.

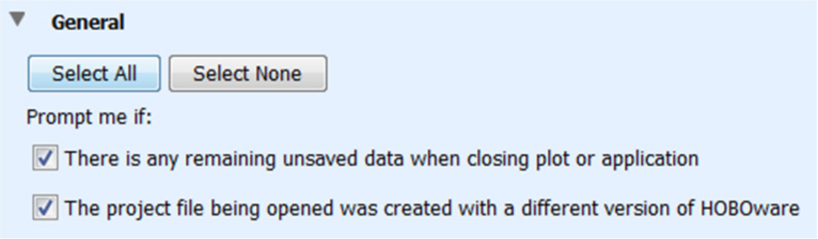
You access the Warnings Preferences by going to File > Preferences > Warnings.

To change these settings:

1. From the File menu on Windows or the HOBOware menu on Macintosh, select Preferences.
2. Select the Warnings category on the left and then click the subcategory you wish to change.
3. Adjust any of the settings described below. To disable all the warnings in a group, click the Select None button for that group. To enable all the warnings in a group, click the Select All button for that group. Click OK in the Preferences window to save changes.

General

- **There is any remaining unsaved data when closing a plot or application.** This warning reminds you when you made changes to a plot, but haven't saved the changes to a project file.
- **The project file being opened was created with a different version of HOBOware.** This message warns you if you are opening a project file that was saved in different version of HOBOware than you are currently using. In some instances, there may be differences in software versions that could affect the project file.



Prompt me if:

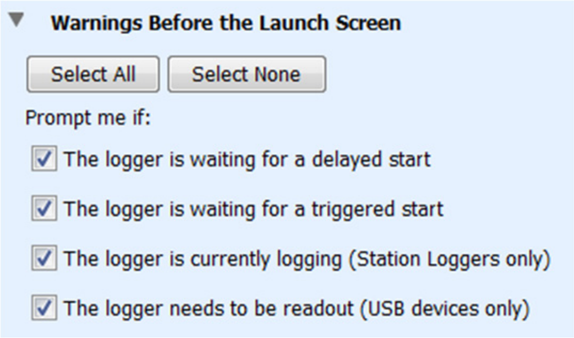
☑ There is any remaining unsaved data when closing plot or application

☑ The project file being opened was created with a different version of HOBOware

Warnings Before the Launch Screen

These preferences control warnings that appear when the logger is connected to the computer and you select Launch from the Device menu or the Launch icon from the toolbar. If enabled, these warnings will display before the Launch Logger window is opened.

- **The logger is waiting for a delayed start.** This warning indicates that the logger has already been configured to start logging on a specific date and time; logging has not begun.
- **The logger is waiting for a triggered start.** This warning indicates that the logger has already been configured to launch with a push button or triggered start, but logging has not begun.
- **The logger is currently logging (Station Loggers only).** This warning indicates the a station-type logger (U30, HOBO Weather Station, HOBO Micro Station) is currently recording data.
- **The logger needs to be readout (USB devices only).** This warning indicates the data on the USB logger (U-Series) has not been offloaded, or read out, yet.



Prompt me if:

☑ The logger is waiting for a delayed start

☑ The logger is waiting for a triggered start

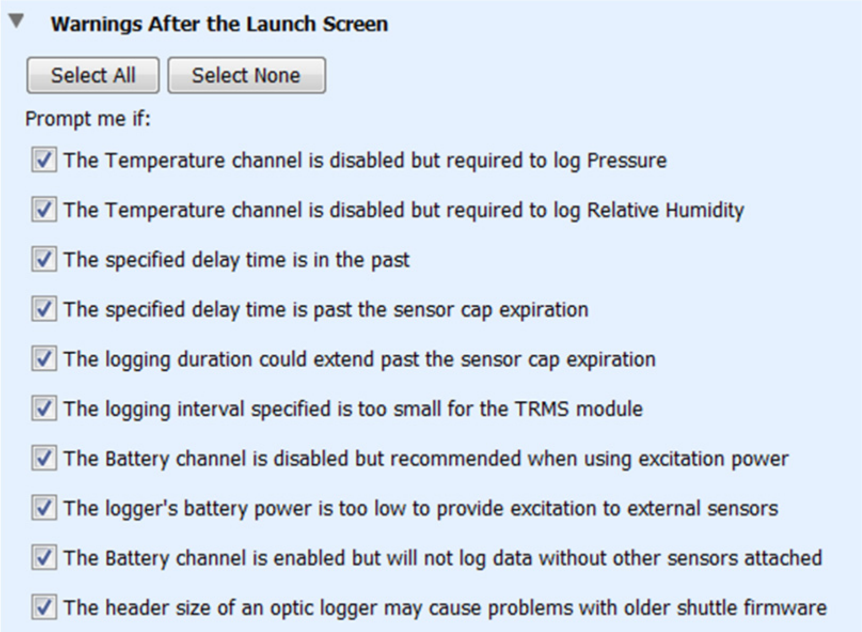
☑ The logger is currently logging (Station Loggers only)

☑ The logger needs to be readout (USB devices only)

Warning After the Launch Screen

These preferences control warnings that appear after you click the Start button in the Launch Logger window.

- **The Temperature channel is disabled but required to log Pressure.** For some loggers that record barometric pressure data, the temperature must also be logged. This message warns you if you selected the pressure sensor or channel in the Launch Logger window, but not temperature.
- **The Temperature channel is disabled but required to log Relative Humidity.** For some loggers that record relative humidity data, the temperature must also be logged. This message warns you if you selected the relative humidity sensor or channel in the Launch Logger window, but not temperature.
- **The specified delay time is in the past.** This warning indicates that you have selected a start date or time for logging that is in the past instead of the future.
- **The specified delay time is past the sensor cap expiration.** This warning indicates that the date or time you selected for the launch to begin is past the U26 Dissolved Oxygen logger sensor cap expiration date.
- **The logging duration could extend past the sensor cap expiration.** This warning indicates that projected logging duration (the amount of time it takes for the logger's memory to fill) lasts beyond the U26 Dissolved Oxygen logger sensor cap expiration date.
- **The logging interval specified is too small for the TRMS module (HOBOware Pro only).** This warning indicates that the logging interval (how often the logger records data) is not supported by the TRMS module in a U30 station logger.
- **The Battery channel is disabled but recommended when using excitation power (HOBOware Pro only).** This warning indicates that the battery channel in the Launch Logger window has not been selected on a U30 or FlexSmart logger configured to use excitation power.
- **The logger's battery power is too low to provide excitation to external sensors (HOBOware Pro only).** This warning indicates the battery is too low for a U30 or FlexSmart logger that has been configured to power excitation to external sensors.
- **The Battery channel is enabled but will not log data without other sensors attached (HOBOware Pro only).** This warning indicates that you have only selected the battery channel in the Logger Launch window and no other sensors.
- **The header size of an optic logger may cause problems with older shuttle firmware (HOBOware Pro only).** This warning indicates that if you will be offloading an optic logger to a HOBO shuttle, the shuttle should have the latest firmware installed. Otherwise, the header size (part of the logger data file) could cause the offload to fail or result in a corrupted file.



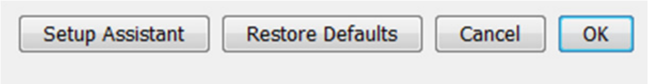
Warnings After the Launch Screen

Prompt me if:

- ☑ The Temperature channel is disabled but required to log Pressure
- ☑ The Temperature channel is disabled but required to log Relative Humidity
- ☑ The specified delay time is in the past
- ☑ The specified delay time is past the sensor cap expiration
- ☑ The logging duration could extend past the sensor cap expiration
- ☑ The logging interval specified is too small for the TRMS module
- ☑ The Battery channel is disabled but recommended when using excitation power
- ☑ The logger's battery power is too low to provide excitation to external sensors
- ☑ The Battery channel is enabled but will not log data without other sensors attached
- ☑ The header size of an optic logger may cause problems with older shuttle firmware

Restoring Default Preferences

To return all preferences to their original settings in both the Preferences and custom-defined Launch Logger window settings (State Description, % or Time, Logging Interval), open the Preferences window (click the File menu in Windows or the HOBOware menu on Macintosh and select Preferences). Click the Restore Defaults button.



A message appears asking if you are sure you want to restore all preferences to their default values. Click Yes to restore the default preferences. In addition to the options configured in the Preferences window, the following settings are also affected:

- **Data File Folder Locations.** When you restore the preference defaults, the default folder locations for datafiles, text files, and project files is reset to:
  - C:\Documents and Settings\<user>\My Documents\HOBOware
    (for Windows XP)
  - C:\Users\<user>\Documents\HOBOware
    (for Windows 7 or Windows 8)
  - Users/<user>/Library/Application Support/HOBOware
    (for Macintosh OS X)
- **FlexSmart modules or Analog Sensor Ports channel names and units (HOBOware Pro Only).** Any custom-defined channel names and units for FlexSmart modules or Analog Sensor Ports are removed from the pull-down menus in the Configure Channel window. However, this will not affect customized channel names and units that you saved in configuration files (.hcfg).
- **HOBOware software updates.** The date and time of the most recent check for HOBOware software updates will not be retained. A message will appear next time you reopen HOBOware asking if you want to check for updates.
- **Custom-defined Launch Logger window menus.** Any custom-defined Launch Logger window settings, such as State Description, % or Time, Logging Interval, will be cleared.

Menus

The following menus are available in HOBOware:

- HOBOware (on Macintosh)
- File
- Device
- Edit
- View
- Tools
- Window
- Help

The HOBOware Menu

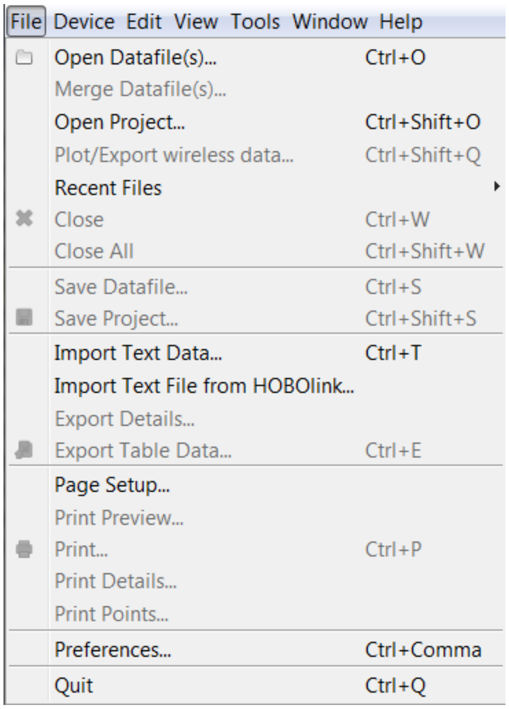
The HOBOware menu is available on Macintosh only. Some of the menu options available from the File menu in Windows are displayed here instead on Macintosh.

The HOBOware menu options are:

- **About HOBOware.** Select this option to open a compatible datafile. See Opening Files for more information.
- **Preferences.** Select this option to open the Preferences window where you can change the default settings in HOBOware. See Setting Preferences for more information.
- **Services.** This is a Macintosh operating system menu option.
- **Hide HOBOware.** This option hides HOBOware from view.
- **Hide Others.** This option hides all currently open programs except for HOBOware from view.
- **Show All.** This option displays all currently open programs.
- **Quit.** Select this option to close HOBOware.

The File Menu

From the File Menu, you can open and close datafiles and projects, import and export data, and print plot elements.



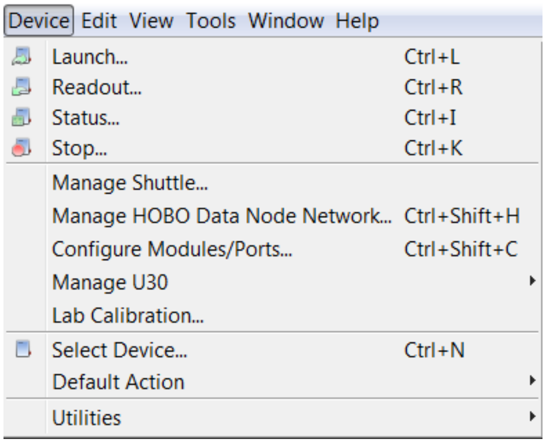
The File menu options are:

- **Open Datafile(s).** Select this option to open a compatible datafile. See Opening Files for more information.
- **Merge Datafile(s).** Select this option to add a datafile to the end of another datafile. See Merging Datafiles for more information.
- **Open Project.** Select this option to open a HOBOware project. See Opening Files for more information.
- **Plot/Export Wireless Data.** This applies to a ZW series wireless network and is only available in HOBOware Pro. See Plotting or Exporting Wireless Data for more information.
- **Recent Files.** Select this option to quickly access the last 10 files you opened.
- **Close.** Select this option to close the active file or project.
- **Close All.** Select this option to close all open files and projects.
- **Save Datafile.** Select this option to save the active datafile.
- **Save Project.** Select this option to save the active project.
- **Import Text Data.** Select this option to import and graph non-HOBOware data in certain text files (available in HOBOware Pro only). See Importing Text Files for more information.
- **Import Text File from HOBOlink.** Select this option to open a text file generated by HOBOlink for a HOBO U30 Station.
- **Export Details.** Select this option to export the information in the Details Pane into a text file that can be opened in any text editor or imported into many other types of programs (word processors, spreadsheets, etc.). See Exporting Details for more information.

- **Export Table Data.** Select this option to export the points shown in the Points table to a text file (.csv or .txt) or Microsoft Excel (.xls) file. See Exporting Table Data for more information.
- **Page Setup.** Select this option to set up the paper size, margins, and orientation for printing a plot.
- **Print Preview.** Select this option to preview the page for printing a plot.
- **Print.** Select this option to print a prot.
- **Print Details.** Select this option to print the Details Pane.
- **Print Points.** Select this option to print the Points Table.
- **Preferences.** Select this option to open the Preferences window where you can change the default settings in HOBOware. See Setting Preferences for more information. Note that Preferences is available from the HOBOware menu on Macintosh.
- **Quit.** Select this option to close HOBOware. Note that this is available from the HOBOware menu on Macintosh.

The Device Menu

Use the Device menu to launch, read out, and stop loggers as well as access HOBOnode Manager and work with other features for specific devices.



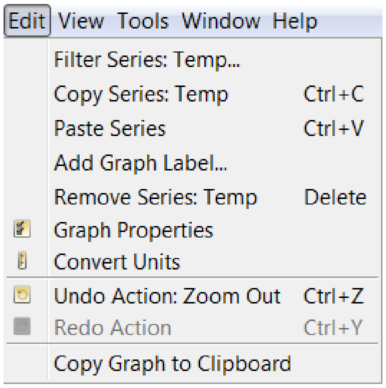
The Device menu options are:

- **Launch.** Select this option to open the Launch Logger window where you can set launch settings and start the logger.
- **Readout.** Select this option to offload, or read out, data from the logger to your computer, allowing you to save the data in a datafile and view the plot in HOBOware.
- **Status.** Select this option to view the current status of the logger, including current readings (for some sensors), remaining battery, and logger memory.
- **Stop.** Select this option to stop a device.
- **Manage Shuttle.** Select this option to manage a HOBO shuttle (available for HOBOware Pro only). See Working with a Shuttle for more information.
- **Manage HOBO Data Node Network.** Select this option to open the HOBOnode Manager where you can manage a ZW series wireless network (available for HOBOware Pro only).
- **Configure Modules/Ports.** Select this option to configure analog sensor ports on the HOBO U30 station logger or FlexSmart modules (available for HOBOware Pro only).

- **Manage U30.** Select this option to access features specific to the HOBO U30 Station. From this menu option, select Control U30 Relay to configure the default state of a relay or to activate or deactivate the relay for testing (available for HOBOware Pro only). See Controlling the Relay on the HOBO U30 Station for more information. Or, select Configure U30 Alarms to set up alarms on the HOBO U30 Station (available for HOBOware Pro only).
- **Lab Calibration.** Use this option to open the Lab Calibration tool used with the HOBO U26 Dissolved Oxygen Logger.
- **Select Device.** Use this option to select a device currently connected to the computer.
- **Default Action.** Select this option to set up HOBOware to perform the same action (Launch, Readout, or get Status) every time a logger is connected (available for HOBOware Pro only). See Repeating an Action on Multiple U-Series Devices for more information.
- **Utilities.** Use the Utilities submenus to select one of the three Force Offload options only if you are having problems reading out your device or as directed from Onset Technical Support. You can also select the Reset UX Logger submenu option as directed by Onset Technical Support.

The Edit Menu

Use the Edit menu to modify the plot, including filtering series, removing series, setting properties, and converting units.



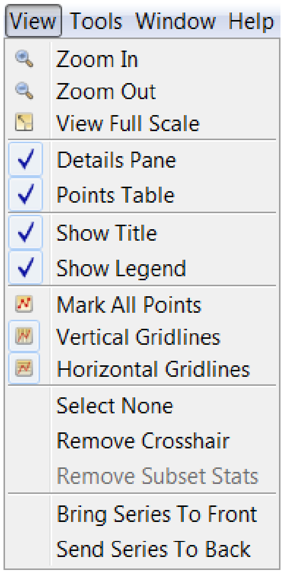
The Edit menu options are:

- **Filter Series.** Select this option to create a new series based on statistical analysis of an existing series over specified periods of time. See Filtering a Series for more information.
- **Copy Series.** Select this option to copy a series and then paste it into another plot. See Copying a Series to another Plot for more information.
- **Paste Series.** Select this option to paste a series into another plot. See Copying a Series to another Plot for more information.
- **Add Graph Label.** Select this option to access the Graph Label Properties window to add labels to a plot that identify specific points or call attention to a region of the graph. See Adding Labels to a Graph for more information.
- **Remove Series.** Select this option to remove series from a plot after you have selected it in the graph or the Details pane. If you remove a series, it can only be recovered by reopening the original datafile or a saved project file that contains the series.
- **Graph Properties.** Select this option to access the Series Properties window. See Setting Series Properties for more information.

- **Convert Units.** Select this option to access the Convert Plot window, which allows you to convert some or all of the series on the currently focused plot to other units (for example, from degrees Fahrenheit to degrees Celsius). Note that changing the units will result in the entire plot being redrawn. See Converting Units for more information.
- **Undo Action.** Select this option to undo the last change made to the current plot. The most recent change is listed after the Undo Action menu choice. In this example, the most recent change to the plot was to "Zoom Out." See Undo and Redoing Plot Changes for more information.
- **Redo Action.** Select this option to redo the last change that was previously undone. See Undo and Redoing Plot Changes for more information.
- **Copy Graph to Clipboard.** Select this option to copy the graph to the clipboard to paste it into another application.

The View Menu

Use the View menu to change the appearance of the plot, including zooming, showing or hiding components, marking points, and setting gridlines.



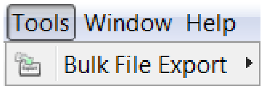
The View menu options are:

- **Zoom In.** Select this option to zoom in on the plot.
- **Zoom Out.** Select this option to zoom out on the plot.
- **View Full Scale.** Select this option to view the plot in full scale.
- **Details Pane.** Select this option to show or hide the Details Pane.
- **Points Table.** Select this option to show or hide the Points Table.
- **Show Title.** Select this option to show or hide the title of the plot.
- **Show Legend.** Select this option to show or hide the plot legend.
- **Mark All Points.** Select this option to mark all points on the plot.
- **Vertical Gridlines.** Select this option to show or hide vertical gridlines on the plot.
- **Horizontal Gridlines.** Select this option to show or hide horizontal gridlines on the plot.

- **Select None.** Select this option to deselect all elements in the plot.
- **Remove Crosshair.** Select this option to remove crosshairs from the graph.
- **Remove Subset Stats.** Select this option to remove subset statistics from the plot.
- **Bring Series To Front.** Select this option to bring a series to the front on the plot on top of all other series.
- **Send Series To Back.** Select this option to send a series to the back of the plot behind all other series.

The Tools Menu

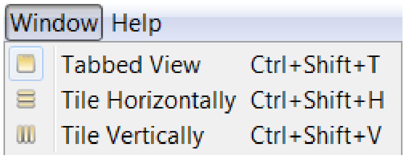
Use the Tools menu to access the Bulk File Export tool, which allows you to export numerous datafiles at one time. See the Bulk Export Tool for more information.



Note: The Alarm & Readout Tool is also available from this menu if it was installed in older version of HOBOware Pro. This tool is no longer installed as of HOBOware version 3.4.

The Window Menu

Use the Window menu to organize several plots.



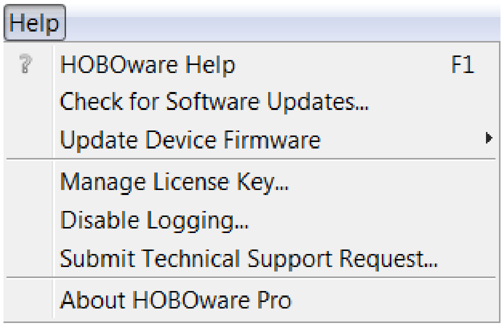
The Window menu options are:

- **Tabbed View.** With this option, plots are layered as tabs so you can see the file name of each open plot (or "Untitled*" for an unsaved datafile). You can also get to this view by clicking the Tabs icon in the lower left of the window.
- **Tile Horizontally.** Select this option to arrange up to five plots horizontally. If six or more plots are open, they will be tiled as a grid. You can also get to this view by clicking the Horizontal Tile icon in the lower left of the window.
- **Tile Vertically.** Select this option to arrange up to five plots vertically. If six or more plots are open, they will be tiled as a grid. You can also get to this view by clicking the Vertical Tile icon in the lower left of the window.

Tip: You can open the same datafile multiple times to create different views of the graph, then use the Tile commands on the Window menu (or resize and move the windows manually) to see all of them at once. This is helpful if you want to zoom in on several different areas and view them side-by-side, see the detail of a small area while the full graph is still in view, or view each series in a different window.

The Help Menu

Use the Help menu to get more information about HOBOware, upgrade the software and certain devices, and request help from Onset Technical Support.



The Help menu options are:

- **HOBOware Help.** Select this option to open the help system, displaying the full table of contents.
- **Check for Software Updates.** Select this option to check if there are any HOBOware updates available on the Onset website. You can also set the general startup settings in Preferences to automatically check for software updates on a schedule that you select.
- **Update Device Firmware.** Select this option to check if there are firmware updates available for certain devices. This option is only enabled when either a HOBO U-Shuttle or HOBO UX series logger is connected to the computer. Select the appropriate submenu for your device, either "Update U-DT-1/U-DT-2 Firmware" for a HOBO U-Shuttle or "Update UX Series Logger Firmware" for a logger. You likely will only need to do this as directed by Onset Technical Support. Note that firmware updates for HOBO ZW series receivers and data nodes are completed within HOBOnode Manager.
- **Manage License Key.** Select this option if you need to enter a new license key. This is only necessary if you are running a trial version of HOBOware and have a new license key to enter, or if you are using HOBOware Lite and have a license key to upgrade to HOBOware Pro.
- **Enable/Disable Logging.** Select this option to turn on or off logging within HOBOware. When logging is enabled, a series of text files will be generated and saved every time you use HOBOware. It is recommended that you only enable logging when requested to do so by Onset Technical Support, who may need additional files to troubleshoot any technical problems you may be having with the software.
- **Submit Technical Support Request.** Select this option if you are having a problem with HOBOware and would like to request help from Onset Technical Support. Fill in all the requested information in the form, including your name, email address, logger/device model name and serial number, and a detailed description of the problem you are encountering.
- **About HOBOware.** Select this option to see which version of HOBOware you are using in Windows. This option is available from the HOBOware menu on Macintosh.

The Toolbar

The toolbar, located at the top of the main HOBOware window, allows point-and-click access to the most frequently used functions. Pause the pointer over each icon on the toolbar for a description of each tool.

Launch - - Opens the Launch window.

Readout - - Opens the Readout window.

Status - - Opens the Status window, which displays the logger's state and current readings.

Stop - -Stops a logging logger.

Select Device - - Opens the select Device window, which displays available devices. For HOBOware Pro, the accompanying pull-down menu allows you to specify whether you want HOBOware to look for USB devices, serial devices, or both.

Set Default Units - - Change the default unit type between US and SI. Any changes you make will take effect with the next plotted file.

Undo Action - - Undoes the most recent change made to the plot.

Redo Action - - Redoes the most recent change that was undone to the plot.

Open - - Launches the Open window, from which you can open HOBOware files.

Save - - Opens the Save window, from which you can save the plot as a project (.hproj) file.

Close - - Closes the currently focused plot.

Export - - Opens the Export Options window, from which you can configure settings for exporting a text file of the data (in .csv or .txt format) for use in spreadsheet and other applications.

Print - - Prints the graph as it appears on your screen.

Arrow - - Launches the Arrow Tool, which you can use to point to and select items on the graph to edit their properties.

Crosshair - - Launches the Crosshair Tool, which you can use to display values for points on the graph and cross-references them to cells in the Points pane.

Hand Drag - - Launches the Hand Drag Tool, which you can use to scroll an axis or the entire graph.

Zoom - -Launches the Zoom Tool, which you can use to adjust the scaling of an axis or the entire graph.

Subset Statistics - -(HOBOware Pro Only) Launches the Subset Statistics Tool, which you can use to view statistics for a particular time span.

Zoom In - - Launches the Zoom In Tool, which allows you to zoom in on a smaller area of the graph.

Zoom Out - - Launches the Zoom Out Tool, which allows you to zoom out to a larger area of the graph.

Show Graph at Full Scale - - Resets the scale of a graph to accommodate all of the displayed data.

Graph Properties - - Opens the properties window for the element currently selected (such as series, legend, axis).

Vertical Gridlines - - Toggles vertical gridlines on or off.

Horizontal Gridlines - -Toggles horizontal gridlines on or off.

Mark Points - -Toggles point markers on or off.

Convert Units - -Opens the Convert Units window, which allows you to convert some or all of the series on the currently focused plot to other units (for example, from degrees Fahrenheit to degrees Celsius).

Filter Series - -You can create a new series based on statistical analysis of an existing series over specified periods of time.

Pie Chart - -Opens the Pie Chart window in which you can view, print, and save a pie chart for plotted state series.

Add Graph Label - -Opens the Graph Labels Properties dialog, which allows you to add a label to the plot or to a specific series, and change the appearance of that label.

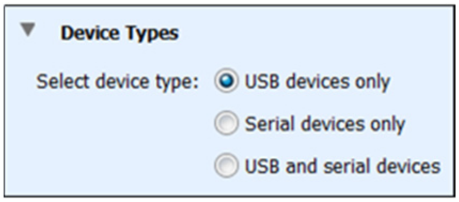
Help - - Opens the Help.

Tips for Working with Multiple Loggers

HOBOware Pro has several built-in features that allow you to bypass some of the repetitive work of launching and reading out multiple loggers. These features not only will save you time, but also will help ensure your loggers are launched with consistent settings. Follow these tips if you plan to launch or read out many numerous loggers of the same type with identical settings.

General Settings

- **Change the Device Types preference to one device type.** Depending on the selections you made when installing HOBOware, it may be configured to search for both serial and USB devices. If you are only using USB devices you can bypass the Select Device Type and save time. To bypass the Select Device Type window, select Preferences from the File menu. Under the Communications preferences, select Device Types. Choose either "USB devices only" or "Serial devices only."



▼ Device Types

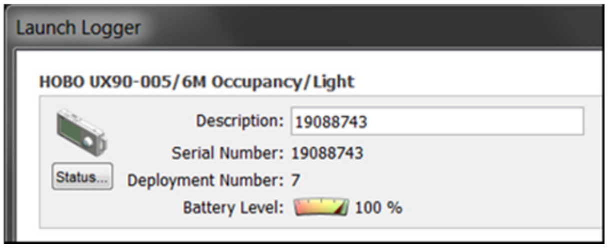
Select device type: ● USB devices only

○ Serial devices only

○ USB and serial devices

Launching Multiple Loggers

- **Check the Description name.** Use a logger serial number or your own unique identifier in the Description field in the Launch Logger window as shown in the example below. The name of the launch description is important because it is also used as the default file name when you read out the logger. Using unique names here will eliminate the need to individually name files during readout.



Launch Logger

HOBO UX90-005/6M Occupancy/Light

Description: 19088743

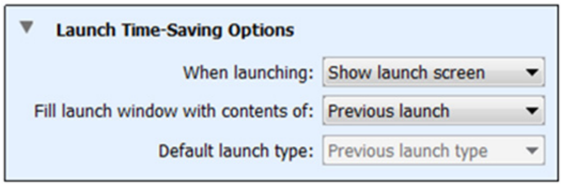
Serial Number: 19088743

Deployment Number: 7

Battery Level: 100 %

- **If you plan on launching multiple loggers of the same type with the same settings (i.e. start time, logging interval, etc.), set up and start one logger first.** To do this, open the Launch Logger window for one logger. Enter your settings for the launch. Double-check that they are correct and then start the launch. Setting and starting this one logger will create a model for all the other loggers of the same type to follow. The key to success is making sure the settings are exactly as you want so be sure to double-check or even triple-check them. You want to be certain the first logger is right!

- **Set the Launch Time-Saving preferences to use the previous logger’s launch settings.** From the File menu, select Preferences. Select General and then click Launch Time-Saving Options. Under "When launching," select "Show launch screen" and under "Launch with contents of," select "Previous launch" to use the same launch settings from the last logger that was launched (same logger model only).



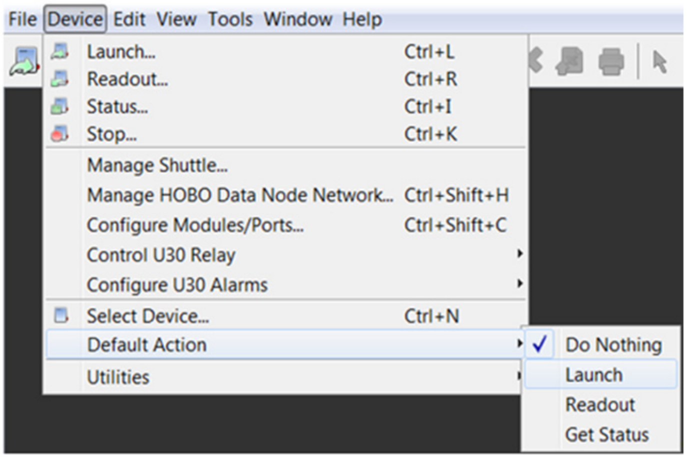
Launch Time-Saving Options

When launching: Show launch screen

Fill launch window with contents of: Previous launch

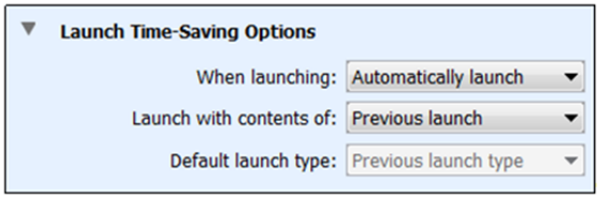
Default launch type: Previous launch type

- **Change the Default Action option (USB devices only).** Under the Device menu in HOBOware, change the Default Action from "Do Nothing" to "Launch." If you also set the launch time-saving preferences to "Automatically launch," then this allows you to launch numerous U-Series loggers in a row simply by plugging and unplugging individual loggers. If you set the launch time-saving preferences to "Show launch screen," this will still save you the step of manually selecting Launch from the toolbar or the Device menu for each logger. Change this back to "Do Nothing" when you’re done. Note: If this is the first time you have used the logger on the computer, you may have to plug the logger in, unplug it, and then plug it back in.



- **Test that your changes have taken effect.** Connect a different logger of the same type to the computer. The Launch Logger window for that logger should immediately open the settings should match what you set up in the first logger. Press Enter or click the Start button in the Launch Logger window and the logger will start (note that the wording on the Start button may vary depending on when logging is scheduled to begin). You can do this repeatedly for loggers of the same type.

- **Optional: Set the preferences to skip the launch window.** If you are comfortable with the previous steps, you can also set up HOBOware to bypass the Launch Logger window entirely. From the File menu, select Preferences. Select General and then click Time-Saving Options. Under "When launching," select "Automatically Launch" to skip the launch window. Note: If you need to change the launch description for each logger, then select "Show launch screen" instead.



Launch Time-Saving Options

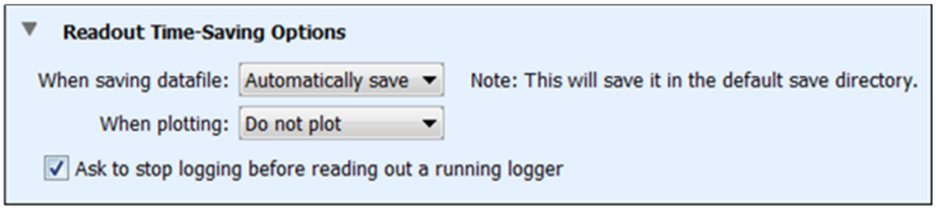
When launching: Automatically launch

Launch with contents of: Previous launch

Default launch type: Previous launch type

Reading Out Multiple Loggers

- **Set the Readout Time-Saving preferences.** From the File menu, select Preferences. Select General and then click Readout Time-Saving Options. Under "When Saving datafile," select "Automatically save" instead of "Show save dialog." Under "When plotting," select "Do not plot." This bypasses the save dialog that normally appears during readout and automatically saves the data file to the default directory without plotting the data. Note: If you also want the logger to continue logging after readout, uncheck the "Ask to stop logging before reading out a running logger" checkbox. If you need to stop the logger, keep that option checked. You'll then see a prompt to stop the logger during each readout.



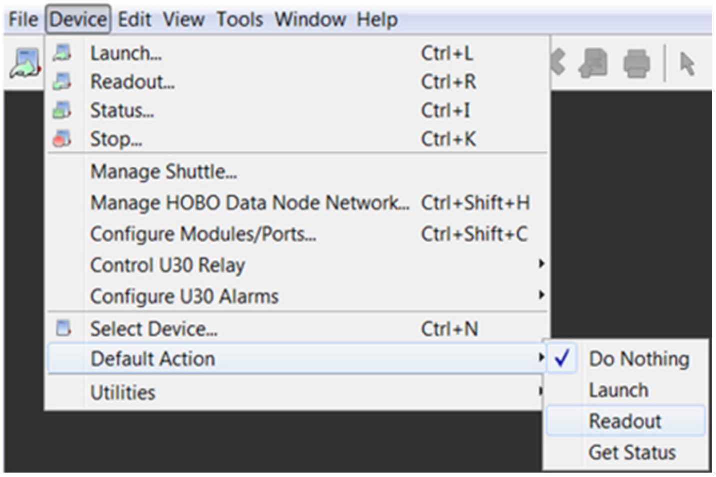
Readout Time-Saving Options

When saving datafile: Automatically save — Note: This will save it in the default save directory.

When plotting: Do not plot

☑ Ask to stop logging before reading out a running logger

- **Change the Default Action option.** Under the Device menu in HOBOware, change the Default Action to "Readout." This feature will automatically initialize the Readout sequence every time you connect a logger to the computer (with HOBOware open). This will still save you the step of manually selecting Readout from the toolbar or the Device menu for each logger.



Setting the Language/Format on Your Computer

The HOBOware user interface has been translated from English into four languages, which are supported by four specific formats. These languages and formats are: French (France), Spanish (Spain), Portuguese (Portugal), and German (Germany). To change the language displayed in the HOBOware user interface, you must change the language/format settings on your computer as described below.

Notes:

- The supported languages only work with the specific format or country listed above. For example, Portuguese is supported in the Portugal format only and not with Brazil.
- The HOBOware Help and all related documentation are available in English only.
- **If you are using HOBOnode Manager:** The language in use at the time the original HOBO data node network database was created is the only language that can be used for that database. You cannot switch to another language. If you need to change the locale on the computer that contains your HOBO data node network database, you must first back up and then move or rename the

database before changing the locale on the computer. Then, form a new network to create a database that operates in the new locale.

On Windows 7 and Windows 8:

1. Close HOBOware.
2. Open the Control Panel and select "Region and Language."
3. Under the Formats tab, select the desired language/format and click OK to save the changes.
4. Reopen HOBOware.

On Windows XP:

1. Close HOBOware.
2. Open the Control Panel and double-click the "Regional and Language Options."
3. Under the Regional Options tab, select the desired language/format and click OK to save the changes.
4. Reopen HOBOware.

On Macintosh OS X:

1. Close HOBOware.
2. Open System Preferences and access the "Language & Text" Preferences.
3. Under the Language tab, drag the desired language to the top of the list. If the desired language does not appear in the list, click the "Edit List…" button to add it.
4. Under the Formats tab, ensure the correct Region is selected in the drop-down menu. Example: For Spanish (Spain), Spanish must be first in the Language list, and Spain must be selected under the Region drop-down menu.
5. Reopen HOBOware.

Alarm & Readout Tool

IMPORTANT: The Alarm & Readout Tool is no longer installed with HOBOware as of version 3.4. This help section is included for reference only for existing Alarm & Readout Tool users.

The Alarm & Readout Tool is a plug-in tool that works in conjunction with HOBOware Pro to monitor select HOBO data loggers, read them out, and notify you when sensor and logger conditions fall outside the limits you specify.

Notes:

- Alarm sensor conditions cannot be set on state or event channels. Only logger conditions, such as communication, memory, and battery level, can be monitored for state and event loggers (U9-001 and U11-001).
- To set up a scheduled readout for a state and event loggers (U9-001 or U11-001 models) with partial readouts, the battery channel must be configured to log valid timestamps using any battery logging interval.
- The HOBO 4-Channel Pulse Input data logger (UX120-017) and UX90 series loggers are not supported with this tool.
- Data assistant and filtered series configured at launch time are not compatible with this tool. These series will cause the tool to read the data incorrectly.
- Alarm & Readout Tool email notifications do not support SSL or port configuration.

Connecting loggers

The Alarm & Readout Tool can perform scheduled readouts and monitor sensor conditions, communication status, memory usage, and battery level on supported loggers.

Tip: Loggers that require a base station to communicate will experience more rapid battery drain when left in the coupler. Refer to your logger's manual for more information.

For most reliable operation, it is recommended that you use direct USB or serial port connections for your loggers and base stations. If your computer does not have a serial port, you may use a USB port with a Keyspan USB Serial Adapter.

In addition, remote connections to USB loggers are possible with a Keyspan or Tibbo USB Server connected to a local Ethernet port. (It is recommended that you use the Tibbo USB Server with Windows only.) The Alarm & Readout Tool does not support connecting serial loggers to a USB server via a serial adapter.

Using the Alarm & Readout Tool:

1. Connect a logger to the computer. The logger can be logging, waiting for a delayed or button start, or stopped. **Important:** A serial logger that is waiting for a delayed or button start cannot provide an updated sensor reading until the logger begins logging. Once a serial logger begins logging, it can only provide the last logged value.

   Tip: To avoid disrupting an active deployment, do not attach sensors to a serial logger if it is already logging.

2. If you want to include scheduled readouts in your configuration, launch the logger (if it is not already launched) before starting the monitor. The logger must be logging, or waiting for a delayed or trigger start, in order to perform scheduled readouts. If you plan to use partial readouts with a wrap-enabled logger, the logger must not have wrapped before you start the monitor. If the logger wraps after the monitor is started but before the first partial readout, partial readouts will be discontinued.
3. From the Tools menu, choose Manage Alarms, then choose New Configuration.
4. Create and save a configuration. You must create at least one alarm condition OR readout schedule for each logger in the configuration.
5. Click Start on the Configure Alarms and Readouts dialog to begin monitoring the logger.

Software updates

If you have an Internet connection, HOBOware Pro can periodically check the Onset website for software updates, including updates to the Alarm & Readout Tool. The default is to check once per week, but you can configure HOBOware Pro to check daily or monthly. In Preferences, go to the General pane. Click Startup and then select the how often you want to Check for HOBOware Updates.

You can also check for updates manually at any time. Choose Check for Updates from the Help menu.

Related Topics:

- See Configuration for creating, saving, and exporting configurations.
- See Monitoring for starting, viewing, hiding, and stopping the Alarm & Readout Tool monitor.
- See Readout for the numbering scheme for readout files, and describe the format of text files.
- See Preferences for the customizations that help you get the most out of the Alarm & Readout Tool.

Configuration

IMPORTANT: The Alarm & Readout Tool is no longer installed with HOBOware as of version 3.4. This help section is included for reference only for existing Alarm & Readout Tool users.

The Alarm & Readout Tool uses configuration files to save definitions of groups of loggers, alarm conditions, and scheduled readouts.

- Create and save a configuration
- Open and edit a saved configuration
- Export a configuration

Creating and Saving a Configuration

To begin, open HOBOware Pro and connect the loggers and sensors you want to include in the configuration. The loggers can be logging, waiting for a delayed or button start, or stopped.

Tip: You must create at least one alarm condition OR readout schedule for each logger in the configuration.

If you want to include scheduled readouts in your configuration, launch the logger now (if it is not already launched). Once you start the monitor, the logger must be launched and either logging, or waiting for a delayed or button start in order to perform scheduled readouts. If you plan to use partial readouts with a wrap-enabled logger, the logger must not have wrapped before you start the monitor. If the logger wraps after the monitor is started, but before the first partial readout, partial readouts will be discontinued.

Tip: To avoid disrupting an active deployment, do not connect sensors to a serial logger if it is already logging.

Important: A serial logger that is waiting for a delayed or button start cannot provide an updated sensor reading until the logger begins logging. Once a serial logger begins logging, it can only provide the last logged value.

Then take the following steps:

1. Use the logger list and Logger pane to select and organize loggers.
2. Use the Alarms pane to define alarm conditions.
3. Use the Readouts pane to schedule readouts.
4. Use the Notifications pane to set up notifications.
5. Use the Messages pane to construct messages.
6. Click Save to save the configuration. By default, configurations are saved in the Documents\HOBOware\Alarms folder with an extension of .halrm.
7. To start the monitor now, click Start. If the monitor is already running, you will be warned that the monitor will stop the previous configuration before running the new one.

To close the Configure Alarms and Readouts dialog without saving changes or starting the monitor, click Cancel.

Logger Pane

1. From HOBOware Pro's Tools menu, choose Manage Alarms & Readouts, then choose New Configuration. The Configure Alarms and Readouts dialog is displayed with the Logger pane selected.
2. Click Add Logger to select the loggers for this configuration. From the resulting Add Loggers dialog, select the loggers you want to include, then click OK.
3. The loggers you chose will appear in the logger list on the left side of the Configure Alarms and Readouts dialog.

  - Click the folder icon 📁 to create "groups" to organize your loggers. Logger groups can help you set up alarms or readout schedules for similar types of loggers. To add a logger to a group, click the logger's name to select it, then drag it to the group's folder.
  - To delete a logger from the configuration, click the logger's name, then click the trash icon 🗑.
  - To delete a group and all the loggers in it, click the group's name, then click the trash icon 🗑. (If you do not want to delete all of the loggers that are in the group, drag them out of the group before deleting it.)

4. In the Logger pane, enter a Name (up to 25 characters) that will be used to identify the currently selected logger in the monitor, scheduled readouts, and notifications. The first 25 characters of the logger's most recent Launch Description will be used as the default; if you change the text here, the logger's Launch Description will not be affected.
5. Enter the number of retry attempt(s) (if any) the Alarm & Readout Tool should make if the selected logger fails to respond for an alarm check or readout attempt. For most applications, one retry should be enough; there is a 60-second delay between retries. If the Alarm & Readout Tool encounters frequent logger communication failures during a deployment, you may wish to increase the number of retries.

Tip: If the Interval for alarm conditions or readouts is too short to accommodate all retries, the remaining retries will be skipped so as not to delay the start of the next interval.

Alarms Pane ⏰

1. To define alarm conditions, click the Alarms icon ⏰ near the bottom of the Configure Alarms and Readouts dialog.
2. Click a logger's name in the logger list to set the interval at which alarm conditions will be checked, and define alarm conditions for that logger.
3. To copy this logger's alarm settings to other loggers in this configuration, select the setting you want to copy (interval, sensor condition(s), logger condition(s), or all Alarm settings) from the first drop-down next to the Copy button. Then select the destination loggers from the second drop-down. You may choose a logger group, an individual logger, or Group: Loggers for all loggers. Click Copy to complete this step.
    - Copied intervals and logger conditions replace the destination loggers' alarm settings with those of the current logger.
    - Copied sensor conditions are added to the destination loggers' existing conditions, if any. They do not replace any sensor conditions that have already been defined for those loggers. When copying a sensor condition to a destination logger that is a different model than the source logger, the software tries to identify a similar sensor on the destination logger. If it does not find one, or if the sensor on the destination logger has a different measurement range than the sensor on the source logger, you will receive a warning message. You should then review the alarm conditions for each logger to make sure that they are what you expect.

Alarms Fields

Logger Selected

Logger whose alarm settings are displayed. To work with alarm conditions for a different logger, select the logger from the logger list to the left.

Interval

How often the Alarm & Readout Tool should check this logger for alarm conditions. The minimum alarm interval is one second for USB loggers and five seconds for serial loggers. The maximum is 23 hours, 59 minutes, and 59 seconds.

This interval is directly related to the sensor condition durations. If you change the interval after you have set up sensor conditions, be sure to adjust the sensor condition durations accordingly.

Tip: If the logger requires a base station/coupler to communicate, refer to your logger's manual to determine whether it will go to "sleep" if the computer does not communicate with it more often than every 30 minutes.

When loggers are added to a configuration and set to similar alarm intervals, the amount of time needed for the monitor to complete a polling cycle increases. (Adding sensor alarm conditions also slightly increases the amount of time needed.) This is particularly true of serial loggers. If a polling cycle takes longer than the interval, you will see unpredictable behavior in the monitor window and a delay in notifications.

You may need to experiment to determine the best interval for your needs. If you encounter problems, a longer interval is recommended. Longer intervals also put less demand on the logger's battery.

🔄 (Refresh)

If you have added sensors to a serial logger (or removed them), click this button to update the sensor list.

Important: If you have removed a sensor for which a sensor condition has already been defined, the sensor condition will be deleted when you click Refresh. Also, if the logger is logging, clicking Refresh will cause the list to revert to the sensors that were connected at launch.

Conditions to trip alarms (Sensors tab)

Sensor conditions that have been added to this configuration. When any of these conditions are met, the monitor sends a notification. Note that a sensor can have more than one condition.

Important: State and event channel activity cannot trigger alarms.

To add a condition to this list, click Add Condition and use the dropdown lists to describe the condition. Choose a sensor, comparison type, value, units (if applicable), and duration needed to generate an alarm.

Tip: The units you choose for a sensor condition will always be the units displayed for that condition in the monitor window and details, even if you switch units (US/SI) in HOBOware Pro preferences.

The For Duration is directly related to the Interval. For example, if your Interval is 15 minutes, you can choose a Duration of 0, 15 minutes, 30 minutes, etc. With a Duration of 0, the alarm will trip on the first reading that meets the sensor condition. If the Duration is equal to the Interval (in this example, 15 minutes), the alarm will trip only if the condition is met for two consecutive readings; if the Duration is equal to two intervals (in this example, 30 minutes), the alarm will trip only if the condition is met for three consecutive readings; and so forth.

To remove a sensor condition from this list, click the trash icon 🗑 next to the condition.

Conditions to trip alarms (Loggers tab)

Click the Logger tab to select logger conditions (communication, memory, or battery) that can trip the alarm. These conditions are also subject to the Interval for alarms. When *any* of these conditions are met during an alarm interval, the monitor sends a notification.

- **When unable to communicate with logger:** This condition occurs only after all logger communication attempts, including retries, for a given alarm interval have failed. (It does not apply to communication failures that occur during scheduled readouts; this condition can be enabled on the Readouts pane.)
- **When memory used is at or above n%:** This condition occurs when logger memory reaches a threshold you specify. (Note that a serial logger that has been launched with wrapping enabled will always be at 100% once it has wrapped.)

Tip: If you choose the memory and/or battery conditions, be sure to specify limits for these conditions.

- **When battery level/voltage is at or below n:** This condition occurs when battery power reaches a threshold you specify.

Readouts Pane

Important: To perform a scheduled readout, the logger must be logging, or waiting for a delayed or trigger start when you start the monitor.

Tip: There are many preferences related to the formatting of text files and datafiles.

1. To schedule readouts, click the Readouts icon near the bottom of the Configure Alarms and Readouts dialog.
2. Click a logger's name in the logger list to schedule readouts for that logger.
3. Complete the Readouts pane. Readout options are described below.

Logger Selected

Logger whose readout schedule is displayed. To work with the readout schedule for a different logger, select the logger from the logger list to the left.

Mode

Type of readout, if any, for this logger.

- Select Disabled if you do not want to schedule readouts for this logger.
- Full reads out the full contents of the logger. (Refer to Preferences for options.) Performing a full readout each time puts more strain on the logger's battery.
- Partial starts reading out where the last scheduled readout ended. (Refer to Preferences for options.) The initial partial readout reads out the full contents of the logger.

Tips for partial readouts:

- Partial readouts cannot be performed on loggers that have multiple logging intervals defined.
- If the logger was launched with wrap enabled, you will not be able to create data (.dtf) files with partial readouts. However, you will still be able to create text (.txt) files.
- The logger must have the same deployment number at readout time as it did when you started the monitor. If you relaunch the logger while the monitor is running, the deployment number will increase, and partial readouts will fail.
- If you plan to use partial readouts with a wrap-enabled logger, the logger must not have wrapped before you start the monitor. If the logger wraps after the monitor is started, but before the first partial readout, partial readouts will be discontinued.

Interval

How often the Alarm & Readout Tool should read out the logger. Select a readout frequency from one minute to 364 days, 23 hours, and 59 minutes.

Tip: If the logger requires a base station/coupler to communicate, refer to your logger's manual to determine whether it will go to "sleep" if the computer does not communicate with it more often than every 30 minutes.

When loggers are added to a configuration and set to similar readout intervals, the amount of time needed for the monitor to complete a readout cycle increases. This is particularly true of serial loggers. If a readout cycle takes longer than the interval, you will see unpredictable behavior in the monitor window, and a delay in readouts and notifications.

You may need to experiment to determine the best interval for your needs. If you encounter problems, a longer interval is recommended. Longer intervals also put less demand on the logger's battery.

Tip: If you launch a serial logger with wrapping enabled, make a note of the logging duration on the Launch window in HOBOware Pro to determine how often you need to read out the logger to avoid missing data. For example, if the logger will fill and wrap within six days with the connected sensors and you configure the Alarm & Readout Tool to read it out every seven days, you will miss a day's worth of data each week. If data loss is detected, scheduled readouts will fail, and no further readout attempts will be made.

File name

Keep the default File name (the logger name), or enter a new one.

Tip: Be sure to use a unique file name for each of the loggers in a configuration.

Local Disk

Enable Local Disk to store the files on the machine that is running the Alarm & Readout Tool. It is a good idea to save files locally, even if you also plan to send them via email or upload them to an FTP site. This will provide you with a backup of the data if your network connection is lost.

When you enable Local Disk, the words "Local Disk" will turn red to remind you to configure local disk settings. Click the Edit button and complete the Manage Data Storage dialog.

- Click Choose to select a file location. The default location for saved files is the Documents\HOBOware\Readouts folder.
- Specify a File format (data or text) for the resulting file. (You may select both data and text; this will result in the creation of two files.) Datafiles (.hobo and .dtf) can be opened directly in HOBOware Pro. Text files can easily be imported into HOBOware Pro, or used in spreadsheets and many other programs.

Tip: If you selected partial readouts and the logger has wrap enabled, data (.dtf) will not be available.

Email Attachment

Enable Email Attachment to have the files sent as an email attachment. When you enable Email Attachment, the words "Email Attachment" will turn red to remind you to configure email attachment settings. Click the Edit button and complete the Manage Data Storage dialog.

- In the To field, enter the full email addresses (up to 120 characters), separated by semicolons, where you want the email to be delivered.
- In the From field, enter the full email address where you want the email to originate.
- In the Subj field, enter up to 30 characters for the subject line of the message.
- In the remaining fields, enter the information required by your SMTP server. You may be able to find this information in your email software. If you do not know which settings to use, contact your system administrator or Internet service provider.
- Click Test to verify that the settings are correct. The Alarm & Readout Tool should confirm that the test message was sent, and you should receive a message at the To address.
- Finally, specify a File format (data or text) for the resulting file. (You may select both data and text; this will result in the creation of two files.) Datafiles (.hobo and .dtf) can be opened directly in HOBOware Pro. Text files can easily be imported into HOBOware Pro, or used in spreadsheets and many other programs.

Tip: If you selected partial readouts and the logger has wrap enabled, data (.dtf) will not be available.

FTP

Enable FTP to upload the file to an FTP site. When you enable FTP, the word "FTP" will turn red to remind you to configure FTP settings. Click the Edit button and complete the Manage Data Storage dialog.

- Enter the information required by the FTP host. (Do not include "ftp://" in the FTP host field.) If you do not know which settings to use, contact your system administrator or Internet service provider.
- Click Test to verify that the settings are correct. The Alarm & Readout Tool should confirm that a test file was uploaded, and you should find a test file named "test.txt" at the FTP site.
- Specify a File format (data or text) for the resulting file. (You may select both data and text; this will result in the creation of two files.) Datafiles (.hobo and .dtf) can be opened directly in HOBOware Pro. Text files can easily be imported into HOBOware Pro, or used in spreadsheets and many other programs.

Tip: If you selected partial readouts and the logger has wrap enabled, data (.dtf) will not be available.

Notify me

Select the conditions for which you want to be notified. When any selected condition is met, the monitor sends a notification immediately.

- **When readout is successful:** This condition occurs when a scheduled readout has completed, and the resulting file has been saved, emailed, or uploaded to an FTP site.

  Tip: It is possible to be notified of a successful readout, but not receive the expected email with the attached datafile or text file. The Alarm & Readout Tool cannot tell if something goes wrong after the email was sent.

- **When readout fails:** This condition occurs when a scheduled readout (and all retry attempts) failed due to a communication error; or if there was an error saving the file, emailing it, or uploading it to an FTP server.

Copy

To copy this logger's readout settings to other loggers in this configuration, select the setting you want to copy (mode, interval, Local Disk settings, Email Attachment settings, FTP settings, or notifications) from the first drop-down next to the Copy button. Then select the name of a logger group, the name of an individual logger, or Group: Loggers (to select all loggers) from the second drop-down. Click Copy to complete this step.

Notifications Pane

Tip: There are many preferences for notifications.

1. To define notifications, click the Notifications icon near the bottom of the Configure Alarms and Readouts dialog. Notification settings apply to all loggers.
2. Choose one or more notification methods and options. Readout options are described below.

Tip: In general, the reliability of email and mobile text messaging depends on many factors, including but not limited to SMTP servers, wireless service provider, routers, receiving devices, and even environmental forces such as solar flares. This variability means that messages may not be delivered in a timely manner, and could even be delivered out of order. If you often get messages late or out of order, you may be able to improve your odds by using multiple notification methods, and/or multiple addresses (in different domains) in the To: field, separated by semicolons. For example:

john@onsetcomp.com; mary@onsetcomp.com

Email

Enable Email to send email notifications. When you enable Email, the word "Email" will turn red to remind you to configure email settings. Click the Edit button and complete the Manage Notification Methods dialog.

- In the To field, enter the full email addresses (up to 120 characters), separated by semicolons, where you want the email message to be delivered.
- In the From field, enter the full email address where you want the email message to originate.
- In the Subj field, enter up to 30 characters for the subject line of the email message.
- In the remaining fields, enter the information required by your SMTP server. You may be able to find this information in your email software. If you do not know which settings to use, contact your system administrator or Internet service provider.
- Click Test to verify that the settings are correct. The Alarm & Readout Tool should confirm that the test message was sent, and you should receive a message at the To address.

Text Message to Mobile Device

Enable Text Message to Mobile Device to send a text message to an SMS-enabled mobile device, such as a cellular telephone or a pager. When you enable this notification method, the words "Text Message to Mobile Device" will turn red to remind you to configure text message settings. Click the Edit button and complete the Manage Notification Methods dialog.

This setup dialog is similar to the dialog for Email, but there is a 15-character limit for the Subj field.

Tip: There is a maximum length preference for mobile text messages.

Launch Program

Enable Launch Program to have the Alarm & Readout Tool launch a program on the host computer. When you enable this notification method, the words "Launch Program" will turn red to remind you to configure program settings. Click the Edit button and complete the Manage Notification Methods dialog.

Click Choose and browse to the program you would like to run. If you want the program to use a file as input, enable Pass file into program as argument and enter the file location and name in the File field.

Host Computer

Enable this option if you want to the monitor to play a sound and attempt to grab the focus on the host computer. You may change the sound in Preferences.

Notify me

Specify how often you want to be notified of alarm conditions. You can be notified at the start of each alarm condition (once for continuous alarm condition); you can be notified at every duration of a continuous alarm condition (every duration for continuous alarm condition); or you can have the monitor notify you just once, at the start of the first alarm, and then stop the monitor (at first alarm condition, then stop monitor).

Tip: These options apply to alarm condition notifications only. Notifications of readout success or readout failure are sent once per readout.

Notify me when an alarm condition clears

Enable this option if you want to receive a notification when the alarm condition has returned to a non-alarm state.

Send heartbeat every ___

You can have the host machine send you regularly scheduled notifications to let you know that the monitor is still running and able to communicate while you are away. Enable this option and specify how often you want to be notified.

Messages Pane

1. To construct the message that will be sent by certain notification methods, click the Messages icon near the bottom of the Configure Alarms and Readouts dialog. Message settings apply to all loggers.
2. The top portion of this dialog lists the items you can include in a notification message. Select all of the items you would like to include. A sample message, based on your choices, appears below this area.
3. To include additional, customized text in the message, enable "Add text to notification message" and type the text in the area below this option.

Opening and Editing a Saved Configuration

Once you have created and saved a configuration, you can open it to review settings, change the settings, and start the monitor.

Tip: When the monitor is running, you can access the Configure Alarms and Readouts dialog for the current configuration by clicking Configure on the Alarm and Readout Monitor dialog. Changes that you make to the configuration will not take effect until the next time you start the monitor.

1. From the Tools menu, choose Manage Alarms & Readouts, then choose Open Configuration. Select the configuration and click Open. The Configure Alarms and Readouts dialog is displayed.
2. Review the settings and make changes, if desired.
3. To save changes to the existing configuration file, click Save. To save the changes to a new configuration file with a different name, click Save As.
4. To start the monitor now, connect the loggers and sensors (if applicable) that are defined in the configuration. If any loggers in the configuration have scheduled readouts enabled, be sure those loggers are launched, and either actively logging, or awaiting a delayed or triggered start. Click Start. If the monitor is already running, you will be warned that the monitor will stop the previous configuration before running the new one.

   Important: A serial logger that is waiting for a delayed or button start cannot provide an updated sensor reading until the logger begins logging. Once a serial logger begins logging, it can only provide the last logged value.

   Tip: To avoid disrupting an active deployment, do not connect sensors to a serial logger if it is already logging.
5. To close the Configure Alarms and Readouts dialog without starting the monitor, click Cancel.

Exporting a Configuration

To export a configuration to a text file, open the configuration and click Export. By default, exported configurations are saved in the Documents\HOBOware\Alarms folder with an extension of .txt.

Monitoring

IMPORTANT: The Alarm & Readout Tool is no longer installed with HOBOware as of version 3.4. This help section is included for reference only for existing Alarm & Readout Tool users.

The alarm and readout monitor polls the loggers and sensors at the intervals specified by the configuration, compares the values to the alarm conditions, and notifies you if an alarm is triggered. It also performs scheduled readouts and stores and/or sends the resulting files, as applicable.

- Start the monitor
- View the monitor details

- Hide the monitor
- Stop the monitor

Tip: The alarm and readout monitor uses your computer's system clock to determine when to poll loggers and read them out. If you (or an automated program) adjust the time backwards while the monitor is running, the next polling and/or readout time will be delayed until the clock reaches that time. Automatic time changes caused by the start and end of Daylight Saving Time, and manual changes to your time zone setting, do not cause a delay in the monitor.

Starting the Monitor

Tip: The alarm and readout monitor uses your computer's system clock to determine when to poll loggers and read them out. If you (or an automated program) adjust the time backwards while the monitor is running, the next polling and/or readout time will be delayed until the clock reaches that time. Automatic time changes caused by the start and end of Daylight Saving Time, and manual changes to your time zone setting, do not cause a delay in the monitor.

1. From the Tools menu, choose Manage Alarms & Readouts, then choose Open Configuration. Select the configuration you want and click Open. The Configure Alarms and Readouts dialog is displayed.
2. Connect the loggers and sensors (if applicable) that are defined in the configuration. The loggers can be logging, waiting for a delayed or button start, or stopped. Any loggers that have scheduled readouts must be either logging, or awaiting a delayed or triggered start when you start the monitor. The loggers should be logging by the time of the first scheduled readout. Serial loggers that are scheduled for partial readouts and have wrap enabled must not wrap before the first scheduled readout; if they are wrapped, the readout will fail.

   Important: A serial logger that is waiting for a delayed or button start cannot provide an updated sensor reading until the logger begins logging. Once a serial logger begins logging, it can only provide the last logged value.

   Tip: To avoid disrupting an active deployment, do not attach sensors to a serial logger if it is already logging.
3. Click Start. If the monitor is already running, you will be warned that the monitor will stop the previous configuration before running the new one. The Alarm and Readout Monitor dialog is displayed, and an alarm icon appears in the lower right corner of the main HOBOware Pro window.
4. Each logger has its own panel in the monitor window, which lists the logger name, monitored conditions, and a countdown to the next reading. To view details about the logger's status, click the logger's panel.
   - Once the monitor is running, if there is a communication failure, any sensor readings are italicized and in purple text to indicate that they are not current.
   - If the logger is in an alarm condition, the logger name is displayed in red text.
   - If a sensor is in an "above" alarm condition, its text is displayed in red. If it is in a "below" alarm condition, its text is displayed in blue. If it is "okay," its text is black.
   - If a monitored logger condition (communication, memory, battery status, or readout) is in an alarm condition, its icon is displayed in red. Otherwise, the icon is green.
   - A icon indicates a notification failure.
   - Because different loggers may be read at different intervals, the Next Readout and Next Alarm Check at the top of the monitor window lets you know when the next readout and alarm check will be taken for the configuration.

  - To access the configuration dialog for the current configuration, click Configure. Changes that you make to the configuration will not take effect until the next time you start the monitor.

5. You can continue to use HOBOware Pro to work with other loggers and datafiles. In addition, you can work with the monitored loggers in HOBOware Pro when the monitor is not taking a reading.

Tip: A logger cannot communicate with HOBOware Pro and the monitor at the same time. If both applications attempt to access the logger at the same time, you will receive communication errors.

Viewing the Monitor Details

To view the details of a logger's condition while the monitor is running, click the logger's panel in the Alarm and Readout Monitor dialog. The following explains the fields on the Alarm and Readout Monitor - Details window.

- **Monitor started:** Time when the monitor was started.
- **Monitor number:** Number of times the monitor has been started. Each time you start the monitor, the Alarm & Readout Tool's internal counter (the monitor number) increases by one. If the monitor performs readouts, the monitor number is added after the file name, before the sequence number (if any).
- **Notification method(s):** Notification methods in use. This can be any combination of email, mobile text message, launch program, or host computer.
- **Last notification at:** Time when the most recent notification was sent. If this is "None Sent," no notifications have been sent yet. Click View to see the text of the last notification that was sent.
- **Select logger:** This box lists the loggers that are being monitored. The information in this dialog refers to the logger that is currently highlighted in the logger list. To view details for a different logger, click that logger's name.
- **Name:** Description that was entered for the logger on the Configure Alarms and Readouts dialog.
- **Device:** Model and serial number of the logger.
- **Communication:** Communication protocol for this logger (USB or serial).
- **Readout Mode:** Readout mode selected for this logger (full, partial, or disabled).
- **Interval (readouts):** Frequency with which the monitor is reading out the logger.
- **Readout Storage:** Storage method(s) for the resulting datafile or text file (local disk, email attachment, or FTP).
- **Last Readout:** Time when the last readout was performed. If a scheduled readout has not been performed yet, this is "None."
- **Next Readout:** Time of the next scheduled readout attempt, if applicable, and a countdown timer.

  If readouts can no longer be performed on the logger (because the logger was relaunched, or has stopped, filled up, wrapped more than once between readouts so that data was lost, or wrapped before the first partial readout), the countdown timer will read 00:00:00. If you are not sure why readouts were cancelled, pause the mouse pointer over the countdown timer for an explanation.
- **Interval (alarms):** The frequency with which the monitor is polling the logger for alarm conditions.
- **Last Alarm Check:** Time when the last alarm check was performed.
- **Next Alarm Check:** Time of the next scheduled alarm check, if applicable, and a countdown timer.
- **Monitored sensor conditions (not labeled):** This box lists the sensor conditions, if any, that were defined for this logger, along with their current values as of the last reading.

If a sensor is in an "above" alarm condition, its text is red. If it is in a "below" alarm condition, its text is blue. If it is "okay," its text is black. If there is a communication failure, the current reading is italicized and in purple text to indicate that it is outdated.

- **Monitored logger conditions (not labeled):** The area at the bottom of the window lists the logger conditions (communication, memory, battery status, and readout), if any, that were defined for this logger. The memory icon also displays the amount of memory that has been used.

If one of these items is in an alarm condition, its icon is red. Otherwise, it is green.

Hiding the Monitor

To hide the monitor without stopping it, click the Hide button on the Alarm and Readout Monitor dialog, or choose Hide Monitor from the Manage Alarms & Readouts submenu on HOBOware Pro's Tools menu. The alarm clock icon will remain in the lower right corner of the main HOBOware Pro window to remind you that the monitor is active, and the icon will turn red and "jump" when an alarm is triggered. In addition, if the configuration is set to notify on the host machine when an alarm is triggered, the monitor window will open automatically at that time.

To restore the monitor window at any time, click the alarm clock icon, or choose Show Monitor from the Manage Alarms & Readouts submenu on HOBOware Pro's Tools menu.

Stopping the Monitor

To stop the monitor, click the Stop button on the Alarm and Readout Monitor dialog, or choose Stop Monitor from the Manage Alarms & Readouts submenu on HOBOware Pro's Tools menu. This ends all readouts and notifications until you start the monitor again.

After all alarm checks and readouts in progress have finished, the Stop button becomes a Start button, and the Hide button becomes a Close button. You can restart the monitor by clicking the Start button, or close it by clicking the Close button.

You can define a configuration to stop the monitor immediately after sending the first alarm notification. Enable the "at first alarm condition, then stop monitor" option on the Notifications pane.

There are also preference settings that cause the monitor to stop automatically. In Alarm Preferences, in the Notification category, enable "Stop monitor after N notifications sent" if you want the monitor to stop after sending a specific number of notifications. Enable "Stop the monitor if sending a notification fails" if you want the monitor to stop when it is unable to send a notification.

Readout Files

IMPORTANT: The Alarm & Readout Tool is no longer installed with HOBOware as of version 3.4. This help section is included for reference only for existing Alarm & Readout Tool users.

When you use the Alarm & Readout Tool to perform scheduled readouts, you have a choice of creating datafiles (.hobo and .dtf) and/or text (.txt) files. Only HOBOware can open datafiles, but text files can be imported easily into HOBOware Pro, and be viewed in text editors, spreadsheets, and other kinds of software.

Note: When reading out files to text file format, the data is in SI units. Preferences set to US in HOBOware are not followed.

Readout file numbering scheme

The Alarm & Readout Tool employs a simple numbering scheme to avoid overwriting files that have been created as a result of scheduled readouts. Each time you start the monitor, the Alarm & Readout Tool's internal counter (the monitor number) increases by one. If the monitor performs readouts, the monitor number is added after the file name, before the sequence number (if any).

For example, consider a configuration with two loggers – LoggerA and LoggerB. Each logger will be read out once per day, over a period of seven days. LoggerA is configured for partial readouts, which (with default Preference settings) results in one file. LoggerB is configured for full readouts, which (again, with default Preference settings) results in seven files.

The first time you start the monitor, the monitor number is 1. When you stop the monitor, you should have eight files: LoggerA_1.hobo, and LoggerB_1_0000.hobo, LoggerB_1_0001.hobo, LoggerB_1_0002.hobo, etc.

The next time you start the monitor, the monitor number is 2. When you stop the monitor, you should again have eight files: LoggerA_2.hobo, and LoggerB_2_0000.hobo, LoggerB_2_0001.hobo, LoggerB_2_0002.hobo, etc.

The monitor number advances every time you start the monitor, even if no readouts are performed. If the monitor number reaches 99,999, it will roll over to 1.

Tip: Be careful when renaming files while they are still in their original location. If, for some reason, you rename "MyLogger_1.txt" to "MyLogger_2.txt," the file could be overwritten the second time you run the monitor.

Text File Format

The first section of the text file contains the header. This header conforms to YAML standards, allowing maximum compatibility with other software. The remainder of the file contains the data.

There are three sections in the text file header:

- Data Format
- Logger Info
- Series Info

The second section of the text file contains the data.

Header Section: Data Format

This section of the header includes detailed information about the way your text file is formatted.

- dateTimeDelimiter, dataDelimiter, and decimalSeparator identify (between double-quotes) the character used to separate date and time; the character used to separate data values from one another; and the character that is used as a decimal.
- dateFormat and timeFormat describe the way dates and times are formatted within the file. These formats are determined by the preference settings in HOBOware Pro and the regional format settings of your operating system. For example, 07/31/06 would be represented as MM/dd/yy. (Single-digit values have leading zeros.)
  - Uppercase HH refers to 24-hour time (e.g., 15:00:00).
  - Lowercase hh refers to 12-hour time (e.g., 3:00:00 PM). This time format should be followed with "a" to denote an AM/PM indicator (hh:mm:ss a).
  - Lowercase ss refers to whole seconds. Uppercase SSS refers to milliseconds.
  - Lowercase mm refers to minutes. Uppercase MM refers to months.
- gmtOffset and daylightSavings indicate the offset, in hours, from GMT on the computer that launched the logger, and whether the computer was in Daylight Saving Time when the logger was launched (true or false).

Header Section: Logger Info

This section of the header contains information about each logger that has data in this file. There is one subsection for each logger. (*For scheduled readouts, there is only one logger per file.*)

- The first line of each subsection is:

```
- &#
```

where "#" is an integer that counts the loggers in this file, beginning with 1. (For scheduled readouts, &1 is the only subsection.)

- The remaining fields in each subsection list the logger's launch description, model, vendor, etc., similar to the fields on the Status window in HOBOware Pro.

Header Info: Series Info

This section of the header lists each column in the file, excluding the first column ("#") and date/time column. There is one subsection for each series. Series are listed in the same order as their columns within the data.

- The first field of each subsection is name, followed by the series name.
- The next field is type, which can be value, state, event, or internalEvent.
- For value, external event, and state series, type is followed by unitName. Values and external events have only one unitName. For state series, the two states are listed on two separate lines, with the high state listed first.
- For value series only, OMClassName, OMPartNumber, OMUnitIndex, OMChannelType, and OMValuePattern provide additional series information to Onset's software.
- The location, if any, is the location string for a serial logger sensor.
- The last field of each subsection is logger. This identifies the logger that logged this series or provided the data from which this series was derived (such as dew point). The logger is identified as *# where "#" corresponds to the logger number in the Logger Info section. (*For scheduled readouts, *1 is the only logger.*)

Data Section

- Data is separated from the file header by a row of hyphens.
- The first row of data consists of the column headings. Each column heading is enclosed in double quotation marks (" ") and separated by the dataDelimiter character. The first column header is "#"; the second column header is "Time, GMT-04.00" (or whatever offset is appropriate).
- The remaining columns identify each series name and unit type, if applicable, in the format "Series Name, Unit" (enclosed in double quotation marks). Each series, including states, external events, and internal logger events, has its own column. (There are preferences that allow you to include more information in the series column headers.)
- The first column is the point number, as shown in a HOBOware datafile.
- The date and time are separated by the dateTimeDelimiter character. (There is a preference that allows you to split date and time into two columns.)
- For internal logger events, the field value is Logged; otherwise, there is no field value.
- No zeros or spaces are used for fields that do not contain values.
- Rows of data are separated with a paragraph return.
- Thousands separators are not used. Two thousand (2,000) is expressed as 2000.

Preferences

IMPORTANT: The Alarm & Readout Tool is no longer installed with HOBOware as of version 3.4. This help section is included for reference only for existing Alarm & Readout Tool users.

When you install the Alarm & Readout Tool, an Alarms pane is added to the HOBOware Pro preferences dialog. To change preferences:

1. From the HOBOware Pro (Macintosh) or File (Windows) menu, choose Preferences.
2. Click the Alarms icon to open the Alarms pane.
3. Make changes as needed in the Alarm Conditions, Readouts, Notification, Messages, and Warnings preference groups and click OK.

Clicking the Restore Defaults button on the Preferences dialog will restore all preferences, including HOBOware Pro and Alarm & Readout Tool preferences.

Readout Preferences

The following preferences are available in the Readouts group:

- **For full readouts:** If you have configured loggers for full readouts, a new file is normally created at every readout, with the file name you entered in the configuration, followed by the monitor number, followed by a numeric suffix to identify the sequence (the sequence number). For example, LoggerA_X_0000.hobo, LoggerA_X_0001.hobo, etc. where X is the monitor number.

  If you prefer to keep only one file, select "overwrite existing file at each readout." This setting is not recommended when performing full readouts to text files for serial loggers that have wrapping enabled; once the logger has wrapped, the data from the beginning of the deployment will be lost when the original file is overwritten.

- **For partial readouts:** If you have configured loggers for partial readouts, a new text file or datafile is created with the first readout, and subsequent partial readouts are normally appended to this file.

  To control the size of text files only, enable "for text files, create new file when appended file exceeds" and enter the number of rows. This will not split a readout into multiple files; rather, it will create a new file only when the existing file has already exceeded this limit. Each file name will have a monitor number, followed by a numeric suffix to identify the sequence (the sequence number). For example, LoggerB_X_0000.txt, LoggerB_X_0001.txt, etc. where X is the monitor number.

  You can also have the Alarm & Readout Tool create a new text file for every partial readout. Select "create new file at each readout." Each file name will have a monitor number, followed by a numeric suffix to identify the sequence (the sequence number). For example, LoggerA_X_0000.txt, LoggerA_X_0001.txt, etc. where X is the monitor number.

Tip: When performing scheduled readouts, the Alarm & Readout Tool will use the preference settings that were in effect when you started the monitor. If you change any of the following Readouts preferences while the monitor is running, the new settings will not take effect until the next time you start the monitor.

- **Text file data column separator:** This setting controls how the columns are separated in the text file. Choose comma, semicolon, or tab.
- **Text file date and time format:** Separate into two columns. By default, date and time are kept in a single column in the text file to facilitate graphing in spreadsheet programs. If enabled, this setting splits the date and time into two columns.
- **Include logger serial number in column header:** This setting adds the logger's serial number to each column header when a text file is saved. This is especially useful if you plan to analyze data from different loggers.
- **Include sensor serial number (if available) in column header:** This setting adds the sensor's serial number, if it has a serial number, to each column header when a text file is saved. This is especially useful if your data includes similar series that were recorded on different sensors; for example, three different temperature series.
- **Include sensor location (if available) in column header:** This setting adds the sensor's location string, if it had a location defined at the last launch, to each column header when a text file is saved.

This is especially useful if your data includes similar series that were recorded on different sensors; for example, three different voltage sensors.

Alarm Condition Preferences

The following preferences are available in the Alarm Conditions group:

- **Include channel number in sensor description:** For USB loggers, you may include the channel number in the sensor description. This is especially helpful if you are using external sensors.
- **Include location in sensor description:** For serial loggers, you may include the location that was defined for the sensor the last time the logger was launched.

Notification Preferences

The following preferences are available in the Notifications group:

- **Enable notification logging:** Enable this option if you would like the Alarm & Readout Tool to keep a log of all notifications that have been created. You may find this helpful if you suspect that you are not receiving all of your notifications due to problems with your email or text messaging service. The log file will be named NotificationLog.txt, and it will be overwritten each time you start the monitor.

For Windows users, the notification log will be located in:

C:\Documents and Settings\username

For Macintosh users, the notification log will be located in:

~\Library\Logs

- **For new configurations, remember notification settings from the last started configuration:** If you generally use the same notification settings for each configuration, enabling this option will save you some time when creating new configurations.
- **For text messages...:** Some mobile text messaging services have maximum message length limits. To ensure that you do not miss any text notifications, enable this option and enter the limit in the Text Message Limit box. If a notification exceeds this number of characters, it will be sent in a series of shorter messages.
- **Stop the monitor if sending a notification fails:** Enable this option if you want the monitor to stop if it is not able to send a notification.
- **Stop monitor after N notifications sent:** To stop the monitor after a certain number of notifications are sent, enable this option and specify the number of notifications. This helps you limit unnecessary battery drain on the logger and the expense of frequent text messaging if you will not be able to stop the monitor directly at the host system.
- **Enable sound for host notification:** By default, notifications on the host machine are accompanied by a sound. You can select a different sound file, or disable the sound by unchecking the box.

To change the sound played with the notification, select a sound from the dropdown list, or click Choose to browse to the .wav file you want to use. To preview the sound, click the ▶ icon.

Message Preferences

The following preference is available in the Messages group:

- **Select the following Message items by default:** If you want to include or exclude certain items from most notification messages, select the items you want to include here. These will become the default message items when you create a new configuration.

Warning Preferences

Some warning dialogs offer you a checkbox to disable the warning so that you do not see it again. You can also disable (and re-enable) these warning preferences here.

- **There are unsaved file changes:** If you try to start the monitor or cancel the configuration dialog when the displayed configuration contains settings that have not been saved, this warning gives you a chance to save the changes before the configuration dialog closes.
- **The configuration file being opened was created with a different version of the Alarm & Readout Tool:** Configuration files from the previous version of this software ("Real Time Alarm Software") are fully compatible with the current version. If you save the configuration file after you open it, it will be updated to the current version. If the configuration includes references to serial loggers, you should click Refresh on the Sensors tab of the Alarms pane before saving the file. This will add more information about the sensors to the configuration file.
- **The monitor is running when closing the application:** If you try to quit HOBOware Pro while the monitor is running, this warning reminds you that quitting HOBOware Pro will stop the monitor, and gives you a chance to cancel.
- **There may be concurrent logger access:** This warning appears if you try to communicate with (add or refresh) a logger in the Configure Alarms and Readouts dialog while the logger is included in the currently running alarm and readout monitor.

HOBO® Waterproof Shuttle (U-DTW-1) Manual

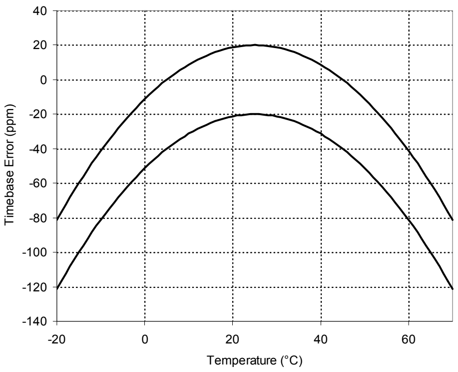
The HOBO Waterproof Shuttle performs several major functions:

- Reads out all logger information (serial number, deployment number, data, etc.) from loggers in the field for transfer to host computer, and stores each logger's data in a "bank"
- Nonvolatile memory preserves data, even if batteries are depleted
- Relaunches the logger, resetting the logger's time to the shuttle's time and synchronizing the logging interval on relaunch
- Can be used as an optic-to-USB base station

Although the HOBO Waterproof Shuttle is easy to use, Onset strongly recommends that you spend a few minutes reading this manual and trying out the procedures described here before taking the shuttle into the field.

Specifications

Compatibility	All HOBO U-Series loggers with optic USB. Not compatible with the HOBO U-Shuttle (U-DT-1).
Data Capacity	63 logger readouts of up to 64K each
Operating Temperature	0° to 50°C (32° to 122°F)
Storage Temperature	-20° to 50°C (-4° to 122°F)
Wetted Materials	Polycarbonate case, EPDM o-rings and retaining loop
Waterproof	To 20 m (66 feet)
Time Accuracy	±1 minute per month at 25°C (77°F); see Plot A
Logger-to-Shuttle Transfer Speed	Reads out one full 64K logger in about 30 seconds
Shuttle-to-Host Transfer Speed	Full shuttle offload (4 MB) to host computer in 10 to 20 minutes, depending on computer
Batteries	2 AA alkaline batteries required for remote operation
Battery Life	One year or at least 50 complete memory fills, typical use
Weight	150 g (4 oz)
Dimensions	15.2 x 4.8 cm (6.0 x 1.9 inches)
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU). To maintain CE compliance, this product must be used with the supplied USB cable or equivalent (less than 3 m long).



Plot A

HOBO Waterproof Shuttle

U-DTW-1

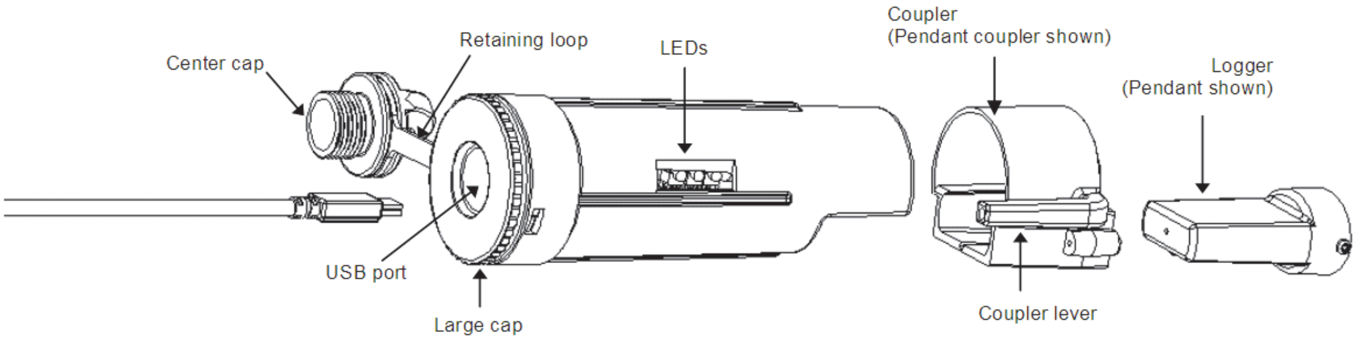
Included Items:

- USB cable
- Set of couplers;
  - For UA Pendant (COUPLER2-A)
  - For U20 Water Level (COUPLER2-B)
  - For U22 Water Temp Pro v2, U24 Conductivity, and U26 DO (COUPLER2-C)
  - For UTBI TidbiT v2 (COUPLER2-D)
  - For U23 HOBO Pro v2 (COUPLER2-E)

Required Items:

- HOBOware 2.2 or later
- Compatible logger and matching coupler

HOBO Waterproof Shuttle Features



Preparing to Go on Location

Before using the shuttle for the first time, you must launch it with HOBOware 2.2 or greater. You must also launch any compatible loggers that were last launched with an earlier version of HOBOware, or have never been launched at all.

1. Use HOBOware 2.2 or greater to launch each logger you wish to read out and relaunch with the shuttle later. (Read “Using the shuttle as a base station” for instructions if you do not have another base station for the loggers.) The shuttle cannot relaunch loggers that were last launched with an earlier version of HOBOware. (You only have to do this once for each logger.)
2. Plug the large end of a USB interface cable into a USB port on the computer. (Avoid using a USB hub, if possible.)
3. Unscrew the center cap on the shuttle. If the cap is too tight to loosen by hand, insert a screwdriver through the lanyard hole and rotate counterclockwise until the cap is loosened.
4. Plug the small end of the USB interface cable into the USB port in the shuttle. (If the shuttle has never been connected to the computer before, it may take a few seconds for the new hardware to be detected.)
5. Follow the instructions in the *HOBOware User’s Guide* to access the **Manage Shuttle** dialog. Make sure the battery level is good, and change the batteries now if they are weak.

Important: If you change the batteries in the field, the shuttle’s clock will stop, and the shuttle will not read out loggers again until you relaunch it in HOBOware.

6. If you are using the shuttle for the first time, launch the shuttle as described in the *HOBOware User’s Guide*. Launching synchronizes the shuttle’s clock to the host computer and initializes the shuttle’s header.

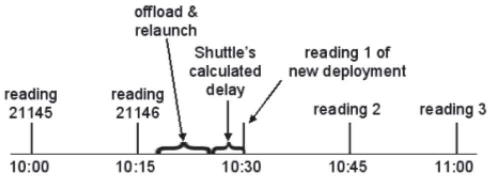
Important: The shuttle’s clock is used to set the logger’s clock at relaunch. For most accurate results, make sure the host computer’s clock is correct before launching the shuttle. If you need to adjust the computer’s clock, quit HOBOware, set the computer’s clock, then reopen HOBOware and launch the shuttle.

7. If you have used the shuttle before, make sure there are enough banks available to accommodate the loggers you plan to read out.
8. Disconnect the USB cable from the shuttle and replace the center cap securely.

Reading Out and Relaunching Loggers in the Field

After you have ensured that the shuttle’s batteries are good, there is sufficient memory available, and the shuttle’s clock is synchronized, follow these steps to read out and relaunch a logger in the field:

1. Make sure the shuttle’s large cap and center cap are closed securely. Tighten the center cap until it is just flush with the large cap, or until the O-ring is no longer visible.
2. Make sure the communication end of the shuttle is clean. Attach the correct coupler for the logger, and ensure that it is seated properly.
3. Insert the logger into the coupler, following the instructions that came with the coupler.
4. Momentarily press the coupler lever (pressing hard enough so the lever bends). Readout should begin immediately. The amber LED blinks continuously while readout and relaunch are in progress. Do not remove the logger when the amber LED is blinking.
5. After reading out the logger, the shuttle synchronizes the logger’s clock to the shuttle’s internal clock and relaunches the logger, using the description, channels to log, logging interval, and other settings that are already in the logger. (If the logger was launched with multiple logging intervals, the final defined logging interval will be used.) The logger is launched with a slight delay that causes its readings to be synchronized with those of the previous deployment, as shown in the following diagram.



Important: If the logger was launched with multiple logging intervals, there will be no synchronizing delay. The logger will start immediately with the last defined logging interval.

6. When the relaunch has completed, the green LED blinks for 15 minutes, or until you momentarily press the coupler lever to stop it (press hard enough so the lever bends). If the red LED blinks instead, there was an error, and the logger may have stopped. Refer to "Troubleshooting" in this manual for details.
7. Remove the logger from the coupler.

Checking Shuttle Status in the Field

The shuttle's memory has 63 "banks." One logger readout can be stored in each bank. To check the shuttle's memory and batteries in the field, remove the logger and press the coupler's lever for at least three seconds (pressing hard enough so the lever bends). When you release the lever, the green LED blinks once for each unoccupied bank in the shuttle's memory. (Press the lever momentarily to stop the blinking, pressing hard enough so the lever bends.)

If the shuttle's batteries are running low, all of the shuttle banks are full, or the clock has not been set, the red LED blinks. (Press the lever momentarily to stop the blinking, pressing hard enough so the lever bends) Use HOBOware to check the shuttle's battery level, available memory, and clock. You may need to change the batteries, or offload the datafiles to the host computer and delete them from the shuttle to free up memory before you can continue reading out loggers.

Offloading Data to the Host Computer

You can offload the data stored in the shuttle even when the batteries are depleted. Take the following steps:

1. Connect the shuttle to a host computer running HOBOware.
2. Follow the instructions in the *HOBOware User's Guide* to offload the new datafiles or access the **Manage Shuttle** dialog. The **Manage Shuttle** dialog shows you how many banks are occupied, and whether they have already been offloaded and saved to the host computer.
3. Offload and save data from the banks of your choice. Refer to the *HOBOware User's Guide* for details on saving datafiles offloaded from the shuttle.
4. Review the list of banks and delete any that are no longer needed. Make sure the battery level is good, and change the batteries now if they are weak. (If you change the batteries in the field, the shuttle's clock will stop, and the shuttle will not read out loggers.) Update the shuttle's clock, if necessary.
5. When finished, disconnect the shuttle from the computer and close the center cap securely.

Using the Shuttle as a Base Station

You can use the shuttle as a base station for any U-Series logger with an optic USB interface. (This function is available even when the batteries are depleted.) To use the shuttle as a base station:

1. Connect the shuttle to the host computer running HOBOware.
2. Attach a compatible logger and coupler.
3. Momentarily press the coupler's lever (pressing hard enough so the lever bends).
4. The amber LED blinks momentarily, then the green LED should glow steadily to indicate that the logger is ready to communicate with HOBOware. (If the red LED blinks instead, the logger was not found. Make sure the logger and coupler are aligned and seated properly, and that there is no dirt or strong sunlight interfering with communications.)
5. When finished, remove the logger from the coupler. The green LED stops glowing when you disconnect the logger or the USB cable.

Important: The Waterproof Shuttle cannot be used *as a base station* with Pendant logger models UA-001 and UA-003 (including rain gauges RG3 and RG3-M) with serial numbers less than 988278. These loggers require a BASE-U-1 for communication with the host computer.

Indicator Lights

Green "OK" LED

The green "OK" LED blinks when HOBOware recognizes it as a base station; when it finishes reading out and relaunching a logger; and when you press the coupler lever to check the shuttle's status (see "Checking shuttle status in the field" for details). Momentarily press the coupler lever to stop the blinking (pressing hard enough so the lever bends).

The green LED glows steadily when the shuttle is being used as a base station.

Amber "Transfer" LED

The amber "Transfer" LED blinks when the shuttle is reading out a logger and relaunching it. Do not remove the logger when the Transfer light is lit.

Red "Fail" LED

The red "Fail" LED blinks whenever the shuttle encounters an error condition. Refer to "Troubleshooting" for details.

All LEDs

All LEDs blink in unison when the shuttle has just been powered up, either by installing fresh batteries or (if batteries are not installed) by connecting to the computer's USB port.

Troubleshooting

This section describes problems you may encounter while using the shuttle.

Shuttle is not recognized by host computer

If HOBOware does not recognize the shuttle when you connect it to the computer, simply disconnect and reconnect the shuttle.

Red "Fail" LED blinks
The red "Fail" LED blinks (for 15 minutes, or until you press the coupler lever, pressing hard enough so the lever bends) whenever the shuttle encounters an error. There are several conditions that might cause an error:

- **Shuttle is full:** If the red LED blinks when you try to read out a logger, check whether all of the banks are full, as described in "Checking shuttle status in the field." Or, use HOBOware to check the shuttle's memory.
- **Shuttle batteries are low:** If you cannot read out any loggers at all, check the logger's status, as described in "Checking shuttle status in the field," or use HOBOware to check the shuttle's batteries. The batteries may simply need to be replaced.
- **Compatibility:** The shuttle cannot read out or relaunch loggers that were last launched from HOBOware prior to version 2.2. You will need to read out these loggers on the host computer and relaunch them in HOBOware 2.2 or greater before you can use them with the shuttle.
- **Shuttle clock is not set:** The shuttle has experienced a power failure that caused the clock to reset. You must use HOBOware to offload the files that are already on the shuttle, then relaunch the shuttle before you can read out another logger.
- **Can't communicate with logger:** Remove the logger and coupler. Inspect them and the shuttle to ensure that all are free of dirt that could block the optic communication sensor. Carefully reassemble the shuttle, coupler, and logger, and make sure they are all seated properly. Shield the shuttle from strong sunlight, if applicable, which can interfere with optic communications.
- **Other logger problems:** If you can read out some loggers but not others, or if you cannot read out any loggers even with fresh batteries in the shuttle, check the loggers in HOBOware. Make sure their batteries are at acceptable levels and that there is no "corrupted header" message.

Amber "Transfer" LED stays on without blinking
The amber light is magnetically activated when you press the coupler lever. If it glows steadily at any other time, the magnet in the lever may be too close to the magnetic switch in the shuttle, or another strong magnet may be present. Try bending the lever away from the coupler to reduce the magnet's effect.

LEDs do not function
If the LEDs are not functioning at all, the batteries may be completely exhausted. To test this, attach the shuttle to the host computer and check the battery level. The shuttle should be able to communicate with the host computer, blink its LEDs normally, and perform as a base station even when the batteries are missing or depleted.

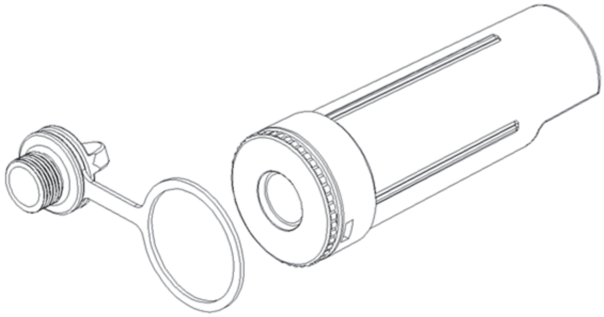
Replacing the Shuttle's Batteries

The shuttle's batteries should last about one year or at least 50 complete memory fills in typical conditions. When the shuttle's batteries run low (2.2 V or less), any logger data that is already in the shuttle will remain safe, but the shuttle will not read out another logger until its batteries are replaced.

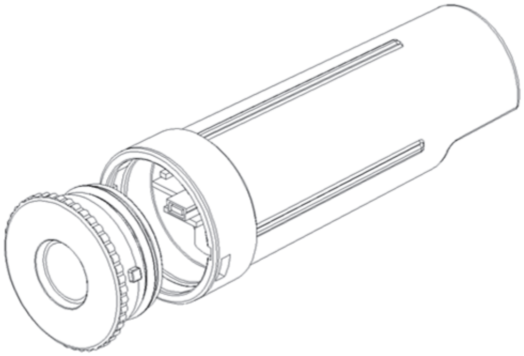
To avoid battery problems, always check the shuttle's batteries in HOBOware before going into the field, and replace them if needed. If you cannot replace the bad batteries right away, you should remove them as soon as possible to ensure that they do not leak and damage the shuttle.

To change the shuttle's batteries:

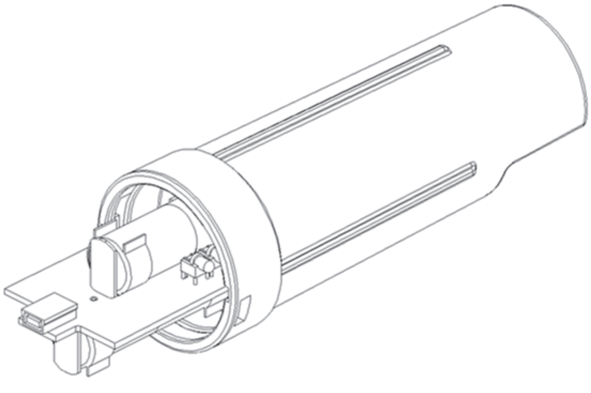
1. Work over a clean surface to provide a safe platform for the disassembly.
2. Unscrew the center cap on the shuttle. If the cap is too tight to loosen by hand, insert a screwdriver through the lanyard hole and rotate counterclockwise until the cap is loosened.
3. Use the center cap to help you carefully pull the rubber loop free of the large cap. The large cap cannot be removed while the rubber loop is in place.



4. Turn the large cap counter-clockwise slightly, then pull it off.



5. Turn the shuttle over and tap it gently. The circuit board should slide into your hand.



6. Remove the old batteries and install two new ones in the correct orientation. Both batteries should be turned the same way, with their positive ends facing the USB port on the board. (When the second battery makes contact, all of the shuttle's LEDs will blink in unison.)
7. Put the board back into the case, taking care not to bend the communication LEDs. Align the circuit board with the runners in the case. The USB port should face the open end of the shuttle, and the LEDs should show through the window on the label.
8. Close the shuttle's case. Line up the tabs on the large cap with the slots on the case, press gently, and turn slightly clockwise until the large cap is closed securely.
9. Replace the rubber loop and center cap. Tighten the center cap until it is just flush with the large cap, or until the O-ring is no longer visible.
10. Using HOBOware, offload any datafiles that are on the shuttle and launch the shuttle before going into the field again. The shuttle will not read out and relaunch loggers until the clock has been synchronized.

⚠ **WARNING:** Do not install batteries backwards, recharge, put in fire, expose to extreme heat, or mix with other battery types, as the batteries may explode or leak. Contents of an open or leaking battery can cause chemical burn injuries. **Replace all used batteries at the same time.** Recycle or dispose of batteries according to applicable federal, state, and local regulations.

APPENDIX E
OTT MF PRO AND WADING ROD MANUALS

DOC026.53.80211

OTT MF pro

07/2012, Edition 3

Operating Instructions

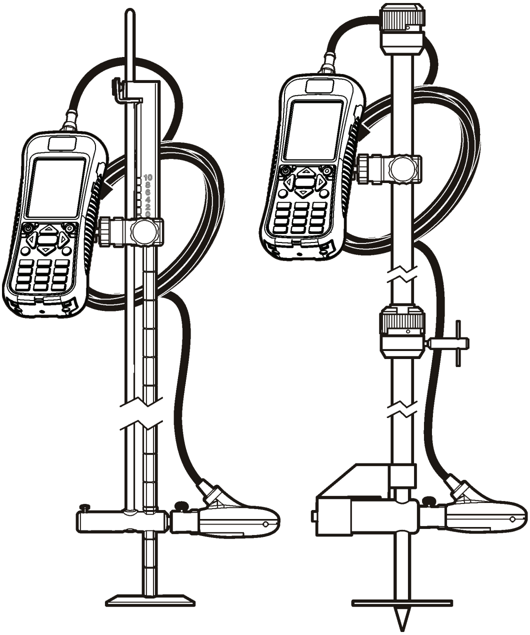


Table of Contents

Specifications

Specifications are subject to change without notice.

Sensor specifications

Specification	Details
Velocity measurement	
Method	Electromagnetic
Range	0 to 6.09 m/s (0 to 20 ft/s)
Minimum water depth	3.18 cm (1.25 in.)
Accuracy	±2% of reading ±0.015 m/s (±0.05 ft/s) 0 to 3.04 m/s (0 to 10 ft/s); ± 4% of reading from 3.04 to 4.87 m/s (10 to 16 ft/s)
Resolution	0.01 value < 100; 0.1 value < 1000; 1.0 value ≥ 1000
Zero stability	±0.015 m/s (±0.05 ft/s)
Material	ABS, glass filled
Enclosure rating	IP68
Dimensions (L x W x H)	11.9 x 4.3 x 6.3 cm (4.7 x 1.7 x 2.5 in.)
Cable material	Polyurethane jacketed
Cable lengths	1.5, 6.1, 12.2 and 30.5 m (5, 20, 40 and 100 ft)
Depth measurement	
Method	Diaphragm type: absolute pressure with single point calibration
Accuracy (static)	The larger of ± 2% of reading or ± 0.015 m (± 0.504 inches). Steady state temperature and static non-flowing water.
Range	3.05 m (0-10 ft)
Resolution	0.01 value < 100; 0.1 value < 1000; 1.0 value ≥ 1000

Portable meter specifications

Specification	Details
Pollution degree	2
Protection class	II
Charging temperature	0 to 40 ºC (32 to 104 ºF)
Operating temperature	–20 to 55 ºC (-4 to 131 ºF)
Storage temperature	–20 to 60 ºC (-4 to 140 ºF)
Enclosure rating	IP67
Battery life gauge	Five-segment bar graph
Battery type	Rechargeable lithium ion, 3.7 V, 4.2 Ah
Battery life	18 hours heavy typical day use[1]; 20 ºC (68 ºF)
Battery charger	External Class III power adapter 100–240 VAC, 50–60 Hz, 0.3 A input; 12 VDC, 1.0 A output
Dimensions (L x W x H)	21.8 x 9.3 x 5.3 cm (8.6 x 3.7 x 2.1 in.)

Specification	Details
USB connector	Type Mini-B, 5-pin, rated to IP67 when capped
Material	Polycarbonate with a thermoplastic elastomer (TPE) overmold

[1] Defined as 30 minutes of set up, six 1-hour periods of continuous use with an active sensor and the display at maximum brightness and 30 minutes of sleep mode between use periods, data download and power off.

User interface specifications

Specification	Details
Graphics display	Color, LCD 3.5" QVGA transflective (readable in direct sunlight)
Measurement resolution	0.01 value < 100; 0.1 value < 1000; 1.0 value ≥ 1000
Keypad	Alpha-numeric
Operating modes	Real time, profiling
Profile types	Stream, conduit
Conduit shapes	Circular, rectangular, trapezoidal, 2/3 egg, inverted 2/3 egg
Stream entries	Fixed, non-fixed stations
Noise rejection	User-selectable, 50 Hz or 60 Hz
Units of measure	Velocity: ft/s, m/s, cm/s, mm/s
	Flow: ft^3/sec, million gal/day, gal/day, gal/min, m^3/s, m^3/min, m^3/hour, m^3/day, liters/s, liters/min
	Depth: in., ft, m, cm, mm
Stream flow calculation	Mean-section or mid-section method
Diagnostics	Self test, keypad, display, event log
Conduit profiling methods	0.9 x Vmax, 0.2/0.4/0.8, velocity and level integrator, 2D
Stream profiling methods	1, 2, 3, 5 and 6 point (velocity method - USGS and ISO)
File types	Real-time, profiling, event log
Languages	English, French, Spanish, German, Italian, Dutch, Danish, Swedish, Chinese, Polish, Japanese, Korean, Portuguese, Slovak, Russian, Hungarian, Bulgarian, Romanian, Czech, Turkish, Finnish, Greek

General specifications

Specification	Details
Profiles	Data storage for up to 10 profiles with 32 stations per profile
Maximum number of real-time files	Three each with up to 75 readings captured by the user.
Firmware	The sensor and portable meter are field upgradeable via USB

General information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer’s website.

Safety information

NOTICE

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than specified in this manual.

Use of hazard information

⚠ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

Precautionary labels

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol indicates the presence of devices sensitive to Electro-static Discharge (ESD) and indicated that care must be taken to prevent damage with the equipment.
	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user. ***Note:*** *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.*

Certification

Canadian Radio Interference-Causing Equipment Regulation, IECS-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numèrique de la classe A respecte toutes les exigences du Rëglement sur le matériel brouilleur du Canada.

FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

Product overview

The portable velocity system is used in the field, laboratory and municipalities. Turbulent, noisy and low flows can be measured with this system.

When the sensor is placed in flowing water, a magnetic field around the sensor creates a voltage proportional to the flow velocity. This voltage amplitude, which represents the rate of water flow around the sensor, is detected by electrodes in the sensor and processed by the sensor microprocessor. The processed signal is digitally transmitted through the sensor cable to the portable meter and the information is shown on the meter display. The system includes a portable meter, sensor with cable and accessories.

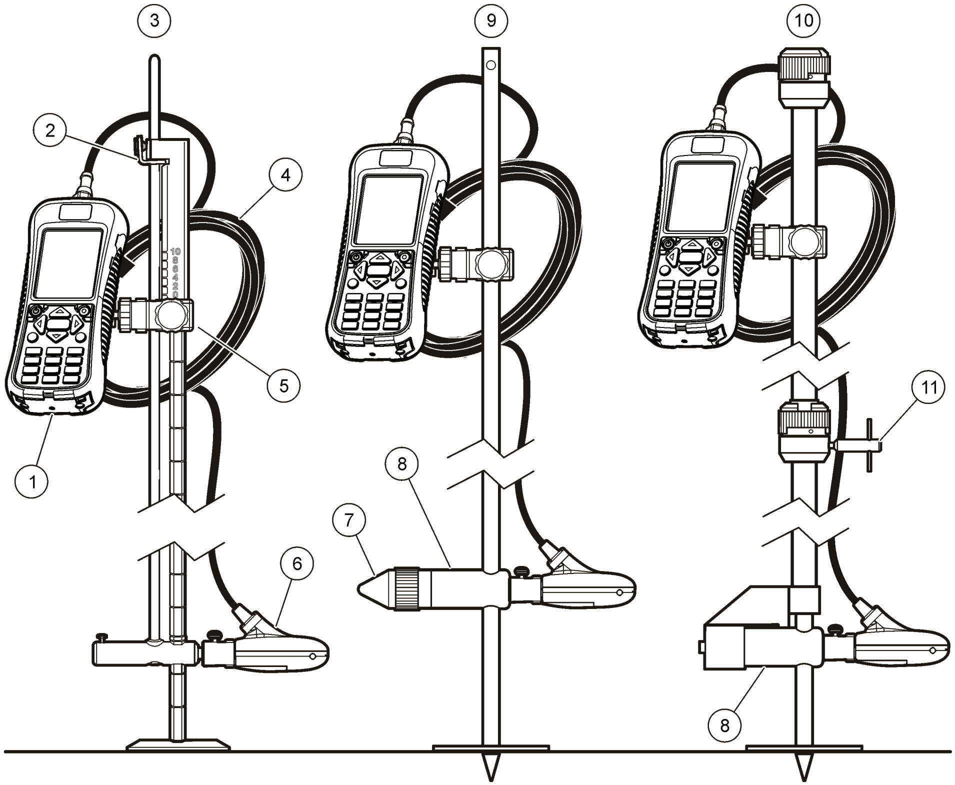
The meter and sensor get velocity information in conduits and streams. These measurements are important for calibration in municipal wastewater industries, as well as for developing and maintaining stage discharge relationship curves.

Two types of sensor are available: velocity-only and velocity plus depth. This manual covers both types of sensors. If information applies to a specified type of sensor, this fact is noted in the text.

System overview

An overview of the assembled system is shown in Figure 1 . Refer to the documentation supplied with the individual components or accessories for more information.

Figure 1 Assembled components

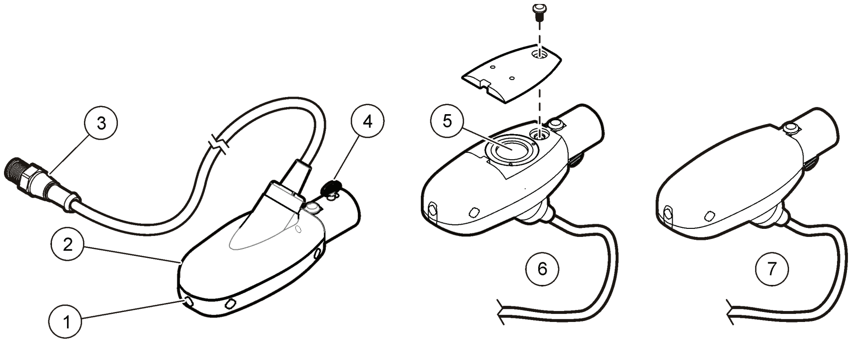


1 Portable meter	**7** Sensor height lock/release screw (optional accessory)
2 Sensor height lock/release device	**8** 20 mm/HERES wading rod adapter (optional accessory)
3 Top setting wading rod (optional accessory)	**9** 20 mm wading rod (optional accessory)
4 Sensor cable	**10** HERES wading rod (optional accessory)
5 Adjustable mount for portable meter	**11** Sensor height lock/release screw
6 Sensor assembly	

Sensor overview

Figure 2 shows the main sensor components. Instructions for how to attach the sensor on a standard or top-setting or HERES or 20 mm wading rod are supplied with the accessory.

Figure 2 Sensor components

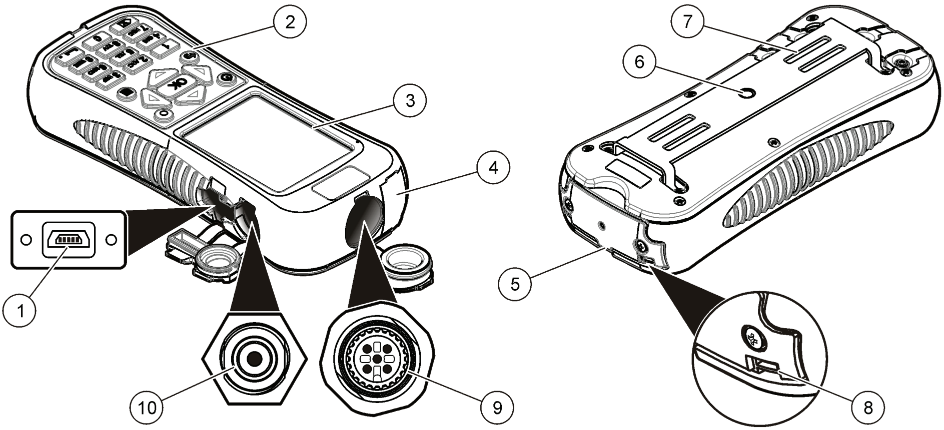


1 Sensor electrodes	**5** Pressure cell (sensors with depth option)
2 Sensor body	**6** Sensor with depth option
3 Sensor connection plug	**7** Sensor without depth option
4 Sensor attachment thumb screw	

Meter overview

Figure 3 shows the features of the meter.

Figure 3 Meter components

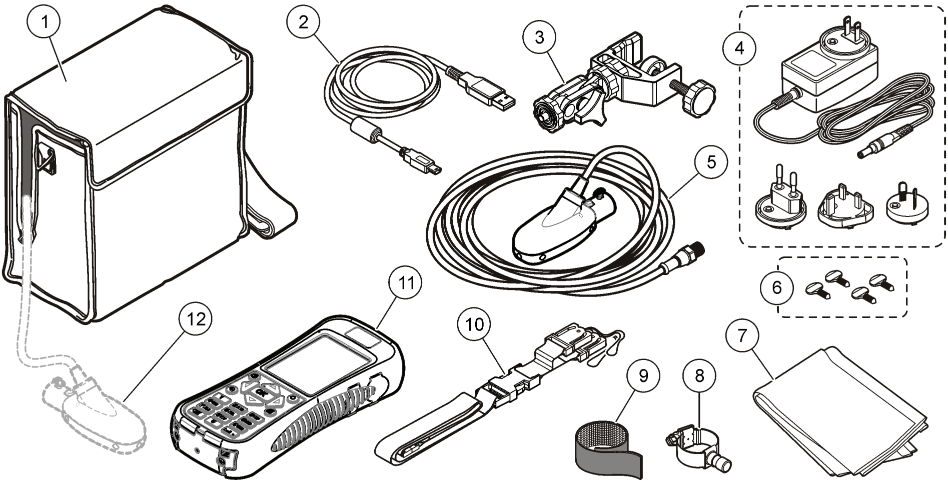


1 USB connection port	**6** Threaded hole for adjustable meter mount
2 Keypad	**7** Slots for velcro or strap attachment
3 Meter display	**8** Slot for neck strap attachment threads (2x)
4 Expansion port (not used)	**9** Sensor connection port
5 Battery compartment cover	**10** Wall-charger connection port

Product components

When purchasing a complete system, refer to Figure 4 to make sure that all components have been received. If any of these items are missing or damaged, contact the manufacturer or a sales representative immediately.

Figure 4 System components



1 Carrying case (with slot for sensor cable)	**7** Cloth to dry the sensor
2 USB communication cable	**8** Universal sensor mount
3 Adjustable portable meter mount	**9** Velcro strap
4 Wall charger and universal plug kit	**10** Lanyard
5 Sensor	**11** Portable meter
6 Extra thumb screws (4x)	**12** Sensor as connected to meter inside case

Installation

Installation with optional accessories

Mount the meter on an optional wading rod for use in low-stage stream environments where the stream can be waded. Optional accessories let the user take measurements from a bridge or cable over a stream. A torpedo shaped weight attached below the sensor keeps the sensor in place when under water. For more information, refer to the documentation supplied with the accessory.

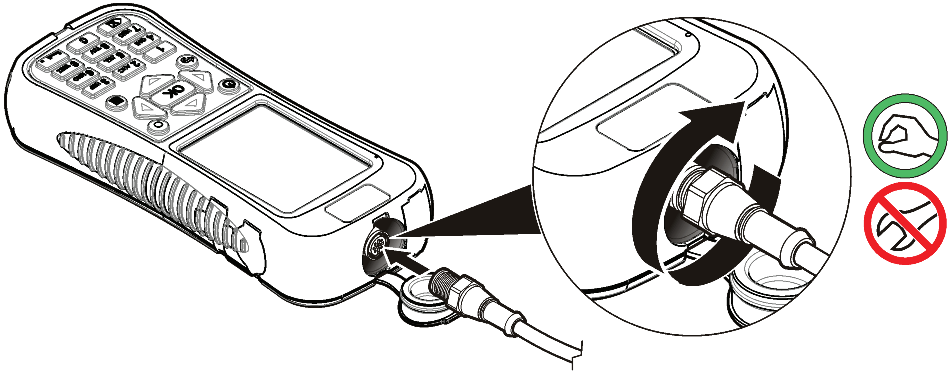
Install the sensor on the universal sensor mount

Use the universal sensor mount to attach the sensor to poles 1 inch or less in diameter. For correct operation and accurate readings, the front of the sensor must be pointed upstream with the electrodes in full contact with the flow.

Note: *Keep the sensor electrodes free from nonconductive substances such as oil and grease. To remove sensor contamination, refer to* Clean the sensor *on page 26.*

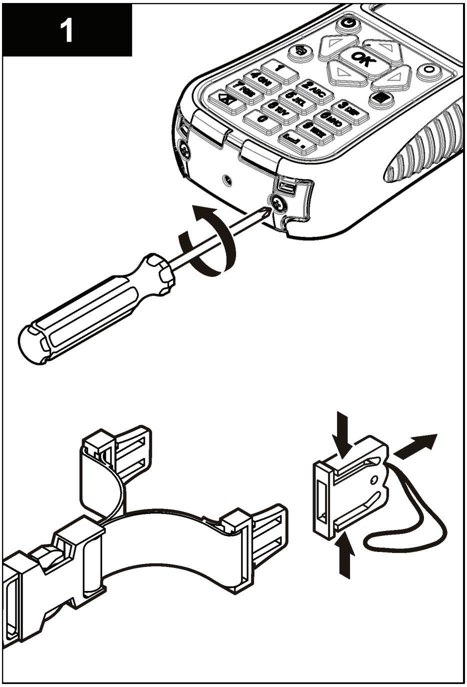
1. The front part of the sensor is round and contains three electrodes. The sensor has a mounting hole in back and a thumbscrew on top. Put the mounting shaft of the universal mount in the mounting hole at the back of the sensor. Make sure that the mounting shaft is completely engaged with the mounting hole and the thumbscrew is engaged with the groove.
2. Hand tighten the thumbscrew.
3. Move a pole 1 inch or less in diameter through the clamp of the universal sensor mount. Tighten the clamp.
   Note: *Instructions for how to mount the sensor on a standard, top-setting, HERES or 20 mm wading rod are supplied with the accessory.*

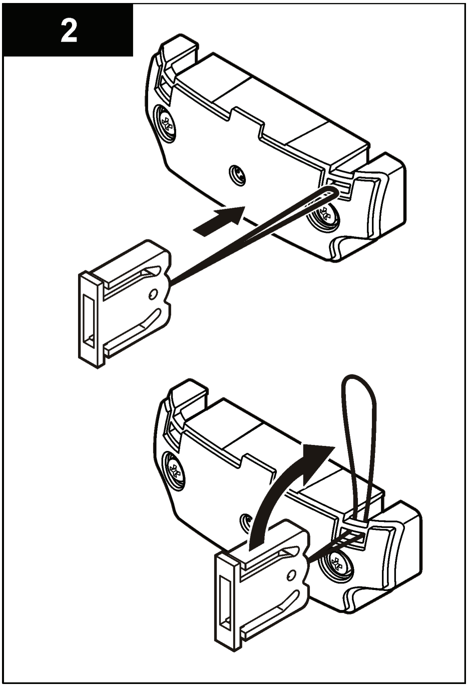
Connect the sensor to the meter

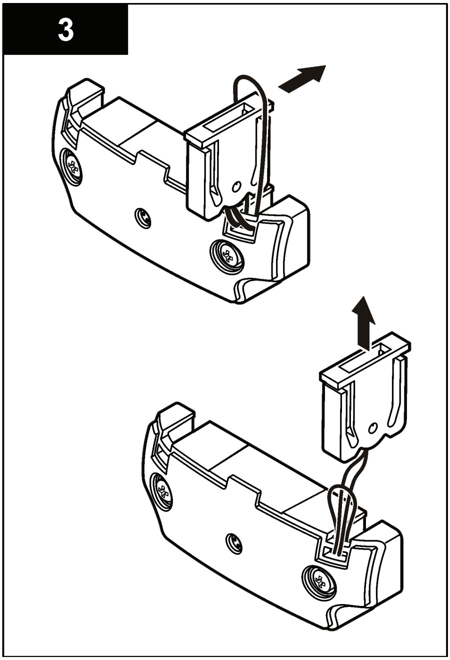


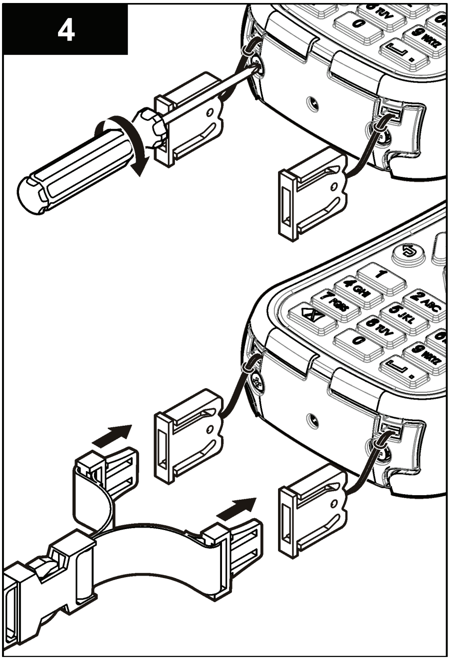
Attach the lanyard

Attach the lanyard to wear the meter safely around the neck.





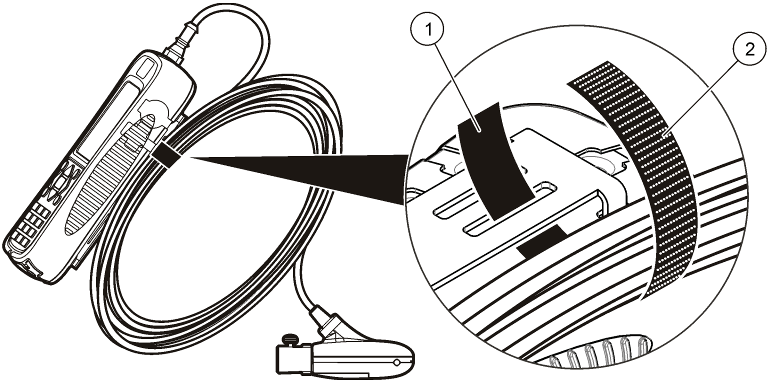




Attach the velcro strap

Use the velcro strap to hold the extra cable. Refer to Figure 5.

Figure 5 Attach the velcro strap



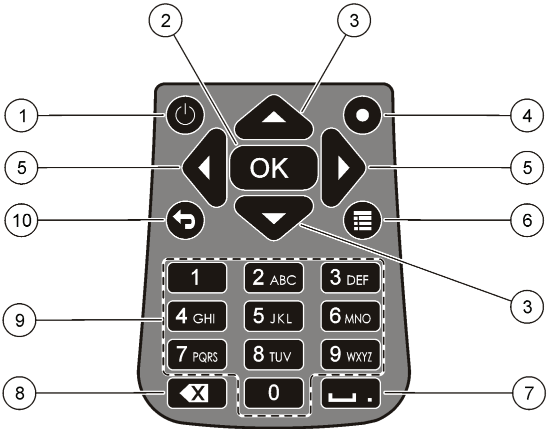
1 Loop side	**2** Hook side

User interface and navigation

Keypad and key functions

Figure 6 shows the meter keypad. Table 1 gives the functions of each key or key type.

Figure 6 Keypad



1 Power On/Off	**6** Main Menu
2 OK	**7** Underscore or decimal
3 Up and Down arrows	**8** Backspace
4 Quick Jump	**9** Alpha-numeric
5 Right and Left arrows	**10** Previous menu

Table 1 Key description

Key	**Description**
Power On/Off	Energizes and de-energizes the meter.
OK	Confirms an entry or highlighted menu option.
Up and Down arrows	Moves up or down in the display. If the cursor is at the top or bottom of the display, the cursor wraps to the bottom or top when the UP or DOWN arrow is pushed.
Quick Jump	In normal operation, this key jumps to the Select conduit shape screen. If the auto-zero feature is disabled, hold this key for five seconds to do a manual zero of the depth sensor. In Real-Time mode, the Quick Jump key toggles between the digital and graph views.
Right and Left arrows	Moves to the right or left in the display.
Main Menu	Moves to the Main Menu from any submenu or screen.
Underscore or decimal	Puts in an underscore or decimal character. In numeric-only fields, this key automatically puts a decimal point in the cursor position.
Backspace	Moves the cursor back one space.
Alpha-numeric	Puts in the key alpha or numeric value. Values are put in the order shown on the key. After 2 seconds, the value shown in the display is stored and the cursor advances.
Previous menu	Moves to the previous screen.

Status bar

A status bar is shown in the top of the display. Descriptions of the information in the status bar are given in Table 2.

Table 2 Status bar indicators

Indicator	Description
Time and Date	Shows the current time and date.
USB	Shows when a USB cable is connected. If a USB cable is connected and this indicator does not show in the status bar, the USB cable is not fully engaged. Make sure that the USB cable is pushed in completely and makes full contact with the connection port.
Conductivity	If the sensor is out of the water and non-conductive, a blue ring appears next to the battery icon. If the sensor is in the water and conductive, the indicator is a solid blue circle.
Battery	A five-bar graph shows the level of charge in the battery.
File access	Shows while the meter gets access to a file.
Auto zero depth indicator	If the depth sensor was zeroed in the last 30 minutes, a solid green circle shows next to the Conductivity indicator. If the depth sensor was not zeroed in the last 30 minutes, this indicator flashes red.

Navigation and Main Menu

Push **OK** to confirm a selected menu option or a value shown in the display. Select More and push **OK** to see additional screens and options if available. Push the Main Menu button to go to the Main Menu from a submenu.

Note: *Some operations cannot be completed unless a sensor is connected to the meter. If these operations are tried when there is no sensor connected, the display shows an error message. Connect a sensor and try the operation again.*

1. **Real time**—Select this option to get real-time velocity and depth information. (A sensor with depth capability is necessary to read depth). An example of a Real Time screen for sensors with velocity only is shown in Figure 7. Real time screens for sensors with both velocity and depth is shown in Figure 8. The format of the information and options shown depends on the type of sensor used. In Real Time mode, the Quick Jump key toggles between digital and graphic views of Real Time information. The velocity is updated in FPA filter mode according to fixed period averaging time. In RC filter mode, the velocity is updated continuously on the screen every 250 ms.

Option	Description
Capture	Stores the depth and velocity information shown in memory. The information is saved until power is cycled, the memory is saved to a non-volatile real-time file, or the user exits from real-time mode.
Save	Saves captured measurements in the volatile memory to a non-volatile real-time file. A message will show if the number of files is greater than the maximum possible. Files are stored in tab delimited (.tsv) format.
Done or OK	Exits the real-time mode and returns to the Main Menu. If there is unsaved data in volatile memory, a confirmation message asks the user to confirm the exit without saving the data.
Clear	Clears captured measurements from the volatile memory buffer. The user can choose from Clear Last, Clear All or Cancel options.

Option	Description
Setup	Allows the user to modify the main filter parameters and enable and program the Maximum Depth sensor positioning feature. The Maximum depth feature allows a user to enter system parameters for depth measurement in Real Time mode. The user can choose to enter a maximum depth value taken directly with a ruler measurement (manual), or taken indirectly with the depth measurement (automatic). Both methods enable the Maximum Depth sensor positioning feature. In automatic mode setup, the user directly enters the distance from the bottom of the channel to the bottom of the sensor mount (offset). The setup interface will continuously show the current depth value returned by the sensor plus the offset. The meter stores this value as the Maximum Depth when the OK button is pushed. In all other cases, the depth values shown do not include the offset. The Maximum depth feature requires a sensor with velocity plus depth.
Files or View	Shows a summary of each real-time file stored in non-volatile memory. Files can be individually viewed and deleted.

Figure 7 Real time screen

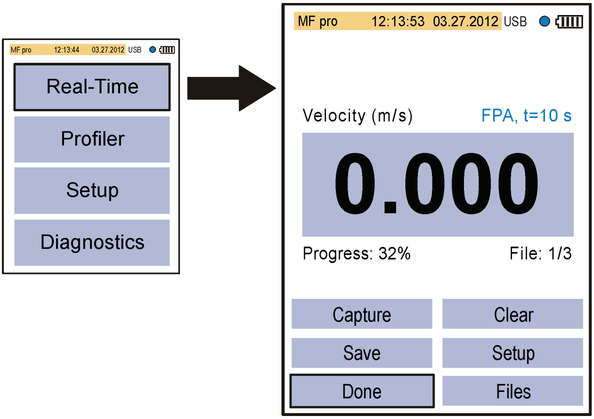
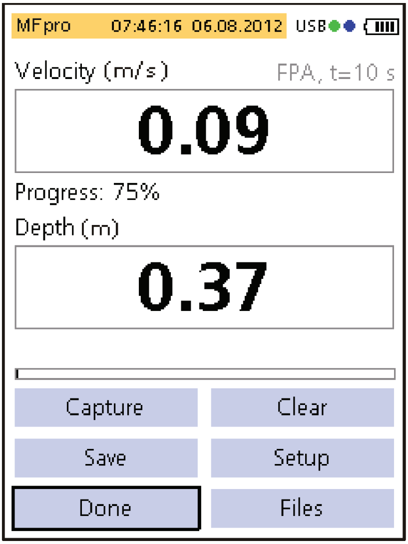


Figure 8 Real time screen for sensor with depth



Velocity (m/s) FPA, t=10 s

0.09

Progress: 75%

Depth (m)

0.37

2. **Profiler—** Select this option to do stream or conduit velocity measurements. The meter shows prompts when user input is necessary. The meter saves up to 10 profiles with up to 32 stations per profile. This number can be greater if data acquisition time is less than the maximum. A percentage of the remaining memory is given in 1% resolution. Refer to the Appendix on page 30 for more information about profiles.

Option	Description
Stream	This option is used to set up a profile for a stream or flowing channel. Do velocity measurements to calculate total discharge based on ISO 748 or USGS standards for Mid-section or Mean-section methods.
Conduit	This option is used to set up a profile for a conduit.
Files	This option is used to view or delete stored files. Files can be deleted all at once or individually.
Setup	This option is used to set up or change the settings for filter parameters and the Maximum Depth feature.

3. **Set up**—Select this option to change general system settings and preferences.

Option	Description
Velocity calibration	Calibrates the sensor. Adds a field offset to the factory calibration. Refer to the Appendix on page 30 for more information.

Option	Description
Filter parameters	Applies a data acquisition filter (Main filter or Pre-filter). The user can select the filter parameters. **Main filter** • Fixed Period Averaging (FPA)—Fixed Period Averaging averages data over a user selectable fixed period of time (1 to 480 seconds). The default is 30 seconds. If the FPA value is 5, the velocity value shown in the display is updated once every 5 seconds. • RCA time constant—The RC filter helps smooth out turbulence through the use of a selected time constant in the filter algorithm. This mode is useful when searching for a maximum velocity, for example in the common 0.9 x Vmax profile method. High RC filter time constants give higher degrees of smoothing. The time constant can be set from 2 to 20 seconds, with a default value of 6. At 1 time constant, the filter settles to approximately 60% of the final value. At 5 time constants, the filter settles to 99.9% of the final value. Thus, if the RC value is set to 2, the final value shows after 10 seconds. **Pre-filter** • Median filter—The filtering process is done in the sensor. The feature can be disabled. However, the recommended (default) value is 5. Enable the feature to enter or change this value.
Wet/dry threshold	Sets the sensor submersion threshold for wet and dry conditions. The default value is 20%. Refer to Wet/Dry threshold on page 33 for more information.
Auto zero depth	Sets the Auto Zero feature to On or Off. If set to On, the instrument does an air calibration when the sensor is removed from the water and is in the air. To do the air calibration, the instrument automatically zeroes the sensor. If set to Off, the user can manually zero the sensor. To do this, remove the sensor from the flow, then push and hold the Quick Jump key for five seconds. When the sensor has been in the flow for 30 minutes, the green circle in the upper right corner goes from green to red. This is a prompt to the user to remove and zero the sensor again.
EMI	Sets the local line frequency for ambient noise rejection to 50 Hz (default) or 60 Hz .
Clock	Sets the date and time of the portable meter in 24-hour format. Daylight savings time is not supported.
USB	Sets the USB mode. • Mass Storage (default)—This mode operates like a memory stick or hard drive. Files are read-only. • CDC—This mode is used to update firmware.
Language	Selects the language used in the menus.
Units	Sets the units for velocity, flow and depth measurements. Options are Metric (default) or English .
Beeper	On (default) or Off. If set to On, the meter makes an audible tone when the sensor is at the correct depth for applicable profile methods. The meter also makes an audible tone when an inactive button is pushed in any menu. This feature is available only with the optional depth sensor.
Flow calculation	Selects the method of flow calculation for open water segment (stream profiles only). Options are Mean-section or Mid-section. Refer to the Appendix on page 30 for more information.

Option	Description
Station entry	• Fixed—The operator puts in the width of the stream and the number of stations for measurements. The meter divides the cross-section into evenly spaced distances between the station verticals. • Non-fixed (default)—The operator selects the spacing between station verticals. This is the more commonly used option as it lets the operator include obstructions and other restrictions in the cross section.
Restore defaults	Sets all meter options to the factory default values.

4. **Diagnostics—** Select this option to troubleshoot problems with the meter or an attached sensor. For more information about the Diagnostics options, refer to Diagnostics on page 28.

Startup and self-test

⚠ DANGER

Chemical or biological hazards. If this instrument is used to monitor a treatment process and/or chemical feed system for which there are regulatory limits and monitoring requirements related to public health, public safety, food or beverage manufacture or processing, it is the responsibility of the user of this instrument to know and abide by any applicable regulation and to have sufficient and appropriate mechanisms in place for compliance with applicable regulations in the event of malfunction of the instrument.

⚠ WARNING

Fire and explosion hazards. Do not use or store the instrument in direct sunlight, near a heat source or in high temperature environments such as a closed vehicle in direct sunlight. Failure to take this precaution can make the battery overheat and cause a fire or explosion.

The battery must be installed in the meter and charged before use. For more information about battery installation and replacement, refer to Install or replace the battery on page 27. For information on how to charge the battery, refer to Charge the battery on page 28.

***Note:** The meter is not operational while the battery charges.*

1. Push the meter power button until an audible beep is heard.
   The meter does a self test and the display shows the results. If the meter fails the self-test, the display shows FAIL next to the failed parameter. If the sensor fails, attach a different sensor if available.
2. When the self test is complete, push **OK** to go to the Main Menu.
3. To de-energize the meter, push the power button again. In the Confirmation screen, select Yes and push **OK**.
   If the portable meter becomes unresponsive, push and hold the power button for more than 3 seconds to force the power off. Do not force off the power in normal operation or when the file access icon is visible.

Sleep mode

The meter backlight goes dim after 30 seconds of no activity and goes into sleep mode after 60 seconds of no activity. These actions do not occur if the meter is in real-time mode or while the meter is measuring. After 30 minutes in sleep mode, the meter power goes off.

To cancel the sleep mode, push any key. The display brightness goes back to the normal level and all keys go back to their normal functions.

Operation

Stream profiles

Stations and station spacing

For a well-chosen cross-section, division into 25 to 30 partial sections is typically sufficient. If the cross-section is very smooth and the velocity distribution very consistent, it is possible to decrease the number of stations.

Make the distance between the partial stations so that no individual station contains more than 10% of the discharge. The ideal measurement is one in which each partial station contains 5% or less (≤ 5%) of the total discharge, but this is rarely possible when 25 stations are used. Partial stations should not have equal widths across the entire cross-section unless the discharge is well-distributed.

Distances between stations are generally smaller where water depth and flow velocities change significantly. Places where depth and velocities frequently change significantly include bank areas, vertical or steep slopes, ledges in divided cross-sections and transitions from the main stream bed to the foreland. Stations should also be located at points of significant changes in the stream bed profile.

The measurement cross-section must be set at right angles to the direction of flow. Cross-sections must not contain still areas, counter currents or eddies. Do not put the sensor in deep pools, below large inflows, or near ship moorings, ferries or sluices.

Use Table 3 as a guide for the number of stations necessary for an acceptable measurement. The information is based on EN - ISO 748 standards.

Table 3 Number of stations in relation to the waterway width

Feet	Meters	Number of stations
< 1.6	< 0.5	5 to 6
> 1.6 and < 3.3	> 0.5 and < 1	6 to 7
> 3.3 and < 9.8	> 1 and < 3	7 to 12
> 9.8 and < 16.4	> 3 and < 5	13 to 16
> 16.4	≥ 5	≥ 22

Measure velocity

Measurement quality is dependent on the correct selection of a measurement cross-section. Select a section of stream with the following characteristics:

- The flow directions at each measurement point across the stream are parallel to the bank and perpendicular to the cross-section.
- The streambed is stable and free of large rocks, weeds and protruding obstructions such as piers that cause turbulence.

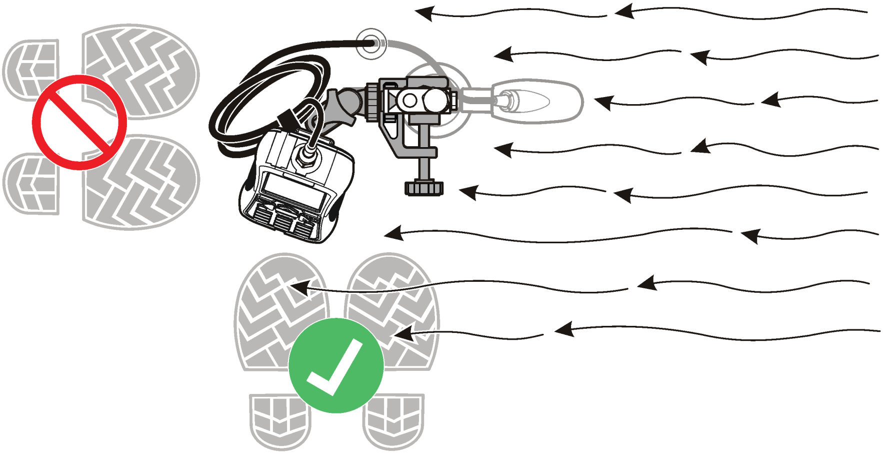
It is often not possible to completely satisfy all of these conditions. Use the criteria to select the best possible section and then select a cross-section.

The general procedure to take velocity measurements in river and stream profiles is described below. Make the first measurement in a stream profile at the top. Make each subsequent measurement below the last one.

- In fixed mode, divide the channel into stations of equal width.
- Conduct a velocity measurement at each station. The portable meter shows and stores the depth and measured velocity information.
- When the stream profile is completed, the meter automatically calculates the total flow.

For accurate measurement results, stand to the side of the instrument. Refer to Figure 9.

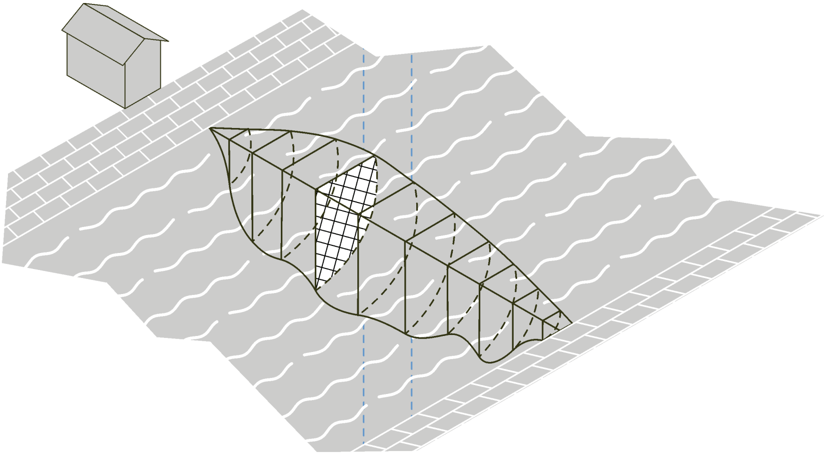
Figure 9 Position of user in the flow



Measure velocities in a cross-section

A typical stream cross-section is shown in Figure 10.

Figure 10 Example of a typical cross section



To measure velocities in a cross-section:

1. In the Main Menu, select Profiler.
2. Enter the Operator name. A list of options will show.

Option	Description
Stream	Used for measurements in a stream profile.
Conduit	Used for measurements in a conduit profile.

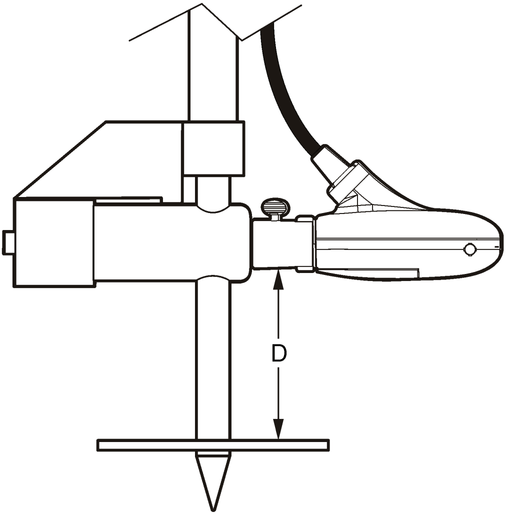
Option	Description
Files	Used to view or delete files.
Setup	Used to set up filter parameters and the Maximum depth feature.

3. Select Setup > Maximum depth. Select Manual or Automatic.

Option	Description
Manual	In this mode, the instrument prompts the user to manually enter the maximum depth of each vertical. This value is normally obtained from a wading rod.
Automatic	In this mode (available only on sensors with the depth option), the instrument uses the pressure transducer to measure the maximum depth at each vertical.

   a. If Automatic is selected, enter the distance from the bottom of the channel to the bottom of the sensor mount.
   b. Put the sensor at the lowest position on the wading rod.
   c. Enter the minimum depth (measured from the bottom) that the sensor can read. Refer to Figure 11. When rods with a base plate and/or tip are used, this extra distance can be larger. This depends on whether the subsurface is firm or yields. The extra distance is important as a parameter for the correct determination of the water depth.

Figure 11 Minimum depth



4. Select Top or Bottom for the measurement reference then push **OK**.
5. If necessary, change or update the filter parameters in Profiler Setup.
6. In the Profiler menu, select Stream.
7. Enter a name for the stream profile. Make profile names alpha-numeric with a maximum of 11 characters. Push **OK** to save the profile name or select Clear to delete all current stream profile data.
8. Enter the stage reference. This is typically an elevation value from an immovable object such as a survey marker or bridge, etc.

9. In the Station menu, select Edge/Obstruction. Select one of the options.

Option	Description
Left	Select this option if the station is at the left edge of the water or an obstruction (i.e, sandbar, pylon or large boulder).
Right	Use this option if the station is at the right edge of water or an obstruction (i.e., sandbar, pylon or large boulder).
Open water	Use this option to configure the edge as an open water environment (default).

10. Select Distance to Vertical and enter the information.
11. Select Set Depth and enter the information. If at an edge, the meter automatically sets this value to 0.00.
    a. If Manual mode was selected in the Profiler setup, enter the total depth of water at this vertical position.
    b. If Automatic mode was selected in the Profiler setup, push **OK** to set the maximum flow depth at the value shown.
12. If Left or Right was selected in Step 9, enter an edge factor for the vertical. Select a factor from the list or User-defined. For User-defined values, enter a roughness factor between 0.50 (very rough) and 1.00 (smooth). The roughness factor is relevant only for right angled cross sections. It is used as a factor in the calculation of the discharge proportion of edge areas. For example:
    - Smooth edge with no vegetation (e.g., concrete, steel, cement)— 0.8 to 0.9
    - Brick sides with vegetation— 0.7
    - Rough walls with heavy vegetation—0.6 to 0.5
13. Select Measure Velocity. Select the number of points on the vertical to collect.
14. Select a measurement point from the list. Obey the instrument prompts and adjust the sensor to the correct depth. If the sensor has a depth option, adjust the sensor depth until the depth box is green. This means the sensor is in at the correct position.
    Note: *Red indicates more adjustment is necessary. Yellow indicates the depth is close to the correct depth.*
15. Select Capture to start the measurement process.
16. If necessary, the setup can be changed and the measurement can be repeated. When the measurement is complete, push **OK** to store the data.
17. Repeat steps 13–16 for the other measurement points on the vertical.
18. When all measurements for the station are complete, select Main or Verify. results. Push **OK** to return to the list of measurement points.

Option	Description
Main	Returns to the station menu.
Verify	Shows the average velocity reading for the station based on the measurement method.

19. Select Next to go to the next station.
20. Repeat steps 10–19 for the remaining stations.
21. When all measurements for all stations in the profile are complete, select Channel Summary to view the results.
    Note: *A warning flag will show if the discharge in one or more segments is > 5% of the total discharge.*

Insert or delete a station

Prev, **Next**, **Ins** and **Del** options show at the bottom of the display in the Station screen. **Prev** and **Next** are used to navigate to a previous or subsequent station. **Ins** and **Del** are used to insert or delete a station.

For example, after measurements have been done at 10 stations, a user may wish to insert a new station between stations 3 and 4. The steps below describe how to do this. These steps can be applied in similar situations.

1. Select **Prev** and push **OK** until the display shows the information for Station 3.
2. Select **Ins** and push **OK**.
   The instrument adds a new station named Station 4. Subsequent stations are automatically given new sequential numbers.
3. To delete the current station (when in non-fixed mode), select **Del** and push **OK**.

Conduit profiles

It is possible to use all of the methods for conduit profiles in this section in sites with a typical profile shape and sufficient depth to measure 3-point velocities. The 0.9 x Vmax method can also be used when the depth is not sufficient for multi-point profiles.

Note: *In typical conduit profiles, the first measurement is made at the bottom. Subsequent measurements are made above the one made before. A different procedure may be necessary for some profiles.*

1. In the Main Menu, select Profiler.
2. Enter the operator name.
3. In the list of options, select Conduit.
4. Enter a name for the new Conduit profile.
5. Select the conduit shape.
   Note: *The input screens that show next depend on the shape selected.*
6. Enter values at the screen prompts.
   When the necessary values have been entered, the display shows the Select Method menu.
7. Select a profile method and do the steps for the method.

Option	Description
0.9 x Vmax	The meter calculates flow based on 90% of the fastest velocity. This is the recommended method when the depth is less than 12.7 cm (5 in.) or when the velocity is not stable.
0.2/0.4/0.8	The meter calculates the flow value based on velocity measurements taken at 0.2, 0.4 and 0.8 x the depth. One and two-point versions of this method are also possible.
Vel./Lev. Integ.	The meter integrates 10 separate velocity and level measurements to calculate the flow level.
2D	The sensor collects information while constantly moved through the flow in a specified pattern. The meter calculates the flow value when the user selects Save. This method is recommended for flows where a difference of 30% or more exists between the right and left side velocities.

0.9 x Vmax measurement method

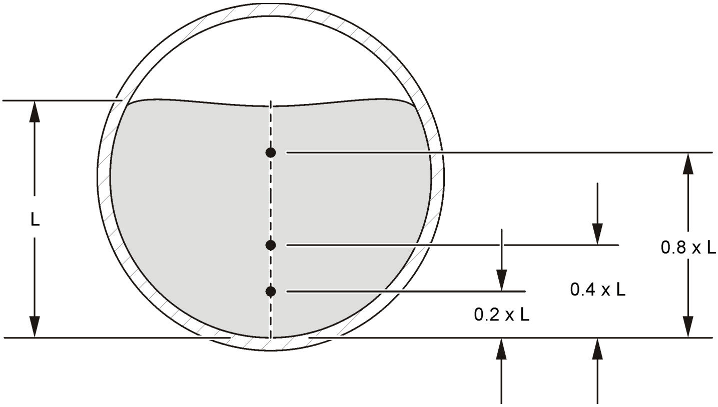
The meter uses the maximum velocity measurement in the conduit and multiplies this value by 0.9 to calculate the total flow.
Note: *The RC filter mode with a value of 2 to 4 seconds is recommended for this method.*

1. In the Select Method menu, select 0.9 x Vmax.
2. With the sensor in the flow, select Measure Velocity to get a velocity measurement.
   The measured values are shown on the graph.
3. Move the sensor until a point of maximum velocity is found, then push **OK**.
   The meter calculates and shows the flow, maximum and average velocity values.
4. Select Save.
   The information is saved to a data file.

0.2/0.4/0.8 method

Do measurements at one, two or three points to calculate an average velocity. Each point represents a percentage of the maximum depth as measured on the center line as shown in Figure 12.

Figure 12 2-4-8 profile



1. In the Select Method menu, select **0.2/0.4/0.8**.
2. Select one of the options.

Option	Description
One point	One-point measurement at 0.4 x maximum depth
Two point	Two-point measurement at 0.2 and 0.8 x maximum depth
Three point	Three-point measurement at 0.2, 0.4 and 0.8 x maximum depth

3. For the selected option, select a measurement point. The meter shows the sensor adjustment information.
4. If necessary, adjust the sensor as necessary.
5. Select Capture.
   The meter gets information from the sensor and shows the velocity value in numerical and graphical form.
6. If necessary, select Setup to change the Y-axis range or the data filter parameters.
7. Push **OK**.
8. Do steps 3–7 for all of the other measurement points then push **OK** to return to the list of measurement points.
9. Select Flow.
10. Select Save to save the information to a data file.

Velocity/Level Integration measurement method

Measurements are done at 10 different depths. The results from all segments are integrated to calculate the flow value.

- Select Prev or Next to go to another measurement.
- Select Main to return to the Select Method menu.

1. In the Select method menu, select Vel./Lev. Integ.
   The display shows the first measurement screen.
2. Select Measure Velocity.
   The sensor depth information is shown.

3. If necessary, adjust the sensor depth as shown.
4. Select Capture.
   The handheld unit gets information from the sensor and shows the average velocity value in numeric and graphical form.
5. If necessary, select Setup to change the Y-axis range in FPA filtering mode, the X and Y-axis range when in RC filtering mode or the data filter parameters.
6. Push **OK** to confirm the information.
7. Select Next. The next measurement screen in the series appears.
8. Do steps 2–7 for the other measurement depths.
9. Select one of the options at the bottom of the screen.

Option	Description
Save	Calculates the current flow value and saves this information to a data file.
Units	Changes the unit type (English or Metric).

2D measurement method

Velocity is measured while the sensor is moved through the flow as shown in Figure 13.

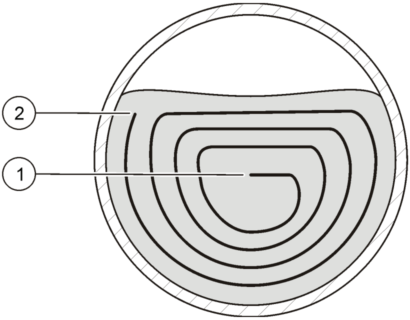
Select Cancel at any time to cancel the measurement and return to the Select Method menu.

Note: *The RC filter mode with a value of 2 to 4 seconds is recommended for this method.*

1. In the Select method menu, select 2D.
   The sensor depth information is shown.
2. If necessary, adjust the sensor depth.
3. Select Capture. While the sensor collects data, move the sensor through the entire cross-section in the pattern shown in Figure 13.
4. If necessary, select Setup to change the Y-axis range in FPA filtering mode, the X and Y-axis range when in RC filtering mode or the data filter parameters.
5. Push **OK**.
6. Select one of the options shown at the bottom of the screen.

Option	Description
Save	Calculates the current flow value and saves this information to a data file.
Units	Changes the unit type (English or Metric).

Figure 13 Path of the sensor in the flow



1 Start	**2** Finish

Download data

The meter directory is Read Only. In Windows, the meter operates as a mass storage device or removable hard drive.

1. Set the meter to USB Mass Storage mode.
2. To edit the data in a file, drag and drop the file to a laptop or PC. File names are limited to eight characters.
3. Data files are kept in the tab separated variable (.TSV) format. To see files in Microsoft® Excel, double or right-click a file and open the file with Excel.
   Real time files are stored in a directory called RT. Stream and conduit profile files are stored in a directory called P.

Delete data files

1. To delete all files from USB memory:
   1. Go to Main Menu > Diagnostics > Delete Files.
   2. In the confirmation window, select Yes.
   3. Push **OK** once to delete the files, then one more time to return to the previous screen.
2. To delete Real Time files:
   1. Go to Main Menu > Real-Time > Files.
   2. Select Delete All or use the UP or DOWN arrow to select a file in the list.
   3. Push **OK** once to delete the files, then one more time to return to the previous screen.
3. To delete Profiler files:
   1. Go to Main Menu > Profiler > Files.
   2. Select Delete All or use the UP or DOWN arrow to select a file in the list.
   3. Push **OK** once to delete the files, then one more time to return to the previous screen.

Maintenance

Download the PVM utility

The PVM utility is used to update the firmware in the portable meter. The PVM Utility is available at http://www.ott.com or http://www.hachhydromet.com. Do the steps listed for the selected URL.

1. Go to http://www.ott.com.
2. Login to MyOtt.
3. Click Software Updates.
4. Select MF pro.
5. Click More.
6. Click PVMSetup.msi.
7. Choose Save or Run.

1. Go to http://www.hachhydromet.com.
2. Click the Service and Support tab.
3. Click More (below Software Downloads).
4. Select MF pro.
5. Click the download link.
6. Select Save or Run.

Update the firmware

***Note:** All data files in mass storage are lost when the firmware is updated. To download data, refer to Download data on page 25.*

The PVM Utility is necessary for this procedure. To download the PVM Utility, refer to Download the PVM utility on page 25.

This is the general procedure to update firmware for the meter and sensor. To update the sensor firmware, the sensor must be connected to the meter.

1. Double-click the PVM Utility desktop icon.
2. Push the power button on the meter. When the meter self-test is complete, push **OK**.
3. In the Main Menu, select Setup, then push **OK**.
4. Select USB>CDC, then push **OK**.
5. Connect the USB cable to the portable meter and the PC.
6. In the PVM Utility window, select Connect.
7. In the drop-down menu, select the PVM (COM X) port, where COM X is the virtual port number assigned to the PVM by Windows. Push **OK**.
8. In the left-side panel, select Firmware Update, then select the Meter or Sensor tab.
9. Select the correct firmware version, then click Start.
   The firmware download starts. A "Firmware update successful" message shows when the download is complete. For meter updates, the instrument display turns off until the instrument completes the update. Then, the instrument automatically resets and powers up again after a few minutes. Do not try to make the instrument power on or off before the update process is complete.
10. In the Main Menu, select Diagnostics > About. Make sure that the firmware versions for both the Handheld Boot and the Handheld Application are correct.

Clean the sensor

⚠ WARNING

Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current material safety data sheets (MSDS) for safety protocols.

Clean the sensor when unexpected increases or decreases in flow or level trends occur and after use in sandy or muddy waterways.

For heavy contamination, soak the sensor in clear water for a few minutes to help make the contamination easy to remove.

Disconnect the sensor from the meter before it is cleaned. Use only solutions listed as acceptable in Table 4 to clean the sensor. For sensors with a pressure cell (i.e., velocity plus depth sensors), make sure the holes for the pressure cell chambers are washed out and clear of contamination. Rinse the sensor with clean water before re-attaching the sensor to the assembly.

Table 4 Acceptable and unacceptable cleaning solutions

Acceptable	Do not use
Dish detergent and water	Concentrated bleach
Window cleaner	Kerosene
Isopropyl alcohol	Gasoline
	Aromatic hydrocarbons

Clean the meter

1. Push the power button to de-energize the meter.
2. Use a clean, moist cloth to clean the meter exterior. Mix the water with a mild detergent if necessary.
3. Dry the meter exterior with a clean cloth. Let the meter dry in air completely before it is energized again.
   Note: *Do not use paper-based cloths to clean the display. This type of cloth can cause damage to the display screen.*

Install or replace the battery

⚠ WARNING

Personal injury hazard. This instrument contains one or more batteries. To prevent battery degradation, leakage or explosion, do not use or keep the instrument in places where the temperature is higher than the specified temperature limits of the instrument.

⚠ WARNING

Fire and explosion hazards. Battery substitution is not permitted. Use only batteries that are supplied by the instrument manufacturer.

⚠ WARNING

Multiple hazards. Do not disassemble the instrument for maintenance. If the internal components must be cleaned or repaired, contact the manufacturer.

NOTICE

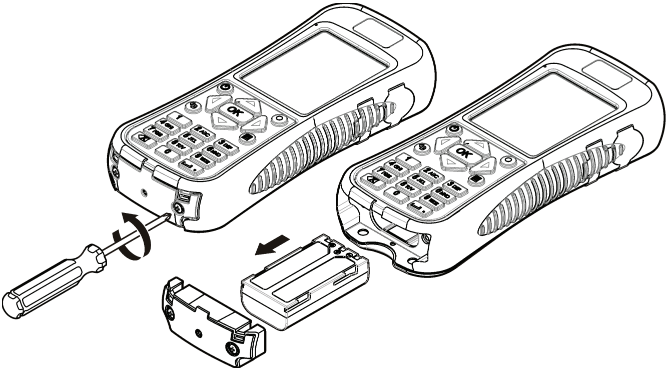
Discard used batteries promptly. Keep used batteries away from children. Do not disassemble the battery or discard the battery in fire.

The instrument is shipped without the battery installed. Order new batteries from the instrument manufacturer. Refer to Replacement parts and accessories on page 29. Recycle or discard used batteries in accordance with local regulations.

Note: *If the instrument must be returned to the factory for repair or maintenance, remove the battery and put the battery in a protective cover before shipment.*

1. If necessary, remove the used battery as shown in Figure 14.
2. Install a new battery in the same location and with the same orientation.
3. Install the battery cover. Make sure that the cover is secure to keep the enclosure rating.
4. Charge the battery if necessary. Refer to Charge the battery on page 28.

Figure 14 Remove the battery



Charge the battery

Make sure that the correct plug-type for the geographic location is installed on the wall charger.

***Note:** Battery charger substitution is not permitted. Use only the charger specified in the list of parts and accessories for the instrument. Refer to Replacement parts and accessories on page 29.*

A lithium ion battery in the meter supplies power to both the meter and the sensor. Install and charge the battery before the instrument is used.

A full battery charge will supply power to the system for approximately 10–11 hours with constant use. When the level of battery charge drops to 3.4 V or less, the display shows a warning and the meter automatically powers off. The battery must be charged before the unit becomes functional again.

1. Connect the round end of the charger cable to the power jack of the portable meter. Refer to Figure 3 on page 8.
2. Connect the wall charger plug to a power outlet.
   A blue light shows around the charge port while the battery charges. When the charge process is complete, the blue light goes off. A discharged battery gets a full charge in about 8 hours.
   ***Note:** The meter is not operational while the battery charges. The battery does not charge through the USB cable connection.*

Troubleshooting

Diagnostics

In the Main Menu, select Diagnostics to see information about the meter and do the diagnostic tests in Table 5.

Table 5 Meter diagnostics

Option	Description
About	Shows information about the meter and the sensor. Includes the serial number and the firmware version.
Delete files	Deletes all files from memory to make space for new measurements. Make sure that the data is downloaded to a PC before this option is selected. The system automatically reformats the memory after file deletion.
Sensor	Shows diagnostic information about the sensor.
Self test	Makes the meter do a diagnostic self test.
Key pad test	Does a test of any button to make sure that the button is functional.

Table 5 Meter diagnostics (continued)

Option	Description
Display test	Does a test on the display to make sure that the display is functional.
Event log	Lets the user see, delete or export the event log. Export the event log to make the contents available as an accessible file through USB mass storage. This option is used primarily by factory service.

Troubleshoot errors

The meter and sensor contain no user-serviceable parts. For the errors and messages listed, try the corrective action.

If the problem does not go away or a problem occurs that is not in the list, contact the manufacturer.

Message or problem	Solution
Sensor is not connected	Connect a sensor and try the action again.
Value is out of range	Change the measurement parameters or put in a different value, then try the action again.
Sensor data is known to be not correct or not accurate	Clean the sensor and test.
Sensor is not recognized	Check the sensor connection. Make sure that the lock nut on the connection port is tight (finger-tighten only).
Display is dim or is not visible	Push a key on the keypad.
Data is not available or access to the data is not possible	Make sure that the USB option (Main Menu) is set to Mass Storage.
Meter is unresponsive	Push and hold the power button for at least 3 seconds. This de-energizes the meter. Energize the meter again. ***Note:*** *Do not use this method to power off while in normal operation or if the file access icon is visible in the display.*

Replacement parts and accessories

Note: *Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.*

Replacement parts

Table 6 Velocity only sensor

Description	Item no.
Sensor with 1.5 m (5 ft) cable	1040500595-0N
Sensor with 6.1 m (20 ft) cable	1040500595-1N
Sensor with 12.2 m (40 ft) cable	1040500595-2N
Sensor with 30.5 m (100 ft) cable	1040500595-3N

Table 7 Velocity with depth sensor

Description	Item no.
Sensor with 1.5 m (5 ft) cable	1040500595-0D
Sensor with 6.1 m (20 ft) cable	1040500595-1D

Table 7 Velocity with depth sensor (continued)

Description	Item no.
Sensor with 12.2 m (40 ft) cable	1040500595-2D
Sensor with 30.5 m (100 ft) cable	1040500595-3D

Table 8 Handheld meter

Description	Item no.
English/Metric	1040500195-S

Accessories

Table 9 General accessories

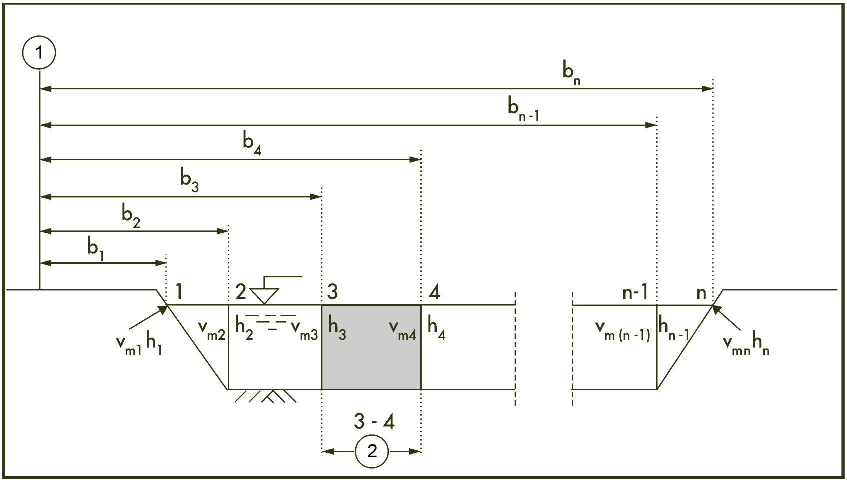
Description	Item no.
Adjustable meter mount	10.405.405.9.5
Battery charger	97.850.039.9.5
Carrying case	10.405.401.9.5
Lanyard, double ended loop	10.405.403.9.5
Lithium ion battery	97.820.021.9.5
Thumb screw kit (includes four thumb screws)	10.405.418.9.5
Universal sensor mount	10.405.419.9.5
USB cable	97.120.412.9.5

Appendix

Mean-section and Mid-section methods

The user can select the Mean-section or the Mid-section method for flow calculations. The Mean-section method divides the cross-section into individual flow segments. Pairs of adjacent verticals are the limits of the segments. The two edges of the cross-section are given values of 0 for the velocity and depth. The total flow is the sum of the partial flows of all segments. Figure 15 shows the definitions and the equation for the Mean-section method.

Figure 15 Mean-section method



$$q_{3-4} = \left(\frac{V_{m3} + V_{m4}}{2}\right) \times \left(\frac{h_3 + h_4}{2}\right) \times (b_4 - b_3)$$

Where:

V = velocity at vertical

b = distance to vertical from bank

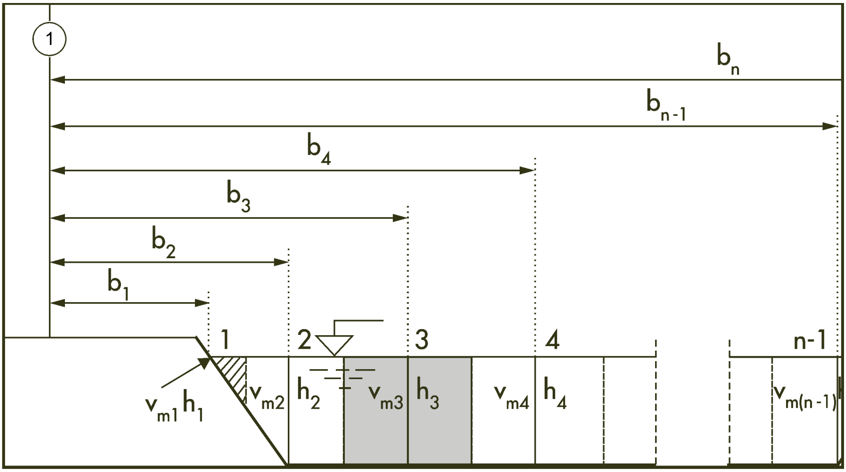
h = depth at vertical

q = flow at vertical

The Mid-section method also divides the cross-section into individual flow segments. With the Mid-section method, the segments are not between verticals but are defined by half of the distance to neighbor verticals in each case. For this reason, the first and last verticals should be as near to the edges as possible (i.e., left edge of water (LEW) and right edge of water (REW)). Boundary conditions dictate the proximity of the first and last vertical to the edge of water.

Experience shows that the Mid-section method gives more exact results compared to the Mean-section method so it is the default setting. Figure 16 shows the definitions and equation for the Mid-section method.

Figure 16 Mid-section method



$$q_3 = V_{m3} \times \left(\frac{(b_3 - b_2) + (b_4 - b_3)}{2} \right) \times h_3$$

Where:

m = station number

n = total number of stations

V = velocity at vertical

b = distance to vertical from bank

h = depth at vertical

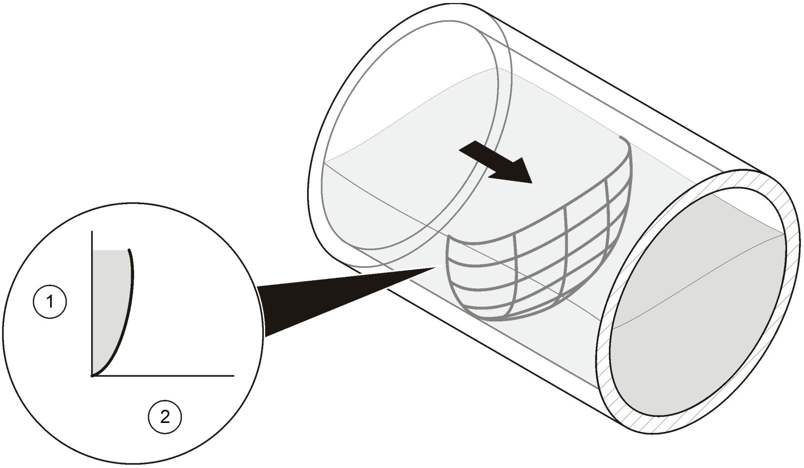
q = flow at vertical

Profiles and measurements

Profiles can be set up for streams or conduits. Figure 17 shows an example of a typical profile shape in a conduit. In a typical profile, velocity is less near a wall or edge than at the center and decreases near the surface. Multiple velocity measurements in the profile are averaged to calculate the total flow. Measurements for conduit profiles are made from the bottom up. Measurements for stream profiles are made from the top down.

In the Main Menu, select Profiler. The meter prompts for the operator name, the type of profile (stream or conduit) and the profile name. Do the instructions for the selected profile type.

Figure 17 Typical profile



1 Depth	**2** Velocity

Site selection

A site with the typical profile shape gives the most accurate results. Visual inspection is typically sufficient to identify problem sites. Use the information in these guidelines to help select the best site.

These guidelines apply to conduit and stream profiles.

- The channel should have as much straight run as possible. If the length of the straight run is limited, the length upstream from the profile should be two times the downstream length.
- The channel should be free of flow disturbances. The site must not have protruding pipe joints, sudden changes in diameter, contributing side-streams, outgoing side-streams or obstructions. Remove all rocks, sediment or other debris from the bottom of the pipe.
- The flow should not have visible swirls, eddies, vortices, back-flow or dead zones.
- Do not select areas immediately downstream from sharp bends or obstructions.
- Do not select areas with converging or diverging flow (approaches to a flume) or vertical drops.
- Do not select areas immediately downstream from sluice gates or places where the channel spills into a body of stationary water.

Do a velocity calibration

Use this feature to remove a velocity offset if necessary. The velocity offset stays active until the meter power is switched off.

1. Collect a bucket of water from the water in the profile area. The bucket must be non-metallic and at least 20.32 cm (8 in.). The water depth must be at least 15.24 cm (6 in.).
2. Put the sensor in the center of the bucket so that it does not touch the sidewall or the bottom of the bucket.
3. Let the water become still.
4. Let the velocity reading stabilize.
5. Select Zero Velocity.

Wet/Dry threshold

The wet/dry threshold is the trigger point for the meter to know when the sensor is in or out of the water. This information is important because if the meter does not know that the sensor is under the surface of the water, the meter sets the velocity value to zero. For a profile or real-time reading, the meter prompts the user to submerge the sensor in the water.

If the specific conductivity of the water being measured is very low, adjust the threshold value for the best performance. Go to Setup Menu>Wet/Dry Threshold.

For troubleshooting, the present reading is used as a guide to set a custom threshold. Get a reading in the water (wet) and then out of the water (dry). The threshold value must be between the wet and dry value. For example, if the actual wet value is 17 and the actual dry value is 2, put in a threshold value half way between 2 and 17. The default value is 20.

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INSTRUCTION MANUAL

TOP SETTING WADING RODS

MODEL TSR

QUALITY SYSTEM
IS0
9001
CERTIFIED

HYDROLOGICAL SERVICES PTY LTD
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Phone: (Int.) 612 9601 2022   Fax:(Int.) 612 9602 6971
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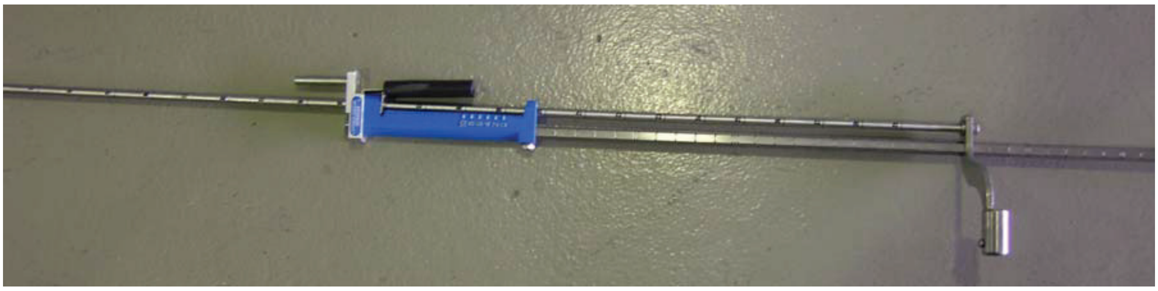
Email: sales@hydrologicalservices.com

CONTENTS

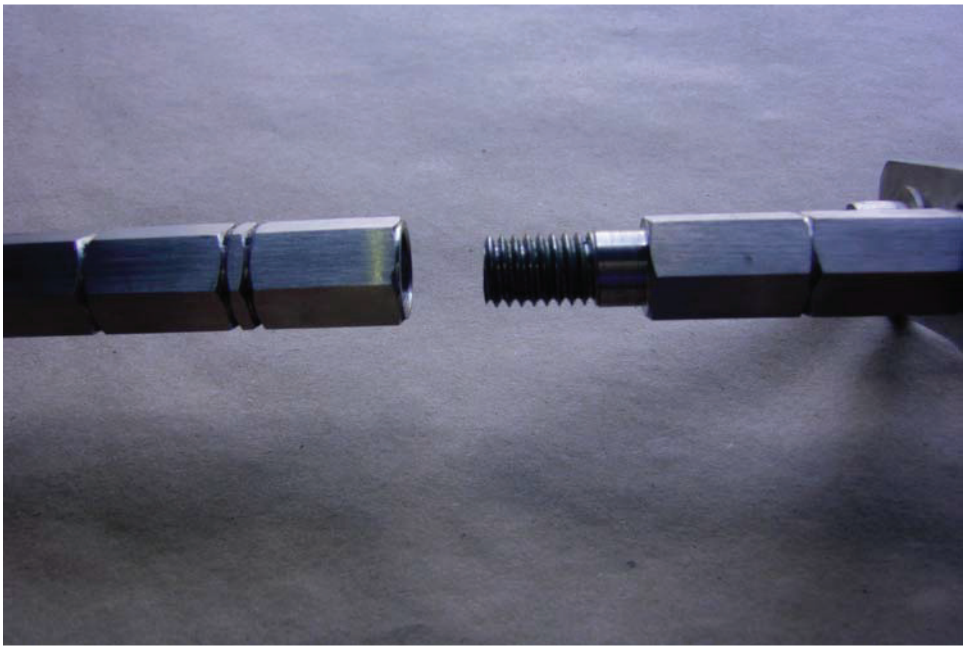
TOP SETTING WADING RODS MODEL TSR

I INSTRUCTION FOR SEPARATION OF SPLIT TOP SET ROD



STEP 1: ALIGN 19 WITH 0 FOR METRIC
(ALIGN 4 WITH 0 FOR IMPERIAL)

STEP 2: UNSCREW THE SUSPENSION ROD AS SHOWN



STEP 3: UNSCREW THE HEX ROD AS SHOWN

NOTE: To re-assemble reverse order from Step 3 to Step 1

II GENERAL

The model TSR Top Setting Wading Rods were developed to simplify the task of the hydrographer while carrying out gauging of small streams.

The TSR shall only be used in shallow streams, where it is safe for the hydrographer to carry out gaugings while wading.

The TSR is available in Metric and Imperial models and each model is available in lengths of 4 feet (1200mm), 6 feet (1800mm) and 8 feet (2400mm)

The device:

- ensures the stable placement of the rod on the stream bed.
- allows the depth of the stream to be measured.
- enables the hydrographer to precisely position the current meter at 0.2, 0.4, 0.6 and 0.8 of water depth without removing the rod from the stream bed.
- allows the direct connection of the current meter and pulse counter without external cables.

The Top Setting Wading Rods are manufactured from durable materials selected to meet the environmental conditions in the field.

III UNPACKING

Remove the packing material from the TSR carry case

This product has been inspected to ensure compliance with your purchase order and has been appropriately packed to ensure the safe transit to your warehouse, however a thorough inspection of the product should be carried out upon receipt to confirm compliance and to identify any damage that may have occurred during transit.

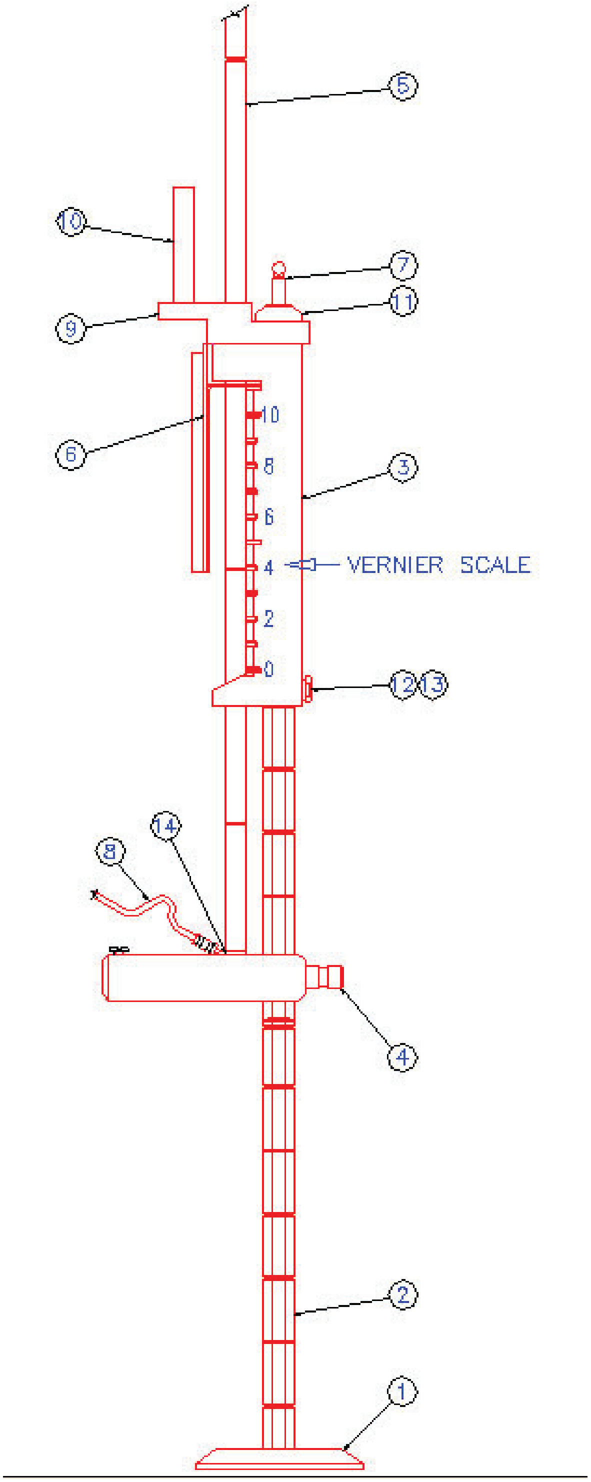
Any short supply or damage should be reported to Hydrological Services Pty Ltd within seven days of receipt of the product.

The Hydrological Services Model TSR Top Setting Wading Rods have been pre-assembled in the factory and are ready for service.

This product does NOT include a pulse counter or current meter unless specifically requested in the purchase order.

IV OPERATION

Diagram 1



Preparation – refer to Diagram 1 above

Position the tail fin on the METER MOUNTING (Item 4) and secure with screw.

Position the appropriate current meter, complete with fan on the METER MOUNTING (Item 4) and secure with screw.

Connect CABLE (Item 8) to current meter.

Position the pulse counter (current meter counter) on PIN (Item 9) and connect lead to CONTACT (Item 7).

Depress TRIGGER (Item 6) the SUSPENSION ROD (Item 5), complete with the current meter, to slide within the HAND GRIP BODY (Item 3).
Ensure that the suspension rod slides smoothly for its full length.

Do not permit the current meter to fall to the foot as damage to the meter may occur.

Power up the pulse counter (current meter counter) and carry out function test as per manufacturer's instructions.

Rotate the current meter fan to generate pulses then check that the pulses are being received by the pulse counter.

The device is now ready for operation.

An appropriate stream cross section should have been previously selected and set up for gauging.

Operation

Place the Top Setting Wading Rod vertically in the stream at the appropriate point in the cross section, ensuring that the base plate is stable and that the meter is directed into the flow.

Read off the depth of stream on the GRADUATED ROD (Item 2).

Top Setting Wading Rods are available in both Metric and Imperial models. The following pages shows the use of both models in detail.

Relationship between the GRADUATED ROD (Item 2) & the SUSPENSION ROD (Item 5)

The GRADUATED ROD (Item 2) is designed for measurement of individual soundings across the stream section. This rod is graduated with markings every 0.1 feet for the imperial TSR and 20 millimetres for the metric TSR.

NB: The graduations on the SUSPENSION ROD (Item 5) and VERNIER SCALE (Item 3) are NOT to be used for direct measurement of soundings. These graduations on these Items have been designed for accurate setting of the current meter to the required 'depth of observation'.

Imperial Rods

The GRADUATED ROD (Item 2) is graduated in 0.1 feet. To assist in the reading, the rod is marked with a triple groove at full feet graduations, double groove at half feet graduations and single groove at 0.1 feet graduations.

With respect to the GRADUATED ROD (Item 2), the stream bed is the zero reference.

The current meter can be readily set at 0.2, 0.4, 0.6 and 0.8 of the sounding by aligning the appropriate graduation on the SUSPENSION ROD (Item 5) with the appropriate graduation on the VERNIER SCALE (Item 3).

When a 'multiplier' is applied to the measured sounding (i.e. the reading taken from the GRADUATED ROD (Item 2), the correct 'depth of observation' for a current meter velocity measurement is calculated.

The table below summarises the various multipliers to be used for each required depth of observation:

MULTIPLIER TABLE

Depth of Observation	0.2d	0.4d	0.6d	0.8d
Multiplier Used	2.0	1.5	1.0	0.5

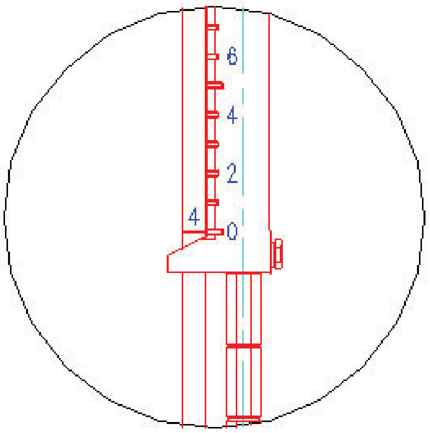
Where d = sounding taken from GRADUATED ROD (Item 2)

Refer to the following examples.

Example 1 - The sounding has been read at 2.0 feet on the GRADUATED ROD (Item 2).

Setting at 0.2d

1. From the table above, the calculated reading is ‘**4**’ (i.e. multiplier ‘2.0’ * sounding ‘2’)
2. To set the current meter at 0.2 of the 2.0 feet sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**4**’ on the suspension rod is in line with graduation ‘**0**’ on the VERNIER SCALE (Item 3).

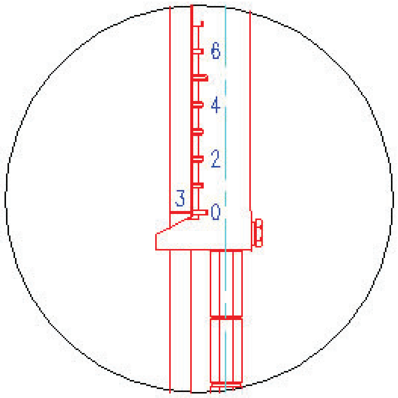


DEPTH OF WATER = 2 FEET
SOUNDING AT 0.2D
CURRENT METER POSITIONED AT 1.6 FEET

3. Release the trigger.
4. This will position the current meter at 1.6 feet on the GRADUATED ROD (i.e.: 0.2 of sounding)

Setting at 0.4d

1. From the table above, the calculated reading is ‘**3**’ (i.e. multiplier ‘1.5’ * sounding ‘2’)
2. To set the current meter at 0.4 of the 2.0 feet sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**3**’ on the suspension rod is in line with graduation ‘**0**’ on the VERNIER SCALE (Item 3).

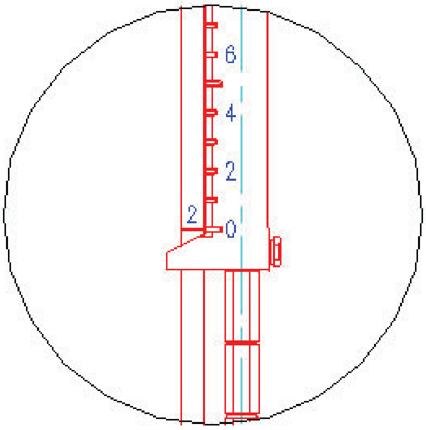


DEPTH OF WATER = 2 FEET
SOUNDING AT 0.4D
CURRENT METER POSITIONED AT 1.2 FEET

3. Release the trigger.
4. This will position the current meter at 1.2 feet on the GRADUATED ROD (0.4 of sounding)

Setting at 0.6d

1. From the table above, the calculated reading is ‘**2**’ (i.e. multiplier ‘1.0’ * sounding ‘2’)
2. To set the current meter at 0.6 of the 2.0 feet sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**2**’ on the suspension rod is in line with graduation ‘**0**’ on the VERNIER SCALE (Item 3).

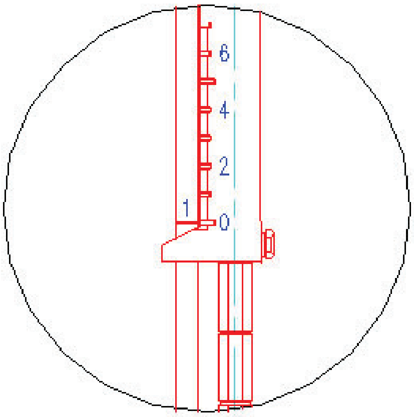


DEPTH OF WATER = 2 FEET
SOUNDING AT 0.6D
CURRENT METER POSITIONED AT 0.8 FEET

3. Release the trigger.
4. This will position the current meter at 0.8 feet on the GRADUATED ROD (0.6 of sounding)

Setting at 0.8d

1. From the table above, the calculated reading is ‘**1**’ (i.e. multiplier ‘0.5’ * sounding ‘2’)
2. To set the current meter at 0.8 of the 2.0 feet sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**2**’ on the suspension rod is in line with graduation ‘**0**’ on the VERNIER SCALE (Item 3).



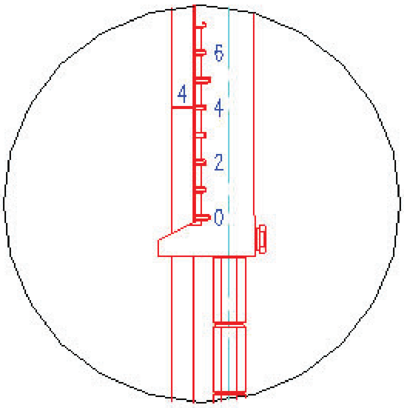
DEPTH OF WATER = 2 FEET
SOUNDING AT 0.8D
CURRENT METER POSITIONED AT 0.4 FEET

3. Release the trigger.
4. This will position the current meter at 0.4 feet on the GRADUATED ROD (0.8 of sounding)

Example 2 The sounding has been read at 2.2 feet on the GRADUATION ROD (Item 2)

Setting at 0.2d

1. From the table above, the calculated reading is ‘**4.4**’ (i.e. multiplier ‘2.0’ * sounding ‘2.2’)
2. To set the current meter at 0.2 of the 2.2 feet sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**4**’ on the suspension rod is in line with graduation ‘**4**’ on the VERNIER SCALE (Item 3).

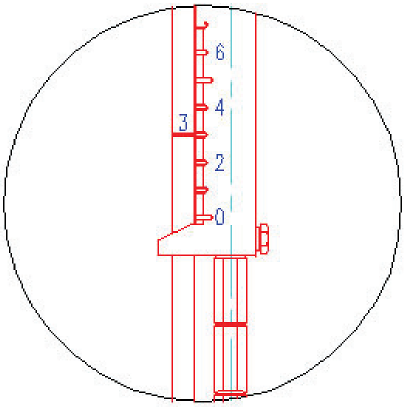


DEPTH OF WATER = 2.2 FEET
SOUNDING AT 0.2D
CURRENT METER POSITIONED AT 1.76 FEET

3. Release the trigger.
4. This will position the current meter at 1.76 feet on the GRADUATED ROD (0.2 of sounding)

Setting at 0.4d

1. From the table above, the calculated reading is ‘**3.3**’ (i.e. multiplier ‘1.5’ * sounding ‘2.2’)
2. To set the current meter at 0.4 of the 2.2 feet sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**3**’ on the suspension rod is in line with graduation ‘**3**’ on the VERNIER SCALE (Item 3).

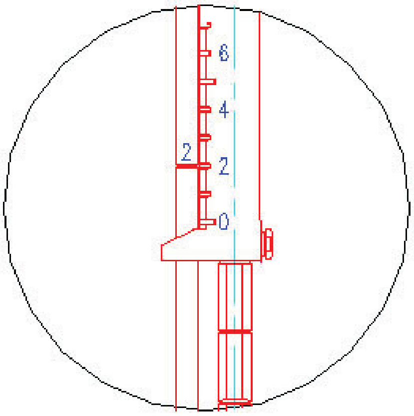


DEPTH OF WATER = 2.2 FEET
SOUNDING AT 0.4D
CURRENT METER POSITIONED AT 1.32 FEET

3. Release the trigger.
4. This will position the current meter at 1.32 feet on the GRADUATED ROD (0.4 of sounding)

Setting at 0.6d

1. From the table above, the calculated reading is ‘**2.2**’ (i.e. multiplier ‘1.0’ * sounding ‘2.2’)
2. To set the current meter at 0.6 of the 2.2 feet sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**2**’ on the suspension rod is in line with graduation ‘**2**’ on the VERNIER SCALE (Item 3).

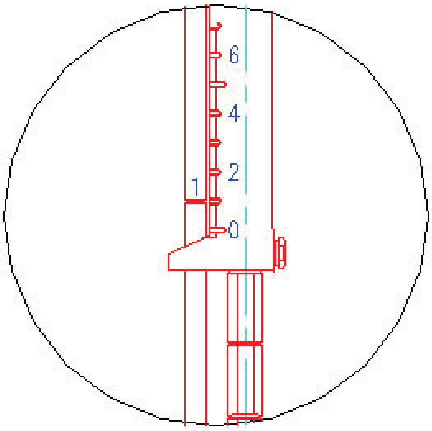


DEPTH OF WATER = 2.2 FEET
SOUNDING AT 0.6D
CURRENT METER POSITIONED AT 0.88 FEET

3. Release the trigger.
4. This will position the current meter at 0.88 feet on the graduated rod (0.6 of sounding)

Setting at 0.8d

1. From the table above, the calculated reading is ‘**1.1**’ (i.e. multiplier ‘0.5’ * sounding ‘2.2’)
2. To set the current meter at 0.8 of the 2.2 feet sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**1**’ on the suspension rod is in line with graduation ‘**1**’ on the VERNIER SCALE (Item 3).



DEPTH OF WATER = 2.2 FEET
SOUNDING AT 0.8D
CURRENT METER POSITIONED AT 0.44 FEET

3. Release the trigger.
4. This will position the current meter at 0.44 feet on the GRADUATED ROD (0.8 of sounding)

Metric Rods

The rod is graduated in 20 millimetres graduations. To assist in the reading, the rod is marked with a triple groove at 500 millimetre graduations, double groove at 100 millimetre graduations and single groove at 20 millimetre graduations.

With respect to the GRADUATED ROD (Item 2), the stream bed is the zero reference.

The current meter can be readily set at 0.2, 0.4, 0.6 and 0.8 of the sounding by aligning the appropriate graduation on the SUSPENSION ROD (Item5) with the appropriate graduation on the VERNIER SCALE (Item 3).

The correct 'depth of observation' for current meter velocity measurement, is based on a multiplier, which when applied to the measured sounding (i.e. that taken from the GRADUATED ROD (Item 2) requires the application of a multiplier to calculate the correct setting to be used on the SUSPENSION ROD (Item 5). The table below summarises the various multiplier to be used, based on required depth of observation:

MULTIPLIER TABLE

Depth of Observation	0.2d	0.4d	0.6d	0.8d
Multiplier Used	2.0	1.5	1.0	0.5

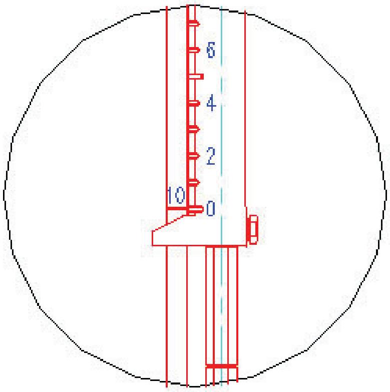
Where d = sounding taken from GRADUATED ROD (Item 2)

Refer to the following examples.

Example 1 – The sounding has been read at 5 decimetres (500mm) on the GRADUATION ROD (Item 2).

Setting at 0.2d

1. From the table above, the calculated reading is ‘**10**’ (i.e. multiplier ‘2.0’ * sounding ‘5’)
2. To set the current meter at 0.2 of the 5 decimetre sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**10**’ on the suspension rod is in line with graduation ‘**0**’ on the VERNIER SCALE (Item 3).

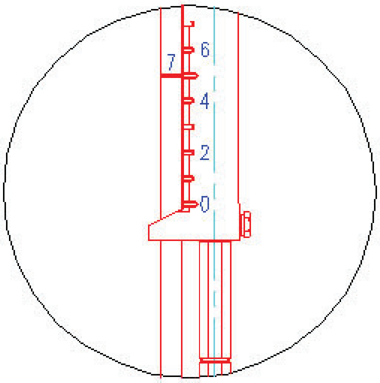


DEPTH OF WATER = 500 MILLIMETRES
SOUNDING 0.2D
CURRENT METER POSITIONED AT 400 MILLIMETRES

3. Release the trigger.
4. This will position the current meter at 4.0 decimetres (i.e. 400mm) on the GRADUATED ROD (0.2 of sounding)

Setting at 0.4d

1. From the table above, the calculated reading is ‘7.5’ (i.e. multiplier ‘1.5’ * sounding ‘5’)
2. To set the current meter at 0.4 of the 5 decimetre sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**7**’ on the suspension rod is in line with graduation ‘5’ on the VERNIER SCALE (Item 3).

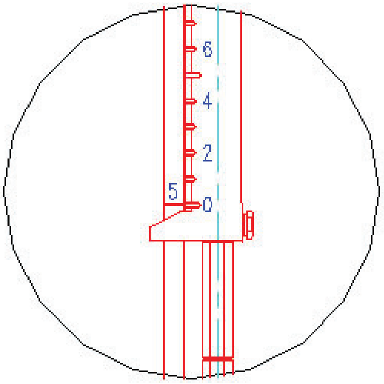


DEPTH OF WATER = 500 MILLIMETRES
SOUNDING 0.4D
CURRENT METER POSITIONED AT 300 MILLIMETRES

3. Release the trigger.
4. This will position the current meter at 3.0 decimetres (i.e. 300mm) on the GRADUATED ROD (0.4 of sounding)

Setting at 0.6d

1. From the table above, the calculated reading is ‘5’ (i.e. multiplier ‘1.0’ * sounding ‘5’)
2. To set the current meter at 0.6 of the 5 decimetre sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**5**’ on the suspension rod is in line with graduation ‘**0**’ on the VERNIER SCALE (Item 3).

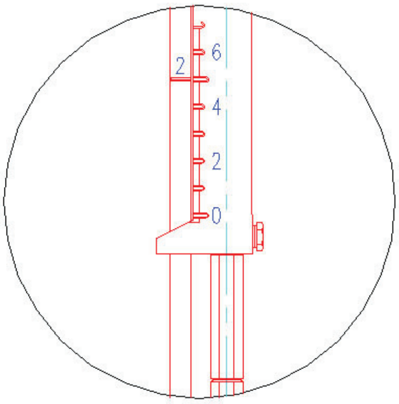


DEPTH OF WATER = 500 MILLIMETRES
SOUNDING 0.6D
CURRENT METER POSITIONED AT 200 MILLIMETRES

3. Release the trigger.
4. This will position the current meter at 2.0 decimetres (200mm) on the graduated rod (0.6 of sounding)

Setting at 0.8d

1. From the table above, the calculated reading is ‘**2.5**’ (i.e. multiplier ‘0.5’ * sounding ‘5’)
2. To set the current meter at 0.8 of the 5 decimetre sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**2**’ on the suspension rod is in line with graduation ‘**5**’ on the VERNIER SCALE (Item 3).



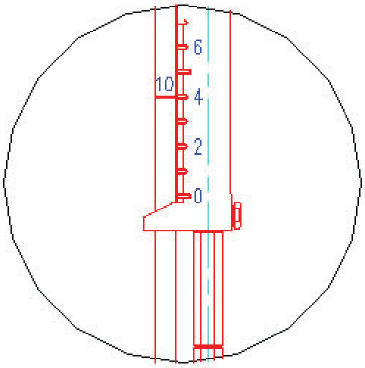
DEPTH OF WATER = 500 MILLIMETRES
SOUNDING 0.8D
CURRENT METER POSITIONED AT 100 MILLIMETRES

3. Release the trigger.
4. This will position the current meter at 1.0 decimetres (100mm) on the GRADUATED ROD (0.8 of sounding)

Example 2 The sounding has been read at 5.2 decimetres or 520mm on the GRADUATION ROD (Item 2)

Setting at 0.2d

1. From the table above, the calculated reading is '**10.4**' (i.e. multiplier '2.0' * sounding '5.2')
2. To set the current meter at 0.2 of the 5.2 decimetre sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark '**10**' on the suspension rod is in line with graduation '**4**' on the VERNIER SCALE (Item 3).

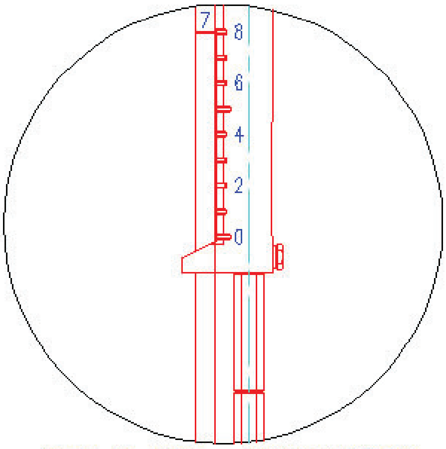


DEPTH OF WATER = 520 MILLIMETRES
SOUNDING 0.2D
CURRENT METER POSITIONED AT 420 MILLIMETRES

3. Release the trigger.
4. This will position the current meter at 4.2 decimetres (420mm) on the GRADUATED ROD (0.2 of sounding)

Setting at 0.4d

1. From the table above, the calculated reading is '**7.8**' (i.e. multiplier '1.5' * sounding '5.2')
2. To set the current meter at 0.4 of the 5.2 decimetre sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark '**7**' on the suspension rod is in line with graduation '**8**' on the VERNIER SCALE (Item 3).

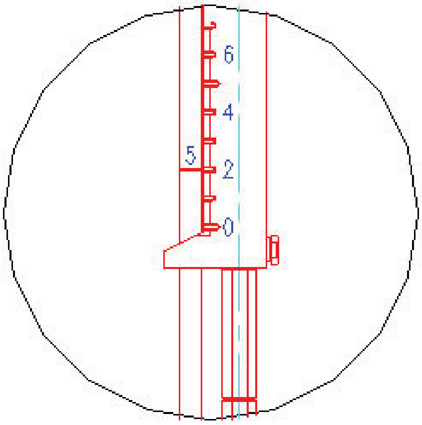


DEPTH OF WATER = 520 MILLIMETRES
SOUNDING 0.4D
CURRENT METER POSITIONED AT 310 MILLIMETRES

3. Release the trigger.
4. This will position the current meter at 3.1 decimetres (310mm) on the GRADUATED ROD (0.4 of sounding)

Setting at 0.6d

1. From the table above, the calculated reading is **’5.2**’ (i.e. multiplier ‘1.0’ * sounding ‘5.2’)
2. To set the current meter at 0.6 of the 5.2 decimetre sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**5**’ on the suspension rod is in line with graduation ‘**2**’ on the VERNIER SCALE (Item 3).

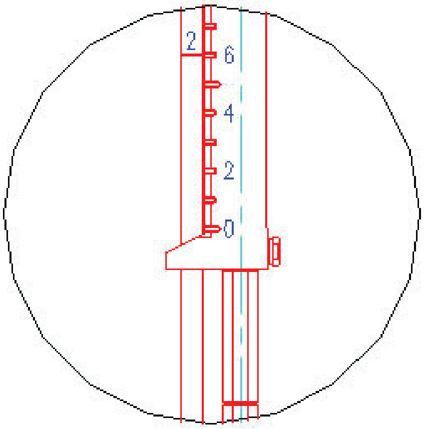


DEPTH OF WATER = 520 MILLIMETRES
SOUNDING 0.6D
CURRENT METER POSITIONED AT 210 MILLIMETRES

3. Release the trigger.
4. This will position the current meter at 2.1 decimetres (210mm) on the graduated rod (0.6 of sounding)

Setting at 0.8d

1. From the table above, the calculated reading is **‘2.6’** (i.e. multiplier ‘0.5’ * sounding ‘5.2’)
2. To set the current meter at 0.8 of the 5.2 decimetre sounding, depress the TRIGGER (Item 6) and slide the SUSPENSION ROD (Item 5) until the graduation mark ‘**2**’ on the suspension rod is in line with graduation ‘**6**’ on the VERNIER SCALE (Item 3).



DEPTH OF WATER = 520 MILLIMETRES
SOUNDING 0.8D
CURRENT METER POSITIONED AT 110 MILLIMETRES

3. Release the trigger.
4. This will position the current meter at 1.1 decimetres (110mm) on the GRADUATED ROD (0.8 of sounding)

V MAINTENANCE

Because of the excellent durability of the Top Setting Wading Rods it is only necessary to clean and thoroughly dry the device after use prior to packing away. This is essential to remove any corrosive contaminants that may be present in the water being gauged.

Periodically it may be necessary to remove oxidization from the electrical contact to ensure positive contact. This should be done with superfine emery paper or "scotchbrite" pad.

VI PART LIST

Refer to Diagram 1

ITEM NO.	DESCRIPTION	PART NO.
1	Foot Plate	TSR07-02
2	Graduated Rod - 48 inch	TSR07-01
	Graduated Rod - 72 inch	TSR07-02
	Graduated Rod - 96 inch	TSR07-03
	Graduated Rod -1200 mm	TSR07-04
	Graduated Rod -1800 mm	TSR07-05
	Graduated Rod -2400 mm	TSR07-06
3	Hand Grip Body - Imperial	TSR01-01
	Hand Grip Body - Metric	TSR01-04
4	Meter Mounting – Price	TSR05-01
	Meter Mounting - HS OSS-PC1	TSR05-03
5	Suspension Rod - 48 inch	TSR08-01
	Suspension Rod - 72 inch	TSR08-02
	Suspension Rod - 96 inch	TSR08-03
	Suspension Rod -1200 mm	TSR08-04
	Suspension Rod -1800 mm	TSR08-05
	Suspension Rod -2400 mm	TSR08-06
6	Trigger	TSR03-01
7	Contact	SC043-43
8	Cable	TSR09
9	Contact Block	TSR02-01
10	Counter Suspension Pin	TSR02-02
11	Contact Body	TSR04-01
12	Insulating Sleeve 1	TSR01-02
13	Insulating Sleeve 2	TST01-03
14	Insulating Washer	TSR05-02
15	Carry Case - 48 inch	TSR10
	Carry Case - 72 inch	TSR11
	Carry Case - 96 inch	TSR12

VII Appendix (A) OSS-B1 Installation to TSR

Figure 1: Initial State

Figure 2: Unscrew the Foot Plate

Figure 3: Loosen the Tail of the OSS-B1 body as shown

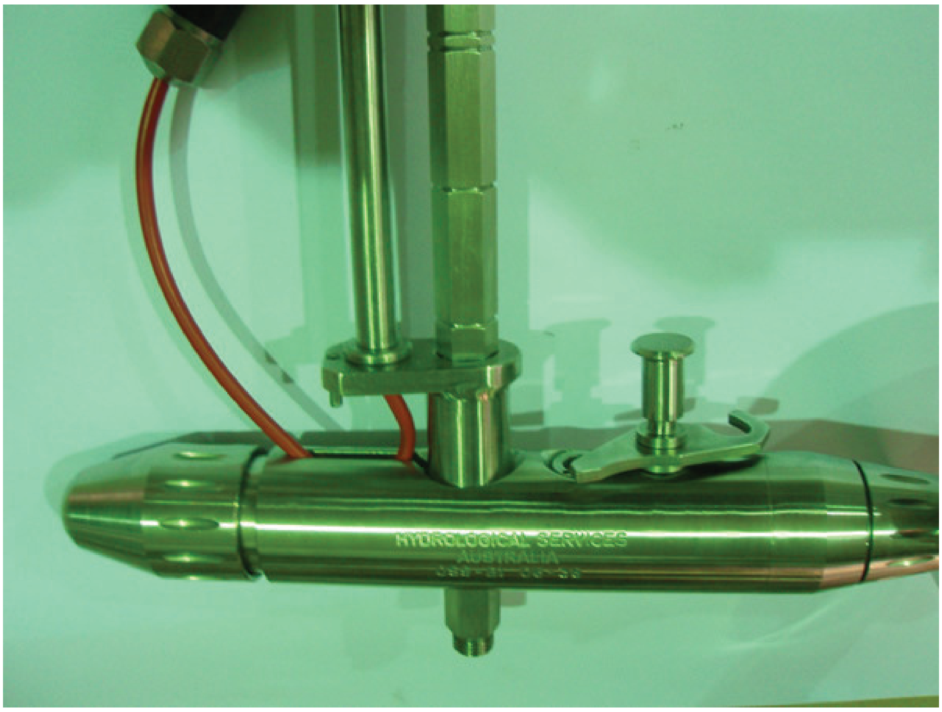


Figure 4: Loop the cable as shown

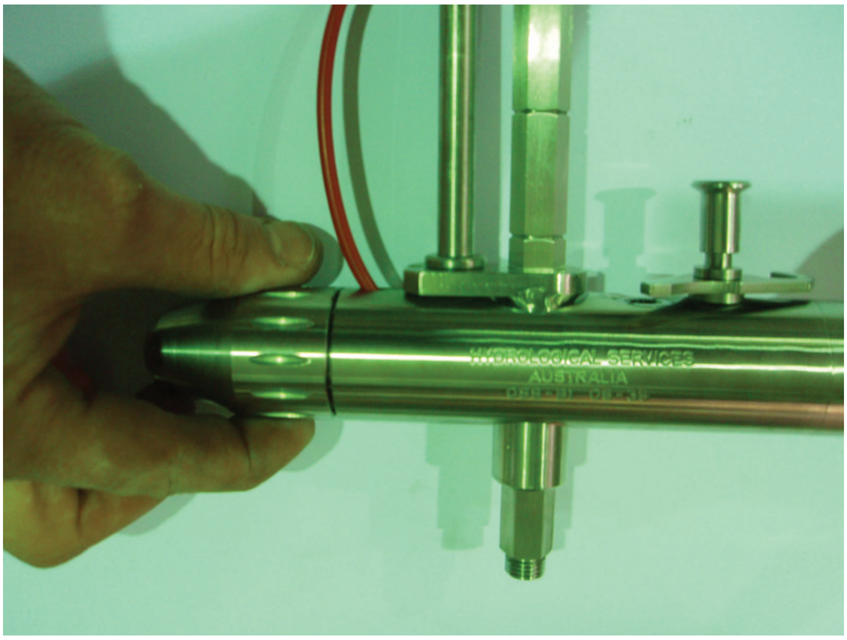


Figure 5: Locate the pin in the OSS-B1 body slot & tighten the tail to the rod as shown

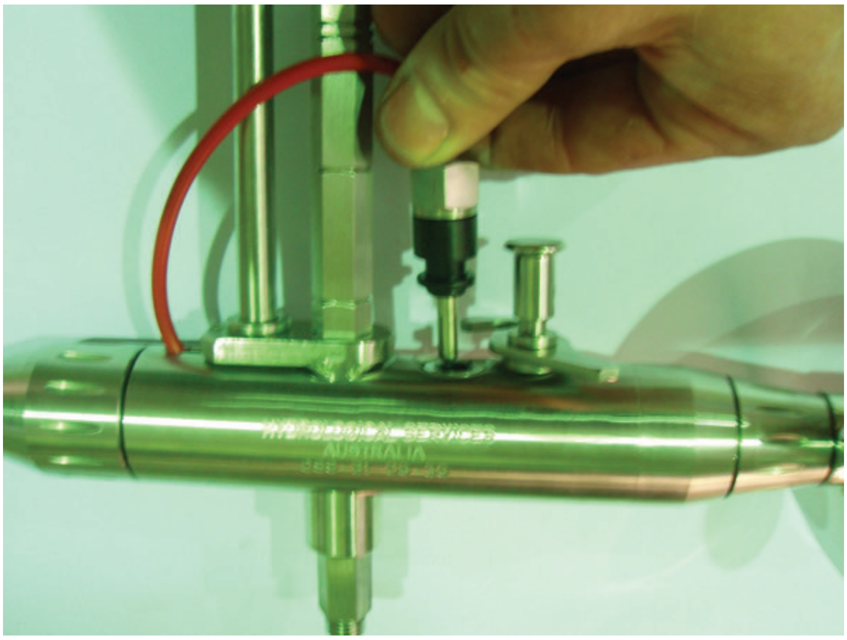


Figure 6: Plug the Angle Plug (AP01) in place by pushing down firmly & Secure Clamp in place

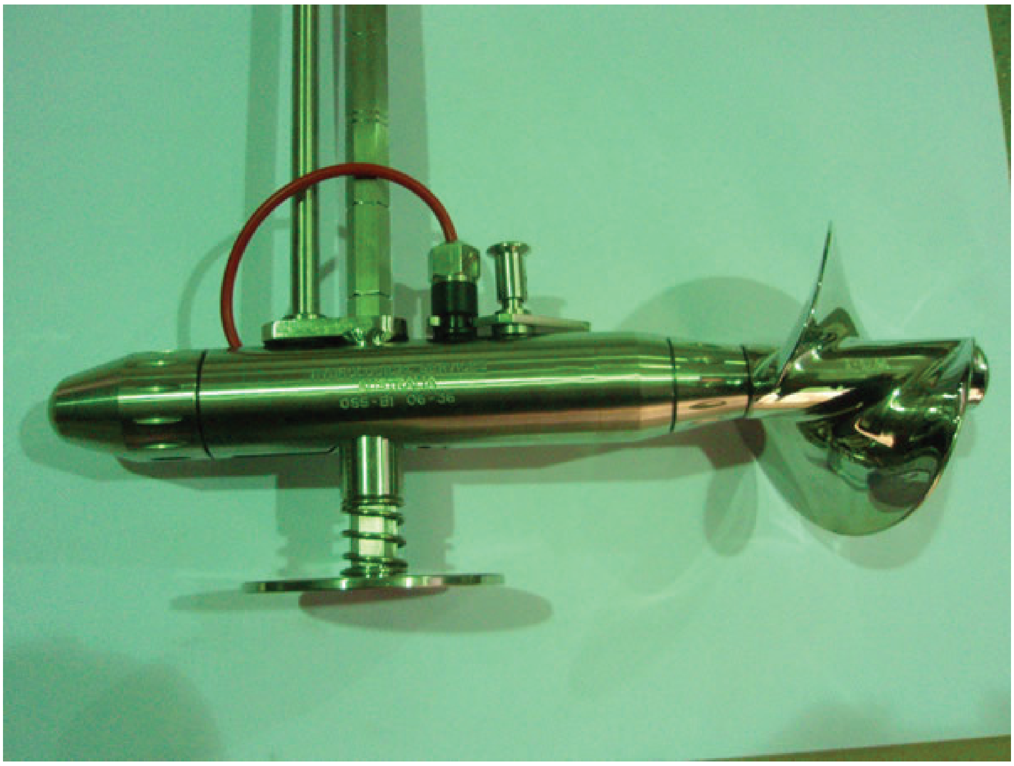
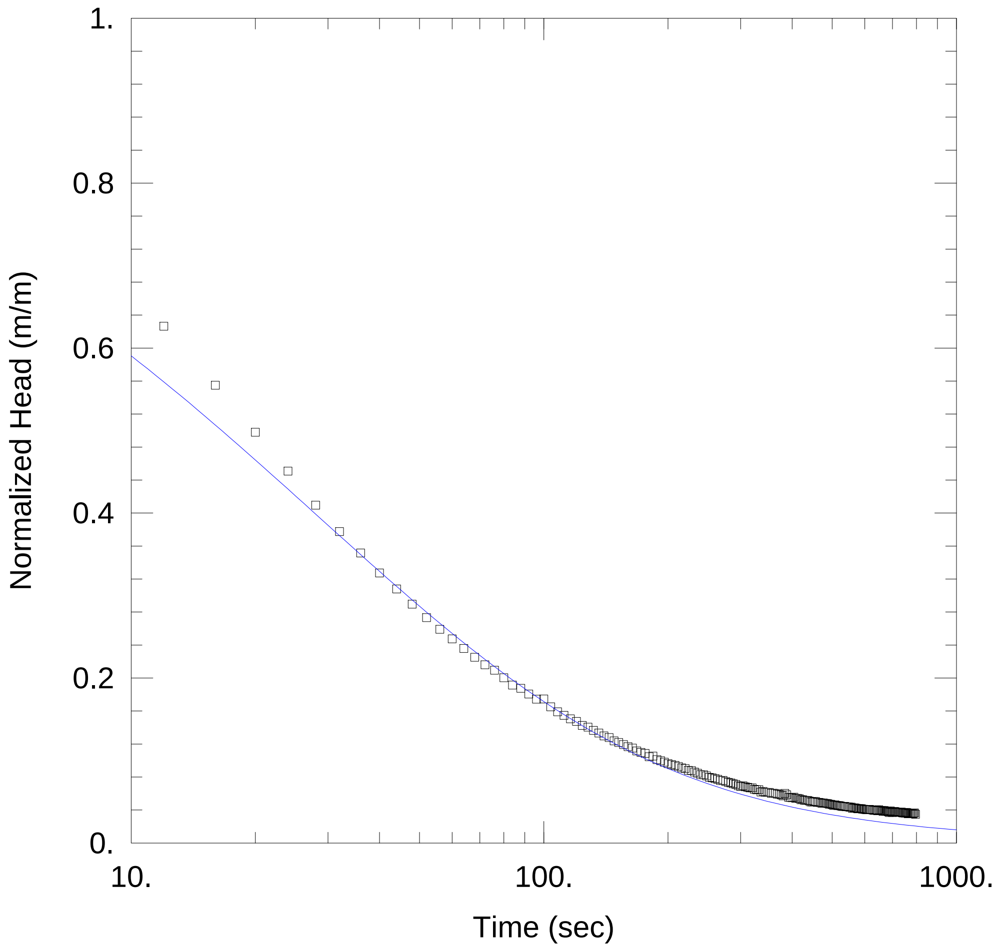


Figure 7: Screw the Foot Plate back on as shown

APPENDIX F
SLUG TEST ANALYSES



BGC14-001D FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-001D
Test Date: 04-Apr-2014

AQUIFER DATA

Saturated Thickness: 13.27 m

WELL DATA (BGC14-001D)

Initial Displacement: 0.5071 m
Total Well Penetration Depth: 13.27 m
Casing Radius: 0.0254 m

Static Water Column Height: 13.27 m
Screen Length: 6.1 m
Well Radius: 0.0762 m

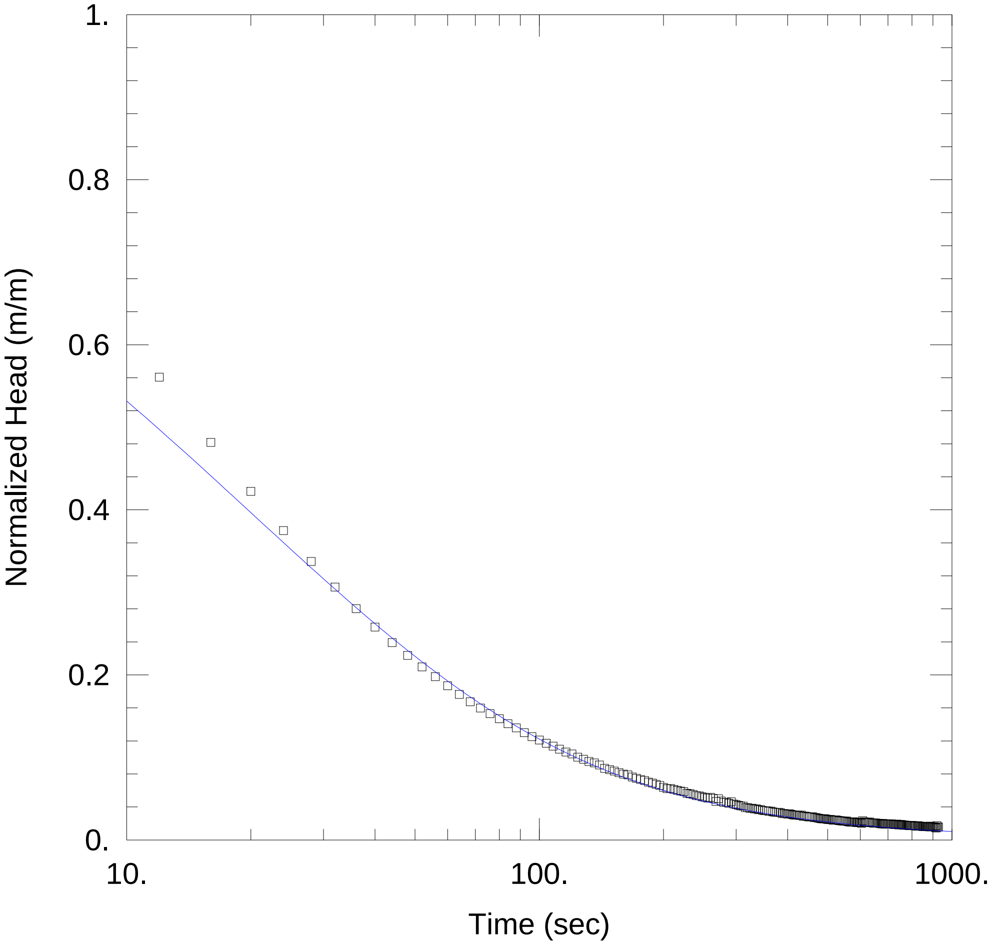
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.699E-6 m/sec
Kz/Kr = 1.

Ss = 0.004603 m^{-1}



BGC14-001D RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-001D
Test Date: 04-Apr-2014

AQUIFER DATA

Saturated Thickness: 13.27 m

WELL DATA (BGC14-001D)

Initial Displacement: 0.7084 m
Total Well Penetration Depth: 13.27 m
Casing Radius: 0.0254 m

Static Water Column Height: 13.27 m
Screen Length: 6.1 m
Well Radius: 0.0762 m

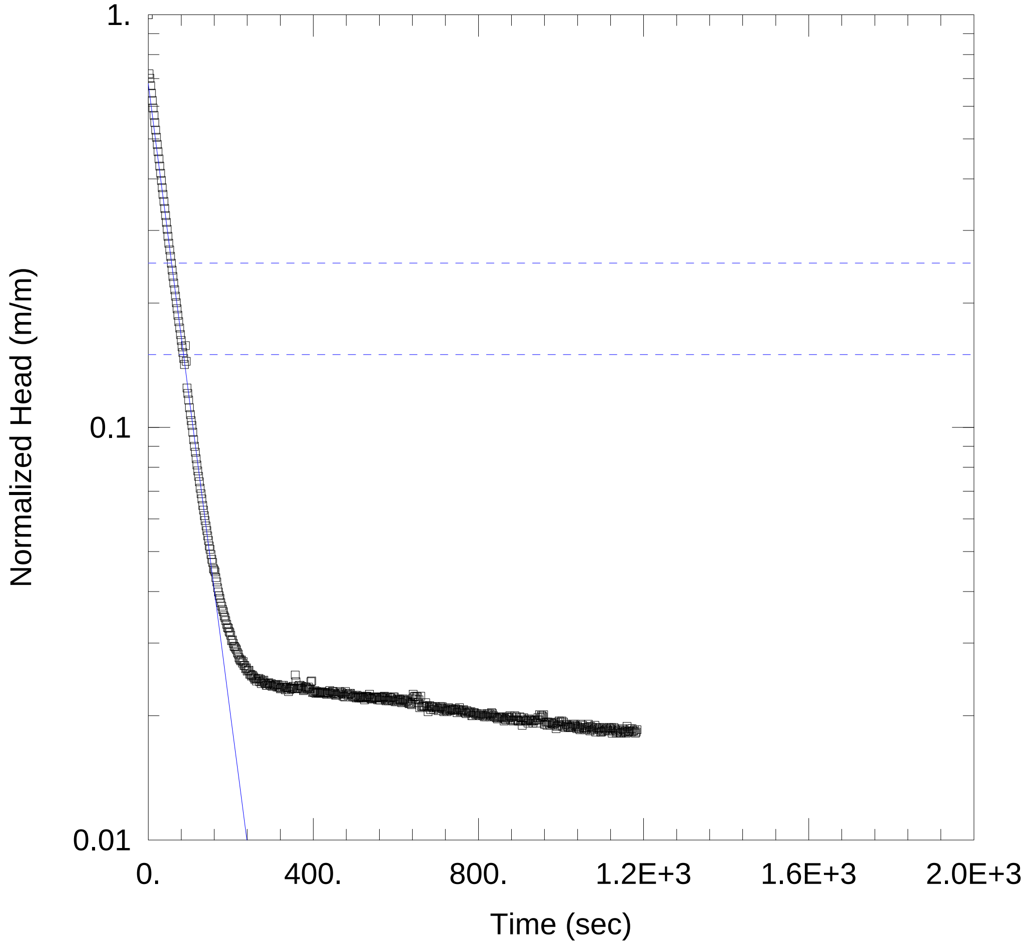
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 2.577E-6 m/sec
Kz/Kr = 1.

Ss = 0.003965 m^{-1}



BGC14-002D FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-002D
Test Date: 21-Mar-2014

AQUIFER DATA

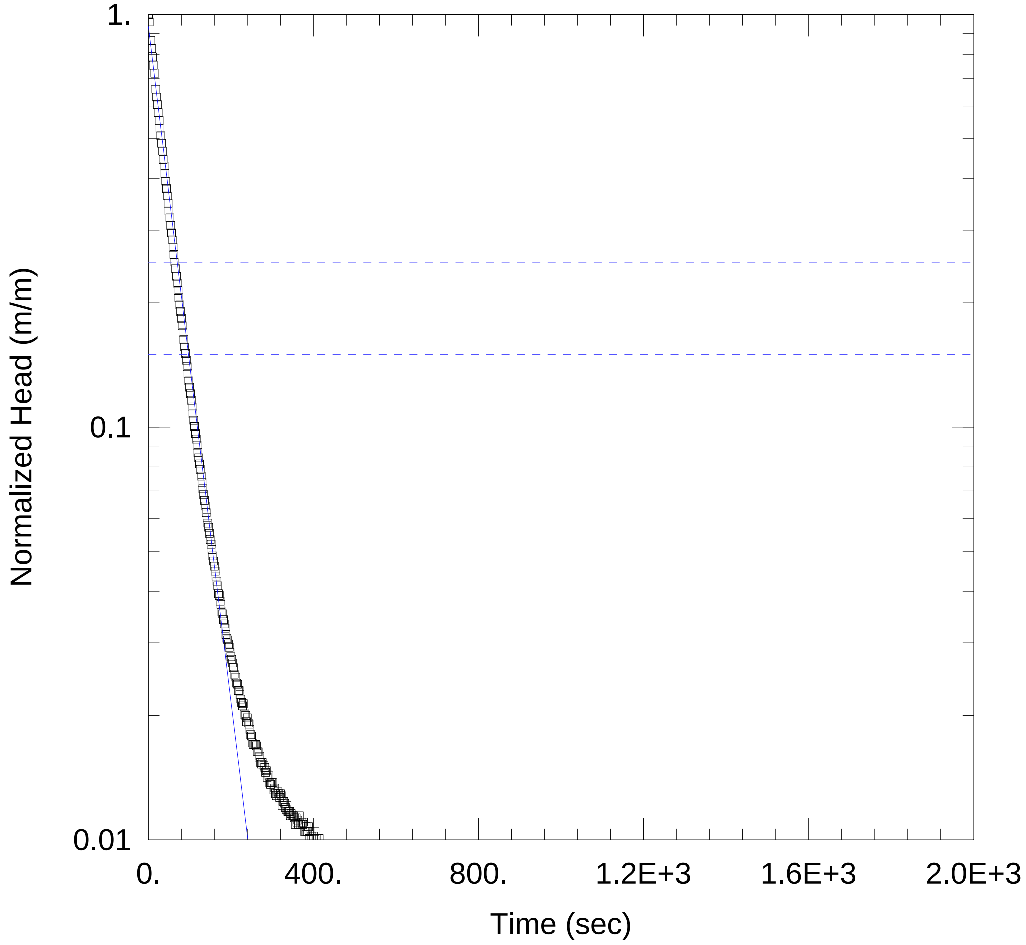
Saturated Thickness: 16.63 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BGC14-002D)

Initial Displacement: 0.865 m
Total Well Penetration Depth: 16.63 m
Casing Radius: 0.0254 m
Static Water Column Height: 16.63 m
Screen Length: 7.92 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 3.838E-6 m/sec
y0 = 0.5886 m



BGC14-002D RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-002D
Test Date: 21-Mar-2014

AQUIFER DATA

Saturated Thickness: 16.63 m
Anisotropy Ratio (Kz/Kr): 1.

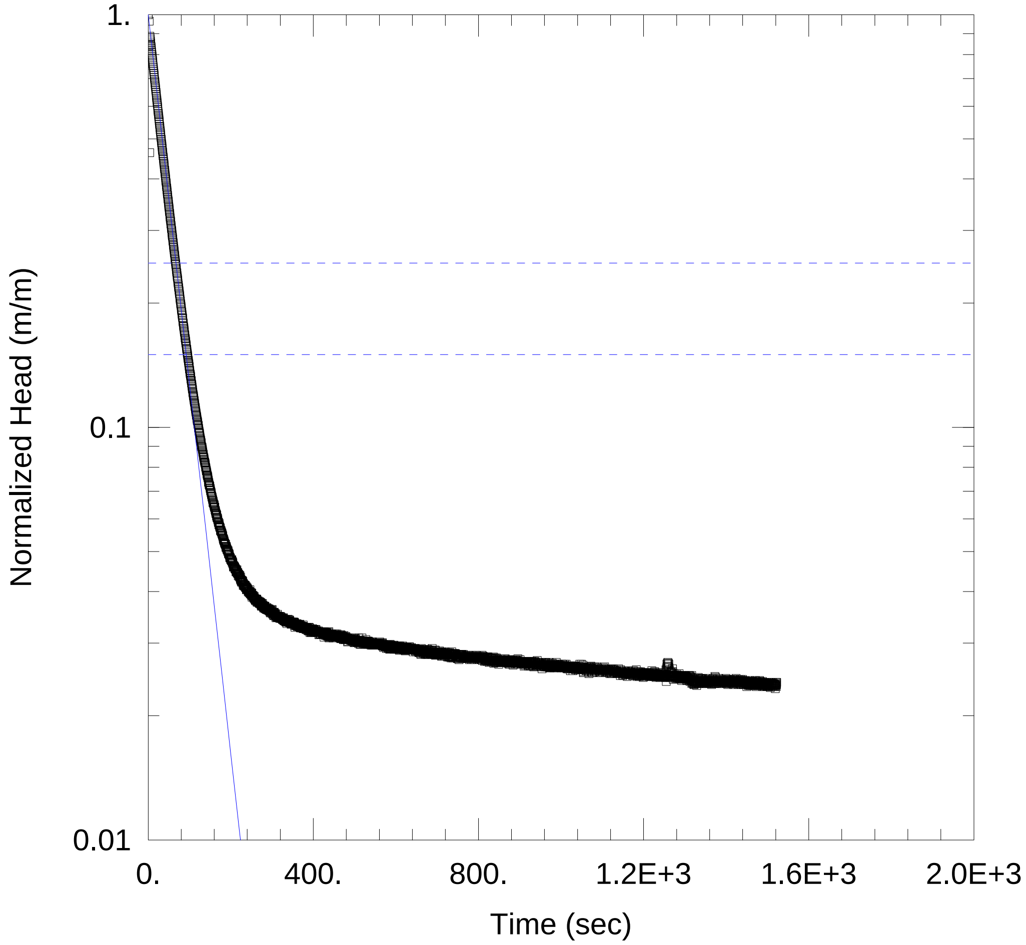
WELL DATA (BGC14-002D)

Initial Displacement: 0.7348 m
Total Well Penetration Depth: 16.63 m
Casing Radius: 0.0254 m
Static Water Column Height: 16.63 m
Screen Length: 7.92 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 4.088E-6 m/sec
y0 = 0.6864 m



BGC14-002D FH TEST 3

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-002D
Test Date: 21-Mar-2014

AQUIFER DATA

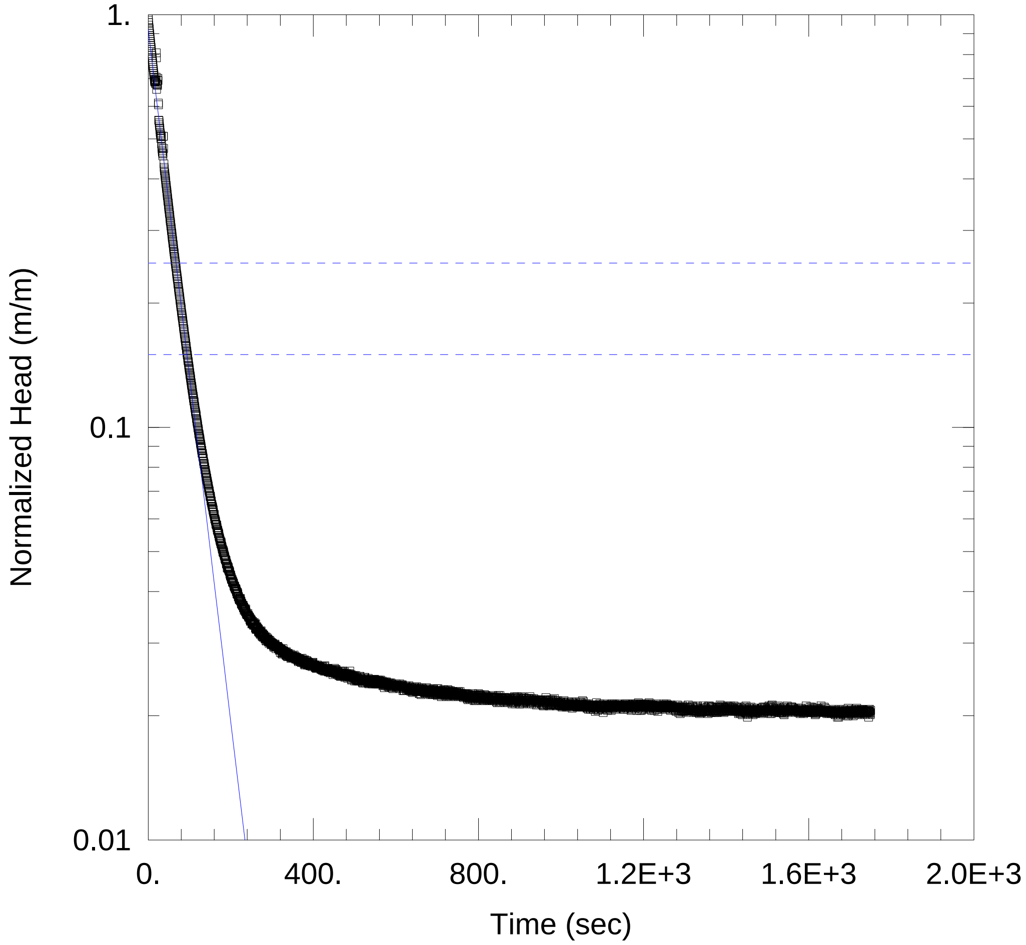
Saturated Thickness: 16.63 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BGC14-002D)

Initial Displacement: 0.7351 m
Total Well Penetration Depth: 16.63 m
Casing Radius: 0.0254 m
Static Water Column Height: 16.63 m
Screen Length: 7.92 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 4.488E-6 m/sec
y0 = 0.7393 m



BGC14-002D RH TEST 4

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-002D
Test Date: 21-Mar-2014

AQUIFER DATA

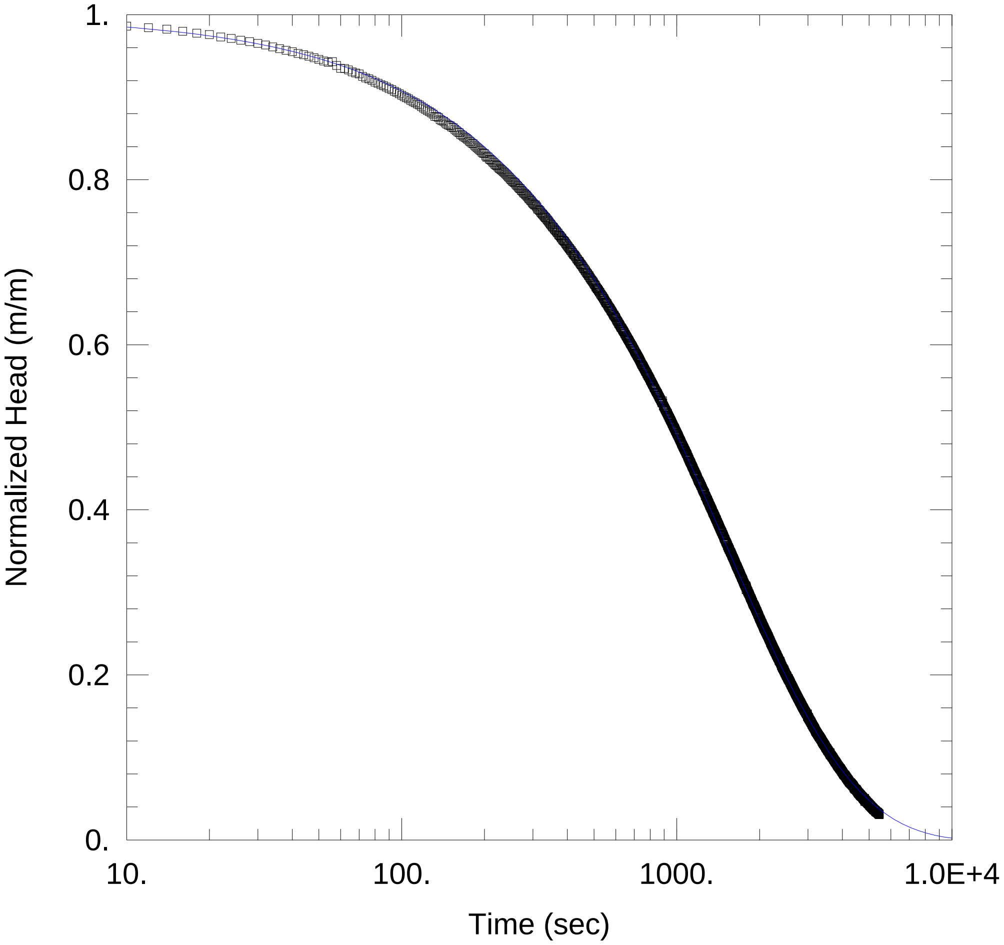
Saturated Thickness: 16.63 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BGC14-002D)

Initial Displacement: 0.7909 m
Total Well Penetration Depth: 16.63 m
Casing Radius: 0.0254 m
Static Water Column Height: 16.63 m
Screen Length: 7.92 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 4.197E-6 m/sec
y0 = 0.728 m



BGC14-002S FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-002S
Test Date: 20-Mar-2014

AQUIFER DATA

Saturated Thickness: 7.85 m

WELL DATA (BGC14-002S)

Initial Displacement: 0.6666 m
Total Well Penetration Depth: 7.85 m
Casing Radius: 0.0254 m

Static Water Column Height: 7.85 m
Screen Length: 6.1 m
Well Radius: 0.0762 m

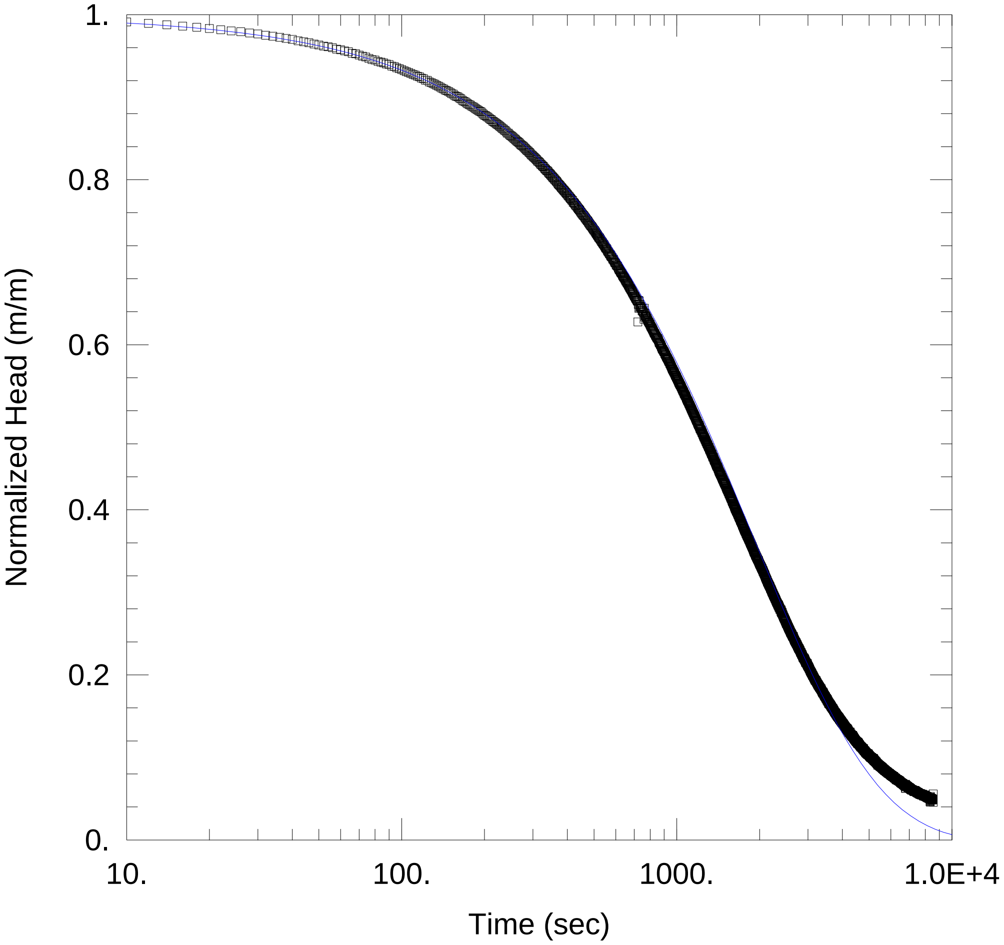
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.44E-7 m/sec
Kz/Kr = 1.

Ss = 7.858E-6 m^{-1}



BGC14-002S RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-002S
Test Date: 20-Mar-2014

AQUIFER DATA

Saturated Thickness: 8.754 m

WELL DATA (BGC14-002S)

Initial Displacement: 0.6955 m
Total Well Penetration Depth: 8.754 m
Casing Radius: 0.0254 m

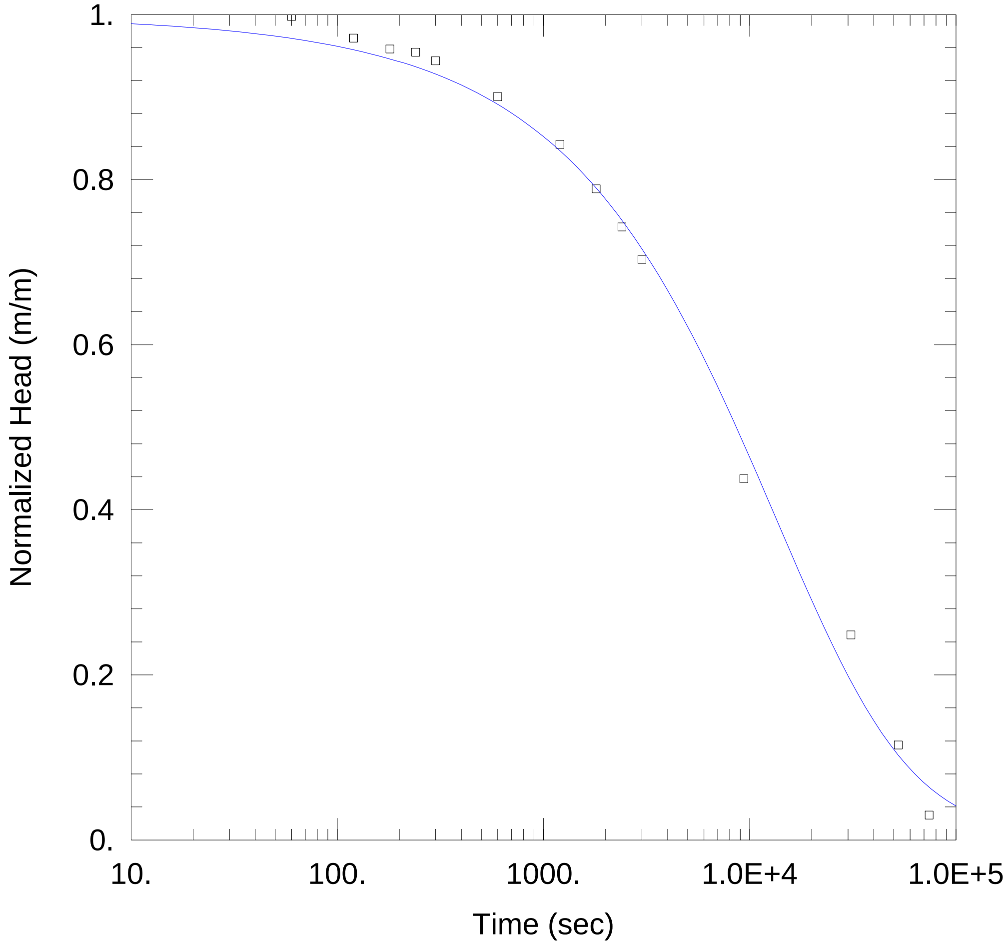
Static Water Column Height: 8.754 m
Screen Length: 6.66 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.077E-7 m/sec
Kz/Kr = 1.

Ss = 2.383E-6 m^{-1}



BGC14-003D FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-003D
Test Date: 29-May-2014

AQUIFER DATA

Saturated Thickness: 28.68 m

WELL DATA (BGC14-003D)

Initial Displacement: 0.7607 m
Total Well Penetration Depth: 28.68 m
Casing Radius: 0.0254 m

Static Water Column Height: 28.68 m
Screen Length: 3.04 m
Well Radius: 0.0762 m

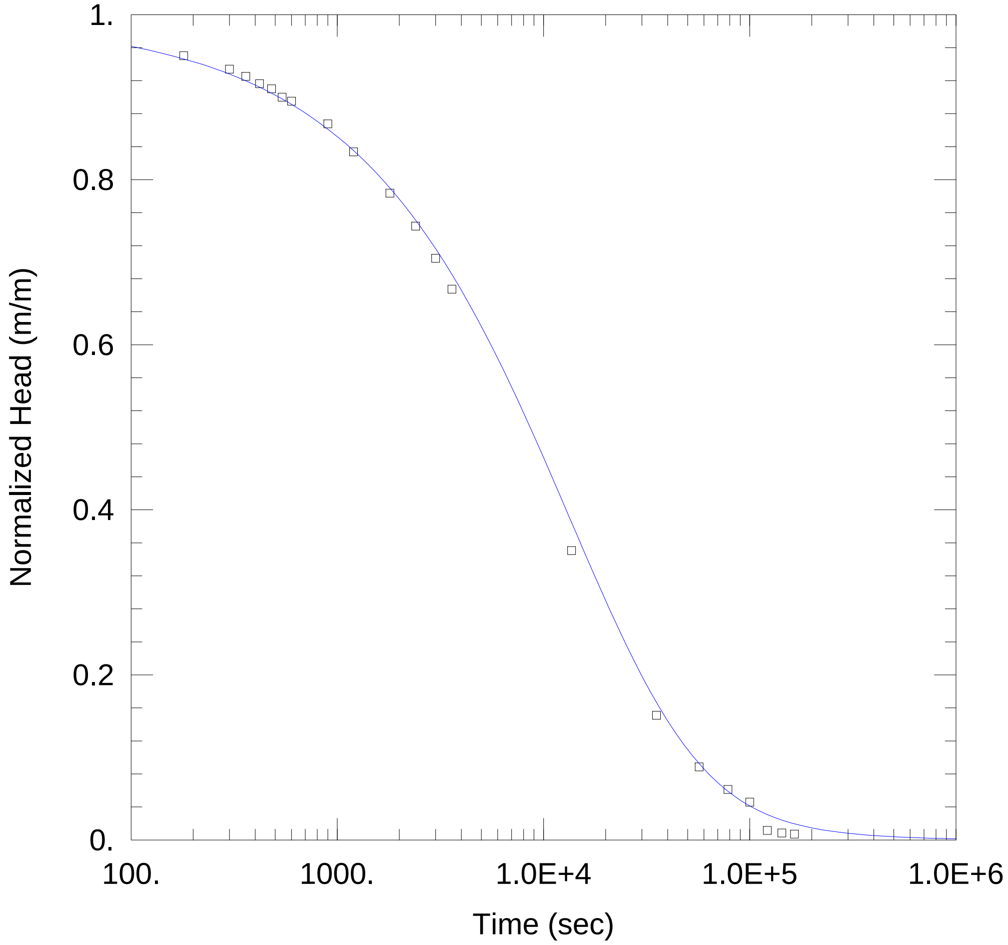
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.583E-8 m/sec
Kz/Kr = 1.

Ss = 0.000972 m^{-1}



BGC14-003D RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-003D
Test Date: 30-May-2014

AQUIFER DATA

Saturated Thickness: 28.68 m

WELL DATA (BGC14-003D)

Initial Displacement: 0.7991 m
Total Well Penetration Depth: 28.68 m
Casing Radius: 0.0254 m

Static Water Column Height: 28.68 m
Screen Length: 3.04 m
Well Radius: 0.0762 m

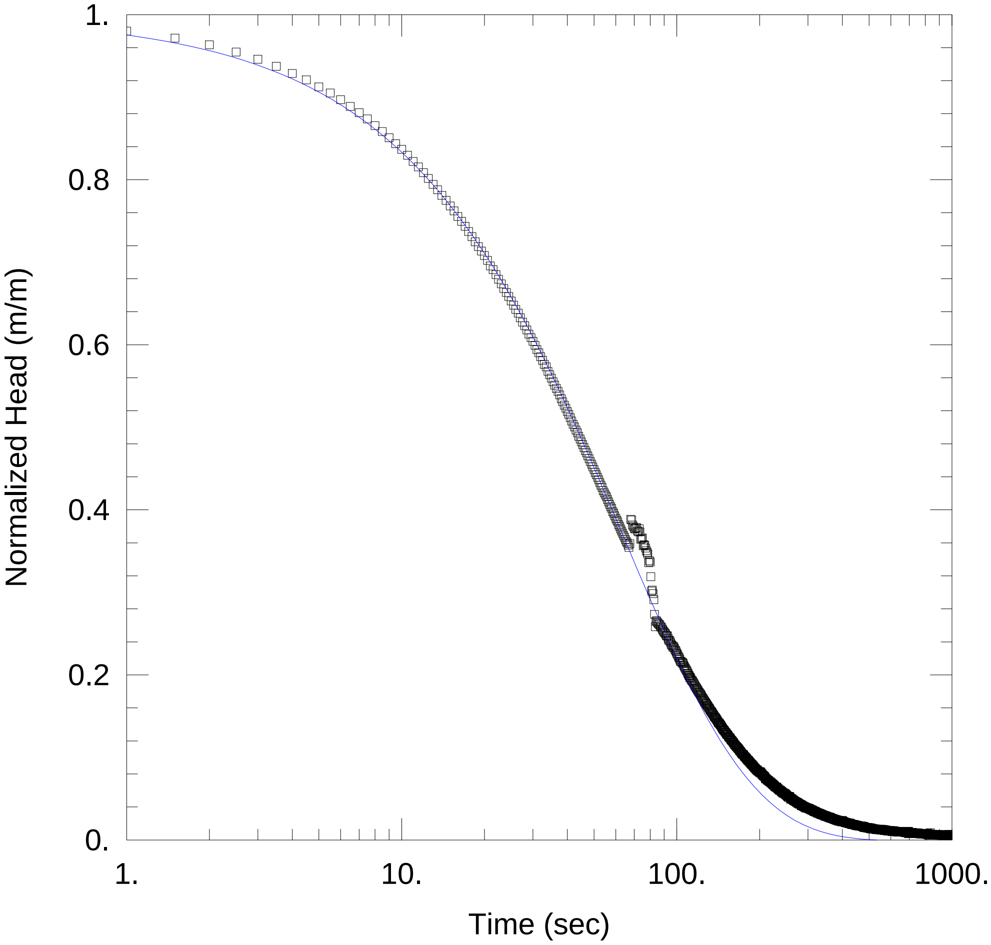
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.583E-8 m/sec
Kz/Kr = 1.

Ss = 0.000972 m^{-1}



BGC14-003I FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-003I
Test Date: 21-Mar-2014

AQUIFER DATA

Saturated Thickness: 14.63 m

WELL DATA (BGC14-003I)

Initial Displacement: 0.5689 m
Total Well Penetration Depth: 14.63 m
Casing Radius: 0.0254 m

Static Water Column Height: 14.63 m
Screen Length: 3.05 m
Well Radius: 0.0762 m

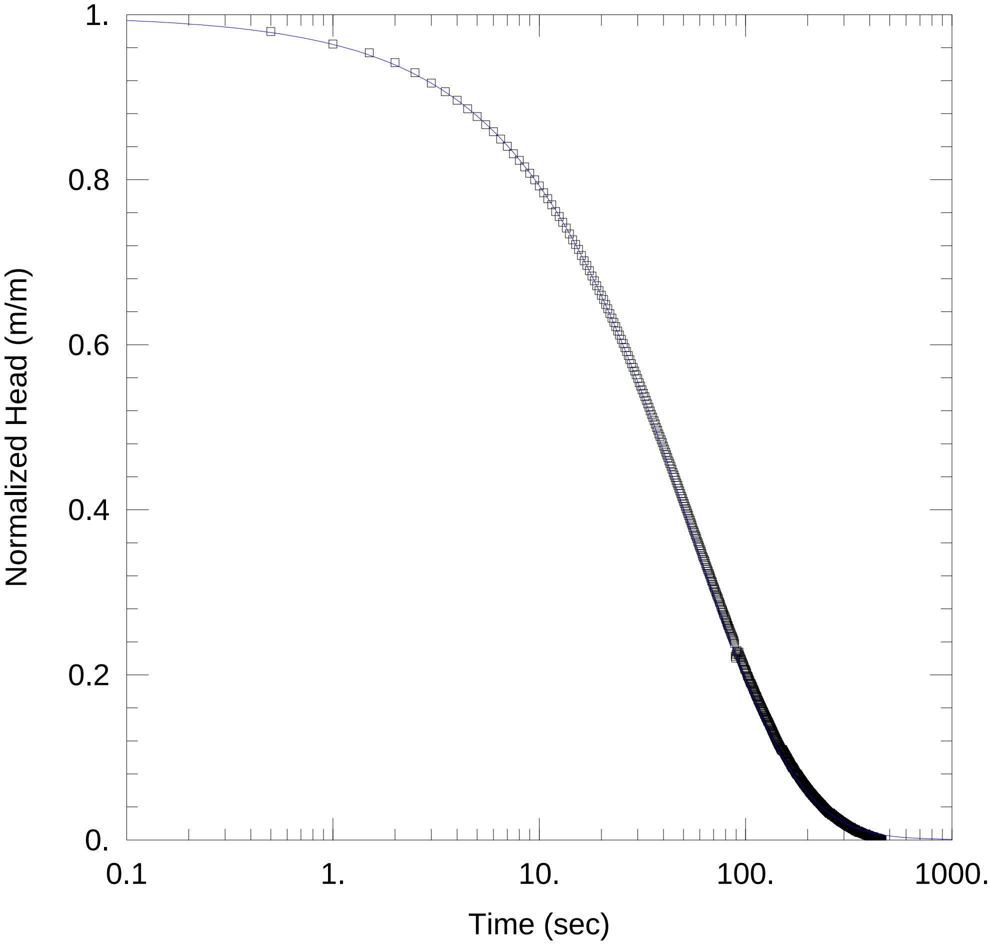
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 6.318E-6 m/sec
Kz/Kr = 1.

Ss = 7.448E-6 m^{-1}



BGC14-003I RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-003I
Test Date: 21-Mar-2014

AQUIFER DATA

Saturated Thickness: 14.63 m

WELL DATA (BGC14-003I)

Initial Displacement: 0.7015 m
Total Well Penetration Depth: 14.63 m
Casing Radius: 0.0254 m

Static Water Column Height: 14.63 m
Screen Length: 3.05 m
Well Radius: 0.0762 m

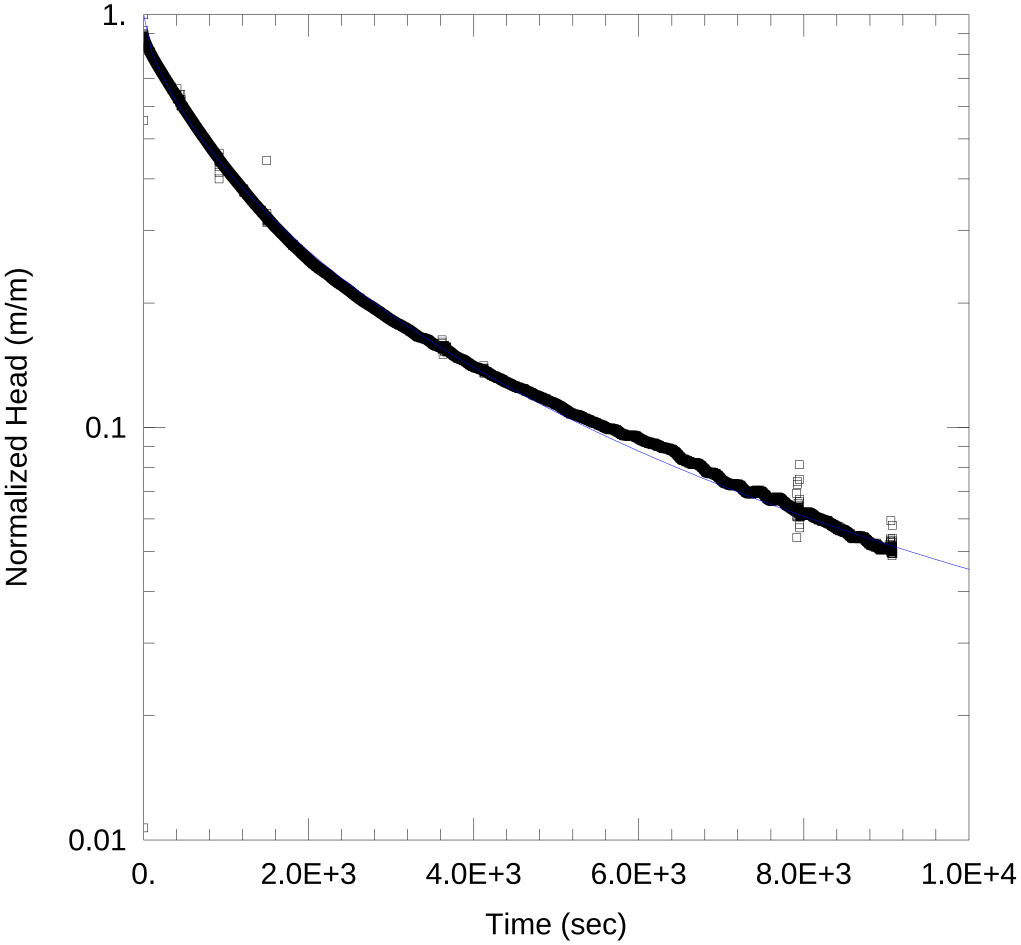
SOLUTION

Aquifer Model: Unconfined

Kr = 6.559E-6 m/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 4.461E-5 m^{-1}



BGC14-003S FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-003S
Test Date: 5-Mar-2014

AQUIFER DATA

Saturated Thickness: 6.97 m

WELL DATA (BGC14-003S)

Initial Displacement: 0.7289 m
Total Well Penetration Depth: 6.97 m
Casing Radius: 0.0254 m

Static Water Column Height: 6.97 m
Screen Length: 1.53 m
Well Radius: 0.0762 m

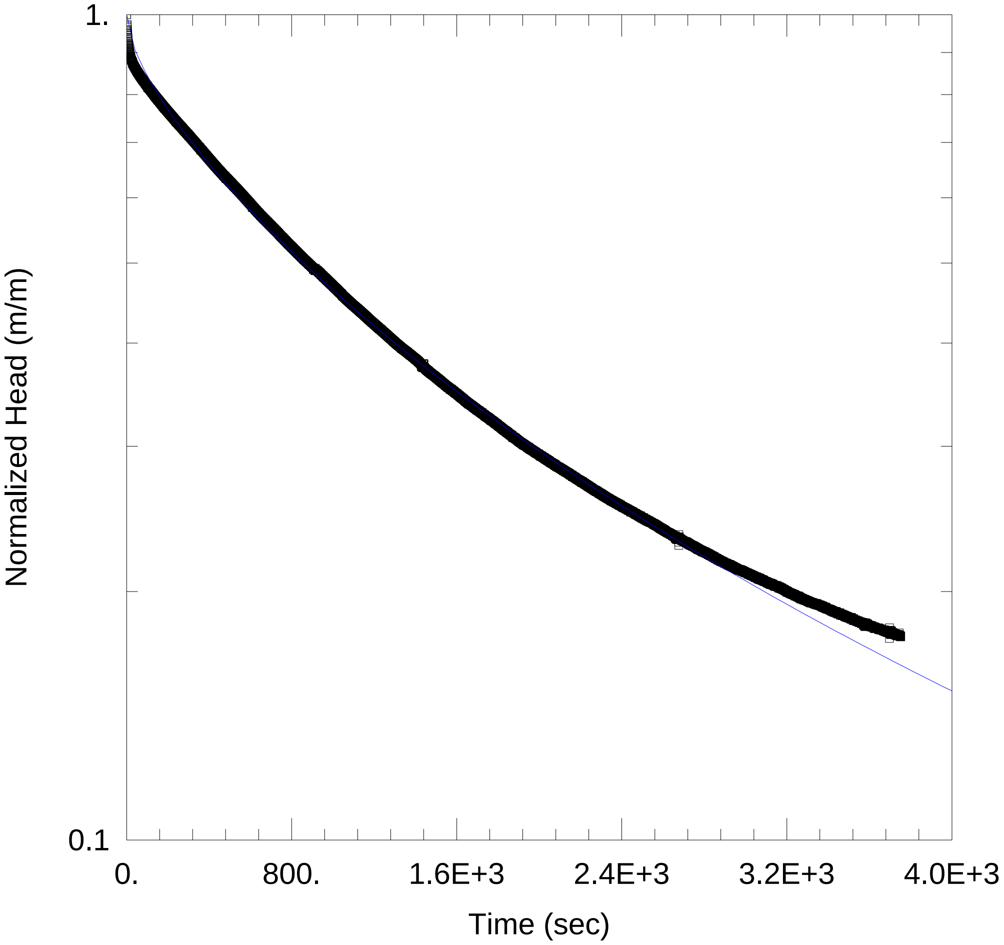
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 2.564E-7 m/sec
Kz/Kr = 1.

Ss = 0.006297 m^{-1}



BGC14-003S RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-003S
Test Date: 5-Mar-2014

AQUIFER DATA

Saturated Thickness: 6.97 m

WELL DATA (BGC14-003S)

Initial Displacement: 0.7393 m
Total Well Penetration Depth: 6.97 m
Casing Radius: 0.0254 m

Static Water Column Height: 6.97 m
Screen Length: 1.53 m
Well Radius: 0.0762 m

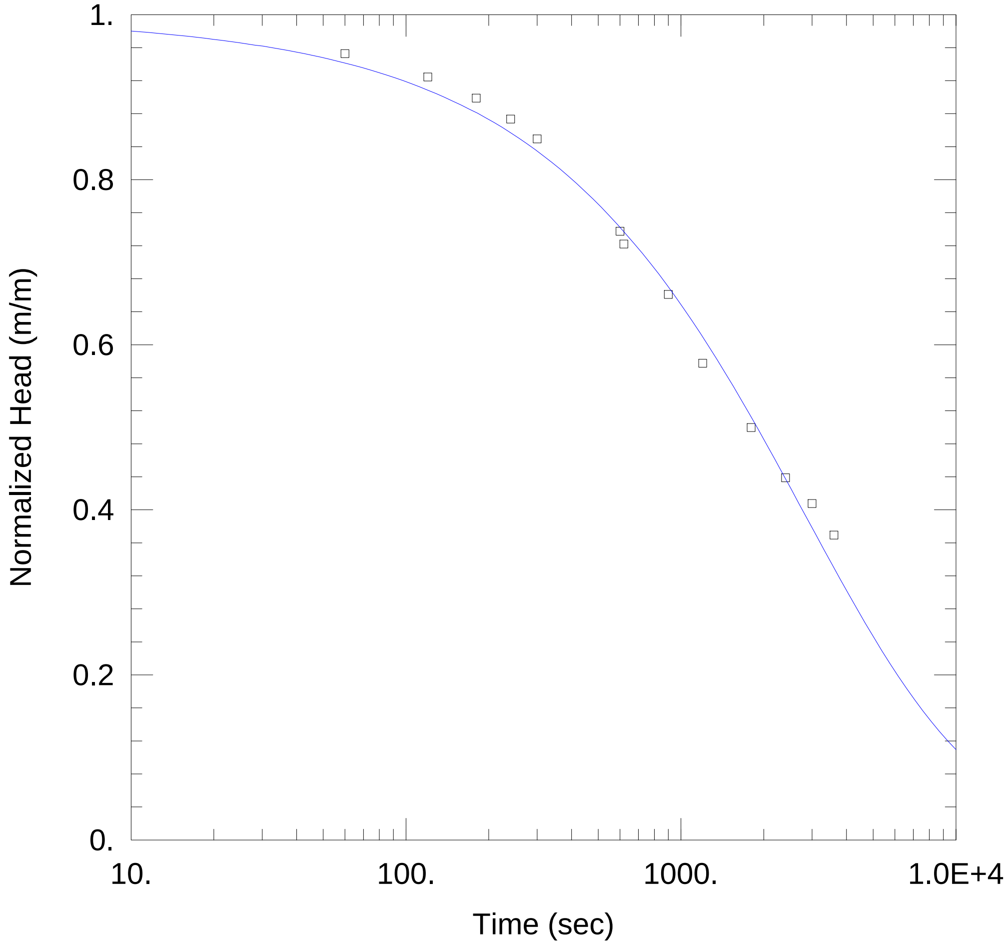
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 2.637E-7 m/sec
Kz/Kr = 1.

Ss = 0.003271 m^{-1}



BGC14-004 FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-004
Test Date: 5-Jun-2014

AQUIFER DATA

Saturated Thickness: 70.7 m

WELL DATA (BGC14-004)

Initial Displacement: 0.7064 m
Total Well Penetration Depth: 70.7 m
Casing Radius: 0.0508 m

Static Water Column Height: 70.7 m
Screen Length: 6.09 m
Well Radius: 0.0762 m

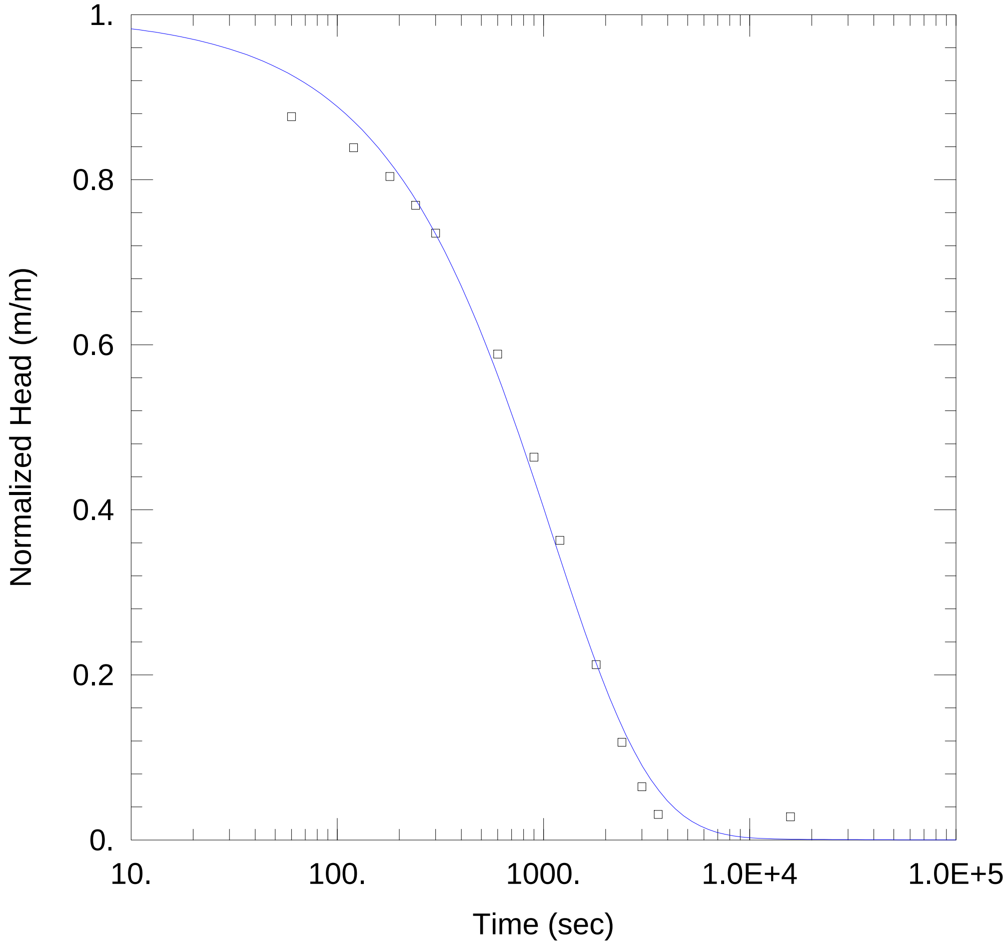
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.817E-7 m/sec
Kz/Kr = 1.

Ss = 0.0008225 m^{-1}



BGC14-004 RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-004
Test Date: 6-Jun-2014

AQUIFER DATA

Saturated Thickness: 70.7 m

WELL DATA (BGC14-004)

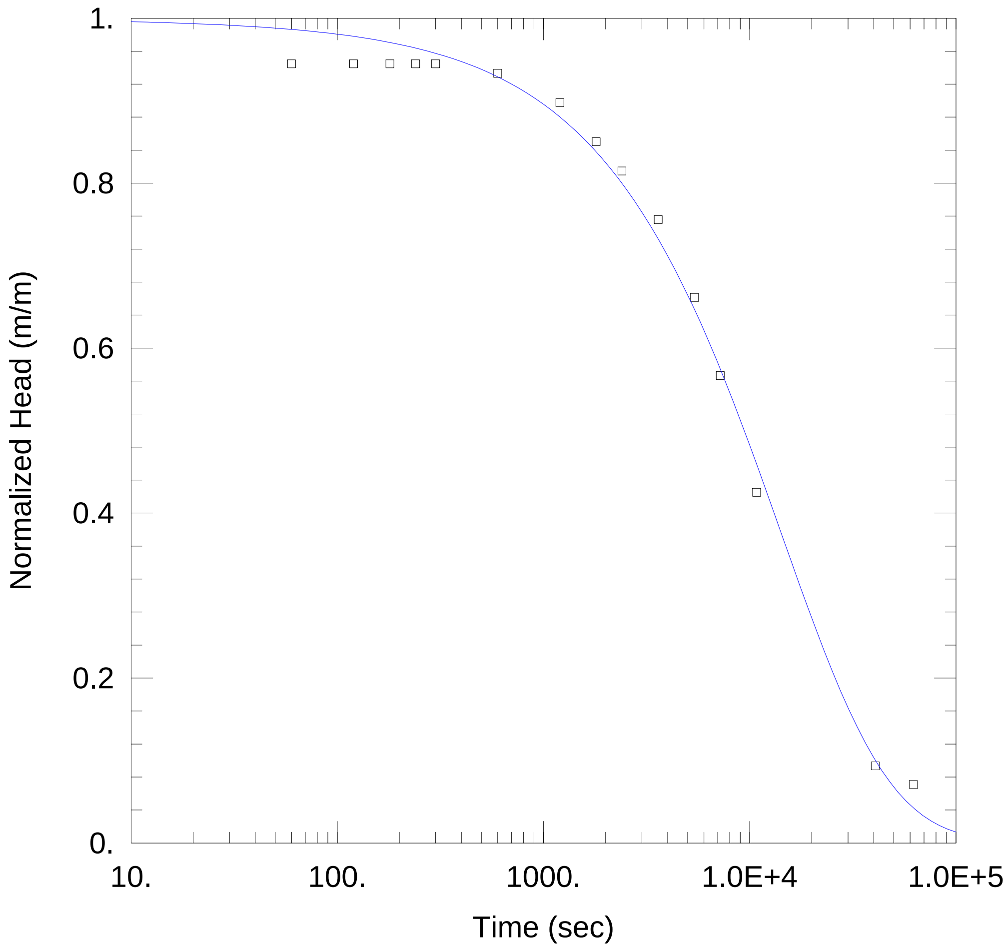
Initial Displacement: 0.7439 m
Total Well Penetration Depth: 70.7 m
Casing Radius: 0.0508 m

Static Water Column Height: 70.7 m
Screen Length: 6.09 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Kr = 8.159E-7 m/sec
Kz/Kr = 1.

Solution Method: KGS Model
Ss = 1.475E-5 m^{-1}



BGC14-005 FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-005
Test Date: 31-Mar-2014

AQUIFER DATA

Saturated Thickness: 33.49 m

WELL DATA (BGC14-005)

Initial Displacement: 0.2117 m
Total Well Penetration Depth: 33.49 m
Casing Radius: 0.0508 m

Static Water Column Height: 33.49 m
Screen Length: 3.22 m
Well Radius: 0.0762 m

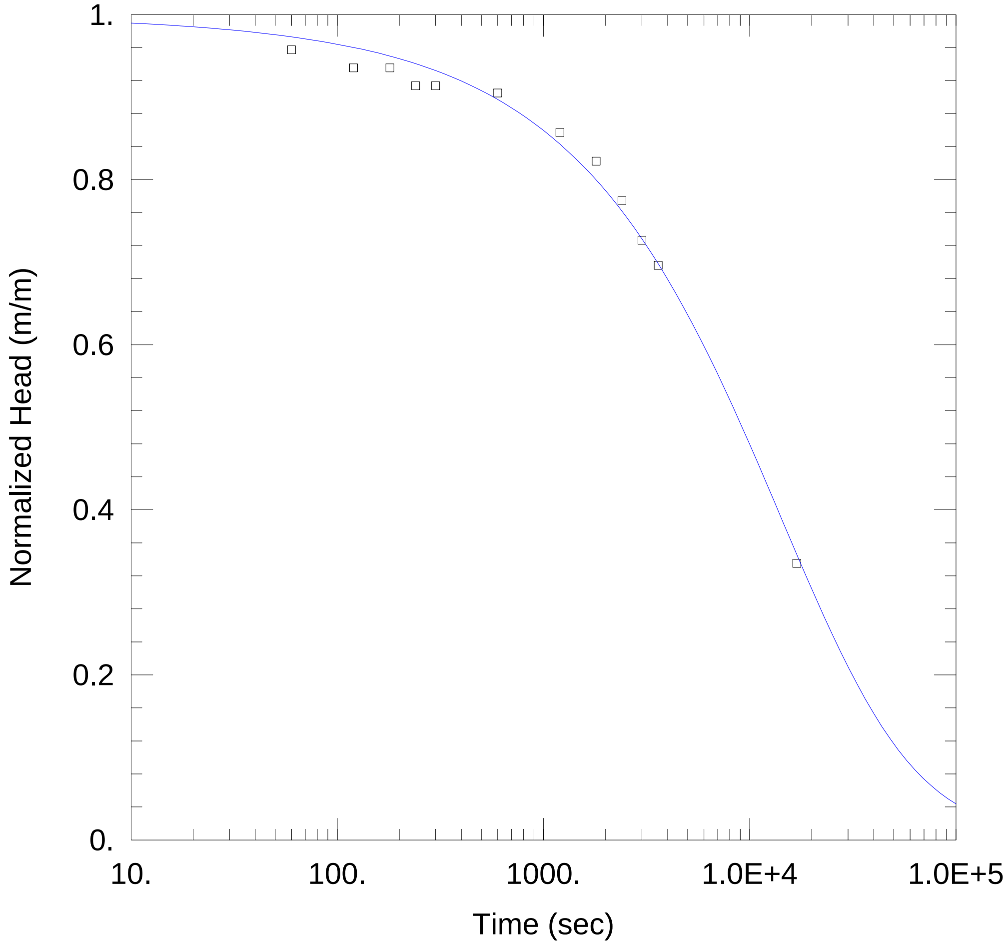
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 9.279E-8 m/sec
Kz/Kr = 1.

Ss = 0.0002371 m^{-1}



BGC14-005 RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-005
Test Date: 31-Mar-2014

AQUIFER DATA

Saturated Thickness: 33.49 m

WELL DATA (BGC14-005)

Initial Displacement: 0.2298 m
Total Well Penetration Depth: 33.49 m
Casing Radius: 0.0508 m

Static Water Column Height: 33.49 m
Screen Length: 3.22 m
Well Radius: 0.0762 m

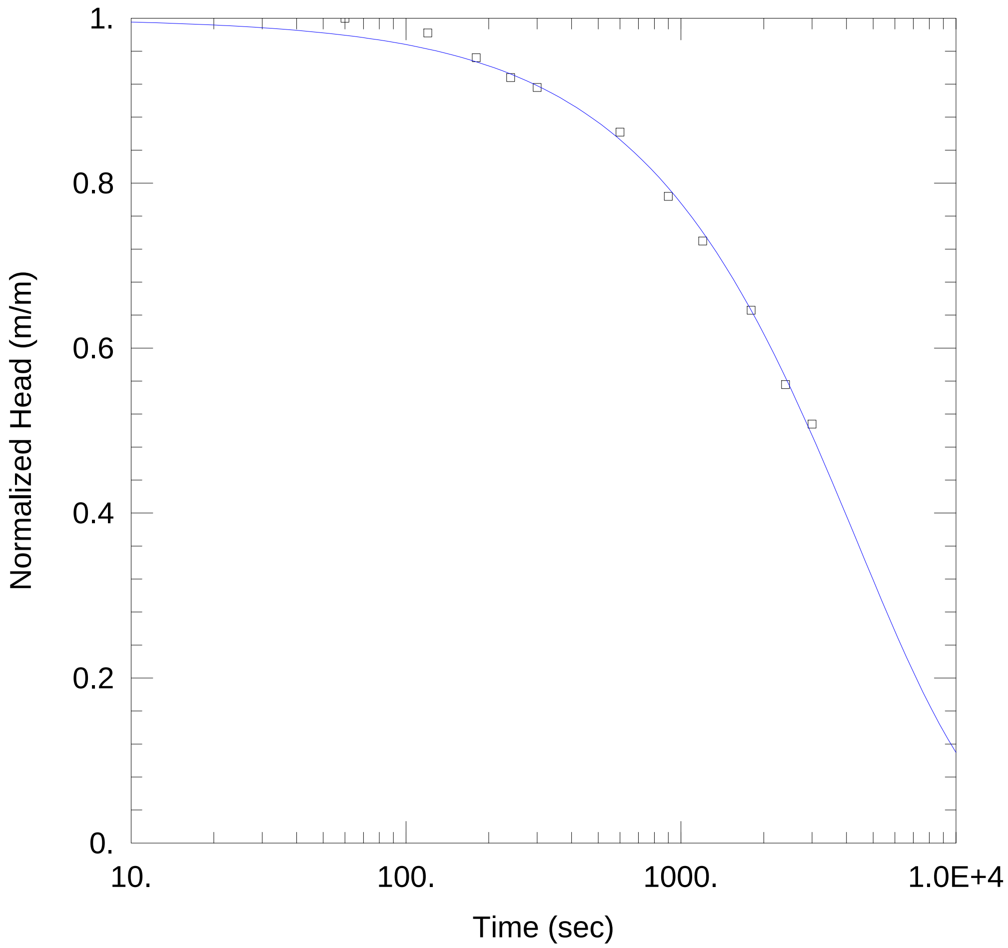
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 5.808E-8 m/sec
Kz/Kr = 1.

Ss = 0.003239 m^{-1}



BGC14-006D RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-006D
Test Date: 2-Jun-2014

AQUIFER DATA

Saturated Thickness: 16.82 m

WELL DATA (BGC14-006D)

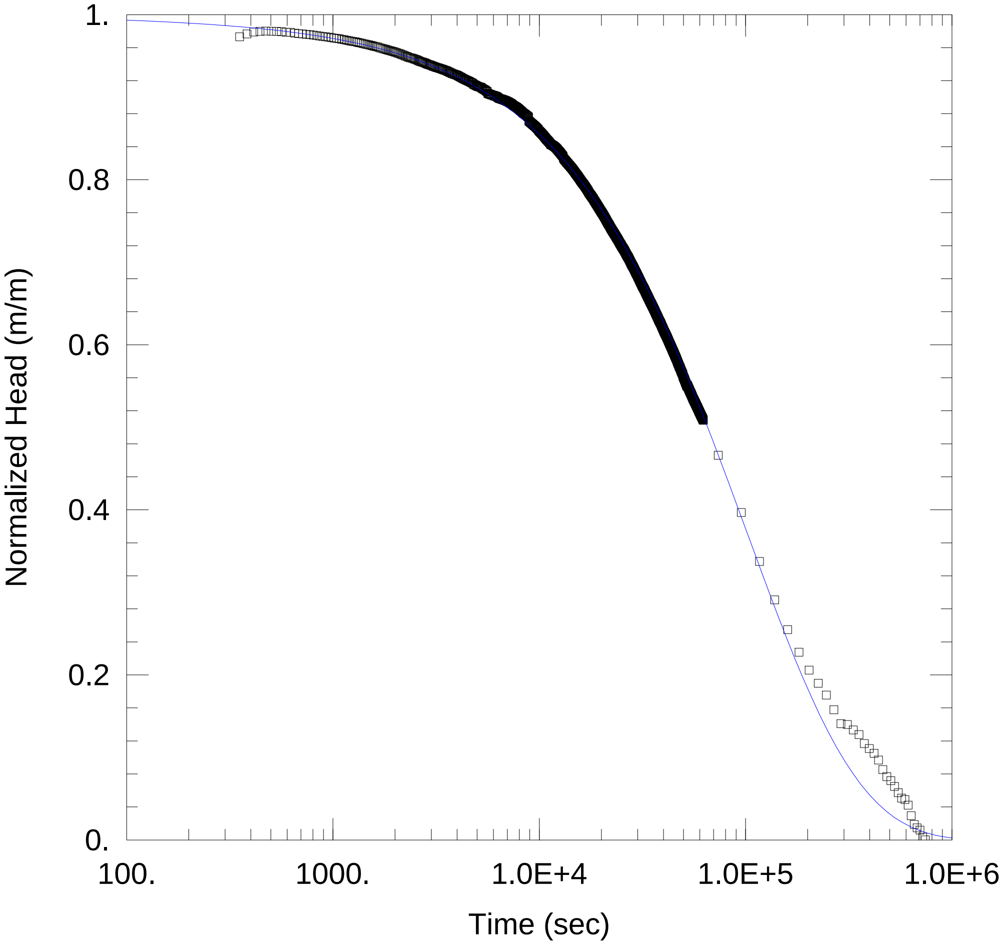
Initial Displacement: 0.1666 m
Total Well Penetration Depth: 16.82 m
Casing Radius: 0.0508 m

Static Water Column Height: 16.82 m
Screen Length: 6.1 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Kr = 2.169E-7 m/sec
Kz/Kr = 1.

Solution Method: KGS Model
Ss = 5.027E-6 m^{-1}



BGC14-006S RH TEST1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-006S
Test Date: 1-Jun-2014

AQUIFER DATA

Saturated Thickness: 4.069 m

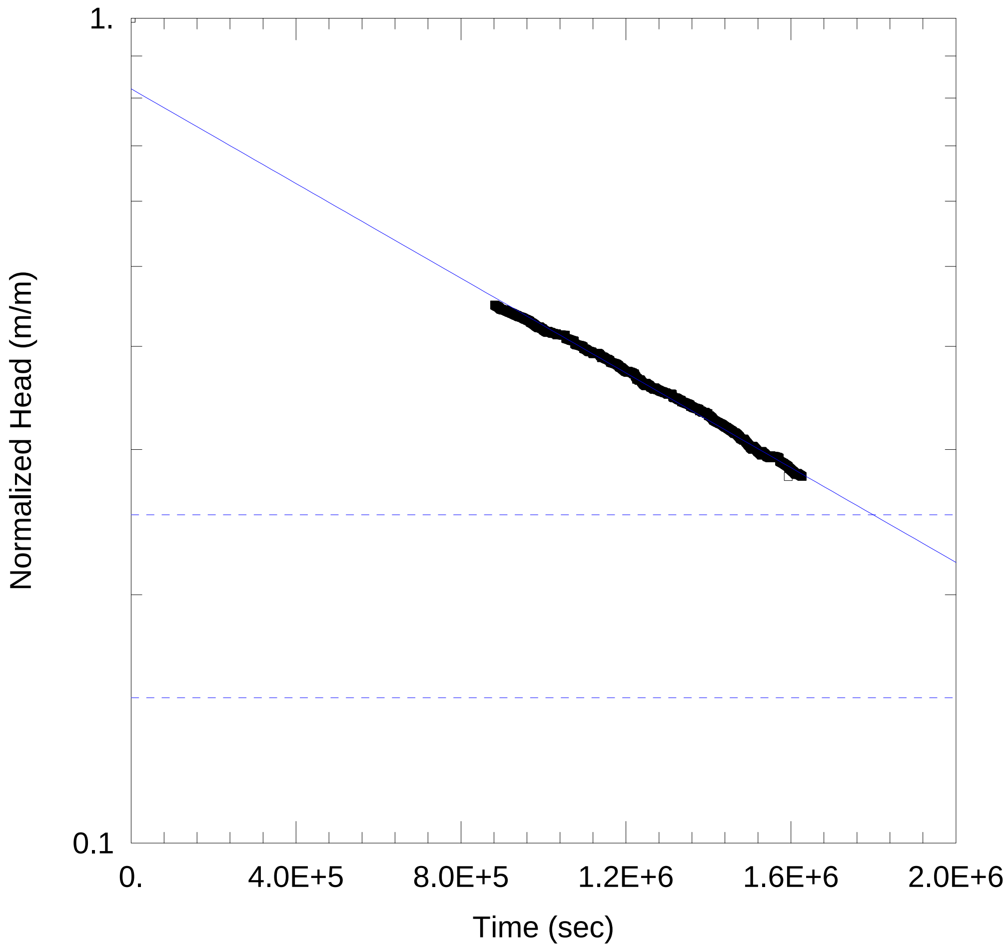
WELL DATA (BGC14-006S)

Initial Displacement: 2.08 m
Total Well Penetration Depth: 4.069 m
Casing Radius: 0.0508 m
Static Water Column Height: 4.069 m
Screen Length: 3.05 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.253E-8 m/sec
Ss = 0.0005556 m^{-1}
Kz/Kr = 1.



BGC14-008D RH TEST1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-008D
Test Date: 30-May-2014

AQUIFER DATA

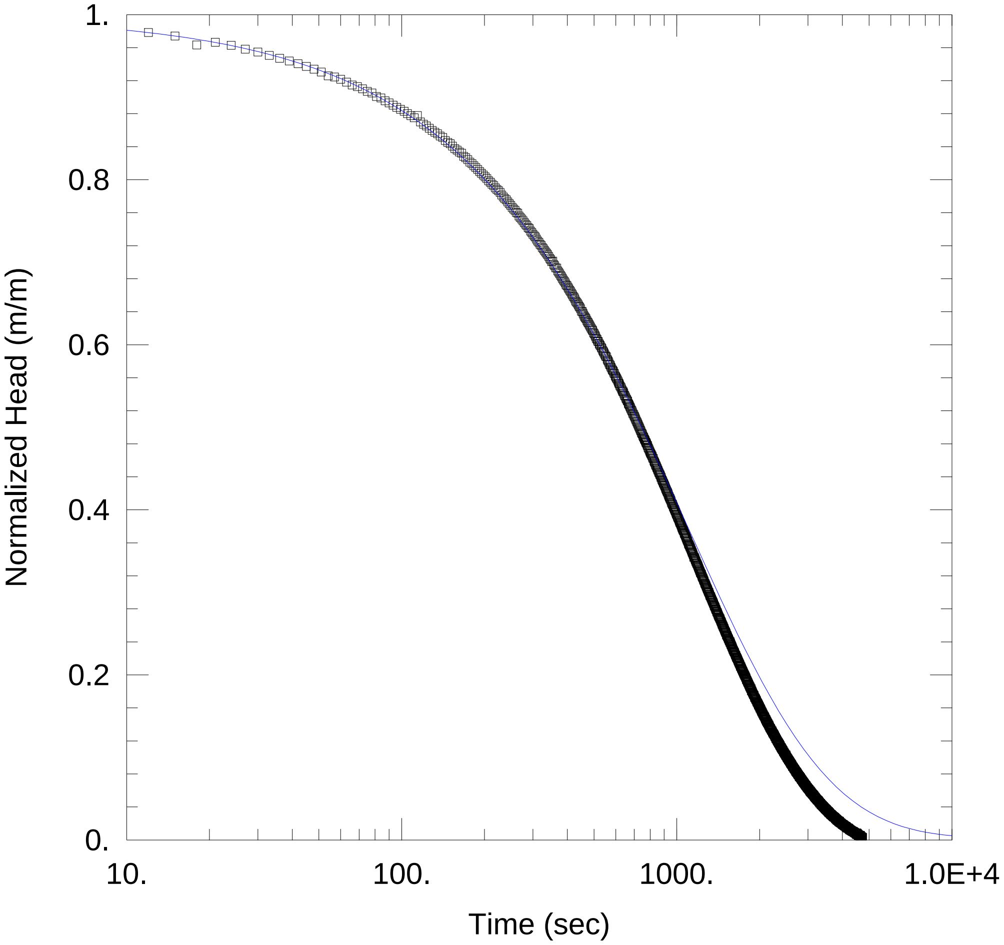
Saturated Thickness: 7.071 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BGC14-008D)

Initial Displacement: 7.071 m
Static Water Column Height: 6.927 m
Total Well Penetration Depth: 6.927 m
Screen Length: 3.04 m
Casing Radius: 0.0508 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.034E-9 m/sec
y0 = 5.805 m



BGC14-009 FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-009
Test Date: 10-Apr-2014

AQUIFER DATA

Saturated Thickness: 38.66 m

WELL DATA (BGC14-009)

Initial Displacement: 0.7383 m
Total Well Penetration Depth: 38.66 m
Casing Radius: 0.0254 m

Static Water Column Height: 38.66 m
Screen Length: 6.1 m
Well Radius: 0.0762 m

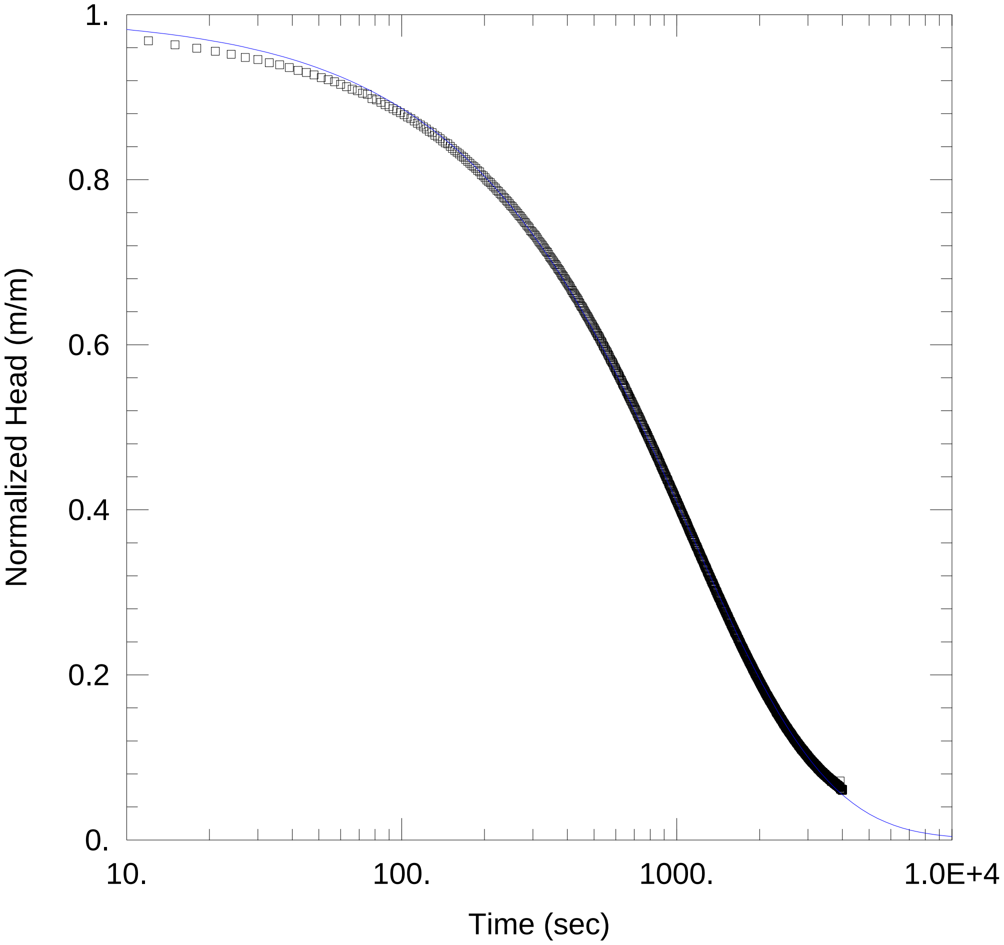
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.89E-7 m/sec
Kz/Kr = 1.

Ss = 8.394E-6 m^{-1}



BGC14-009 RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-009
Test Date: 10-Apr-2014

AQUIFER DATA

Saturated Thickness: 38.66 m

WELL DATA (BGC14-009)

Initial Displacement: 0.7842 m
Total Well Penetration Depth: 38.66 m
Casing Radius: 0.0254 m

Static Water Column Height: 38.66 m
Screen Length: 6.1 m
Well Radius: 0.0762 m

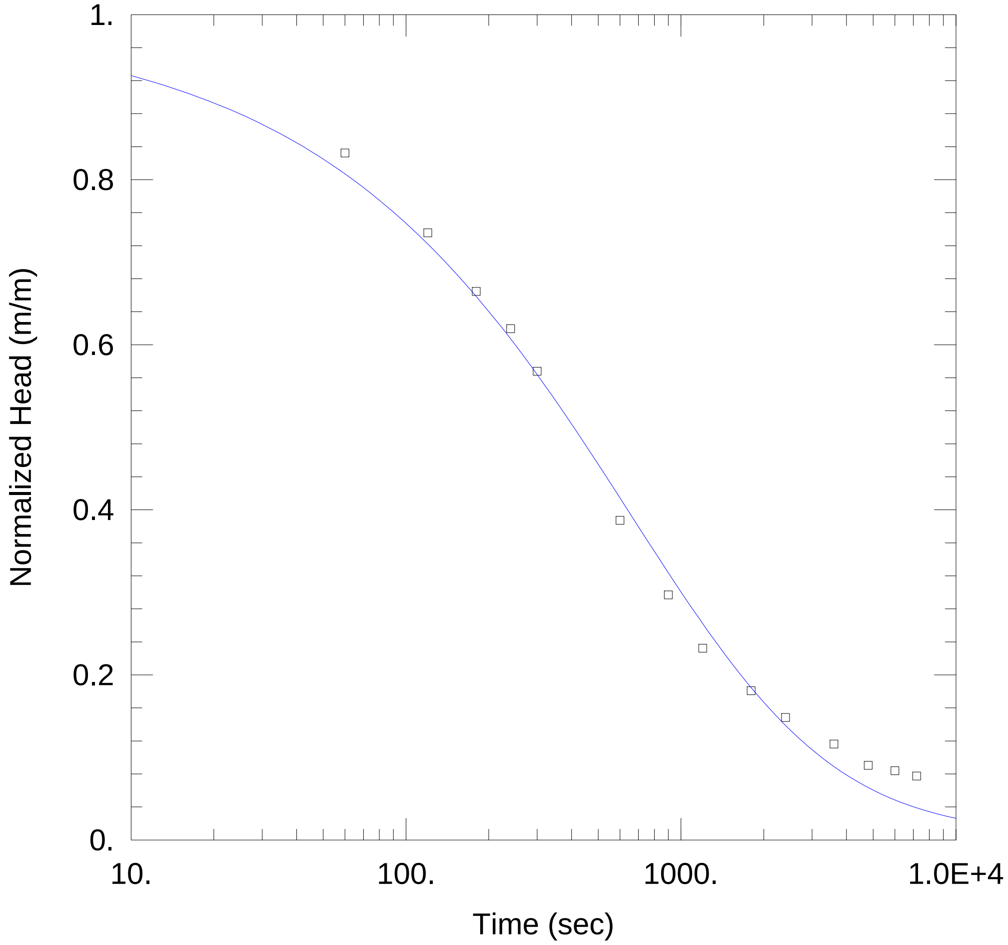
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.927E-7 m/sec
Kz/Kr = 1.

Ss = 6.23E-6 m^{-1}



BGC14-010 FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-010
Test Date: 4-Apr-2014

AQUIFER DATA

Saturated Thickness: 48.04 m

WELL DATA (BGC14-010)

Initial Displacement: 0.7748 m
Total Well Penetration Depth: 48.04 m
Casing Radius: 0.0254 m

Static Water Column Height: 48.04 m
Screen Length: 12.2 m
Well Radius: 0.0762 m

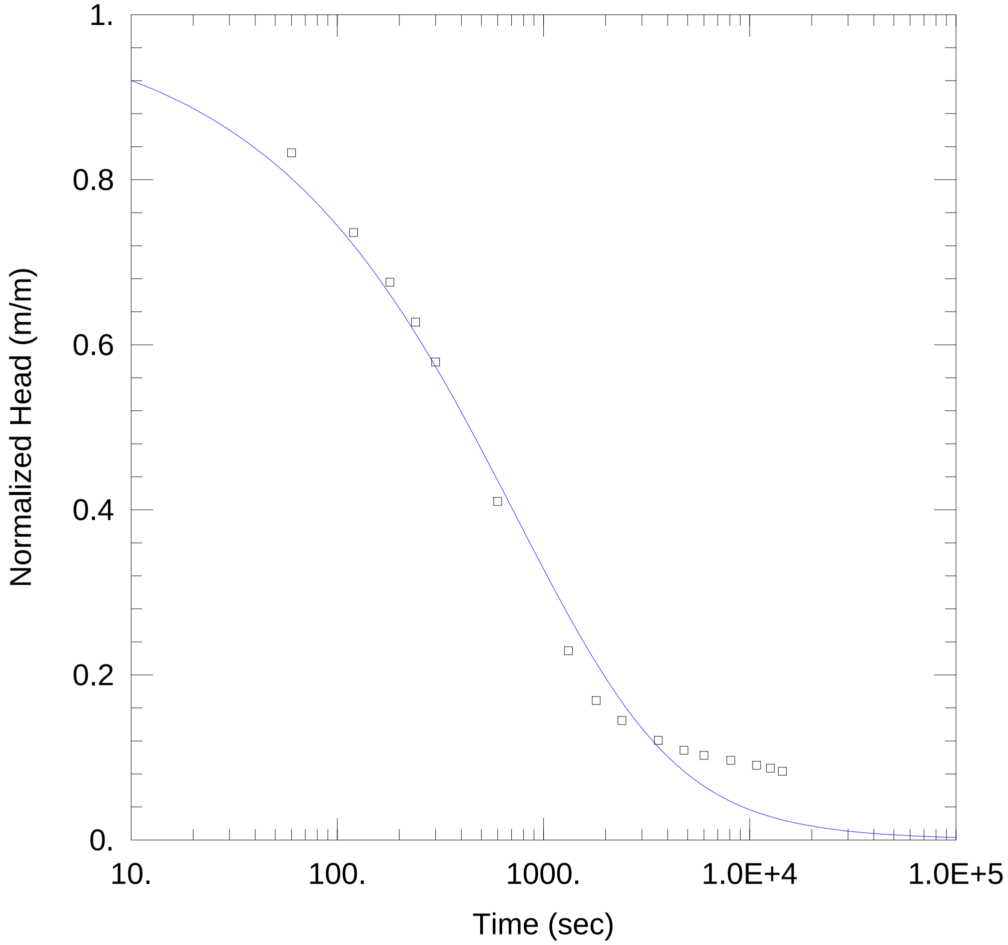
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 5.949E-8 m/sec
Kz/Kr = 1.

Ss = 0.0007141 m^{-1}



BGC14-010 RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-010
Test Date: 4-Apr-2014

AQUIFER DATA

Saturated Thickness: 48.04 m

WELL DATA (BGC14-010)

Initial Displacement: 0.8288 m
Total Well Penetration Depth: 48.04 m
Casing Radius: 0.0254 m

Static Water Column Height: 48.04 m
Screen Length: 12.2 m
Well Radius: 0.0762 m

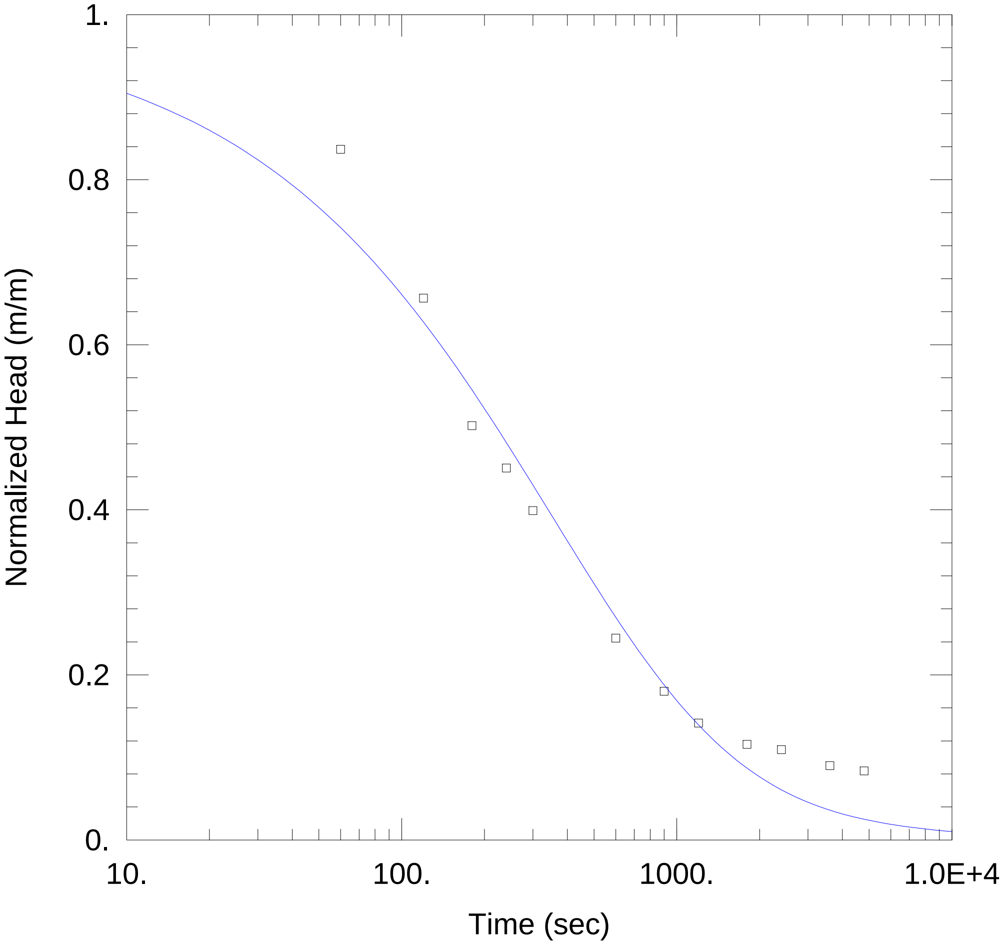
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 4.289E-8 m/sec
Kz/Kr = 1.

Ss = 0.00131 m^{-1}



BGC14-011D FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-011D
Test Date: 3-Apr-2014

AQUIFER DATA

Saturated Thickness: 23.39 m

WELL DATA (BGC14-011D)

Initial Displacement: 0.7767 m
Total Well Penetration Depth: 23.39 m
Casing Radius: 0.0254 m

Static Water Column Height: 23.39 m
Screen Length: 6.09 m
Well Radius: 0.0762 m

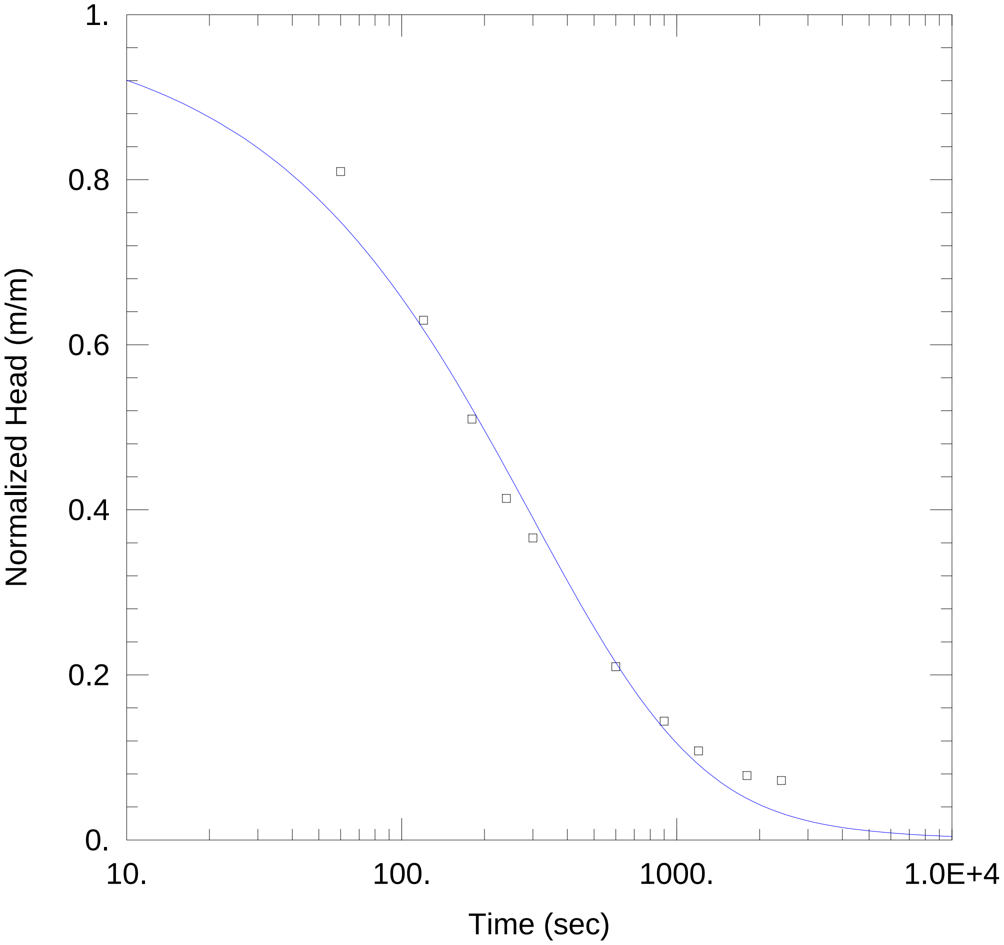
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 2.524E-7 m/sec
Kz/Kr = 1.

Ss = 0.0009631 m^{-1}



BGC14-011D RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-011D
Test Date: 3-Apr-2014

AQUIFER DATA

Saturated Thickness: 23.39 m

WELL DATA (BGC14-011D)

Initial Displacement: 0.8335 m
Total Well Penetration Depth: 23.39 m
Casing Radius: 0.0254 m

Static Water Column Height: 23.39 m
Screen Length: 6.09 m
Well Radius: 0.0762 m

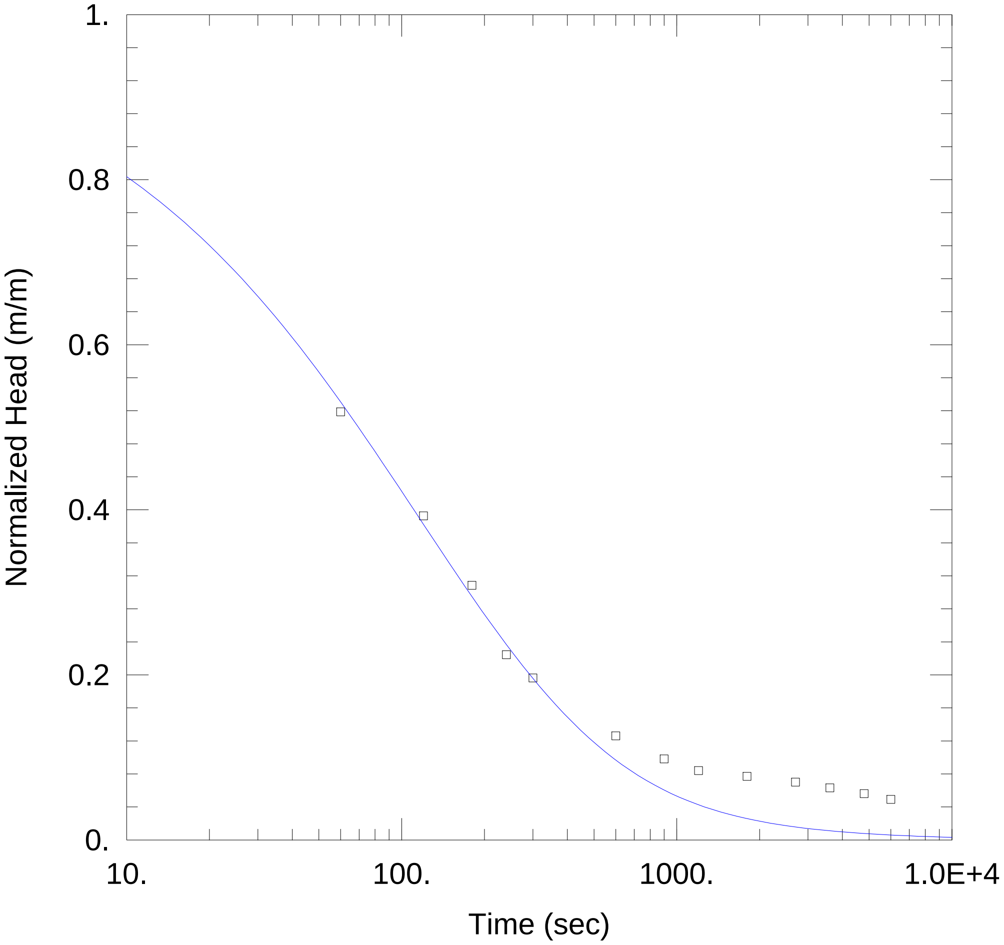
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 4.297E-7 m/sec
Kz/Kr = 1.

Ss = 0.0002201 m^{-1}



BGC14-011S FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-011S
Test Date: 3-Apr-2014

AQUIFER DATA

Saturated Thickness: 12.09 m

WELL DATA (BGC14-011S)

Initial Displacement: 0.7132 m
Total Well Penetration Depth: 12.09 m
Casing Radius: 0.0254 m

Static Water Column Height: 12.09 m
Screen Length: 3.05 m
Well Radius: 0.0762 m

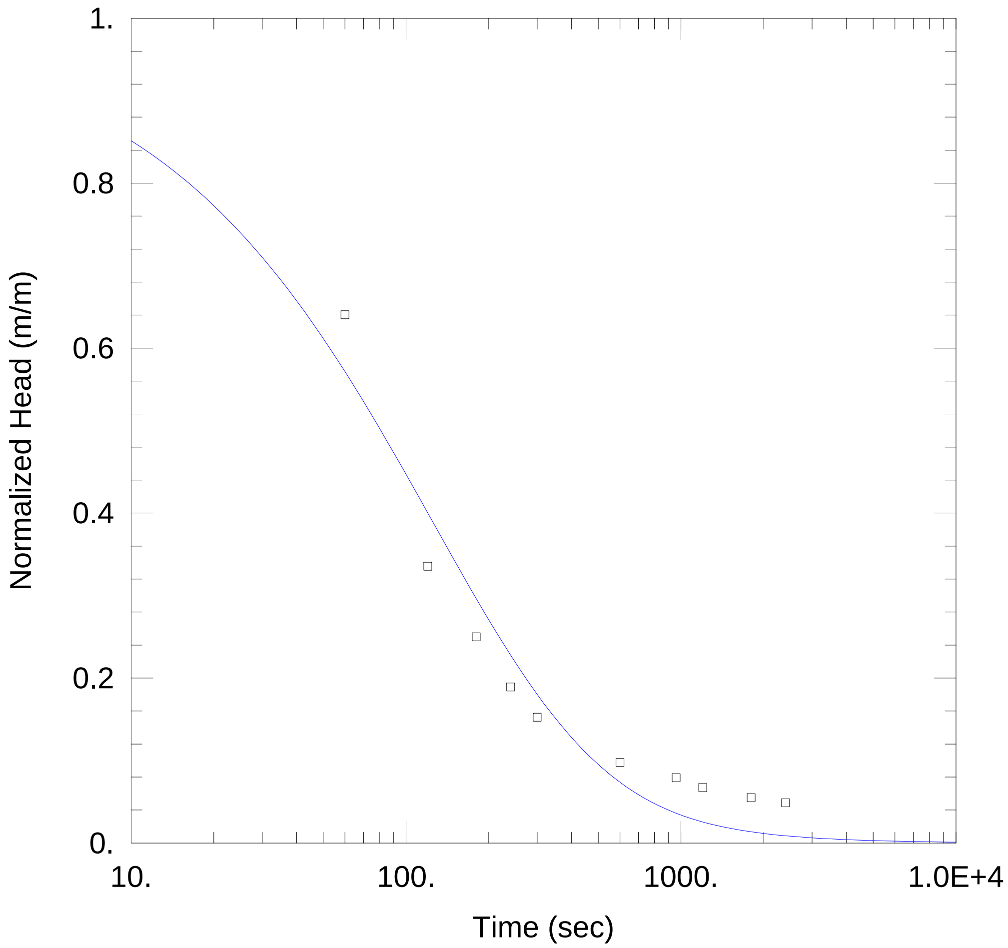
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.209E-6 m/sec
Kz/Kr = 1.

Ss = 0.003929 m^{-1}



BGC14-011S RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-011S
Test Date: 3-Apr-2014

AQUIFER DATA

Saturated Thickness: 12.09 m

WELL DATA (BGC14-011S)

Initial Displacement: 0.8198 m
Total Well Penetration Depth: 12.09 m
Casing Radius: 0.0254 m

Static Water Column Height: 12.09 m
Screen Length: 3.05 m
Well Radius: 0.0762 m

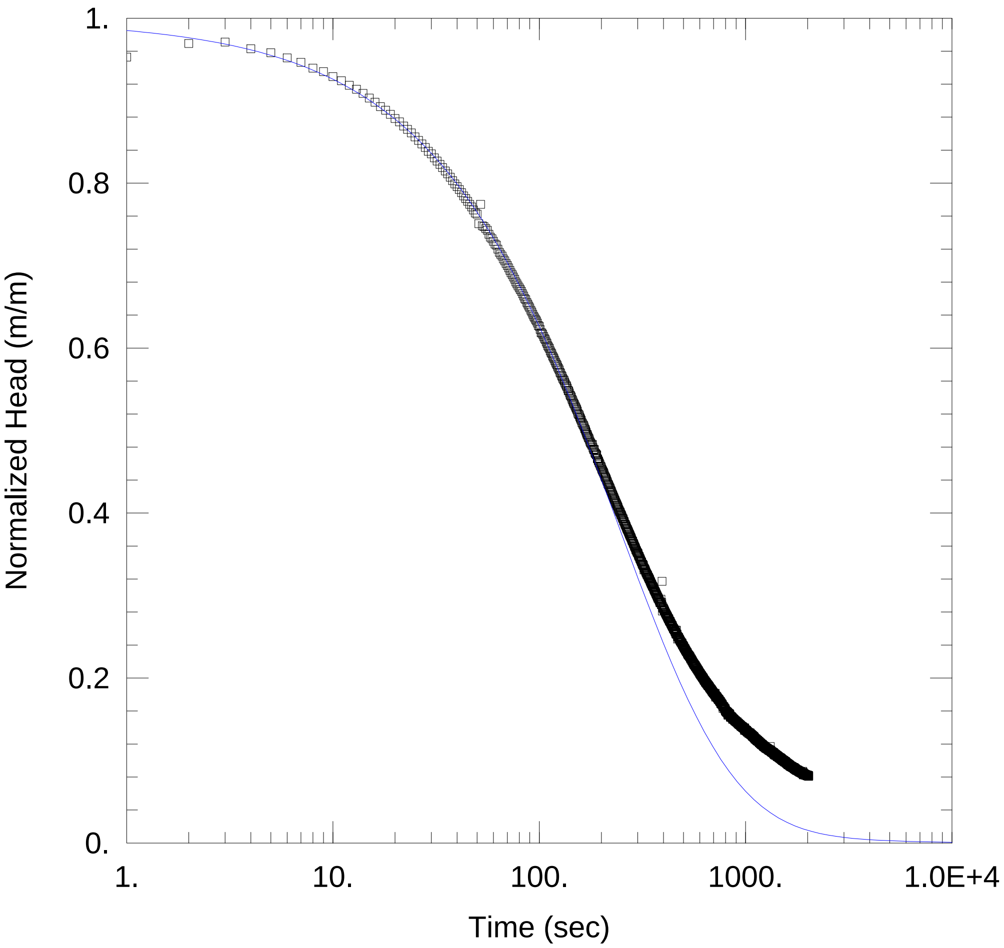
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.797E-6 m/sec
Kz/Kr = 1.

Ss = 0.0007527 m^{-1}



BGC14-012D FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-012D
Test Date: 5-Apr-2014

AQUIFER DATA

Saturated Thickness: 24.71 m

WELL DATA (BGC14-012D)

Initial Displacement: 0.7604 m
Total Well Penetration Depth: 24.71 m
Casing Radius: 0.0254 m

Static Water Column Height: 24.71 m
Screen Length: 4.57 m
Well Radius: 0.0762 m

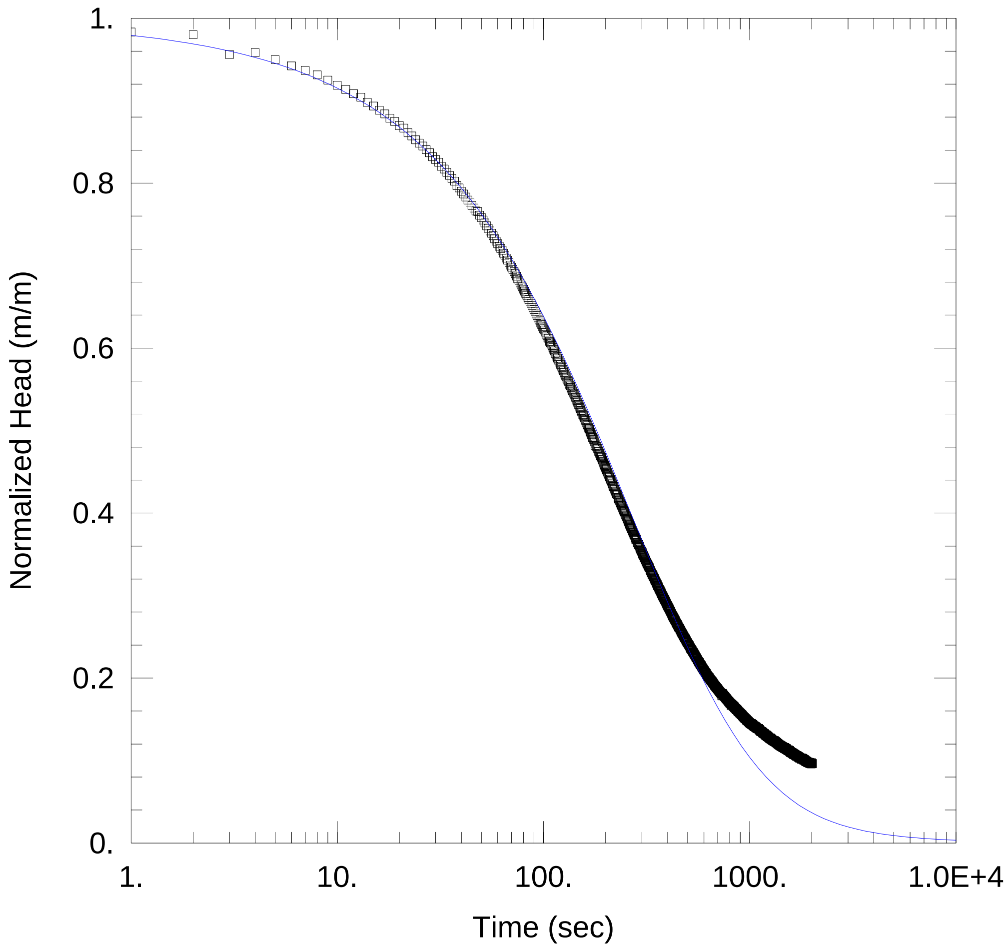
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 9.108E-7 m/sec
Kz/Kr = 1.

Ss = 6.667E-5 m^{-1}



BGC14-012D RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-012D
Test Date: 5-Apr-2014

AQUIFER DATA

Saturated Thickness: 24.71 m

WELL DATA (BGC14-012D)

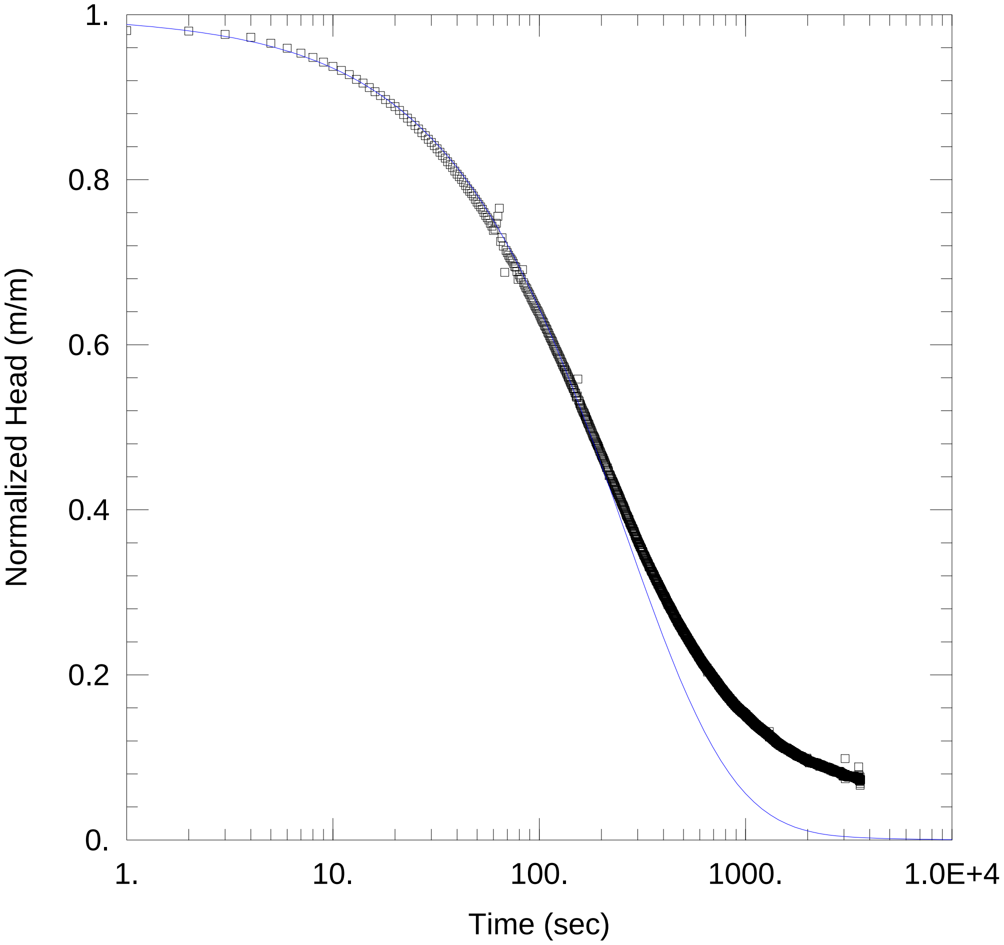
Initial Displacement: 0.8255 m
Total Well Penetration Depth: 24.71 m
Casing Radius: 0.0254 m

Static Water Column Height: 24.71 m
Screen Length: 4.57 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Kr = 6.093E-7 m/sec
Kz/Kr = 1.

Solution Method: KGS Model
Ss = 0.0003155 m^{-1}



BGC14-012D RH TEST 4

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-012D
Test Date: 5-Apr-2014

AQUIFER DATA

Saturated Thickness: 24.71 m

WELL DATA (BGC14-012D)

Initial Displacement: 0.7502 m
Total Well Penetration Depth: 24.71 m
Casing Radius: 0.0254 m

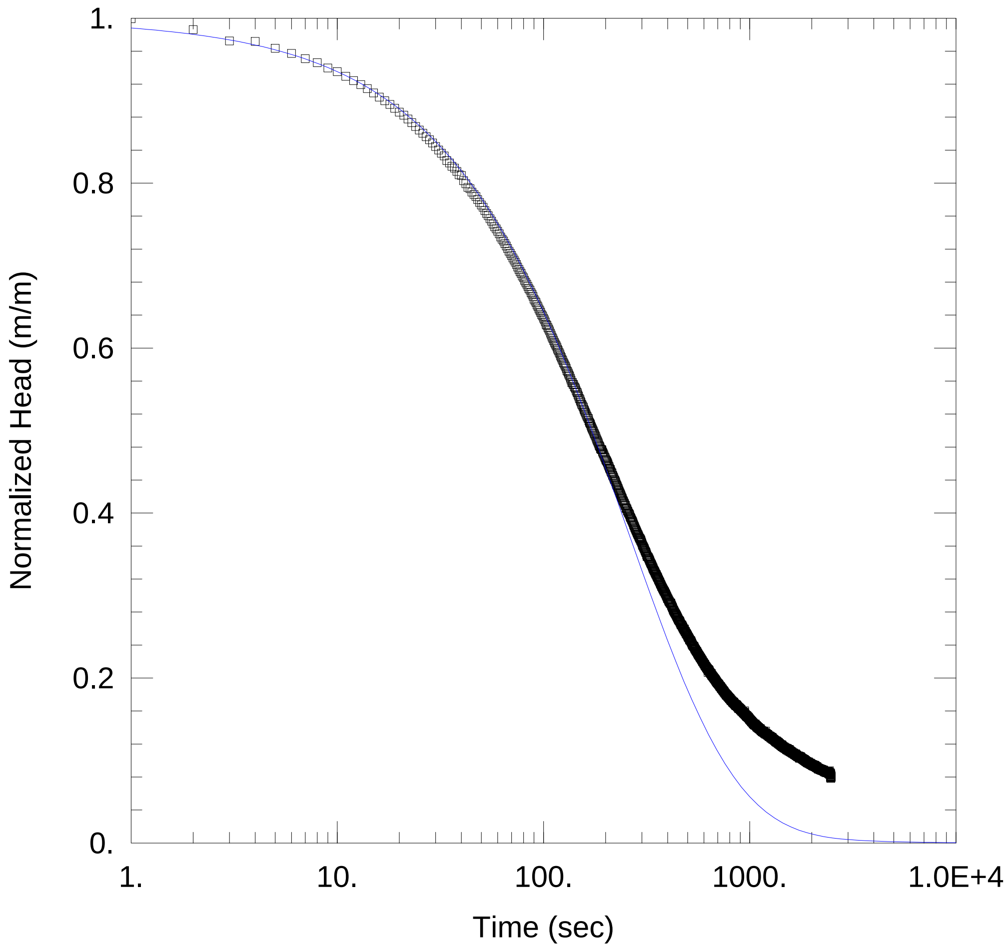
Static Water Column Height: 24.71 m
Screen Length: 4.57 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 9.657E-7 m/sec
Kz/Kr = 1.

Ss = 2.91E-5 m^{-1}



BGC14-012D RH TEST 4

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-012D
Test Date: 5-Apr-2014

AQUIFER DATA

Saturated Thickness: 24.71 m

WELL DATA (BGC14-012D)

Initial Displacement: 0.8012 m
Total Well Penetration Depth: 24.71 m
Casing Radius: 0.0254 m

Static Water Column Height: 24.71 m
Screen Length: 4.57 m
Well Radius: 0.0762 m

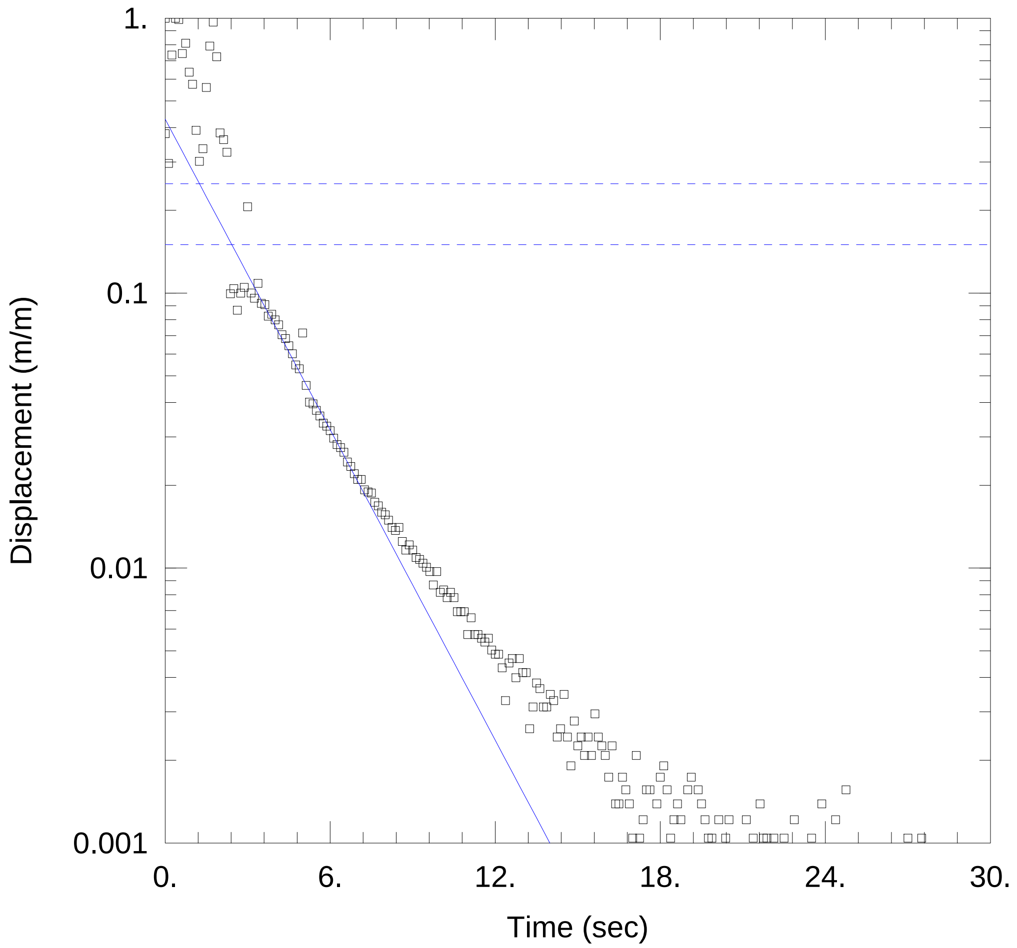
SOLUTION

Aquifer Model: Unconfined

$Kr = 9.657E-7$ m/sec
$Kz/Kr = 1.$

Solution Method: KGS Model

$Ss = 2.91E-5\ m^{-1}$



BGC14-012S FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-012S
Test Date: 5-Apr-2014

AQUIFER DATA

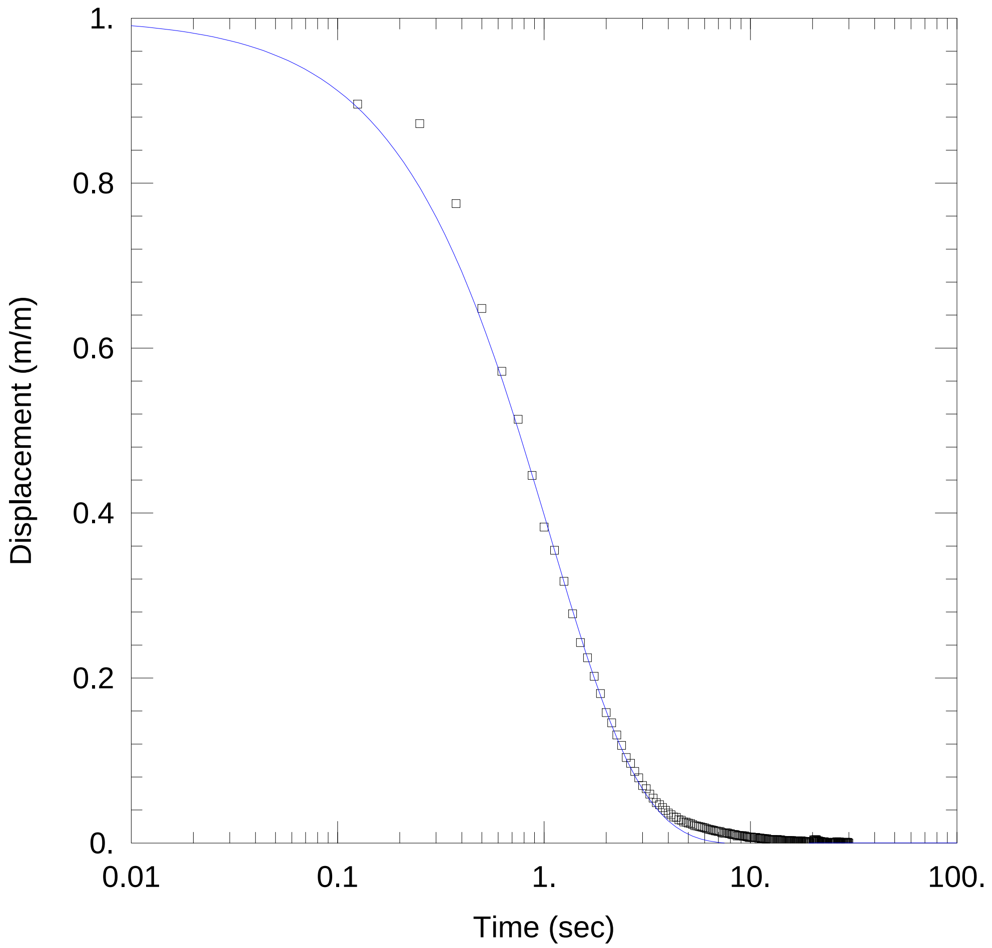
Saturated Thickness: 2.65 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BGC14-012S)

Initial Displacement: 0.5763 m
Total Well Penetration Depth: 2.65 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.65 m
Screen Length: 0.61 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0006365 m/sec
y0 = 0.2473 m



BGC14-012S RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-012S
Test Date: 5-Apr-2014

AQUIFER DATA

Saturated Thickness: 2.65 m

WELL DATA (BGC14-012S)

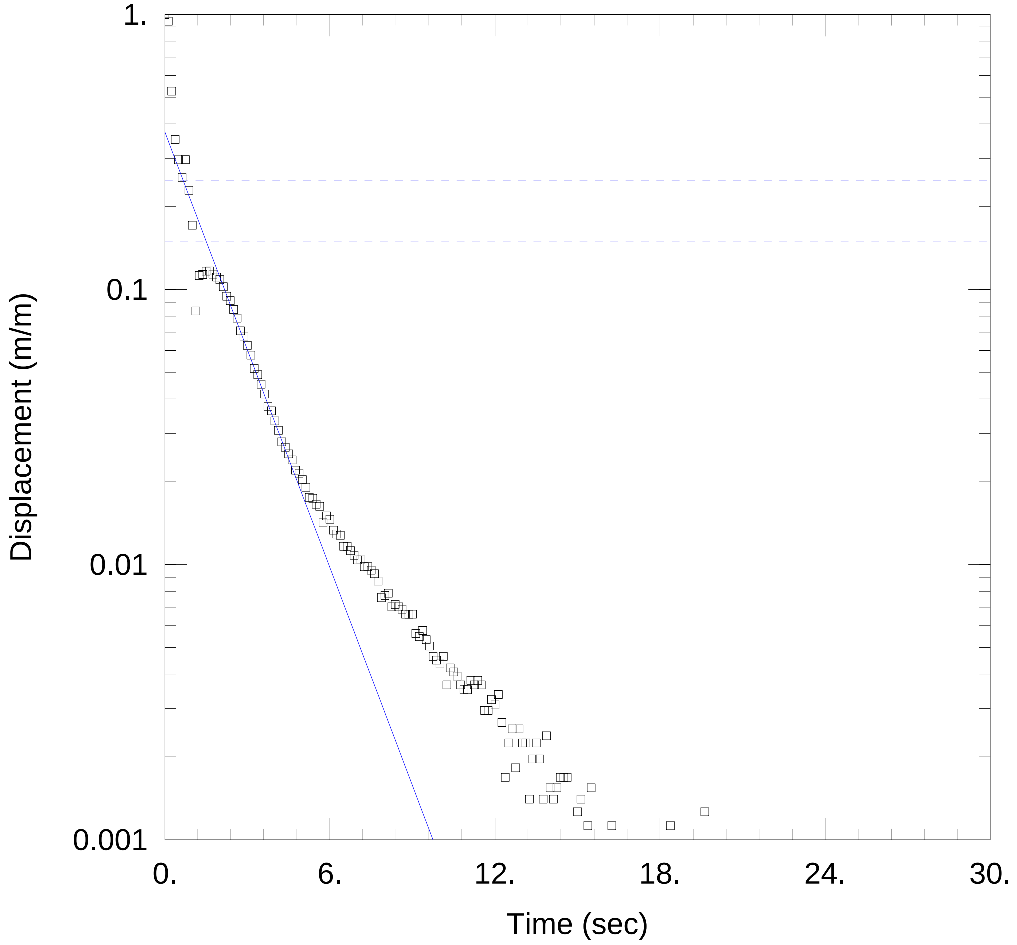
Initial Displacement: 0.5689 m
Total Well Penetration Depth: 2.65 m
Casing Radius: 0.0254 m

Static Water Column Height: 2.65 m
Screen Length: 0.61 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Kr = 0.001179 m/sec
Kz/Kr = 1.

Solution Method: KGS Model
Ss = 3.706E-12 m^{-1}



BGC14-012S FH TEST 3

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-012S
Test Date: 5-Apr-2014

AQUIFER DATA

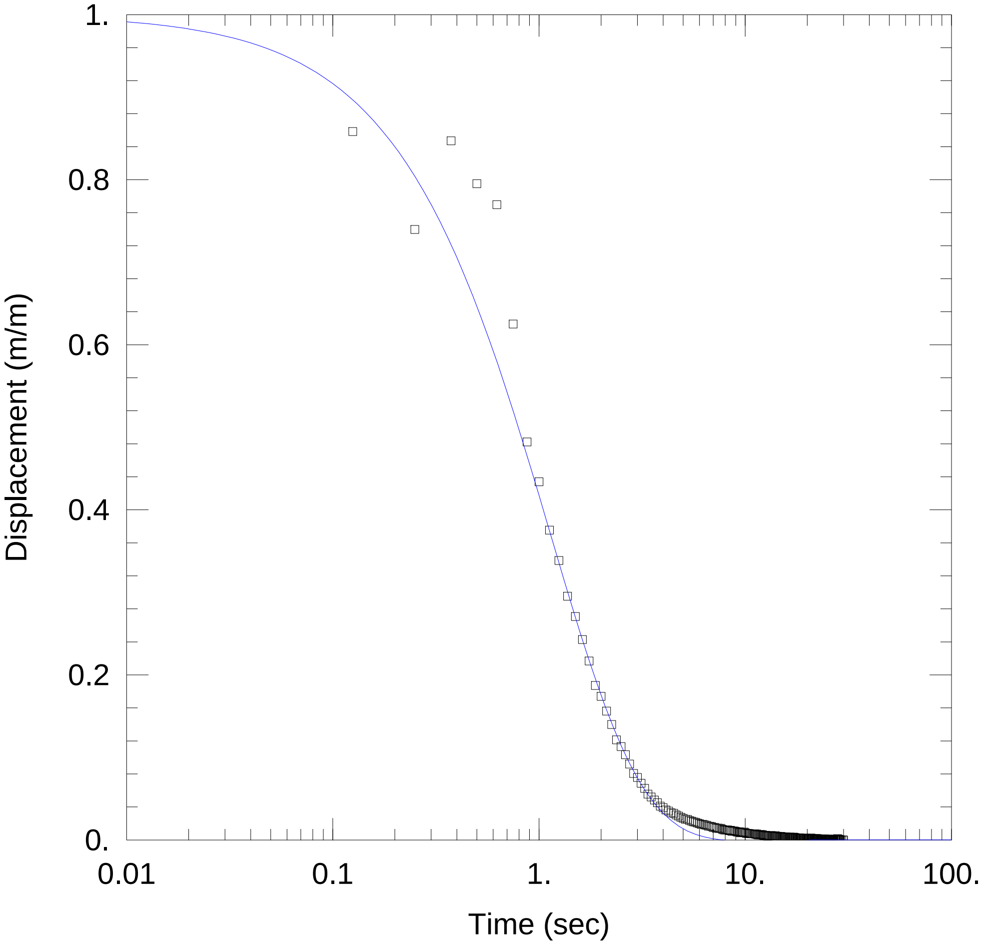
Saturated Thickness: 2.65 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BGC14-012S)

Initial Displacement: 0.712 m
Total Well Penetration Depth: 2.65 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.65 m
Screen Length: 0.61 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0008923 m/sec
y0 = 0.2658 m



BGC14-012S RH TEST 4

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-012S
Test Date: 5-Apr-2014

AQUIFER DATA

Saturated Thickness: 2.65 m

WELL DATA (BGC14-012S)

Initial Displacement: 0.6647 m
Total Well Penetration Depth: 2.65 m
Casing Radius: 0.0254 m

Static Water Column Height: 2.65 m
Screen Length: 0.61 m
Well Radius: 0.0762 m

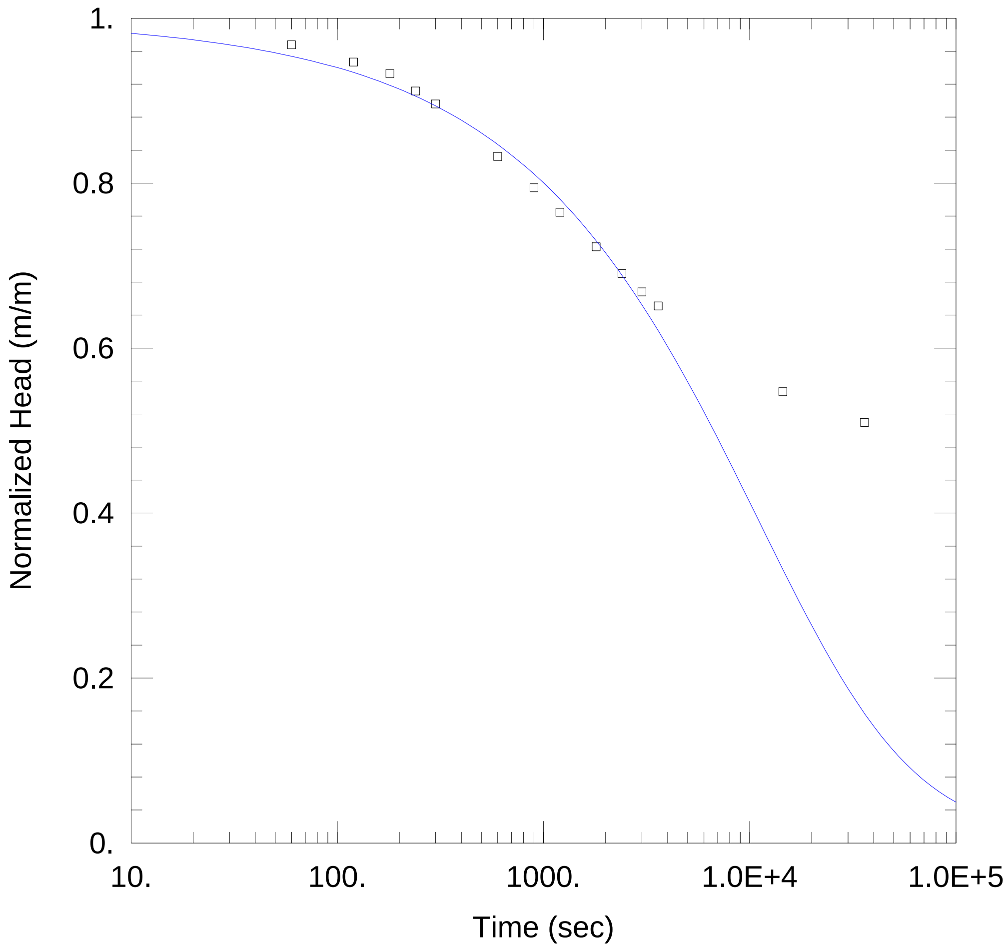
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 0.001118 m/sec
Kz/Kr = 1.

Ss = 3.706E-12 m^{-1}



BGC14-013 FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-013
Test Date: 5-Jun-2014

AQUIFER DATA

Saturated Thickness: 26.34 m

WELL DATA (BGC14-013)

Initial Displacement: 0.7678 m
Total Well Penetration Depth: 26.34 m
Casing Radius: 0.0254 m

Static Water Column Height: 26.34 m
Screen Length: 3.05 m
Well Radius: 0.0762 m

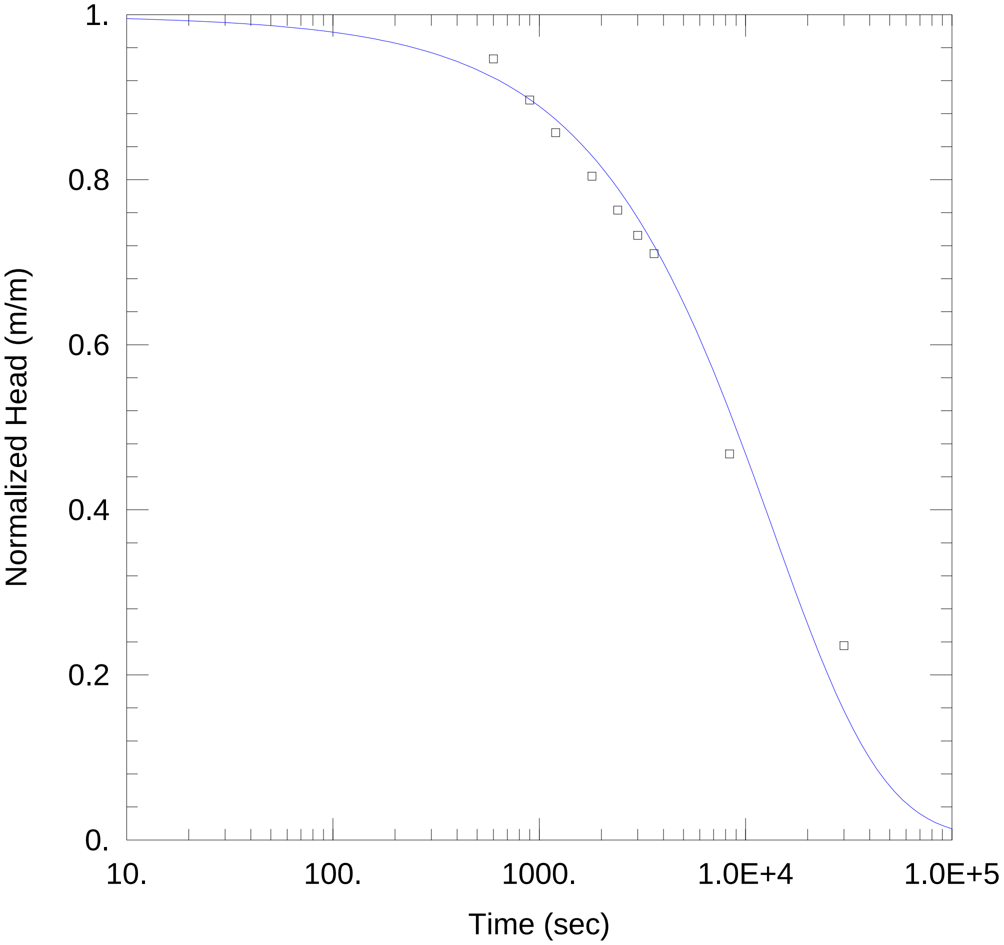
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 1.288E-8 m/sec
Kz/Kr = 1.

Ss = 0.003706 m^{-1}



BGC14-013 RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-013
Test Date: 6-Jun-2014

AQUIFER DATA

Saturated Thickness: 26.34 m

WELL DATA (BGC14-013)

Initial Displacement: 0.6826 m
Total Well Penetration Depth: 26.34 m
Casing Radius: 0.0254 m

Static Water Column Height: 26.34 m
Screen Length: 3.05 m
Well Radius: 0.0762 m

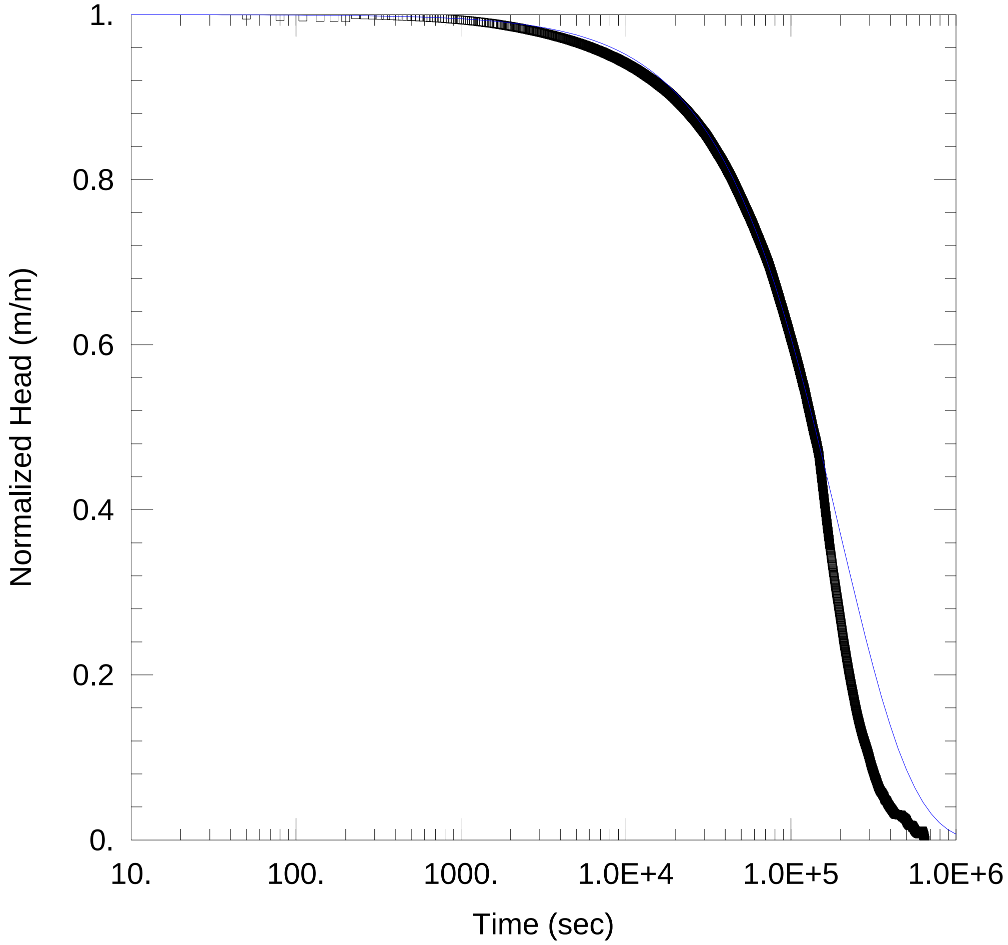
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 2.467E-8 m/sec
Kz/Kr = 1.

Ss = 8.463E-5 m^{-1}



BGC14-014D RH TEST1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-014D
Test Date: 28-May-2014

AQUIFER DATA

Saturated Thickness: 6.759 m

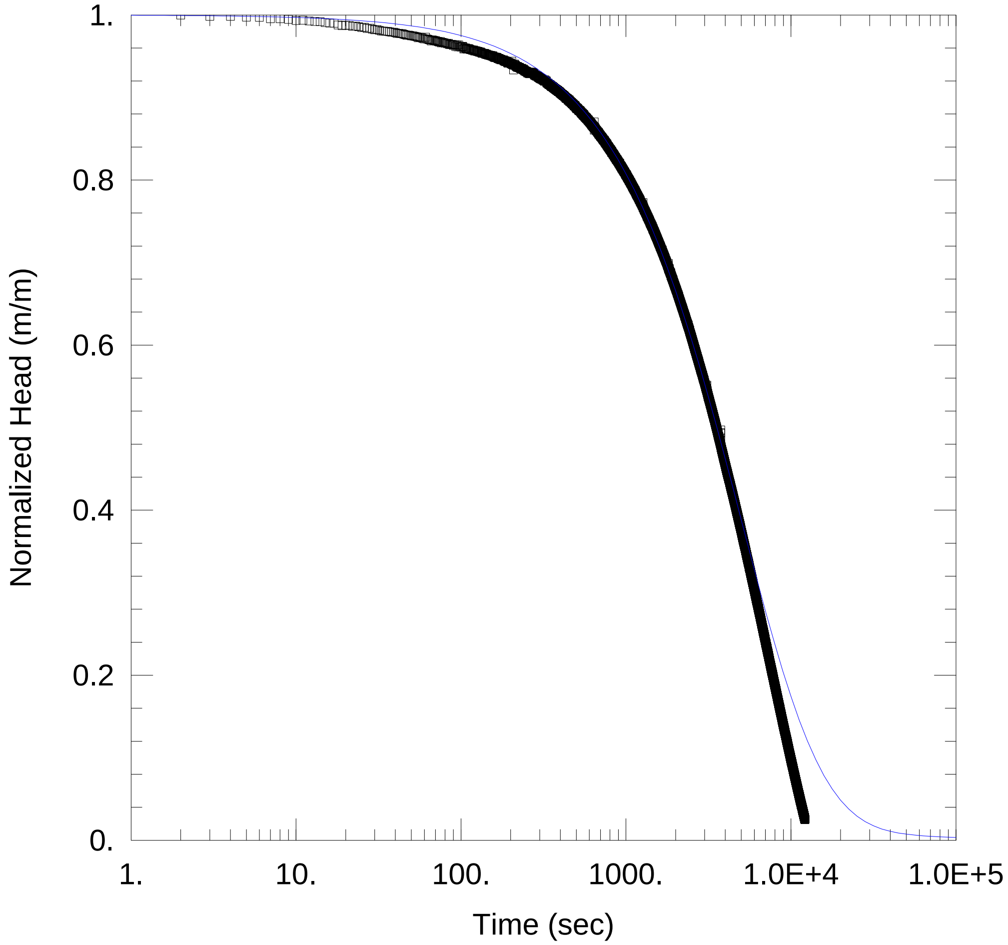
WELL DATA (BGC14-014D)

Initial Displacement: 5.209 m
Total Well Penetration Depth: 6.759 m
Casing Radius: 0.0254 m
Static Water Column Height: 6.759 m
Screen Length: 6.09 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.043E-9 m/sec
Kz/Kr = 1.
Ss = 6.02E-9 m^{-1}



BGC14-015D FH TEST 1

Data Set: \...\BGC14-015D_FH_T1_conf.aqt
Date: 07/15/14 Time: 13:54:15

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-015D
Test Date: 28-May-2014

AQUIFER DATA

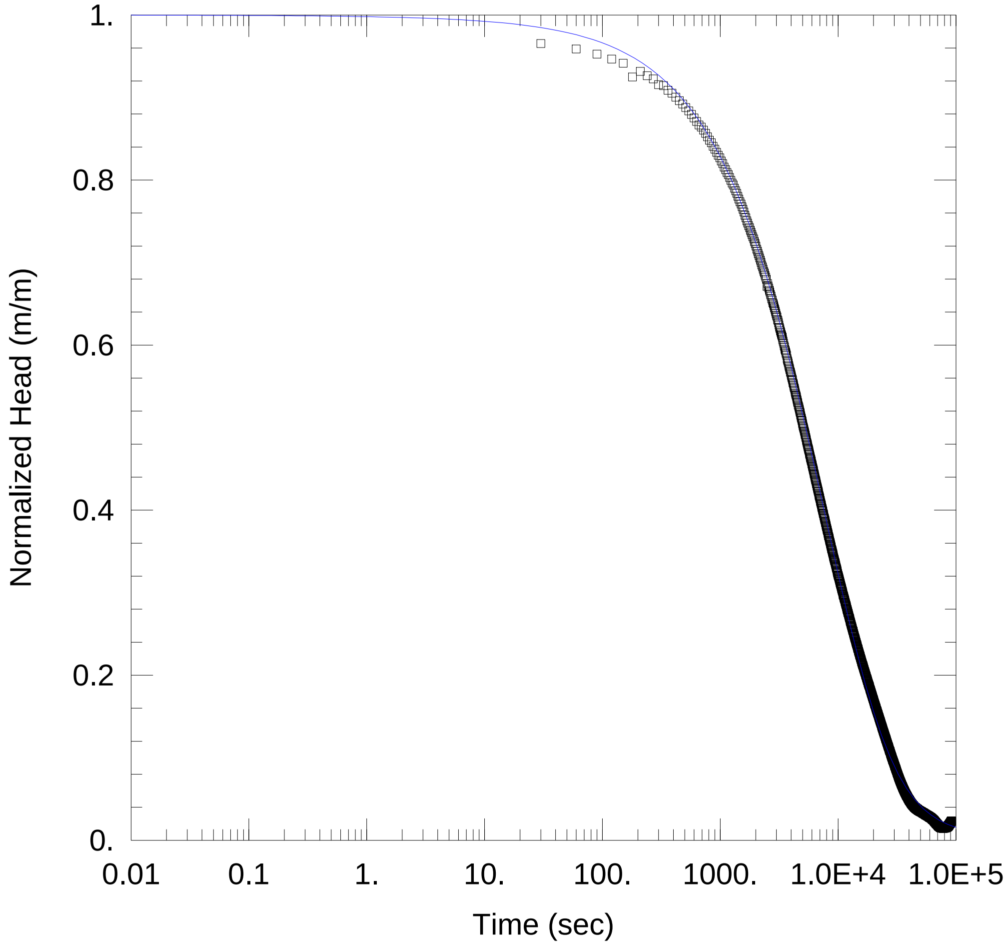
Saturated Thickness: 29.65 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BGC14-015D)

Initial Displacement: 0.5911 m
Total Well Penetration Depth: 29.65 m
Casing Radius: 0.0254 m
Static Water Column Height: 29.65 m
Screen Length: 6. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopul
T = 5.505E-7 m^2/sec
S = 1.061E-8



BGC14-015D RH TEST 2

Data Set: \...\BGC14-015D_RH_T2_conf.aqt
Date: 07/17/14 Time: 09:02:22

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-015D
Test Date: 28-May-2014

AQUIFER DATA

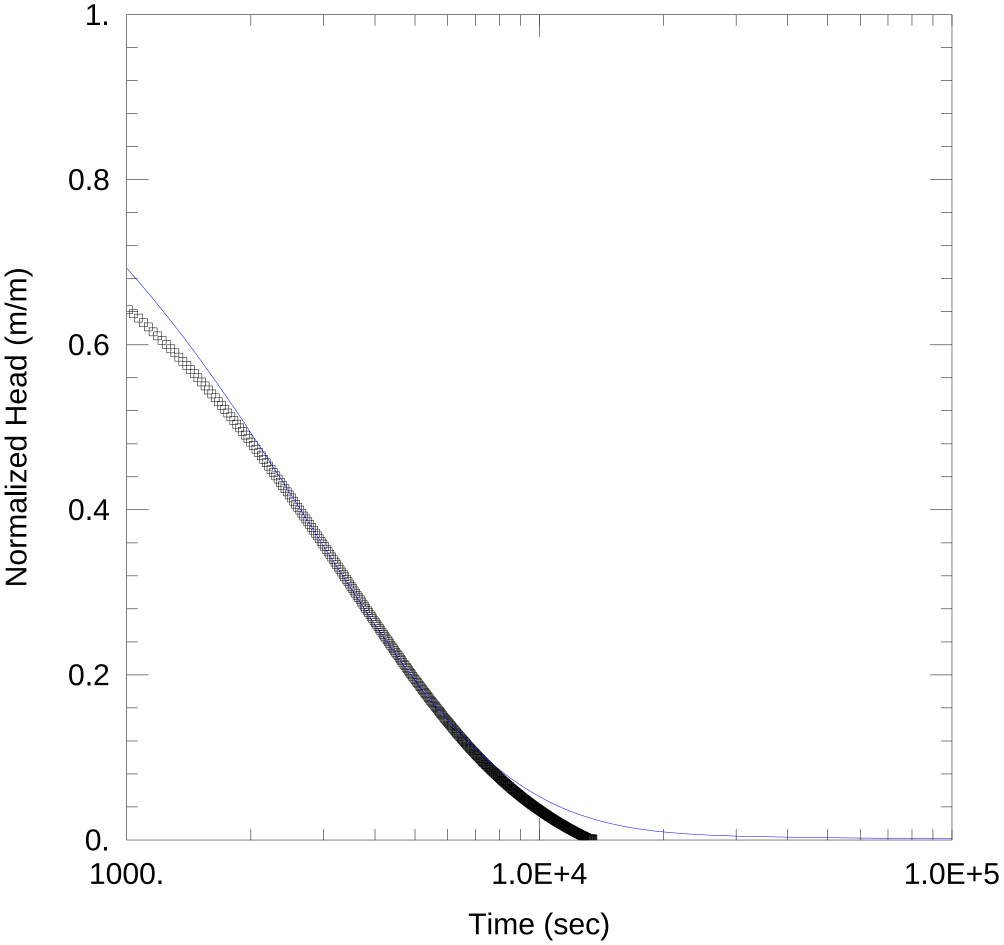
Saturated Thickness: 29.65 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BGC14-015D)

Initial Displacement: 0.8885 m
Total Well Penetration Depth: 29.65 m
Casing Radius: 0.0254 m
Static Water Column Height: 29.65 m
Screen Length: 6. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopul
T = 1.302E-7 m^2/sec
S = 0.0003744



BGC14-015S RH TEST1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-015S
Test Date: 28-May-2014

AQUIFER DATA

Saturated Thickness: 9.502 m
Anisotropy Ratio (Kz/Kr): 1.

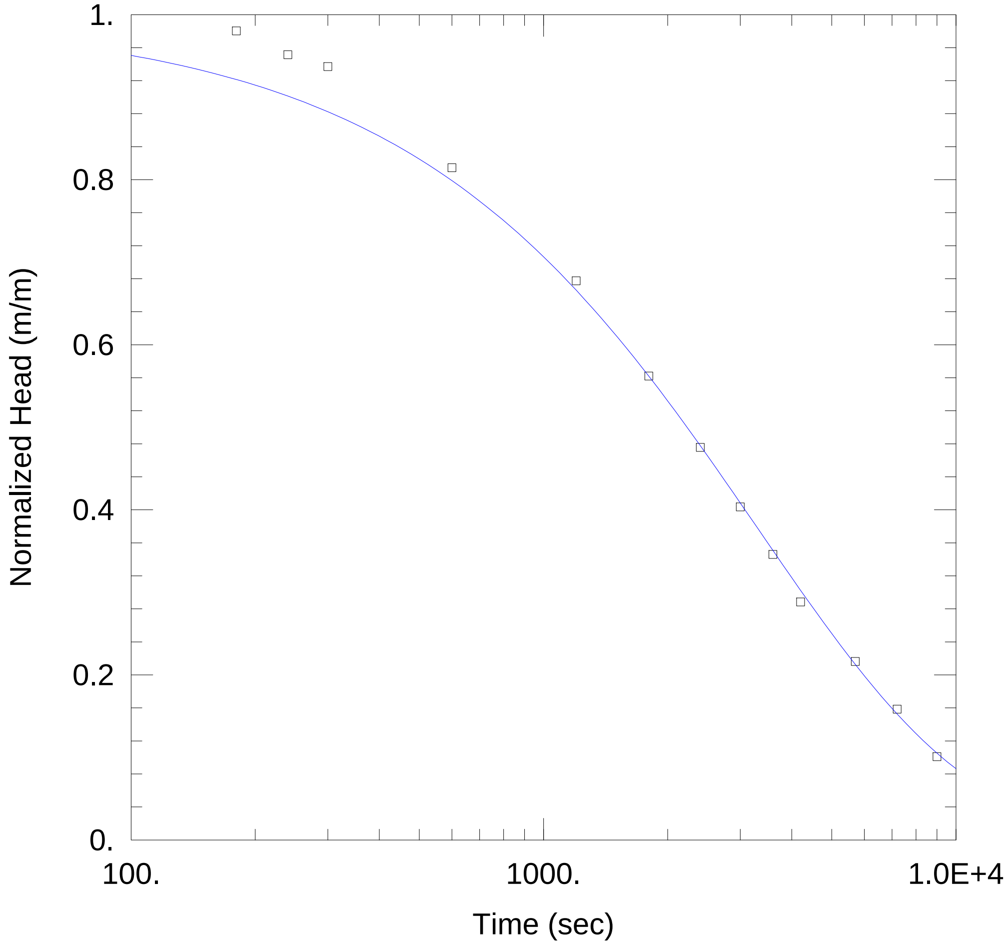
WELL DATA (BGC14-015)

Initial Displacement: 8.112 m
Total Well Penetration Depth: 9.502 m
Casing Radius: 0.0254 m
Static Water Column Height: 9.502 m
Screen Length: 3.05 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopul

T = 1.34E-6 m^2/sec
S = 3.522E-11



BGC14-016 FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-016
Test Date: 2-Apr-2014

AQUIFER DATA

Saturated Thickness: 25.35 m

WELL DATA (BGC14-016)

Initial Displacement: 0.6937 m
Total Well Penetration Depth: 25.35 m
Casing Radius: 0.0254 m

Static Water Column Height: 25.35 m
Screen Length: 6.09 m
Well Radius: 0.0762 m

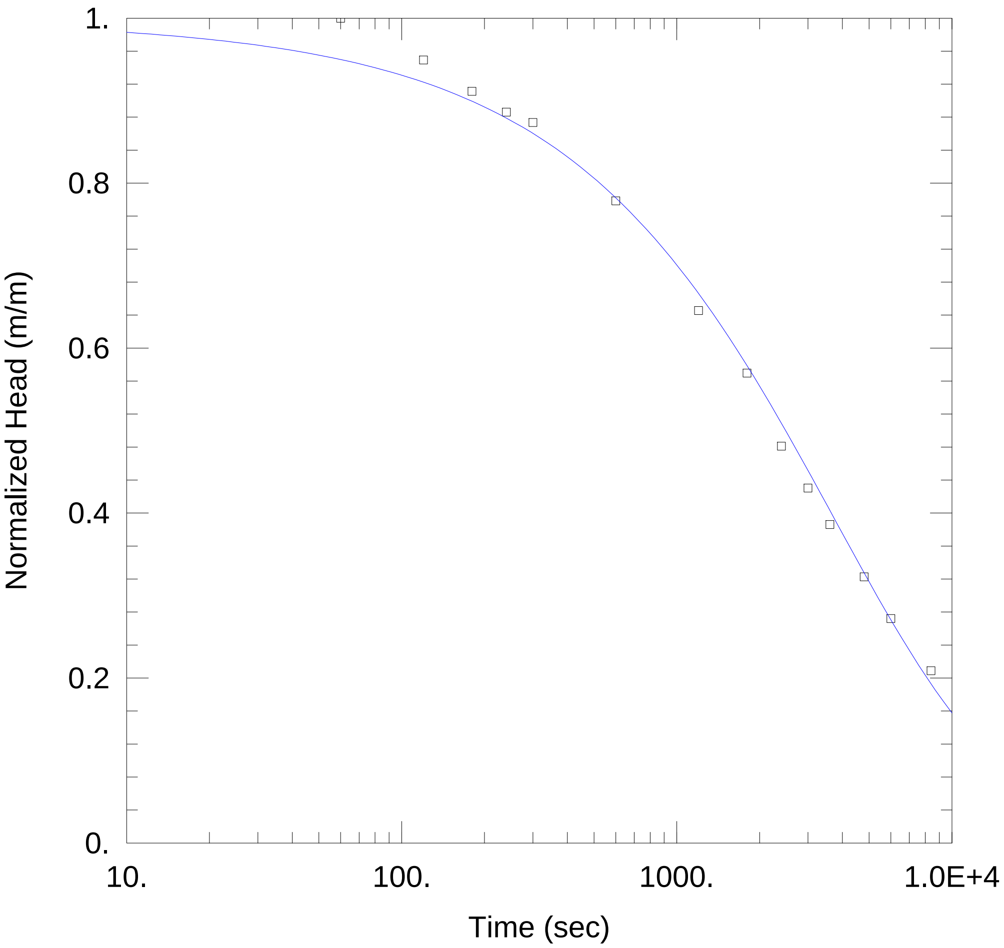
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 6.22E-8 m/sec
Kz/Kr = 1.

Ss = 1.0E-5 m^{-1}



BGC14-016 RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-016
Test Date: 2-Apr-2014

AQUIFER DATA

Saturated Thickness: 25.35 m

WELL DATA (BGC14-016)

Initial Displacement: 0.79 m
Total Well Penetration Depth: 25.35 m
Casing Radius: 0.0254 m

Static Water Column Height: 25.35 m
Screen Length: 6.09 m
Well Radius: 0.0762 m

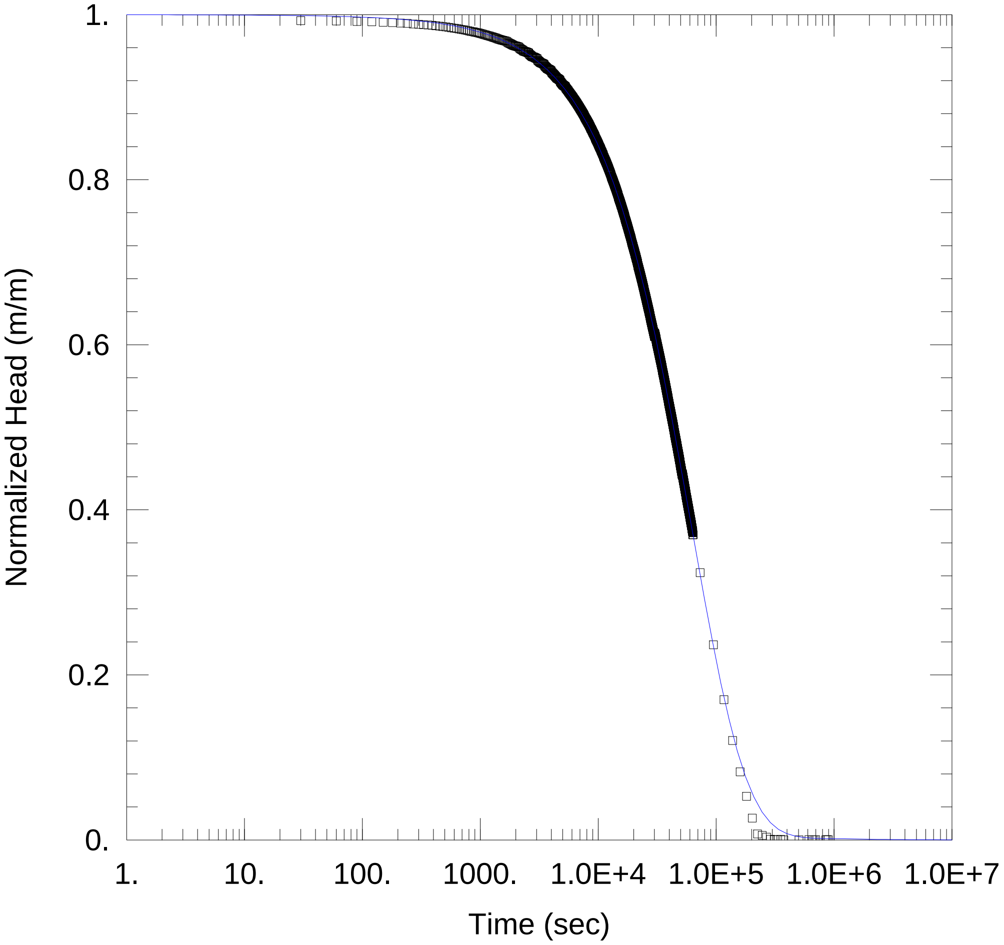
SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 3.369E-8 m/sec
Kz/Kr = 1.

Ss = 0.0002312 m^{-1}



BGC14-017D RH TEST1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-017D
Test Date: 29-May-2014

AQUIFER DATA

Saturated Thickness: 28.65 m

WELL DATA (BGC14-017D)

Initial Displacement: 9.251 m
Total Well Penetration Depth: 28.65 m
Casing Radius: 0.0254 m

Static Water Column Height: 28.65 m
Screen Length: 6.09 m
Well Radius: 0.0762 m

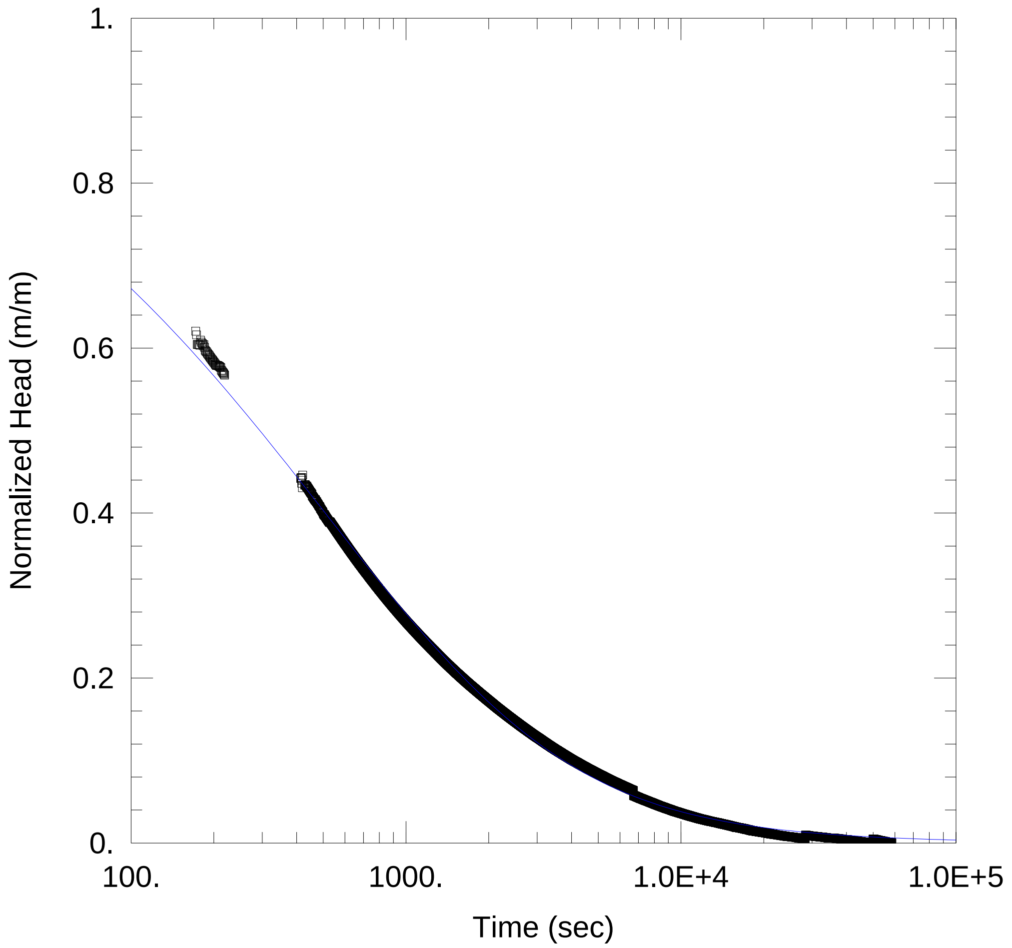
SOLUTION

Aquifer Model: Confined

Kr = 3.791E-9 m/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 5.593E-7 m^{-1}



BGC14-017S RH TEST1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: BGC14-017S
Test Date: 28-May-2014

AQUIFER DATA

Saturated Thickness: 2.856 m
Anisotropy Ratio (Kz/Kr): 1.

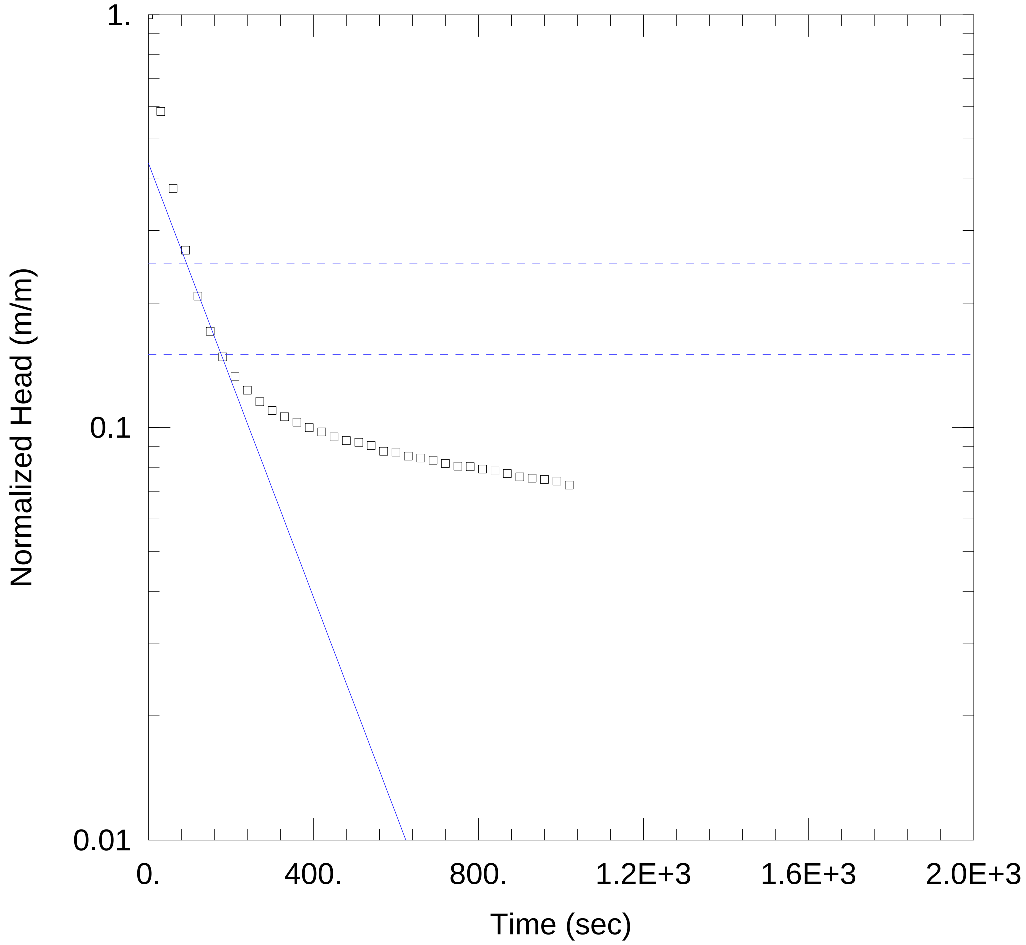
WELL DATA (BGC14-017S)

Initial Displacement: 2.856 m
Static Water Column Height: 2.78 m
Total Well Penetration Depth: 2.78 m
Screen Length: 1.53 m
Casing Radius: 0.0254 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopul

T = 4.568E-7 m^2/sec
S = 0.04348



KAX-14-114S FH TEST 1

Data Set: \...\KAX-14-114S_FH_TEST1_ck.aqt
Date: 07/11/14 Time: 10:52:31

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: KAX-14-114S
Test Date: 3-June-2014

AQUIFER DATA

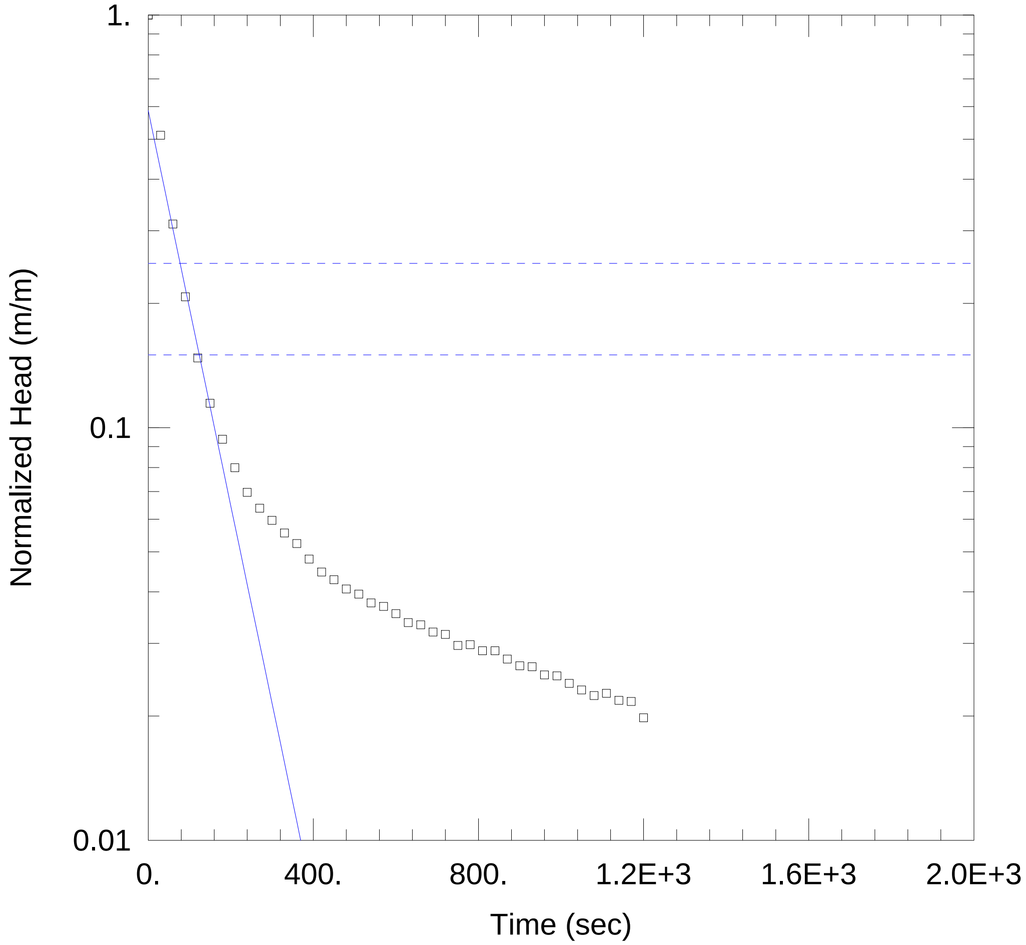
Saturated Thickness: 28.87 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (KAX-14-114S)

Initial Displacement: 0.5588 m
Static Water Column Height: 28.87 m
Total Well Penetration Depth: 28.87 m
Screen Length: 9.1 m
Casing Radius: 0.024 m
Well Radius: 0.0613 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 9.577E-7 m/sec
y0 = 0.2441 m



KAX-14-114S RH TEST 2

Data Set: \...\KAX-14-114S_RH_TEST2_ck.aqt
Date: 07/11/14 Time: 11:00:50

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: KAX-14-114S
Test Date: 4-June-2014

AQUIFER DATA

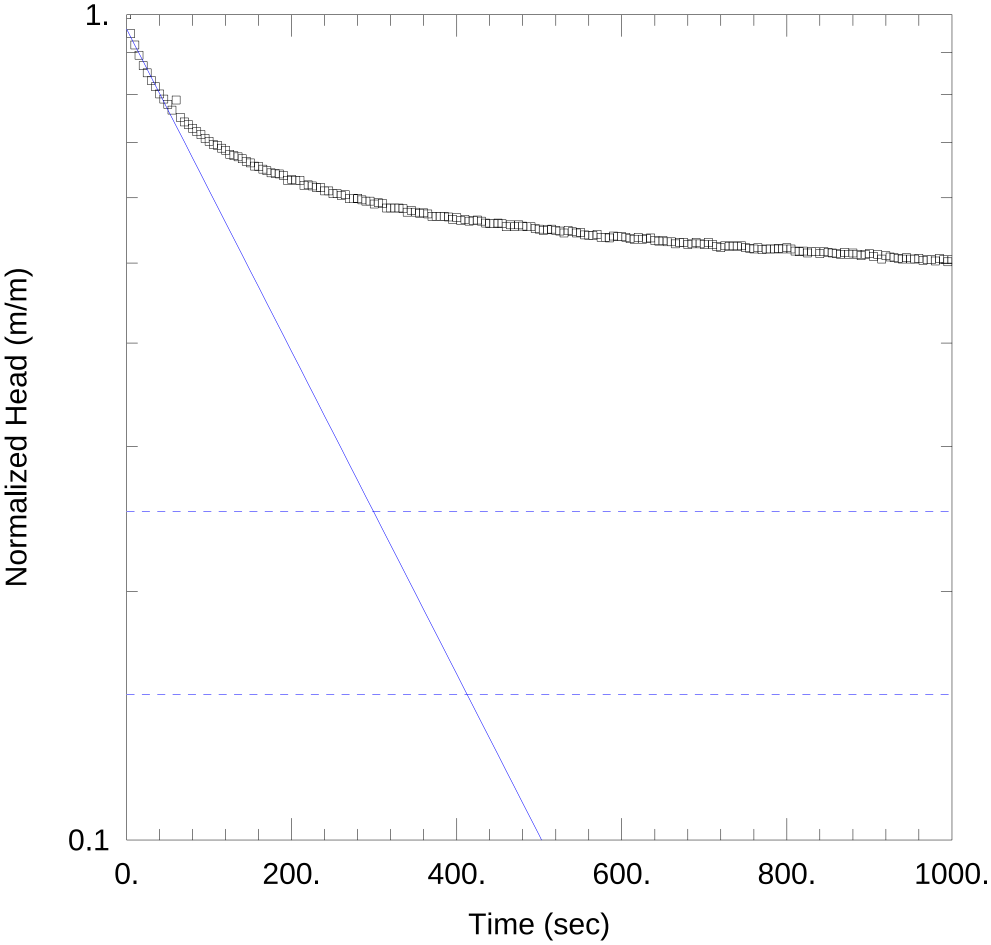
Saturated Thickness: 28.87 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (KAX-14-114S)

Initial Displacement: 0.6914 m
Total Well Penetration Depth: 28.87 m
Casing Radius: 0.024 m
Static Water Column Height: 28.87 m
Screen Length: 9.1 m
Well Radius: 0.0613 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.744E-6 m/sec
y0 = 0.4054 m



KAX-14-128S FH TEST 1

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: KAX-14-128S
Test Date: 6-Jun-2014

AQUIFER DATA

Saturated Thickness: 5.123 m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (KAX-14-128S)

Initial Displacement: 0.1048 m
Total Well Penetration Depth: 3.1 m
Casing Radius: 0.0254 m

Static Water Column Height: 5.123 m
Screen Length: 3.1 m
Well Radius: 0.0762 m

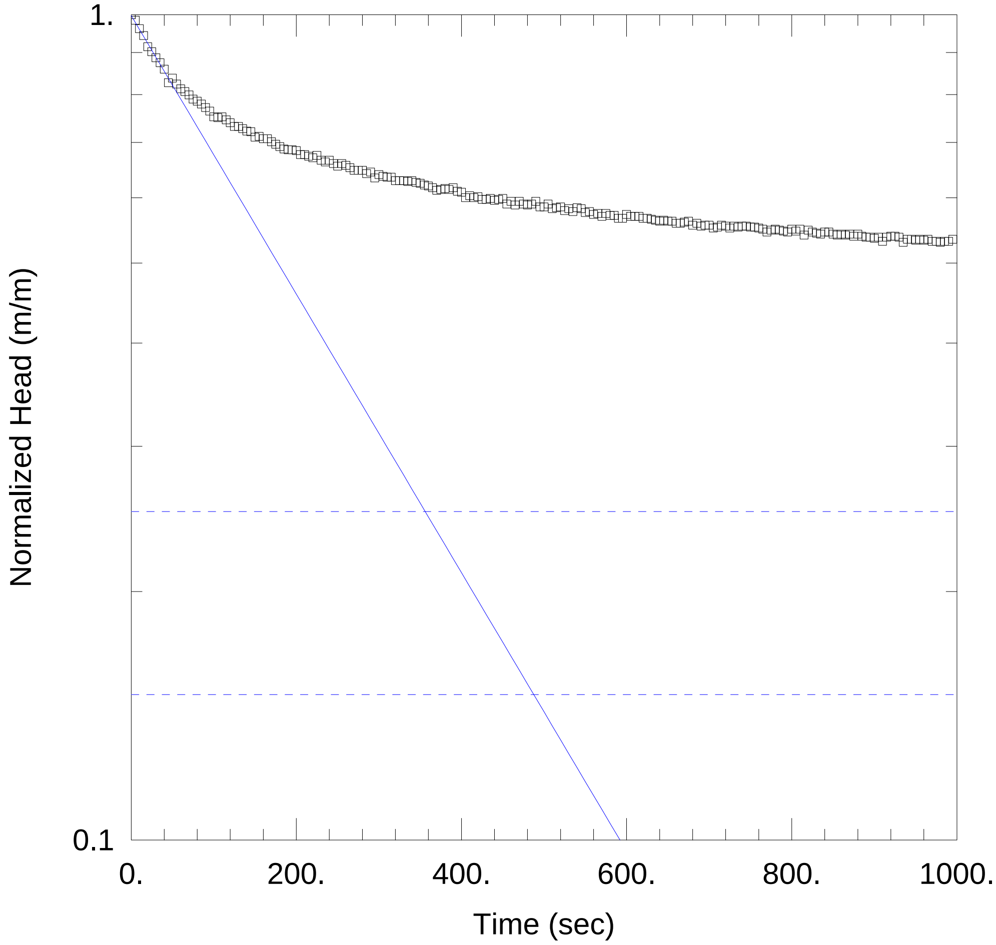
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 1.735E-6 m/sec

y0 = 0.1007 m



KAX-14-128S RH TEST 2

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: KAX-14-128S
Test Date: 6-Jun-2014

AQUIFER DATA

Saturated Thickness: 5.123 m
Anisotropy Ratio (Kz/Kr): 1.

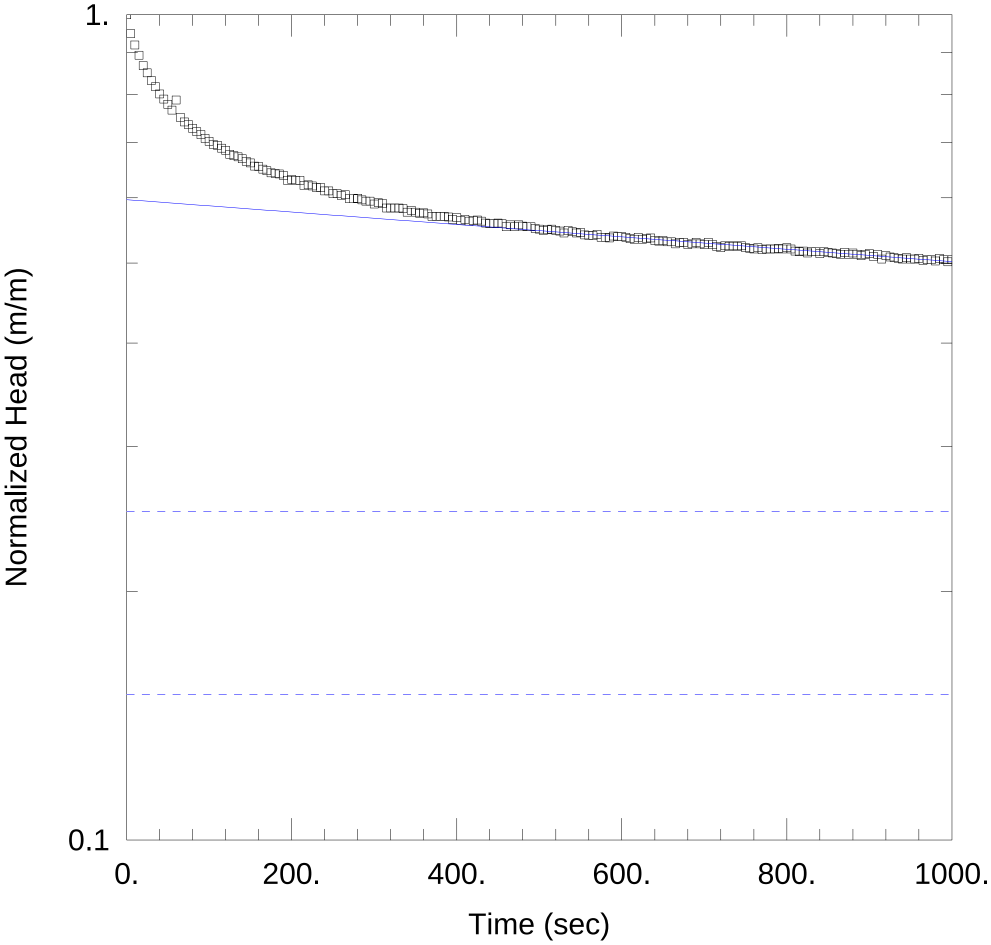
WELL DATA (KAX-14-128S)

Initial Displacement: 0.0653 m
Static Water Column Height: 5.123 m
Total Well Penetration Depth: 3.1 m
Screen Length: 3.1 m
Casing Radius: 0.0254 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 1.499E-6 m/sec
y0 = 0.06515 m



KAX-14-128S FH TEST 1A

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: KAX-14-128S
Test Date: 6-Jun-2014

AQUIFER DATA

Saturated Thickness: 5.123 m
Anisotropy Ratio (Kz/Kr): 1.

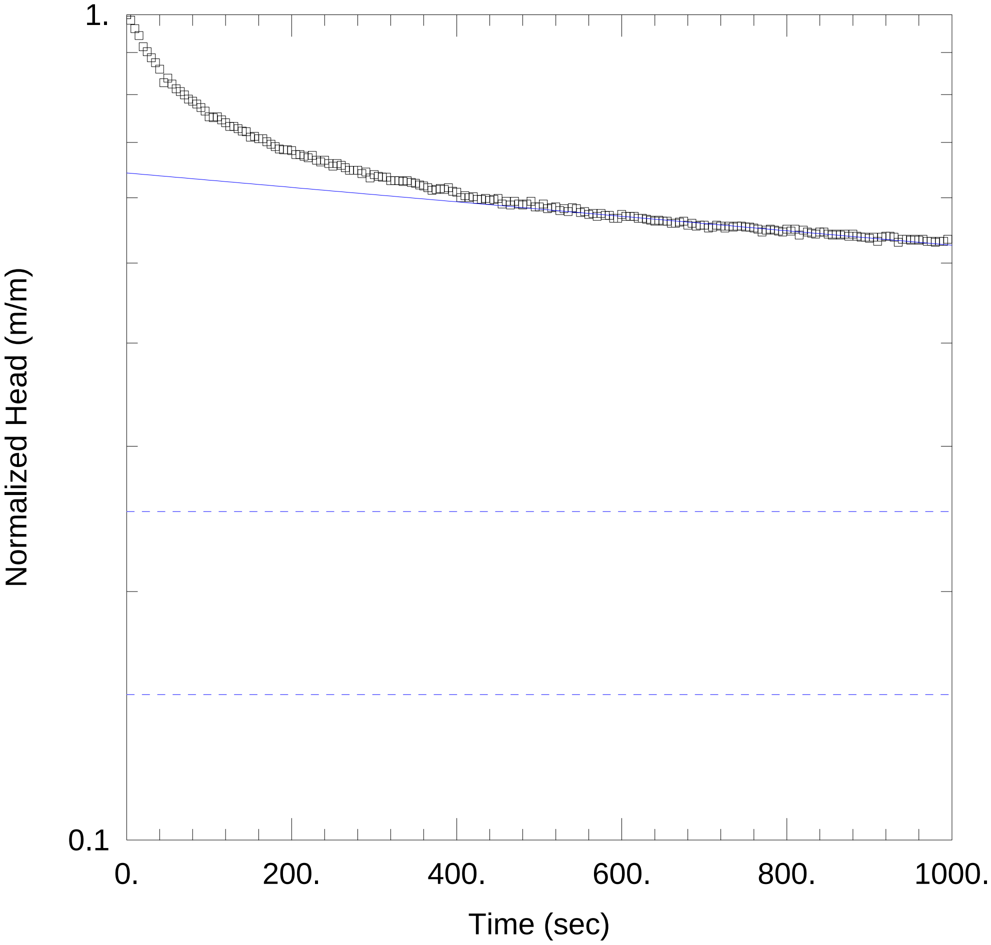
WELL DATA (KAX-14-128S)

Initial Displacement: 0.1048 m
Total Well Penetration Depth: 1.523 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.123 m
Screen Length: 1.523 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 1.098E-7 m/sec
y0 = 0.06255 m



KAX-14-128S RH TEST 2A

PROJECT INFORMATION

Company: BGC Engineering Inc.
Client: KJHM Ajax Mining Inc.
Location: Ajax
Test Well: KAX-14-128S
Test Date: 6-Jun-2014

AQUIFER DATA

Saturated Thickness: 5.123 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (KAX-14-128S)

Initial Displacement: 0.0653 m
Total Well Penetration Depth: 1.523 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.123 m
Screen Length: 1.523 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.281E-7 m/sec
y0 = 0.04199 m

DRAWINGS

SCALE 1:20000

500	0	500	1000	1500

METRES

THIS DRAWING MAY HAVE BEEN REDUCED OR ENLARGED.
ALL SCALE NOTATIONS INDICATED ARE BASED ON
ORIGINAL FORMAT DRAWINGS.

LEGEND

2014 SITE INVESTIGATION PROGRAM
- ⌖ BGC 2014 GROUNDWATER MONITORING WELL
- ▲ KEYNES CREEK GAUGING STATION

PREVIOUSLY EXISTING MONITORING NETWORK
- ⌖ BOREHOLE WITH VWP
- ⌖ GEOTECHNICAL DRILL HOLE WITH STANDPIPE PIEZOMETER
- ⌖ GROUNDWATER MONITORING WELL
- ▲ STREAM GAUGING STATION
- 0276 BC AQUIFER ID NO.
- ▭ MAPPED BEDROCK AQUIFER
- ▭ MAPPED SAND AND GRAVEL AQUIFER

- ▲ EDITH LAKE FAULT ZONE[7] INTERPRETED LOCATION
- ▭ CITY OF KAMLOOPS
- — PAVED ROAD
- ······ UNPAVED ROAD
- ∿ STREAM
- ∿ INTERMITTENT STREAM
- LAKE
- MARSH-SWAMP

THIS BAR MEASURES 100 mm AT FULL SIZE. ALL SCALES REFERENCED TO FULL SIZE.

NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. THIS DRAWING MUST BE READ IN CONJUNCTION WITH BGC'S MEMO TITLED "AJAX PROJECT EA – AJAX SOUTH GROUNDWATER AND SURFACE WATER SITE INVESTIGATION", AND DATED AUGUST 2015.
3. PROJECTION IS NAD83 UTM ZONE 10N
4. UNLESS BGC AGREES OTHERWISE IN WRITING, THIS DRAWING SHALL NOT BE MODIFIED OR USED FOR ANY PURPOSE OTHER THAN THE PURPOSE FOR WHICH BGC GENERATED IT. BGC SHALL HAVE NO LIABILITY FOR ANY DAMAGES OR LOSS ARISING IN ANY WAY FROM ANY USE OR MODIFICATION OF THIS DOCUMENT NOT AUTHORIZED BY BGC. ANY USE OF OR RELIANCE UPON THIS DOCUMENT OR ITS CONTENT BY THIRD PARTIES SHALL BE AT SUCH THIRD PARTIES' SOLE RISK.
5. BASE TOPOGRAPHIC DATA BASED ON AIRBORNE IMAGING LiDAR COLLECTED APRIL 2013. CONTOUR INTERVAL IS 25 m.
6. PROPOSED GENERAL ARRANGEMENT OF MINE SITE FACILITIES PROVIDED BY KGHM ON MARCH 17, 2015.
7. LOGAN AND MIHALYNUK, 2005

SCALE:	1:20000
DATE:	AUG 2015
DRAWN:	WKL, MIB
CHECKED:	SP, CK
APPROVED:	TWC

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT:
KGHM INTERNATIONAL LTD.

PROJECT:
AJAX PROJECT EA –
AJAX SOUTH GROUNDWATER AND SURFACE WATER SITE INVESTIGATION

TITLE:
GROUNDWATER AND SURFACE WATER MONITORING LOCATIONS

PROJECT No.:	DWG No.:
1125007	01

X:\Projects\1125_AJAX007\GIS\Production\Report\20150324_Ajax_Project_EA_Ajax_South Groundwater Surface Water Site Investigation\01 Groundwater and Surface Water Monitoring Locations.mxd Date: Wednesday, August 26, 2015 Time: 9:04 AM