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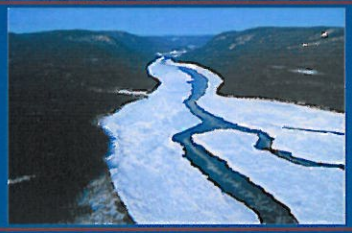

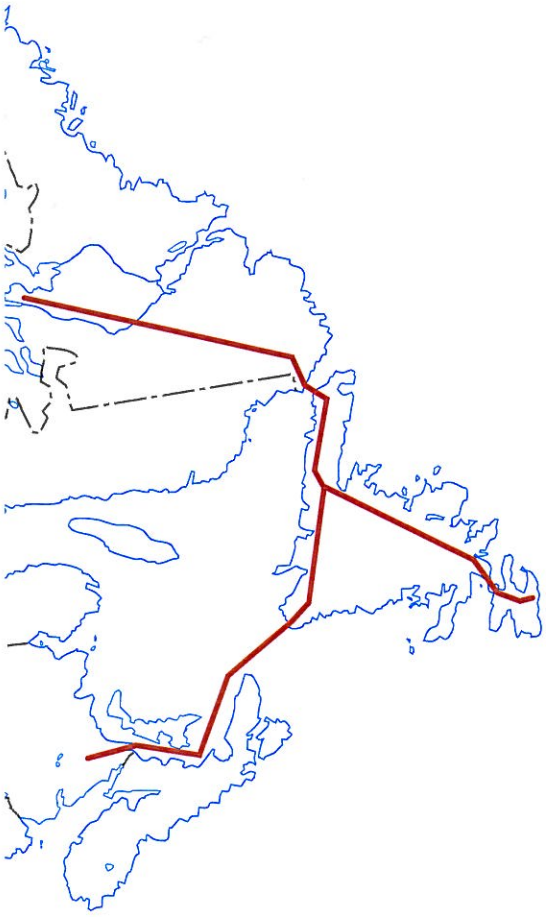

THE Lower Churchill PROJECT

April 2010

MF1272 - Installation of New Piezometers in the Muskrat Falls Pumpwell System

prepared by

HATCH™

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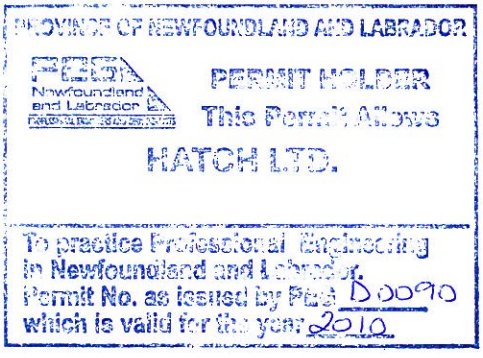

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Executive Summary

Nalcor Energy - Lower Churchill Project (NE-LCP) is pursuing engineering studies with respect to the development of the hydroelectric potential of the Lower Churchill River at Gull Island and Muskrat Falls. At Muskrat Falls there is a large rock knoll and an overburden spur to the north that could be incorporated with a natural embankment dam. However, natural mass wasting processes were quickly eroding the spur and it was determined through engineering studies in the 1970's that the mass wasting could be arrested with the installation of a pump well system. The pump well system was installed in 1981. In 1997, Hatch installed 12 piezometers in 7 boreholes to monitor the groundwater levels in the area of the dewatering system.

The well system is currently 28 years old and was completed initially as a temporary measure. A 2008 Hatch report included several recommendations to extend the life of the system and ensure its continued operation for the next 10 years. The recommendations included the cleaning and inspection of 22 wells in the dewatering system and the installation of 8 new piezometers to be drilled at 4 locations to further assess groundwater conditions in the area of the dewatering system. This document presents the results of the 2009 piezometer installation program.

The historical and geological background and site characteristics are described in Section 1 followed by the scope of work in Section 2. A scope of work was developed prior to mobilization to the site and approved by NE-LCP. It should be noted that some of the tasks were modified slightly due to field conditions. Any changes from the proposed scope of work are summarized in Section 2 and discussed in more detail in Section 4 Drilling Field Program.

The piezometer drilling team consisted of a Hatch site supervisor, an engineering geologist from Jacques Whitford Stantec Limited, sub contracted by Hatch, that supervised the piezometer field program and a soils drilling contractor and helper from Lantech Drilling Services Inc. that completed the drilling and installation of the piezometers.

The Borehole Drilling Program commenced on August 19 and was completed on September 10, 2009. The locations of the boreholes are shown in Drawing 1054326-GE-01, found in Appendix A, Attachment C. All boreholes were advanced using a CME 75 truck mounted drill rig. A total of 5 boreholes were drilled and 8 piezometers were installed in the 5 boreholes. The specific details of the drilling are described in Section 4 and the piezometer construction details are shown in the borehole logs found in Appendix A, Attachment B. Soil samples were collected from the boreholes and grain size analyzes completed on the samples.

Water levels were collected in the piezometers, with the exception of P4A and P4B, on September 9, 2009 and Parrott Surveying surveyed the horizontal position and elevation for each borehole location. . Falling head tests were performed at two of the piezometers to assess the hydraulic conductivity (permeability) of the water bearing formation.

1. Historical and Geological Background

1.1 Site Characteristics

The site of Muskrat Falls on the Lower Churchill River, located about 30 km upstream from Happy Valley-Goose Bay in Labrador, has been recognized as a potential hydroelectric development for several decades. At this site, the Churchill River has a drop of about 15 m from el 18 m at the upstream side to el 3 m at the downstream side. Past studies contemplated raising the head to about 40 m.

The prominent features of the site include a rock knoll rising to almost 150 m in elevation. The rock knoll is connected to the left bank by a spur of land about 1 km long, which forms a natural barrier forcing the diversion of the Churchill River into a channel carved out south of the rock knoll. The spur rises to elevation 60 m and has a minimum width of 150 m on the south end, in the upstream - downstream direction.

1.2 Geology and Sediments

The Muskrat Falls site is underlain at a maximum depth of about 270 m by crystalline metamorphic rocks composed of granitic gneiss of Precambrian age, with some dark mafic bands and occasional irregular pegmatite stringers. In addition to the rock knoll which rises sharply from the buried valley floor, several exposures are found on the right bank of the river.

The Churchill River valley is preglacial in origin, and was formed largely by river action prior to the Pleistocene epoch. Subsequent widening and reshaping of the valley occurred during the Wisconsin glaciation period, about 13,000 years ago. An estimated thickness of 60 m of a deposit of sand, gravel and boulders filled the lower part of the reshaped bedrock valley during the course of glaciation. As the glacier retreated, the sea level rose and caused submergence of the valley by an estuary extending up to Gull Island. This inundation of the valley by the rising sea resulted in the deposition of marine and estuarine sediments in an environment of saline and brackish water.

Isostatic rise of the land relative to the sea then caused a gradual recession of the estuary and resulted in the deposition of a layer of fine sand, over marine clay sediments.

The sediments in the spur consist of four units.

a) Upper Sand (el 60 to 45 m) covering the terrain and consisting of uniform fine to medium sand approximately 10 to 15 m thick.

b) Stratified Drift (el 50 to -10 m) consisting of an upper marine clay deposit generally underlain with a varying thickness of sandy materials The sandy components dominate the southern 250 m long section of the spur against the rock knoll and constitutes an aquifer. The thickness of the upper clay increases toward the north.

It is noted that primarily these two units in (a) and (b) are engaged in the failure activity of the downstream face of the spur.

c) Lower Marine Clay (el -10 to -60 m) is a stratified impervious silty clay deposit.

d) Lower Aquifer (el -70 to -210 m) composed of pervious sand and gravel, and occupying the lower part of the buried valley.

Gullies and creeks exist along both the upstream and downstream slopes of the spur. The most prominent gully is found in the area of the three lakes at the north end of the spur. Numerous creeks and a small stream were found originating as springs at the sand and clay contact.

Hydrogeologically, there are two aquifers. The water level in the Lower Aquifer is at el +5 m which is considerably higher than the surface of the overlying marine clay unit suggesting confined characteristics. However, it is the hydrogeologic behaviour of the upper aquifer which has a dominant effect on bank stability. Recharge into this unit is from the northwest, through the upper sand unit and hydraulic connections in the stratified drift. Along the dewatering system alignment, the water level was originally at about el 30 m at the south side of the spur rising to el 47 m about half way and dropping to about 15 m at the north end.

1.3 Bank Instability and Groundwater Control Facilities

The banks of the Churchill River between Gull Island and Goose Bay are scarred by numerous landslides, some of which involve large quantities of overburden. Instability has affected the slopes of the spur, particularly the downstream slope, as well as the left bank of the river downstream from the spur. In 1978, a major landslide occurred on the south end of the spur resulting in the loss of a considerable portion of land in the downstream perimeter. Minor failures were further experienced in 1980-81. High piezometric water levels and steep hydraulic gradients in the sediments above river level and tailwater rapid drawdown effects due to the collapse of the downstream annual ice-dam have been the major causes contributing to instability.

In order to protect the remaining spur from further instability, a continuously pumped dewatering system was installed along the downstream shoulder of the spur in 1981. At the time of its installation, the system was considered to be “a temporary stabilization measure . . . and not a total defence against mass wasting” (Acres, 1994). The dewatering system was anticipated to lower the groundwater level in the spur from about el 30 m to at least el 15 m and preferably as low as el 3.5 m.

22 wells were installed in a line close to the edge of the downstream slope of the spur. The wells are spaced at 30 m with an average depth of 63 m. The drilling diameter was 300 mm with stainless steel screen and PVC riser pipe having an internal diameter of 150 mm. All the pumps are connected to a 300 mm diameter buried collector pipe, with 75 mm of insulation, finally discharging to an existing stream through an exposed corrugated steel pipe (SNC-Lavalin, 1982).

To monitor the groundwater regime, 17 piezometers (vibrating wire) were installed in 1981 but all were lost in 1984 due to a power surge from a lightning strike on the power line. In 1997, 12 standpipe piezometers were installed in 7 boreholes and these continue to be monitored. Subsequent records of operation of the well system have recorded pump functions only, namely pumping duration and the number of pump cycle initiations per day.

Nalcor Energy – Newfoundland and Labrador Hydro (NE-NLH) and Acres International staff carried out formal maintenance inspections in 1994, 1995 and in 1997 at which times some or all the pumps were retrieved, cleaned and reinstalled or replaced as necessary (Acres International, 1997). The NE-NLH Goose Bay office retains records of such maintenance activities in varying degrees of detail.

In 2007, Hatch conducted a site visit and testing of the pump well system with the objective of assessing the system conditions and making recommendations for a life extension of 10 years. Selected recommendations from the 2008 report are the basis for the work program described in this report.

1.4 Background Reports

Reports of previous site assessments are available as follows:

- SNC-Lavalin, "Muskrat Falls Dewatering System, Construction Report Operation and Maintenance Information", (1982).
- SNC-Lavalin, "Muskrat Falls Dewatering System, Engineering Assessment", (1982).
- Acres International, "Muskrat Falls Development", (1978).
- Acres International, "Muskrat Falls, Review of Dewatering System", (1994).
- Acres International, "Dewatering System Assessment and Rehabilitation", (1997).
- Acres International, "Standpipe Piezometer Installation Program Report", (1997 and 1998).
- Hatch Ltd, "The Lower Churchill Project, MF 1260 – Assessment of Existing Pumpwell System", (2008).

2. Scope of Work

A scope of work was developed prior to mobilization to the site and approved by NE-LCP. It should be noted that some of the tasks were modified slightly due to field conditions. Any changes from the proposed scope of work are summarized below and discussed in more detail in the appropriate subsection in Section 4: Drilling Field Program.

Following is a description of the scope of work:

- A geotechnical drill rig, ancillary equipment/tooling and personnel were mobilized to the Muskrat Falls site.
- A path was cleared to each drill site location by NE-NLH labourers using chainsaws.
- It was proposed to secure a suitable water supply from the Churchill River with adequate pumps to provide water for the drilling operation. However, a field inspection indicated that it would be more effective to draw water from the pond located at the north end of the property. A pump was set up at the pond location and hoses were laid from the pond to each drilling location.
- Drilling commenced at P2B using 4 ¼" hollow stem augers, with the intention of converting to HW/NW casing washboring when the limit of augering was reached. However, difficult drilling conditions were encountered at P2B (heaving sands), which resulted in the borehole being abandoned at approximately 15 m depth. P2B was restarted approximately 2 m from the original location using HW casing.
- Conventional split spoon disturbed sampling was completed of unconsolidated soils with Standard Penetration Tests (SPT) at regular intervals in borehole P2B. In subsequent boreholes, testing was completed at selected locations to identify more permeable soils in with to install the piezometer screens. Samples collected by split spoon were inspected, logged and taken back to the laboratory for further testing and analysis.
- 50 mm diameter standpipe piezometers were installed at P2A and P2B. However, due to the difficult soil conditions encountered, the drilling at these locations took longer than expected. In order to complete the program within budget, the remaining borehole locations (P1, P3 and P4) were drilled only with HW/NW casing washboring, limited sampling was completed with particular attention to the anticipated zone of screen installation, and a nested installation was completed with two 25 mm piezometer pipes: one at an upper and one at a lower depth within the same drill hole. New drilling supplies had to be ordered and delivered to facilitate the change in method.
- A drilling additive fluid was used as required at each borehole to keep the hole open.
- Upon completion of drilling/sampling, each borehole was flushed of drill cuttings and supplementary drilling fluids, using clean, clear water.
- The boreholes were logged at the site by the drilling sub-contractor and engineering geologist. The proposed depth of boreholes was 40 m and 60 m. The precise depth of the borehole was determined based on the proposed depth defined by Hatch, previous boreholes in the area, and field conditions encountered. It was found that the formation encountered at a depth of 60 m (designated depth) in P2B was a dry clay, unsuitable for piezometer installation. The lower

piezometer was therefore installed in a water bearing zone at a depth of less than 60 m. The depths of boreholes are discussed in more detail in Section 4.

Following is a description of the monitoring well installation procedure:

- It was proposed that 150 mm of #40 silica sand be placed at the bottom of each borehole. A comparable material called course silag was used instead at the bottom of the borehole and as a filter pack material. The filter pack was placed around the screen and extended to about 600 mm above the screen.
- It was proposed to install a Casagrande-Type piezometer tip to the top of the sand base. However, based on experience and availability, the drilling contractor supplied PVC slotted screen. A 50 mm diameter No. 20 slot screen was installed at P2A and P2B and 25 mm diameter No. 10 slot screens were installed at P1, P3 and P4. A geosock was placed around the screen for piezometers P1, P3, and P4 as an added means of preventing fines from seeping into the piezometer. The geosock and No.10 slot screens were delivered with the new supplies that arrived at the site and were not available for installation at P2A and P2B.
- Coated 3/8" bentonite pellets were placed to a minimum of 600 mm above the top of the silag sand. The bentonite pellets were left for a short period of time to hydrate before proceeding further with the installation.
- It was proposed to place a cement/bentonite powder grout mixture in each borehole from the top of the bentonite seal to the ground surface. However, the drilling contractor did not have a supply of grout when they first arrived at the site. Therefore, for the installation of 2009 P2A and 2009 P2B, the bentonite pellets were used instead of the grout mixture. Bentonite pellets are commonly used in this type of installation and work equally well as grout.
- For subsequent boreholes, P1, P3 and P4, a tremie tube was used to place a cement/bentonite powder grout mixture called Volclay in each borehole from the top of the bentonite seal to ground surface. The NW/HW drill casing was removed from the borehole in 100 cm to 150 cm increments as the borehole annulus was grouted. Grout volumes and application pressures were monitored during the grouting procedure.
- A steel protective casing fitted with a lockable cap was installed and excess materials were removed from the site.
- It was recommended that falling head tests be performed at each borehole to assess the permeability of the water bearing formation. This test involves adding a measured quantity of water to the piezometer and measuring the water level in the piezometer at specified times until the water level has returned to static or has stabilized. Due to time constraints, falling head tests were conducted only at two piezometer installations: P2A and P2B. The results of the tests are described in Section 4.2.
- The locations of the installed boreholes were surveyed (horizontally and vertically).

3. The Piezometer Drilling Program Team

The piezometer drilling program was completed by a team of specialists which included:

- A Hatch site supervisor that oversaw the completion of the program.
- An engineering geologist from Jacques Whitford Stantec Limited, sub contracted by Hatch, that supervised the piezometer field program, determined the piezometer locations in the field based on locations provided by Hatch, completed detailed logs and directed the piezometer installations.
- A soils drilling contractor and helper from Lantech Drilling Services Inc. that completed the drilling and installation of the piezometers, at the direction of the sub contractor.

4. The Drilling Field Program

The Borehole Drilling Program commenced on August 19 and was completed on September 10, 2009. The Piezometer locations were determined at the site on August 20, 2009.

A safety orientation was conducted at the Nalcor Energy - Lower Churchill Project (NE-LCP) office the morning of August 21, 2009. All personnel involved in the well inspection and piezometer installation field programs took part in the presentation and training and work commenced on site on the afternoon of August 21.

Securing the water supply for the drilling operations was one of the first tasks of the program and involved: clearing of brush from the pond to the general site area, completing minor excavations of the slope to the pond, mobilizing a suitable pump to the pond area and laying of hoses from the pump up to the drill site. While the water supply work was being completed, the drilling contractor unloaded equipment and set up at the first location.

All boreholes were advanced using a CME 75 truck mounted drill rig. A total of 8 piezometers in 5 boreholes were installed; the depths of each monitoring well and depth of water bearing zones are summarized in Table 4.1 and specific details of the drilling are described in the following subsections. The piezometer construction details are shown in the borehole logs found in Appendix A, Attachment B.

Parrott Surveying mobilized to the site on September 4, 2009. The locations of all boreholes were surveyed and the horizontal co-ordinates and elevation collected for each location and included in Table 4.1. The drilling operation was finished at the site on September 9, 2009 and the drilling contractor and all other personnel left the site on September 10, 2009.

Water levels were collected in the piezometers, with the exception of P4A and P4B, on September 9, 2009 and are shown in Table 4.1. The water levels were not collected in P4A and P4B as the piezometers were only completed on September 9 and water levels had not stabilized in the installations. Instructions were left for NE-NLH personnel to take water levels at a later date. Falling head testing was conducted on P2A and P2B on September 9, 2009 and is described in Section 4.2.

Daily summary sheets of the drilling and photographs are also found in Appendix A, Attachments D and E, respectively.

4.1 Piezometer Installation Details

4.1.1 Borehole P1

Borehole P1 is located approximately 20 m west of Piezometer P-C which was installed in 1997 (Drawing 1054326-GE-01, Appendix A, Attachment C). Piezometer P-C has recently become clogged or has collapsed and it is dry. The purpose of Borehole P1 is to replace Piezometer P-C.

Drilling of the borehole and installation of two standpipes was completed between August 31 and September 2, 2009. HW/NW casing and wash boring was used to advance the borehole and SPT measurements and split spoon samples were taken at the anticipated zone of screen installation or at

zones where changes in formation were noted. This borehole is located in close proximity to P-C. The bottom of a P-C was installed at a depth of 45.45 m (in sand), below which a stiff clay was encountered to 59.67 m. Based on the findings in P-C and the conditions encountered in this drilling program, P1 was advanced to a total depth of 42.7 m and the deep piezometer was installed in fine sand.

The bottom of the piezometer tip for P1B (the lower piezometer) was installed at a depth of 42.58 m and the monitoring zone was installed from a depth of 39.53 m to 42.52 m. The bottom of the piezometer tip for P1A (the upper piezometer) was installed at a depth of 25.02 m and the monitoring zone was installed from a depth of 21.92 m to 24.97 m.

A 25 mm diameter, 3 m long, No. 10 slot PVC screen and silag filter pack was installed in both P1B and P1A. A geosock was placed over each screen to prevent the intake of fines. A bentonite pellet seal was placed above the screen of each installation and Volclay grout was placed above the upper seal to surface.

4.1.2 Boreholes P2A and P2B

These were the first boreholes completed for the program - drilling of two boreholes and installation of two standpipes was completed between August 22 and August 29, 2009. P2A and P2B are located approximately 80 m and 75 m north-west of W-11 respectively.

P2B was augered to a depth of 15 m. At this depth, sandy material had pushed up into the augers and there was the possibility that the augers would become stuck. The augers were pulled (with some loss of augers) and the borehole was abandoned at approximately 15 m depth; P2B was relocated approximately 2 m from the original location and HW/NW casing and wash boring was used to advance the borehole the rest of the depth.

As discussed in Section 2, Scope of Work, new supplies were ordered as a result of the difficult drilling conditions at P2B. However, it would take approximately 2 to 3 days for the new supplies to arrive and therefore P2B and P2A were completed with the supplies that were available. P2B was advanced to a total depth of 58.5 m, the designated depth for a deep piezometer. However, the formation at the bottom depth was a dry clay that was not suitable for piezometer installation. Based on the samples collected and driller's experience, it was decided to install the bottom tip of the piezometer at a depth of 47.95 m and the monitoring zone was installed from a depth of 44.85 m to 47.90 m, in a wet zone of silty clay.

A 50 mm diameter, 3 m long, No. 20 slot PVC screen and silag filter pack was installed, approximately 1.0 m of bentonite pellets were placed above the screen and silag was placed above the bentonite to a depth of about 13.7 m. A second bentonite seal was placed from 12.2 m to 13.7 m depth. Native sand was placed above the bentonite to the ground surface.

The drilling contractor then moved the rig approximately 10 m south-west of PB2 and advanced the shallow borehole (P2A) using HW/NW casing and wash boring. A compact fine sand was encountered from 29.0 m to 35.4 m and, therefore, the piezometer tip for P2A was installed at a depth of 33.53 m and the monitoring zone was installed from a depth of 30.43 m to 33.48 m in the fine sand.

A 50 mm diameter, 3 m long, No. 20 slot PVC screen with silag filter pack was installed, approximately 0.3 m of bentonite pellets were placed from 29.4 m to 29.7 m depth and silag was placed to 13.2 m depth. A second 1.5 m bentonite seal was placed above the silag, followed by native sand to the ground surface.

4.1.3 Borehole P3

Borehole P3 is located approximately 75 m east of W-9.

Drilling of the borehole and installation of two standpipes was completed between September 3 and September 6, 2009. The borehole was advanced to a total depth of 40.93 m. The total depth and the depth of the lower piezometer, although not as deep as the proposed depth of 60 m, was based on field conditions encountered in P1, P2 and P-C (1997).

HW/NW casing and wash boring was used to advance the borehole and SPT measurements and split spoon samples were taken at the anticipated zone of screen installation or at zones where changes in formation were noted.

The bottom of the piezometer tip for P3B (the lower piezometer) was installed at a depth of 40.63 m and the monitoring zone was installed from a depth of 37.58 m to 40.48 m in a 0.5 m zone of wet, medium sand and zones of silty clay. The bottom of the piezometer tip for P3A (the upper piezometer) was installed at a depth of 23.17 m and the monitoring zone was installed from a depth of 20.07 m to 23.12 m in a 0.3 m zone of fine sand and silty clay.

A 25 mm diameter, 3 m long, No. 10 slot PVC screen and silag filter pack was installed in both P3B and P3A. A bentonite pellet seal was placed above the lower screen from a depth of approximately 35.4 m to 36.6 m, 23.2 m to 23.8 m depth and 18.8 m to 19.4 m depth. Volclay grout was placed from 18.8 m depth to ground surface. Silag was placed between each of the seals and as a filter pack around the screen. A geosock was placed over each screen to prevent the intake of fines.

4.1.4 Borehole P4

Borehole P4 is located approximately 75 m west of W-16.

Drilling of the borehole and installation of two standpipes was completed between September 6 and September 9, 2009. The borehole was advanced to a total depth of 46.0 m. The total depth of the piezometer, although not as deep as the proposed depth of 60 m, was based on field conditions encountered in P1, P2 and P-C (1997).

HW/NW casing and wash boring was used to advance the borehole and SPT measurements and split spoon samples were taken at the anticipated zone of screen installation or at zones where changes in formation were noted.

The bottom of the piezometer tip for P4B (the lower piezometer) was installed at a depth of 44.07 m and the monitoring zone was installed from a depth of 40.97 m to 44.02 m in a zone of wet, silty sand. The bottom of the piezometer tip for P4A (the upper piezometer) was installed at a depth of 29.11 m and the

monitoring zone was installed from a depth of 25.40 m to 29.06 m in a zone of silty clay with interbeds of medium grained sand.

A 25 mm diameter, 3 m long, No. 10 slot PVC screen and silag filter pack was installed in P4B and a 25 mm diameter, 3.7 m long, No. 10 slot PVC screen with silag filter pack was installed in P4A. The longer screen for P4A provides a greater surface area for infiltration/seepage of groundwater through the silty clay formation.

A bentonite pellet seal was placed above the bottom screen from a depth of approximately 38.5 m to 40.3 m, at 29.2 m to 30.7 m depth and 23.5 to 24.9 m depth. Volclay grout was placed from 23.5 m depth to ground surface. Silag was placed between each of the seals and as a filter pack around the screen. A geosock was placed over each screen to prevent the intake of fines.

4.2 Falling Head Test

A falling head test was performed at piezometer P2A and P2B on September 9, 2009. A static water level was measured in the piezometer and then approximately 40 litres of water was added to the piezometer. The water levels in the piezometers, following addition of water, were recorded for approximately 60 to 90 minutes. The equation below was used to calculate K_c, the hydraulic conductivity of the aquifer formation (after Hvorslev).

$$k_C = \frac{d^2 \cdot \ln\left[\frac{m \cdot L}{D} + \sqrt{1 + \left(\frac{mL}{D}\right)^2}\right]}{8 \cdot L \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$$

Where:

D = Diameter, Screen Intake cm

d = Diameter, Standpipe cm

L = Length of Screen Intake cm

H_c = Constant Piezometric Head cm

m = Transformation Ratio, assumed equals 1

H_1 = Piezometric Head for $t = t_1$ cm

H_2 = Piezometric Head for $t = t_2$ cm

q = Flow of Water cm^3/sec

t = Time sec

r = Radius of Screen Intake cm

The calculated hydraulic conductivity of P2A is 2.793^{-05} cm/s which represents a silty sand. The calculated hydraulic conductivity of P2B is 2.150^{-06} cm/s which represents a clayey silt to silty clay. These results are consistent with the descriptions of the water bearing formations found in the borehole logs.

Table 5.1
Nalcor Energy - Muskrat Falls
2009 Piezometer Installation
Details of Piezometer Installations

Piezometer Number	Northing	Easting	Ground Surface Elevation (m)	Top of Bedrock (m)	End of Hole (m)	Elevation of Top of Protective Casing (m)	Bottom of Piezometer Tip (m)	Top of Monitoring Zone (m)	Bottom of Monitoring Zone (m)	Water Level Sept. 9/09
2009 P1A	5902903.1	648228.9	(61.01)	N/E	42.7 (18.31)	(61.84)	25.02 (35.99)	21.92 (39.09)	24.97 (36.04)	15.89 (45.95)
2009 P1B							42.58 (18.43)	39.53 (21.59)	42.52 (18.49)	26.08 (35.76)
2009 P2A	5903029.9	648290.9	(59.39)	N/E	35.37 (24.02)	(60.33)	33.53 (25.86)	30.43 (28.96)	33.48 (25.91)	17.86 (42.47)
2009 P2B	5903032.8	648296	(59.45)	N/E	58.50 (0.95)	(60.27)	47.95 (11.50)	44.85 (14.60)	47.90 (11.55)	24.63 (35.64)
2009 P3A	5902950.1	648369.8	(58.39)	N/E	40.93 (17.46)	(59.21)	23.17 (35.22)	20.07 (38.32)	23.12 (35.27)	14.88 (44.33)
2009 P3B							40.63 (17.76)	37.58 (20.81)	40.48 (17.91)	23.96 (35.25)
2009 P4A	5903119.9	648378.9	(54.26)	N/E	46.0 (8.26)	(55.02)	29.11 (25.15)	25.40 (28.86)	29.06 (25.20)	N/A
2009 P4B							44.07 (10.19)	40.97 (13.29)	44.02 (10.24)	N/A

N/E - Not Encountered N/A Not Available
x,y,z coordinates provided by Neil Parrott Surveys Ltd.
( ) - indicates elevations in meters

5. Conclusions and Recommendations

Eight new piezometers were successfully installed at the Muskrat Falls site and initial water levels have been collected. The piezometer locations have been surveyed horizontally and vertically and the locations were cleared of any drilling debris. Locks were placed on the protective casings at each location and the keys were given to NE-NLH personnel. The locations of the new piezometer have been reviewed with NE-NLH personnel so that water levels can be collected at the new piezometers as part of their monthly program of water level measurements at the site.

Recommendations with respect to the new and 1997 piezometers include:

- Installation of a data acquisition system and automatic data transmission for all piezometers. This proposed system was outlined in the Hatch Ltd. report "The Lower Churchill Project, MF 1260 – Assessment of Existing Pumpwell System", (2008) and the specifications and a cost estimate was provided in Appendix D of that report.
- Once 6 to 7 new wells have been drilled and installed as outlined in the recommendations of the report: "Lower Churchill Project, MF 1271 – Evaluation of Existing Wells, Pumps and Related Infrastructure in the Muskrat Falls Pumpwell System", (2010), then existing wells W-2, W-4, W-9, W-10, W-15 and W-21 would be used for back-up pumping. It is recommended that standpipes be installed inside these wells, permitting collection of water level elevations and providing additional information about the performance of the system. Connection of these wells to the data acquisition system is also recommended.
- Until such time as the system is automatic, recording of the piezometric elevations should continue to be undertaken on a frequent basis (monthly). It is recommended that the eight new piezometers be incorporated into the NE-NLH monthly program of water level measurements at the Muskrat Falls site.

Appendix A

Monitoring Well Installations – Muskrat Falls, Labrador

Report Completed by Jacques Whitford Stantec Limited, September 30, 2009

Jacques Whitford Stantec Limited
607 Torbay Road
St. John's, NL A1A 4Y6
Tel: (709) 576-1458
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Stantec

September 30, 2009
File: 1054326

Hatch Limited
Bally Rou Place, Suite E200
280 Torbay Road
St. John's, NL A1A 3W8

Attention: Mr. Paul Curran, P.Eng.

Dear Mr. Curran:

Re: Monitor Well Installations – Muskrat Falls, Labrador

Further to your authorization to proceed, Jacques Whitford Stantec Limited (JWSL) has completed the installation of eight (8) new piezometers at the Muskrat Falls site, some 30 km west of Goose Bay, Labrador. The program was carried out between August 19 and September 9, 2009, in general accordance with the Terms of Reference for this component of the work. Daily field reports were compiled and are appended to this report.

At predetermined locations, a total of five boreholes were drilled at four sites in NW size using a skidder-mounted CME-75 drill rig provided by Lantech of Dieppe, NB. Borehole depths ranged from between 35.4 m and 58.5 m below existing ground surface. Piezometers were installed in the completed boreholes as further outlined below. The Piezometer Location Plan, 1054326-GE-01, is appended to this report.

Approximate borehole locations were initially provided on a drawing by Hatch Limited. Actual locations were modified in the field due to site constraints. In order for this component of the project to remain on budget, it was decided to nest smaller piezometers within each borehole and reduce sampling intervals to a minimum. Coordinates, including northings, eastings and ground surface elevations were provided by Neil Parrott Surveys Limited of Goose Bay, NL under contract to JWSL. These coordinates are provided on the Borehole Records included with this report.

Conventional split spoon soil sampling was carried out in detail in borehole 2009 P2B and at selected locations within the other boreholes to identify more permeable soils in which to install the piezometer screens. All soil samples were visually assessed in the field and returned to our St.John's office for more detailed examination. Selected samples were submitted to our laboratory for more comprehensive testing and classification. The results of the laboratory testing are included within this report and are presented on the Borehole Records.

Initial water level readings were obtained from each piezometer, with the exception of 2009 P4 A&B, on September 9, 2009. Stabilized water levels for 2009 P4 A&B were to be gathered by Nalcor at a later date. All readings were taken from the top of the protective casings as requested by Nalcor and are recorded on the Borehole Records. The Borehole Record Water Level column indicator is located at the corresponding actual depth/elevation below ground surface. The results of these readings are provided within each Borehole Record.

Monitor well Nos. 2009 P1 A&B, 2009 P3 A&B and 2009 P4 A&B, each comprise two 25 mm ID nested piezometers installed at different depths. Monitor well Nos. 2009 P2A and 2009 P2B, each comprise a single 50 mm ID piezometer. All piezometer screens were installed using coarse silag material as a filter pack and fill material, were isolated top and bottom with coated bentonite pellets and except for 2009 P2A and 2009 P2B, were fitted with a geosock material and were grouted to near ground surface using a Volclay grout

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Reference: Monitor Well Installations – Muskrat Falls, Labrador

mixture. Each installation was fitted with a cemented in above-ground steel protector, aluminum access cap and keyed-alike lock. Within each cap, each of the piezometers was identified 'A' or 'B', where applicable.

A selection of site photographs illustrating the work carried out is appended.

We trust this report meets your present requirements. Should any additional information be required, please do not hesitate to contact our office at your convenience.

Sincerely,

JACQUES WHITFORD STANTEC LIMITED

Lorne Boone

Lorne Boone, M.Eng., P.Eng., P.Geo.
Senior Associate

Attachments:	Attachment A	Symbols and Terms used on Borehole and Monitor Well Records
	Attachment B	Borehole Records
	Attachment C	Figures 1 and 2: Gradation Curves
		Figure 3: Stratigraphic Section
		New Piezometer Location Plan No. 1054326-GE-01
	Attachment D	Daily Field Reports
	Attachment E	Site Photos

ATTACHMENT A

Symbols and Terms used on Borehole and Monitor Well Records

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Topsoil	-	mixture of soil and humus capable of supporting vegetative growth
Peat	-	mixture of visible and invisible fragments of decayed organic matter
Till	-	unstratified glacial deposit which may range from clay to boulders
Fill	-	material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	-	having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure
Varved	-	composed of regular alternating layers of silt and clay
Stratified	-	composed of alternating successions of different soil types, e.g. silt and sand
Layer	-	> 75 mm in thickness
Seam	-	2 mm to 75 mm in thickness
Parting	-	< 2 mm in thickness

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488). The classification excludes particles larger than 76 mm (3 inches). The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils:
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test N-Value (also known as N-Index). A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests.

Consistency	Undrained Shear Strength	
	kips/sq.ft.	kPa
Very Soft	<0.25	<12.5
Soft	0.25 - 0.5	12.5 - 25
Firm	0.5 - 1.0	25 - 50
Stiff	1.0 - 2.0	50 – 100
Very Stiff	2.0 - 4.0	100 - 200
Hard	>4.0	>200

ROCK DESCRIPTION

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	*Very Poor Quality - Very Severely Fractured, Crushed*
25-50	*Poor Quality- Severely Fractured, Shattered or Very Blocky*
50-75	*Fair Quality - Fractured, Blocky*
75-90	*Good Quality - Moderately Jointed, Sound*
90-100	*Excellent Quality - Intact, Very Sound*

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on N-size core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

Terminology describing rock mass:

Spacing (mm)	Joint Classification	Bedding, Laminations, Bands
> 6000	*Extremely Wide*	-
2000-6000	*Very Wide*	*Very Thick*
600-2000	*Wide*	*Thick*
200-600	*Moderate*	*Medium*
60-200	*Close*	*Thin*
20-60	*Very Close*	*Very Thin*
<20	*Extremely Close*	*Laminated*
<6	-	*Thinly Laminated*

Terminology describing rock strength:

Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	< 1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	> 250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discolouration along major discontinuities
Slightly Weathered	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured.
Moderately Weathered	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly Weathered	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely Weathered	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.

Solid Core Recovery (SCR):
Solid core recovery is defined as the cumulative length of all solid (at full diameter) core in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

Fracture Index (FI):
Fracture Index is defined as the number of naturally occurring fractures occurring per 0.3 m length of core. The Fracture Index is reported as a simple count of fractures. For > 25 fractures / 0.3 m length, the Fracture Index is reported as >25.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.

Boulders Cobbles Gravel | Sand | Silt | Clay | Organics | Asphalt | Concrete | Fill | Igneous Bedrock | Meta-morphic Bedrock | Sedi-mentary Bedrock

SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT

measured in standpipe, piezometer, or well

inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery (or total core recovery - TCR) is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

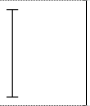
Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and N-values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N value corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to A size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (305 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

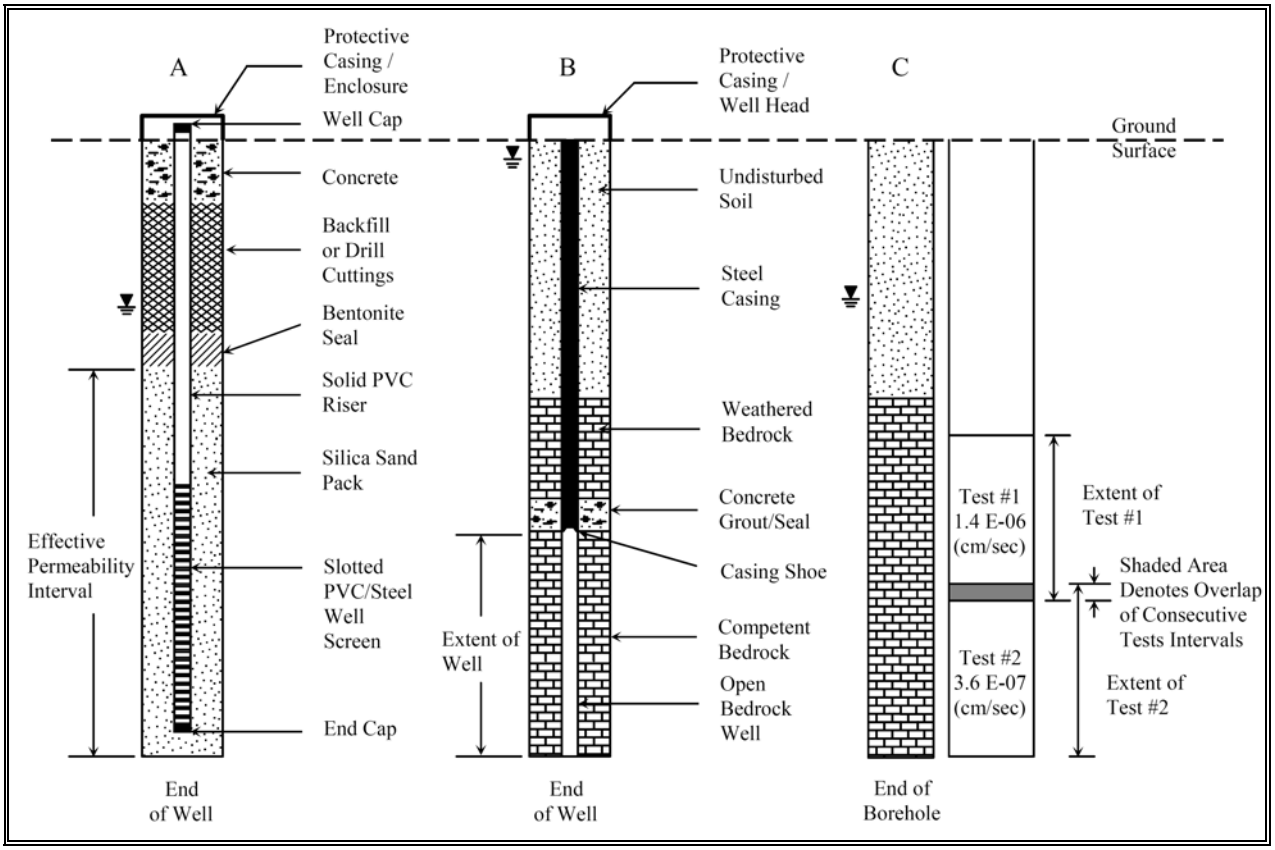
S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

SYMBOLS AND TERMS USED ON MONITOR WELL, WATER WELL AND ENVIRONMENTAL RECORDS

Well Construction and Permeability Testing

Basic symbols used in typical monitor or water well and piezometer construction are shown below. The well construction symbols or materials shown below may be combined or altered to suit a particular application. The diagram shows: A) a typical piezometer or monitor well in overburden; B) a typical water well in bedrock; C) borehole permeability test results in bedrock.



Apparent Moisture Content

Terminology used to describe apparent moisture content at the time of borehole drilling or test pit excavation.

Symbol	Description
D	Dry – containing little or no moisture
M	Moist – containing some moisture without having 'free' moisture
S	Saturated – 'free' moisture can drain from material

Terminology Describing Contamination

Symbol	Description
PID	Photo Ionization Detector (readings in ppm)
TPH	Total Petroleum Hydrocarbon concentration (readings in ppm based on mass)
ppm	Parts Per Million (measurement of concentration, mg/kg or mg/L)
nd	Not Detected – below limit of quantification (LOQ)

Apparent Hydrocarbon Odour

Terminology used to describe apparent hydrocarbon odour at the time of borehole drilling or test pit excavation.

Value	Description
0	No apparent odour
1	Slight odour
2	Moderate odour
3	Strong odour

ATTACHMENT B

Borehole Records

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BOREHOLE RECORD

BOREHOLE No. 2009 P1 A&B
PAGE 1 of 3

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
DATES (mm-dd-yy): BORING 8-31-09 to 9-2-09

PROJECT No. 1054326
DRILLING METHOD Wash Boring
N 5902903.07 m E 648228.87 m
SIZE NW
WATER LEVEL 15.89 m 26.08 m
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm) OR TCR %	SAMPLES: N-VALUE OR RQD %	SAMPLES: OTHER TESTS	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
0	61.01									0.83 m STICK UP; CAST IRON WELL HEAD
	61.0	Organic Soil (OL); ROOTMAT								CEMENT
1		Compact, light to medium brown, fine to medium grained, clean, SAND (SP)								LOCAL SAND
2										
3										
4										
5										
6										
7										
8										
9										VOLCLAY GROUT
10										
11										
12										
13										
14										
15	46.2									

UNDRAINED SHEAR STRENGTH - kPa: 10 20 30 40 50
WATER CONTENT & ATTERBERG LIMITS: W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P1 A&B
PAGE 2 of 3

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
DATES (mm-dd-yy): BORING 8-31-09 to 9-2-09

PROJECT No. 1054326
DRILLING METHOD Wash Boring
N 5902903.07 m E 648228.87 m
SIZE NW
WATER LEVEL 15.89 m 26.08 m
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm) OR TCR %	SAMPLES: N-VALUE OR RQD %	SAMPLES: OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa (10 20 30 40 50) / WATER CONTENT & ATTERBERG LIMITS (W_P W W_L) / DYNAMIC PENETRATION TEST, BLOWS/0.3m ★ / STANDARD PENETRATION TEST, BLOWS/0.3m ●	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
		Continued from Previous Page									
15		Soft to firm, medium grey, silty CLAY (CL-ML) interbedded with thin layers of fine grained silty sand		▼							
16		-P1 A water level at 15.89 m depth below top of casing on September 9, 2009									
17											VOLCLAY GROUT
18											
19											
20											
21											BENTONITE
22											
23											25 mm DIAMETER No. 10 SLOT PVC SCREEN WITH SILAG FILTER PACK AND GEOSOCK
24	37.0	Soft, medium to dark grey, wet, silty CLAY (CL-ML)									
25											BENTONITE
26		-P1 B water level at 26.08 m depth below top of casing on September 9, 2009		▼							
27											SILAG
28											
29											
30											

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P1 A&B
PAGE 3 of 3

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
DATES (mm-dd-yy): BORING 8-31-09 to 9-2-09

PROJECT No. 1054326
DRILLING METHOD Wash Boring
N 5902903.07 m E 648228.87 m
SIZE NW
WATER LEVEL 15.89 m 26.08 m
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) OR TCR %	SAMPLES N-VALUE OR RQD %	SAMPLES OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa (10 20 30 40 50) / WATER CONTENT & ATTERBERG LIMITS (W_P W W_L) / DYNAMIC PENETRATION TEST, BLOWS/0.3m ★ / STANDARD PENETRATION TEST, BLOWS/0.3m ●	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
		Continued from Previous Page									
30											SILAG
31											
32											
33											
34											
35											
36											
37											
38											BENTONITE
39											
40											25 mm DIAMETER No. 10 SLOT PVC SCREEN WITH SILAG FILTER PACK AND GEOSOCK
41											
42	19.1 / 18.7	Compact, wet, medium grey, fine SAND (SP)			SS	1	405	4	S	● ○	END CAP
43	18.3	Soft, wet, medium grey, silty CLAY (CL-ML)									
44		End of Borehole									
45											

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

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BOREHOLE RECORD

BOREHOLE No. 2009 P2A
PAGE 1 of 3

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
DATES (mm-dd-yy): BORING 8-28-09 to 8-30-09

N 5903029.95 m E 648290.94 m
WATER LEVEL 17.86 m

PROJECT No. 1054326
DRILLING METHOD Wash Boring
SIZE NW
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm) OR TCR %	SAMPLES: N-VALUE OR RQD %	SAMPLES: OTHER TESTS	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
	59.39									0.94 m STICK UP CAST IRON WELL HEAD
0	59.3	Organic Soil (OL): ROOTMAT								CEMENT
1		Loose to compact, light brown to grey, fine SAND (SP)								
2										
3										
4										
5										
6										LOCAL SAND
7										
8										
9										
10										
11										
12	47.2									BENTONITE
		Soft, medium grey, silty CLAY (CL-ML)								
13										
14										SILAG
15										

UNDRAINED SHEAR STRENGTH - kPa: 10 20 30 40 50
WATER CONTENT & ATTERBERG LIMITS: W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P2A
PAGE 2 of 3

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
DATES (mm-dd-yy): BORING 8-28-09 to 8-30-09

PROJECT No. 1054326
DRILLING METHOD Wash Boring
N 5903029.95 m E 648290.94 m
SIZE NW
WATER LEVEL 17.86 m
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm) OR TCR %	SAMPLES: N-VALUE OR RQD %	SAMPLES: OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa (10 20 30 40 50) / WATER CONTENT & ATTERBERG LIMITS (W_P W W_L) / DYNAMIC PENETRATION TEST, BLOWS/0.3m (★) / STANDARD PENETRATION TEST, BLOWS/0.3m (●)	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
		Continued from Previous Page									
15											
16											
17		-P2 A water level at 17.86 m depth below top of casing on September 9, 2009		▼							
18											
19											
20											
21	38.1										
		Loose to compact, medium grey, fine SAND (SP)									SILAG
22											
23											
24											
25											
26											
27											
28											
29	30.4										
		Compact, medium grey, fine SAND (SP)									BENTONITE
30											

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◥ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P2A
PAGE 3 of 3

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
N 5903029.95 m E 648290.94 m
DATES (mm-dd-yy): BORING 8-28-09 to 8-30-09
WATER LEVEL 17.86 m

PROJECT No. 1054326
DRILLING METHOD Wash Boring
SIZE NW
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm) OR TCR %	SAMPLES: N-VALUE OR RQD %	SAMPLES: OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa (10 20 30 40 50) / WATER CONTENT & ATTERBERG LIMITS (W_P W W_L) / DYNAMIC PENETRATION TEST, BLOWS/0.3m ★ / STANDARD PENETRATION TEST, BLOWS/0.3m ●	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
		Continued from Previous Page									
30											
31											50 mm DIAMETER SLOT 20 SCREEN WITH SILAG FILTER PACK
32											
33											END CAP
34											SILAG
35	24.0										CAVE-IN
		End of Borehole									
36											
37											
38											
39											
40											
41											
42											
43											
44											
45											

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

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BOREHOLE RECORD

BOREHOLE No. 2009 P2B
PAGE 1 of 4

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
DATES (mm-dd-yy): BORING 8-22-09 to 8-27-09

PROJECT No. 1054326
DRILLING METHOD Wash Boring
N 5903032.79 m E 648296.03 m
SIZE NW
WATER LEVEL 24.63 m
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) OR TCR %	SAMPLES N-VALUE OR RQD %	SAMPLES OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa (10 20 30 40 50) / WATER CONTENT & ATTERBERG LIMITS W_P W W_L / DYNAMIC PENETRATION TEST, BLOWS/0.3m ★ / STANDARD PENETRATION TEST, BLOWS/0.3m ●	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
	59.45										0.82 m STICK UP CAST IRON WELL HEAD
0	59.4	Organic Soil (OL): ROOTMAT			SS	1	405	9		●	CEMENT
1		Loose to compact, light brown to grey, fine SAND (SP); trace to some organics									
2											
3											
4											
5											NATIVE SAND
6					SS	2	430	11		●	
7											
8					SS	3	535	8		●	
9											
10											
11											
12	47.2										
		Soft, medium grey, silty CLAY (CL-ML)			SS	4	560	2		●	BENTONITE
13											
14											SILAG
15											

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P2B
PAGE 2 of 4

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
N 5903032.79 m E 648296.03 m
DATES (mm-dd-yy): BORING 8-22-09 to 8-27-09
WATER LEVEL 24.63 m

PROJECT No. 1054326
DRILLING METHOD Wash Boring
SIZE NW
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) OR TCR %	SAMPLES N-VALUE OR RQD %	OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa (10 20 30 40 50) / WATER CONTENT & ATTERBERG LIMITS W_P W W_L / DYNAMIC PENETRATION TEST, BLOWS/0.3m ★ / STANDARD PENETRATION TEST, BLOWS/0.3m ●	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
		Continued from Previous Page									
15					SS	5	610	2		●	
16											
17											
18					SS	6	125	2		●	
19											
20											
21	38.1										
22		Loose to compact, medium grey, fine SAND (SP)			SS	7	355	24		●	
23											SILAG
24				▼							
25		-P2B water level at 24.63 m depth below top of casing on September 9, 2009									
26											
27											
28					SS	8	280	25		●	
29											
30											

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P2B
PAGE 3 of 4

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
N 5903032.79 m E 648296.03 m
DATES (mm-dd-yy): BORING 8-22-09 to 8-27-09
WATER LEVEL 24.63 m

PROJECT No. 1054326
DRILLING METHOD Wash Boring
SIZE NW
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) OR TCR %	SAMPLES N-VALUE OR RQD %	OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa (10 20 30 40 50)	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
		Continued from Previous Page								WATER CONTENT & ATTERBERG LIMITS W_P W W_L; DYNAMIC PENETRATION TEST, BLOWS/0.3m ★; STANDARD PENETRATION TEST, BLOWS/0.3m ●	
30											
	29.0										
	28.9	Very loose, medium grey, sandy silt and clay			SS	9	610	0		●	
31	28.4	Soft, medium grey, clayey SILT									
		Compact, wet, medium grey fine SAND (SP)									
32											
33											
					SS	10	280	11		●	
34											SILAG
35											
36											
	22.9										
		Stiff, medium grey, silty CLAY (CL-ML)			SS	11	280	0		●	
37											
38											
39											
					SS	12	430	0		●	
40											
41											
42											
43											
44											BENTONITE
45											

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P2B
PAGE 4 of 4

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
N 5903032.79 m E 648296.03 m
DATES (mm-dd-yy): BORING 8-22-09 to 8-27-09
WATER LEVEL 24.63 m

PROJECT No. 1054326
DRILLING METHOD Wash Boring
SIZE NW
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) OR TCR %	SAMPLES N-VALUE OR RQD %	OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa (10 20 30 40 50)	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
45		Continued from Previous Page									
46											50 mm DIAMETER No. 20 SLOT PVC SCREEN IN No. 2 SILICA SAND PACK
47											
48											END CAP
49											
50											
51											
52					SS	13	610	0		●	SILAG
53											
54											
55											
56											
57											
58	0.9				SS	14	610	0	S	● ○	
59		End of Borehole									
60											

WATER CONTENT & ATTERBERG LIMITS: W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P3 A&B
PAGE 1 of 3
PROJECT No. 1054326

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
N 5902950.06 m E 648369.79 m
DRILLING METHOD Wash Boring
SIZE NW
DATES (mm-dd-yy): BORING 9-3-09 to 9-6-09
WATER LEVEL 14.88 m 23.96 m
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm) OR TCR %	SAMPLES: N-VALUE OR RQD %	SAMPLES: OTHER TESTS	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
0	58.39									0.82 m STICK UP; CAST IRON WELL HEAD
	58.3	Organic Soil (OL): ROOTMAT								CEMENT
1		Compact, light to medium brown, medium grained SAND (SP)								
2										
3										
4										
5										
6										
7										
8										
9										VOLCLAY GROUT
10										
11	46.8									
12		Soft, medium to dark brown, silty CLAY (CL-ML); occasional sand lenses								
13										
14		-P3 A water level at 14.88 m depth below top of casing on September 9, 2009		▼						
15										

UNDRAINED SHEAR STRENGTH - kPa: 10 20 30 40 50
WATER CONTENT & ATTERBERG LIMITS: W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◥ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P3 A&B
PAGE 2 of 3

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
DATES (mm-dd-yy): BORING 9-3-09 to 9-6-09

PROJECT No. 1054326
DRILLING METHOD Wash Boring
N 5902950.06 m E 648369.79 m
SIZE NW
WATER LEVEL 14.88 m 23.96 m
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) OR TCR %	SAMPLES N-VALUE OR RQD %	SAMPLES OTHER TESTS	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
		Continued from Previous Page								
15										
16										VOLCLAY GROUT
17										
18	40.1									
		Soft, medium to dark grey, silty CLAY (CL-ML)								
19										BENTONITE
20										25 mm DIAMETER No. 10 SLOT PVC SCREEN WITH SILAG FILTER PACK AND GEOSOCK
21										
22	36.4									
	36.1	Compact, medium grey, fine SAND (SP)								
23		Soft, wet, medium to dark grey, silty CLAY (CL-ML)			SS	1	610		S	BENTONITE
24		-P3 B water level at 23.96 m depth below top of casing on September 9, 2009		▼						
25										
26										
27										SILAG
28										
29										
30										

UNDRAINED SHEAR STRENGTH - kPa
10 20 30 40 50
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●
10 20 30 40 50

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P3 A&B
PAGE 3 of 3

CLIENT **Hatch Ltd.**
PROJECT **New Piezometer Installations**
LOCATION **Muskrat Falls, Labrador** N **5902950.06 m** E **648369.79 m**
DATES (mm-dd-yy): BORING **9-3-09** to **9-6-09** WATER LEVEL **14.88 m** **23.96 m**

PROJECT No. **1054326**
DRILLING METHOD **Wash Boring**
SIZE **NW**
DATUM **Geodetic**

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) OR TCR %	SAMPLES N-VALUE OR RQD %	SAMPLES OTHER TESTS	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
30		Continued from Previous Page								SILAG
31										
32										
33										
34										
35										BENTONITE
36										
37										
38										25 mm DIAMETER No. 10 SLOT PVC SCREEN WITH SILAG FILTER PACK AND GEOSOCK
39										
40	18.3									
	17.8	Compact, wet, medium grey, silty SAND (SM)			SS	2	690	0		END CAP
41	17.5	Stiff, damp, medium grey, silty CLAY (CL-ML)								
		End of Borehole								
42										
43										
44										
45										

UNDRAINED SHEAR STRENGTH - kPa
10 20 30 40 50
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●
10 20 30 40 50

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P4 A&B
PAGE 1 of 4

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador
N 5903120 m E 648378.89 m
DATES (mm-dd-yy): BORING 9-7-09 to 9-9-09
WATER LEVEL N/A

PROJECT No. 1054326
DRILLING METHOD Wash Boring
SIZE NW
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm) OR TCR %	SAMPLES: N-VALUE OR RQD %	SAMPLES: OTHER TESTS	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
	54.26									0.76 m STICK UP; CAST IRON WELL HEAD
0	54.2	Organic Soil (OL): ROOTMAT								CEMENT
		Compact, medium brown then grey, medium grained SAND (SP)								
9										VOLCLAY GROUT
14	39.6	Soft, medium to dark grey, silty								
15										

UNDRAINED SHEAR STRENGTH - kPa (10, 20, 30, 40, 50)
WATER CONTENT & ATTERBERG LIMITS: W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P4 A&B
PAGE 2 of 4

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador N 5903120 m E 648378.89 m
DATES (mm-dd-yy): BORING 9-7-09 to 9-9-09 WATER LEVEL N/A

PROJECT No. 1054326
DRILLING METHOD Wash Boring
SIZE NW
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) OR TCR %	SAMPLES N-VALUE OR RQD %	SAMPLES OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa (10 20 30 40 50) / WATER CONTENT & ATTERBERG LIMITS (W_P W W_L) / DYNAMIC PENETRATION TEST, BLOWS/0.3m (★) / STANDARD PENETRATION TEST, BLOWS/0.3m (●)	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
		Continued from Previous Page									
15		CLAY (CL-ML)									VOLCLAY GROUT
16											
17											
18											
19											
20	33.5										
21		Dense, light to medium grey, fine SAND (SP)			SS	1	610	39		●	
	32.6										
22		Soft, medium grey, silty CLAY (CL-ML)									
23											
	30.4										
24		Interbedded, soft, medium to dark grey, silty CLAY (CL-ML) with compact to dense, medium grey, fine to medium grained SAND (SP)									BENTONITE
25											25 mm DIAMETER No. 10 SLOT PVC SCREEN WITH SILAG FILTER PACK AND GEOSOCK
26											
27											
28											
29											
	24.5										BENTONITE
30											

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P4 A&B
PAGE 3 of 4

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador N 5903120 m E 648378.89 m
DATES (mm-dd-yy): BORING 9-7-09 to 9-9-09 WATER LEVEL N/A

PROJECT No. 1054326
DRILLING METHOD Wash Boring
SIZE NW
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) OR TCR %	SAMPLES N-VALUE OR RQD %	SAMPLES OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa / WATER CONTENT & ATTERBERG LIMITS / DYNAMIC PENETRATION TEST / STANDARD PENETRATION TEST	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
		Continued from Previous Page								10 20 30 40 50; W_P W W_L; ★; ●	
30		Soft, medium to dark grey, silty CLAY (CL-ML)									BENTONITE
31											
32											
33											
34											SILAG
35											
36											
37											
38											
39	15.1										
		Compact to dense, medium grey, fine to medium grained silty SAND (SM)									BENTONITE
40											
41											25 mm DIAMETER No. 10 SLOT PVC SCREEN WITH SILAG FILTER PACK AND GEOSOCK
42					SS	2	330	57	S	>>	
43											
44	9.8										END CAP
		Firm to stiff, medium to dark grey,									BENTONITE
45											

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◥ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. 2009 P4 A&B
PAGE 4 of 4

CLIENT Hatch Ltd.
PROJECT New Piezometer Installations
LOCATION Muskrat Falls, Labrador N 5903120 m E 648378.89 m
DATES (mm-dd-yy): BORING 9-7-09 to 9-9-09 WATER LEVEL N/A

PROJECT No. 1054326
DRILLING METHOD Wash Boring
SIZE NW
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) OR TCR %	SAMPLES N-VALUE OR RQD %	OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa (10 20 30 40 50) / WATER CONTENT & ATTERBERG LIMITS W_P W W_L / DYNAMIC PENETRATION TEST, BLOWS/0.3m ★ / STANDARD PENETRATION TEST, BLOWS/0.3m ●	STANDPIPE/ PIEZOMETER CONSTRUCTION DETAILS
		Continued from Previous Page									
45		silty CLAY (CL-ML)									BENTONITE
	8.2				SS	3	610	1		●	CAVE-IN
46		End of Borehole									
47											
48											
49											
50											
51											
52											
53											
54											
55											
56											
57											
58											
59											
60											

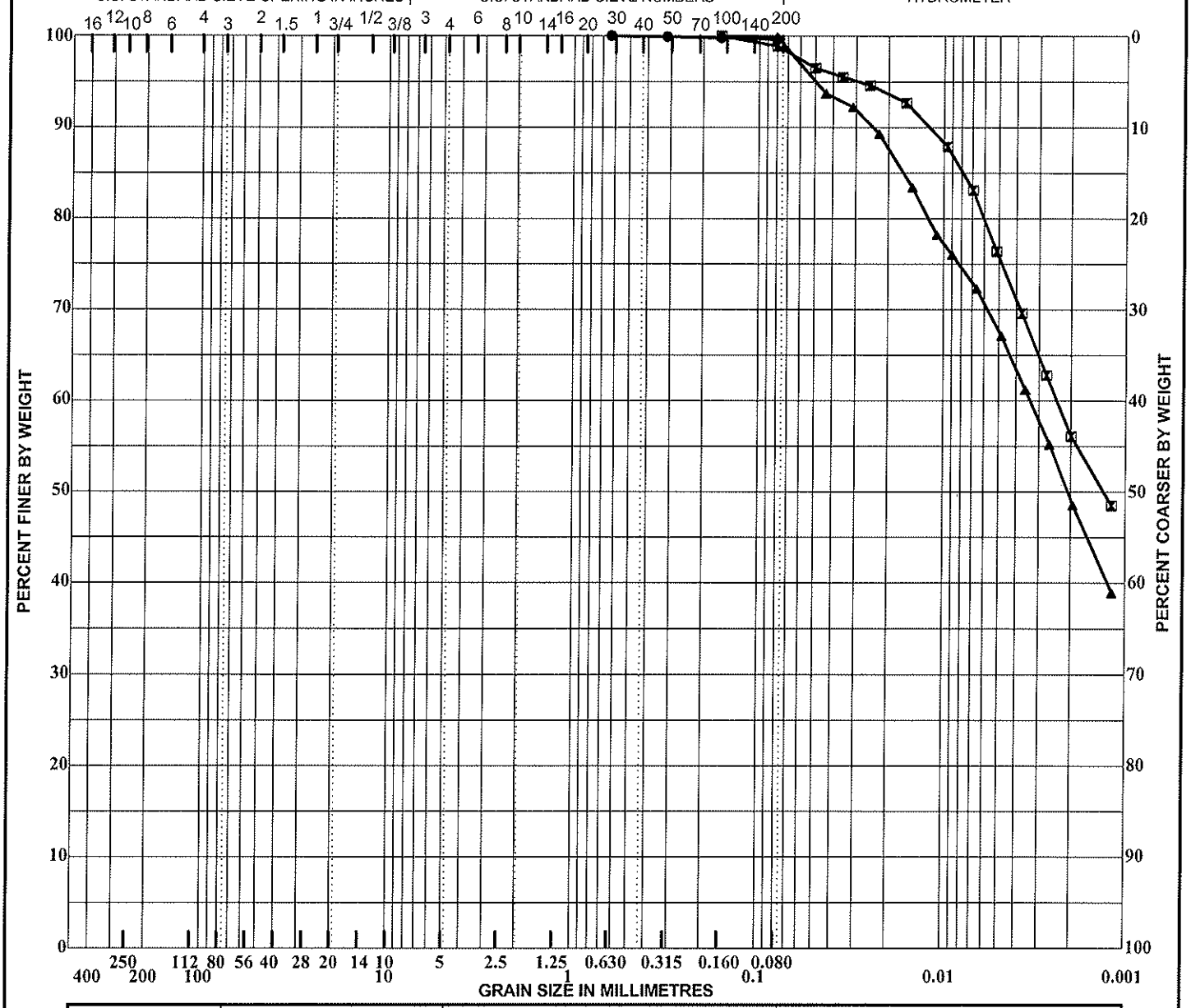
△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◣ Torvane

ATTACHMENT C

Figures 1 and 2: Gradation Curves

Figure 3: Stratigraphic Section

New Piezometer Location Plan No. 1054326-GE-01



COBBLE	GRAVEL		SAND			SILT and CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth (m)	Description	W%	W_L	W_P	I_P
●	2009 P1 A&B SS1	42.26	Silty CLAY (CL-ML)	29.1			
⊠	P2B	58.21	Silty CLAY (CL-ML)	26.1			
▲	2009 P3 A&B SS1	23.13	Silty CLAY (CL-ML)	31.4			

	Sample	Depth (m)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2009 P1 A&B SS1	42.26	0.63				0.0	0.4	99.6	
⊠	P2B	58.21	0.16	0.00			0.0	1.1	42.7	56.2
▲	2009 P3 A&B SS1	23.13	0.16	0.00			0.0	0.1	50.7	49.2

REMARKS:

Stantec

Client: **Hatch Ltd.**

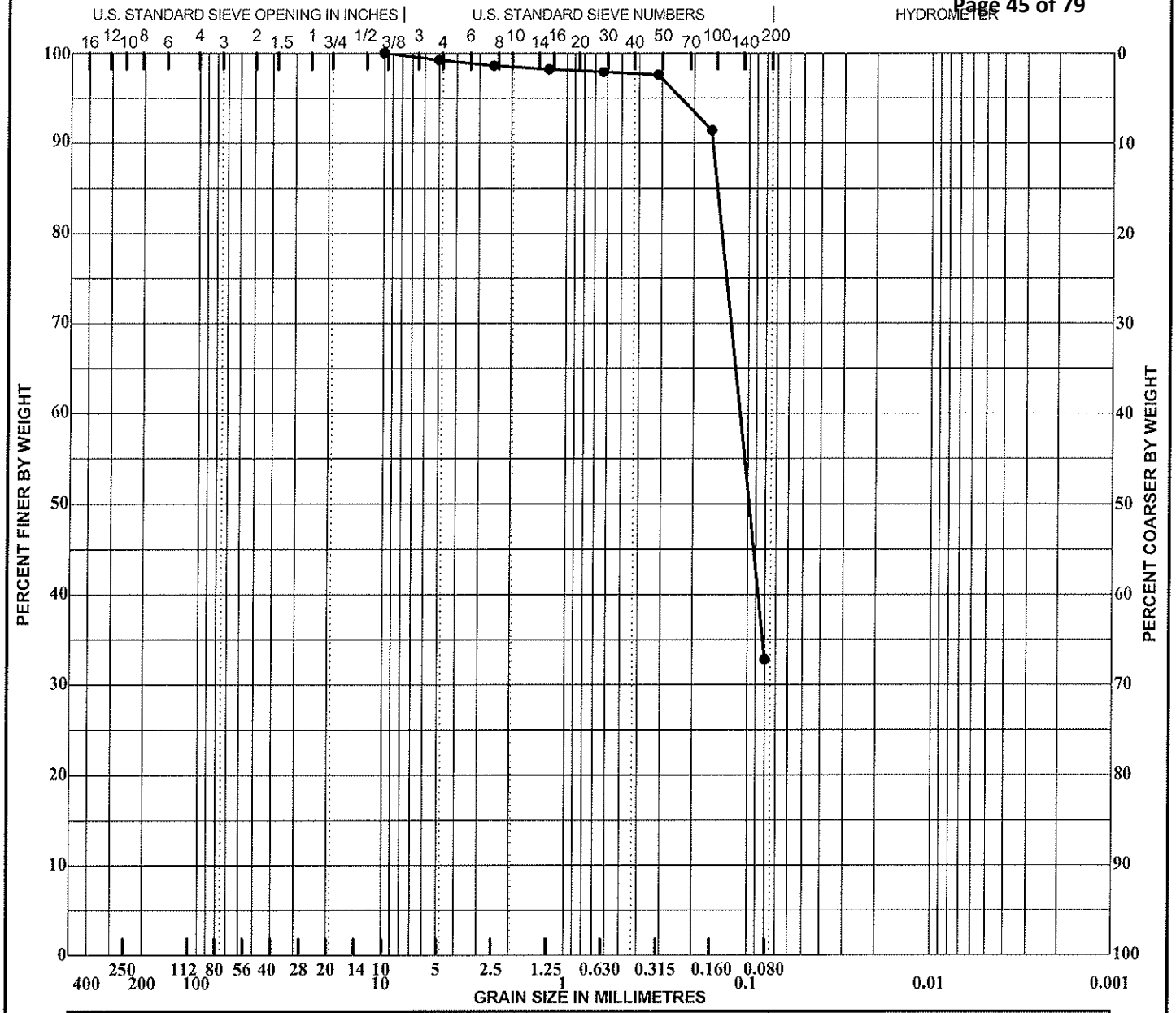
Project: **New Piezometer Installations**

Project No.: **1054326**

Location: **Muskrat Falls, Labrador**

FIGURE 1

GRADATION CURVES



COBBLE	GRAVEL		SAND			SILT and CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth (m)	Description	W%	W_L	W_P	I_P
●	2009 P4 A&B SS2	42.24	Silty SAND with gravel (SM)	25.6			

	Sample	Depth (m)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2009 P4 A&B SS2	42.24	10.00	0.11			0.8	66.4	32.8	

REMARKS:

Stantec

Client: **Hatch Ltd.**

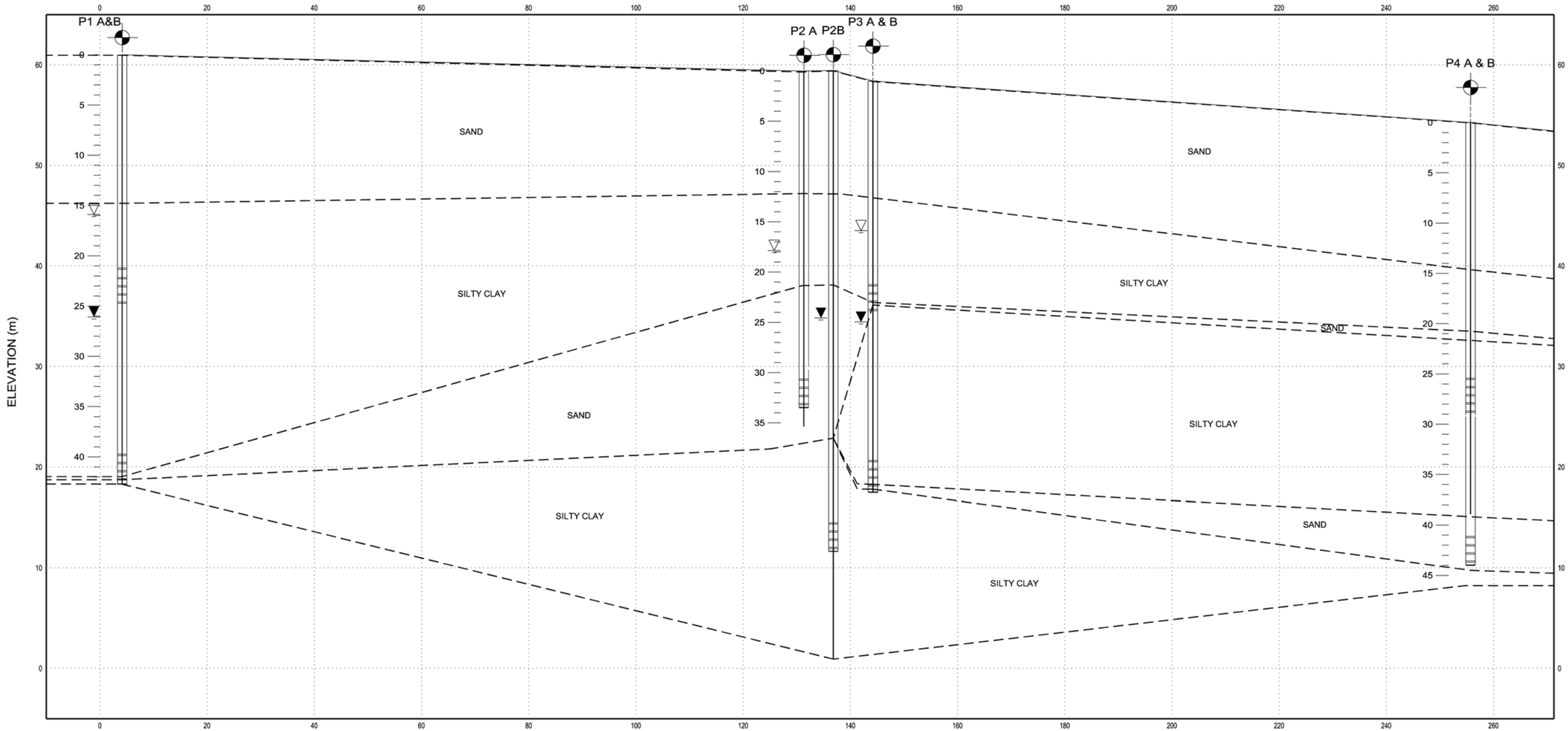
Project: **New Piezometer Installations**

Project No.: **1054326**

Location: **Muskrat Falls, Labrador**

FIGURE 2

GRADATION CURVES



LEGEND:

▽ - DENOTES WATER DEPTH/ELEVATION IN "A" PIEZOMETERS

▼ - DENOTES WATER DEPTH/ELEVATION IN "B" PIEZOMETERS

- NO WATER LEVEL DATA AVAILABLE FOR P4 A & B

NUMBER	ELEVATION (m) TOP OF CSG	DEPTH (m)
2009 P1 A&B	61.01	42.70
2009 P2A	59.39	35.36
2009 P2B	59.45	58.52
2009 P3 A&B	58.39	40.94
2009 P4 A&B	54.26	46.02

REMARKS: 1. INTERPRETATION OF SOIL HORIZONS ARE ESTIMATED BASED ON BOREHOLES 2009 P1 A&B, 2009 P2 A, 2009 P2 B, 2009 P3 A&B AND 2009 P4 A7B.
2. DO NOT SCALE FROM DRAWING.
3. © STANTEC CONSULTING LTD, 2009.

CLIENT: Hatch Ltd.

JOB: 2009 New Piezometer Installations

JOB No: 1054326

LOCATION: Muskrat Falls, Labrador

CAD FILE: 1054326-SECTION1.DWG | DRAWN BY: S.N. | EDITED BY: | CHECKED BY:

SCALE: VERTICAL 1:400 HORIZONTAL 1:750

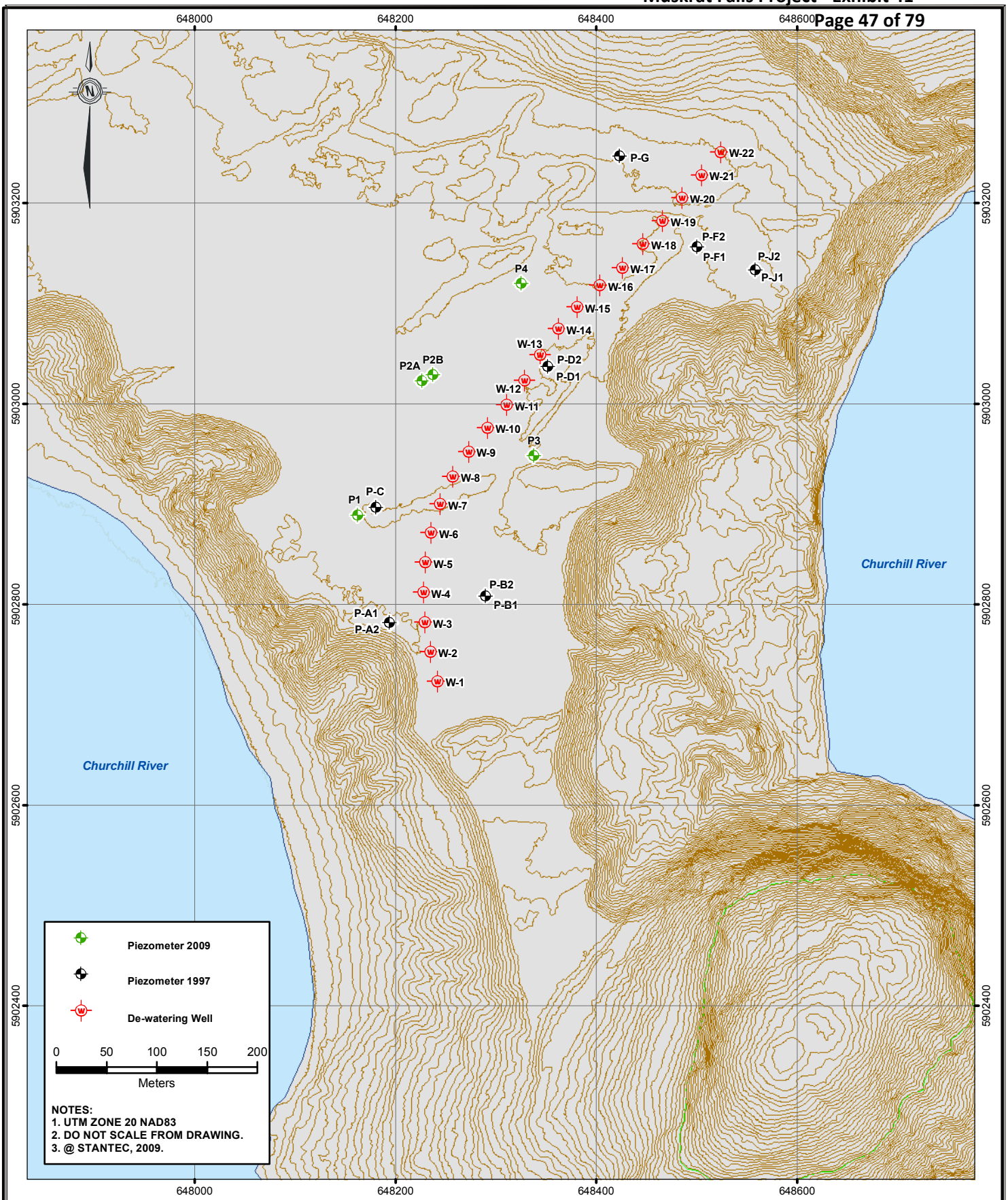
DATE: DEC. 3, 2009

FIGURE

3

STRATIGRAPHIC SECTION

Stantec



CLIENT: HATCH LTD.		SCALE: 1:5,000	DATE: DEC. 11, 2009
		DRAWN BY: EM	CHECKED BY:
PROJECT TITLE: NEW PIEZOMETER INSTALLATIONS (2009)		EDITED BY: EM	REV. No. 0
		DRAWING No.: 1054326-GE-01	
DRAWING TITLE: NEW PIEZOMETER LOCATION PLAN		MAP FILE: 1054326-GE-SITEPLAN.MXD	

Stantec

DD/MM/YEAR

ATTACHMENT D

Daily Field Reports

DAILY FIELD REPORT

Stantec
607 Torbay Road
St. John's, NL A1A 4Y6
Tel: 709-576-1458 Fax: 709-576-2125

Project Name: **Geotechnical Investigation – Construction of New Boreholes with Piezometer Installations**	**Date: 19 August 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, Labrador	**Field Geologist: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of 1**

Remarks:
1000h: depart Wabush for Goose Bay
1215h: arrive Goose Bay. Check into Hotel North. Go to Stantec office to check emails and make copies.
1700h: meet with Terry O'Rielly (Nalcor) and Steve Sproull (Hatch) to discuss project.
1900h: return to room to do emails and prepare for the day tomorrow.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 20 Aug 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of 1**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 19		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
T.Snelgrove				12.0		12.0

Remarks (All times in Eastern Time Zone): Wx: sun/cloud, +18C

0700h – meet Nalcor & Hatch people for breakfast.

0930h – go to site with Hatch people. Layout BH locations. Determine effort for brushcutting.

1130h – lunch with all hands.

1330h – go to safety supply place to get additional equipment with Hatch people.

1430h – return to site to further assess BH locations and get GPS cords.

1600h – meeting at Nalcor office to review each role & responsibilities.

1730h – meet for dinner.

1900h – talk with driller. He just arrived GB. Will meet at safety orientation meeting in AM at Nalcor office.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 21 August 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of 1**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total

Remarks (All times in Eastern Time Zone): Wx-Overcast, no wind, +19C

0700h – Meet personnel for breakfast.

0800h – Begin Safety and Env. orientation at Nalcor's office.

1300h – Finish orientation. Have lunch.

1430h – Head out to site with all personnel involved. Meet with Hickey's to arrange for excavator in AM. Flag BH location for tree-cutters. Offload drill. No wind today. Flies are quite bad.

1730h – Depart site for Goose Bay.

1830h – Have dinner with personnel.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations	**Date: 22 August 2009**
	Project No.: 1054326
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of 1**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P2B	5903032	0648301	12.8	12.8	0	0	12.8

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 P2B	SS	1 thru 4			

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	2.5	7.0	1.0	0.0	0.5	11.0

Remarks (All times in Eastern Time Zone): Wx: AM rain,then sun +18C

0730h – Arrive at site; conduct toolbox meeting; linecutters clear trail to first setup and clear trail to pond for water supply.

1030h – Hickey arrives with excavator. Brushcutters and drill crew work on getting pump and hoses laid out to water supply. Drillers use rig to transport tooling to first setup. Terry (Nalcor) and Steve (Hatch) evaluate linecutters and drillers for safety performance of duties. Linecutters go to Goose Bay to get additional safety equipment, etc. Drillers pass the test. Mark and flag all BH setups and show Don (Nalcor) for clearing.

1430h – Start turning augers. Auger and sample to 12.8m. Augering is easy.

1830h – Sand piping up augers. Need water in the AM. Finish for the day. Check W/L in BH @ 11.8m bgs.

1850h – Depart Site for G. Bay.

1930 – 2130h – working dinner with client.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 23 August 2009**
	Project No.: 1054326
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of 1**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P2B	5903035	0648295	18.9	18.9	-	-	18.9

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 PB2	SS	5, 6			

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	9.0	0.5	2.0	0.0	0.0	11.5

Remarks (All times in Eastern Time Zone): Wx-Sunny, lite winds +20C

0730h – arrive at Site. Conduct toolbox safety meeting; drilers go to finish water pump/waterline setup; run augers to 15.2m. Center plug jambed in augers with 1m of silt/clay on top of plug. Had to pull all augers out. Lost 2X10' AW rods and 4 ¼" center plug down borehole.

1330h – Move rig 2m and restart hole with HW casing. Run casing down to 15.2m before continuing to sample. Went to fuel up water supply pump at pond. (450m away).

1500h – Both Julia and Steve go to airport for departure.

1715h – HW casing at 15.2m. start SS5. Split spoon sank 18" into formation with weight of hammer only. Recovered silty clay to clayey silt.

1815h – HW casing at 18.3m. SS6 – split spoon again sank 14" under hammer weight. Recovered same sort of material. (Blows= 0/0/2/2/)

1830h – Secure rig for the nite. Fuel-up and shut down water pump at pond.

1845h – Depart site for Goose Bay.

1930h – Dinner with Anne (Hatch), Terry and Bob White (Nalcor).

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 24 August 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P2B	5903035	0648295	15.2	34.1	0	0	34.1

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 P2B	SS	7 - 11			

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	8.0		2.5			10.5

Remarks (All times in Eastern Time Zone): Wx-Sunny, breezy, +19C

0730h – Arrive on Site. Conduct toolbox meeting. Driller go fuel-up and start pump.

0800h – Start drilling.Get 5 SS samples today. Anne and Terry O. go to G.Bay to look at boom truck.

1230h – Terry S. go to G.Bay for buckets and stuff.

1445h – Terry S. back on site.

1810h – Depart site for G.Bay.

1900h – Dinner with client.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 25 August 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P2B	5903035	0648295	18.3	52.4	0	0	52.4

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 P2B	SS	12 - 14			

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	8.5	0	3.0	0	0	11.5

Remarks (All times in Eastern Time Zone): Wx Sun, cloud +13C

0730h – Arrive on Site. Conduct toolbox meeting. Review Emerg. Evac. Plan. Saw 2 wolves near site.

0815h – Driller go to startup water pump.

0830h – Start drilling HW

1100h – Terry S. go to get supplies and lunch

1300h – Terry S. back on site. It was discussed with LCB and client and decided to stop sampling until we get to bottom. Therefore, drilled 50 feet in about 4 hrs. Will further discuss tomorrow about installing two 1" wells in each HW borehole to save time.

1820h – Driller at 170'. Clean out BH (9') and take split spoon. Still into firm clays. Will decide tomorrow about well install.

1900h – Depart site for Goose Bay.

2000h – Dinner with client.

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DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 26 August 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P2B	5903035	0648295	6.1	58.6	0	0	58.6

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 P2B	SS	15			

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	6.0		4.5	0	0	10.5

Remarks (All times in Eastern Time Zone): Wx: Rain all day, +11C

0730h – Arrive Site. Conduct toolbox meeting. Arriving to Site today are 2 electricians (Nalcor), 3 envir. Auditors (Nalcor), Sterling Kean and Alex (P.Sullivan). Anne M. orient these guys.

0915h – Instruct driller to run HW casing to 190' (58m). Clean out 11.5' of soil inside casing. Take final split spoon. Prepare to start well installation. Discuss with personnel about where to install screen and why. Since we are in a stiff, damp clay at this depth, decided to install bottom of screen at 157'

1530h – Start installing coarse sand (sillag) at bottom of hole

1745h – Sillag at 157'. Secure site for the night. Will complete installation tomorrow AM.

1810h – Depart Site for Goose Bay

1915h – Dinner with crew.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 27 August 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P2B	5903035	0648295	0	58.6	0	0	58.6

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	0	0	10.5			10.5

Remarks (All times in Eastern Time Zone): Wx-Rain all day +8C

0730h – Arrive Site. Conduct Toolbox meeting.

0810h – Driller startup wter pump and carry out drill rig pre-op check.

0830h – Confirmed order with Lantech for 1" well supplies. He will also ship via truck, Volclay grout and all equipment required to pump grout into boreholes. Scheduled to arrive G.Bay Sunday.

0900h – Begin to install monitor well.

1120h – Peter Sullivan and Julia Hiscock arrive on Site.

1150h – Decided to rent a construction trailer and have it delivered to the Site (confirmed by Nalcor).

1650h – Monitor well completely installed. Perfect installation confirmed by driller.Pull HW casing out of BH.

1715h – Construction trailer arrives. Set it up next to compound. Electricians will wire it up tomorrow.

1815h – Secure rig and Site for the day. Turn off water pump. Ready to move to P2A setup in the AM.

1830h – Depart Site for G. Bay.

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DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 28 August 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P2A	5903029	0648291	35.1	35.1	0	0	35.1

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	11.0					11.0

Remarks (All times in Eastern Time Zone): Wx-Showers then cloudy +11C

0730h – Arrive on Site. Conduct toolbox meeting. All new arrivals are oriented until 1245h. Small crew in AM

0745h – Driller goes to start pump and do pre-op on drill rig.

0815h – Backfill BH with native sand. Install steel protector and cap on 2009 P2B with cement.

1025h – Rig moved onto new setup for BH 2009 P2A. Start running HW casing. No sampling to be done.

1755h – HW casing at 115' (35.1m). Used lots of drilling mud and ran casing slowly. Easy drilling

1850h – Secure Site for the day. Depart Site for Goose Bay.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 29 August 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P2A	5903029	0648291		35.1			35.1

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	8.5			3.0 go to GB to get well supplies		11.5

Remarks (All times in Eastern Time Zone): Wx-Sun, cloud +16C

0730h – Arrive on Site. Conduct toolbox meeting.

0800h – Driller go to start pump and do drill rig pre-op check.

0850h – Driller secured casing last evening. When he disconnected casing from drill head, it fell into the BH about 7' (3' bgs). He was able to see and retrieve it. This implies the soils at ~115' depth are more than likely the soft, wet silty clays we confirmed in the adjacent BH with sampling. Unable to sample.

1100h – Flush drilling mud and soils from inside casing as well as mud on BH wall for 40mins.Prepare to install monitor well.

1300h – Driller had to go to G. Bay to pickup 1" well supplies, grout, grouting materials and equipment and mud

1600h – Driller back from G.Bay with supplies. Complete well installation on 2009 P2A.

1800h – Well installed, casing out of hole. Perfect well installation. Driller drain waterline and pump due to pending frost tonite.

1900h – Depart Site for G. Bay.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 30 August 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech				Driller Sick		

Remarks (All times in Eastern Time Zone): Wx. Sun/cloud +14C

0730h – Arrive on Site. Conduct toolbox meeting. John Mallick replaces Mary-Anne Aylward as bear monitor. He was monitor during the 2007-08 Gull Island field work. Hatch/Nalcor okay with that. Driller sick today !!

0815h – Install rope and flagging tape to keep the public out of work area.

0840h – Organize new office trailer with supplies from G.Bay office. Go to G.Bay and pick up coffee perk and related supplies. Meet with Bob White of Nalcor.

1145h – Get new GPS coordinates for BH locations. Locations were moved slightly to permit easier setups.

Instruct brushcutters to clear path to site from Well road to facilitate access by drillers to move supplies

2000h – Dinner with the group and Bob Barnes.

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DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 31 August 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P1 A&B	5902908	0648228	11.9	11.9	0	0	11.9

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech		6.0				

Remarks (All times in Eastern Time Zone): Wx-Showers, no wind, +13C

0730h – Arrive on Site. Conduct toolbox meeting. Bob Barnes on Site for a few hours today to review program and progress. He is exceptionally pleased with safety and progress to date. Driller is back to work today.

0820h – Driller removes last piece of casing from BH 2009 P2B. Begins to move off this setup and move all tooling, extend waterline, etc. Moving to setup 2009 P1. Discuss procedures with Bob Barnes. He is satisfied.

1255h – Go to G. Bay to pickup water and 3 pails of Lantech's drilling mud for the afternoon.

1405h – Back from G.Bay. Driller completed the setup. Connect all waterline hoses together and start pump.

1435h – Drilling HW casing begins on BH# 2009 P1.

1520h – Lost all mud returns at 18' depth. Casing becomes tight in BH. Driller mixes heavier mud and at 22.5' depth re-establishes complete returns which contain an abundance of fine to med grained brown sand grains.

1725h – HW casing at 39' depth. Driller pump heavy mud in hole for the nite. Secure rig; shut down pump.

1810h – Depart Site for G. Bay.

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 1 September 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P1 A&B	5902908	0648228	30.7	42.6	0	0	42.6

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 P1 A&B	SS	1			

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	9.0		2.5			11.5

Remarks (All times in Eastern Time Zone): Wx-Sun,cloud, +16C

0730h – Arrive on Site. Conduct toolbox meeting.

0800h – Driller go to start water pump; do drill rig pre-op check.

0840h – Resume running HW casing. Encounter softer soils at 48.5’ (14.8m) depth. From 14.8m to 21.3m, generally in softer, med to dark grey soils (silty clay?), with occasional thin layers of denser, light to med brown fine to med sands.

1125h – Encounter consistently softer soils at 79.5’. Driller to watch for brief expected change to sand material at a depth of 130’ to 150’.

1520h – Driller confident he is still in soft clay material at 135’ depth.

1540h – Driller noticed increase in head pressure. Clean out 13.7’ of material inside casing. Prep for SS.

1720h – Take SS 137.7’-139’7’.

1750h – Secure drill rig for the nite. Shut off water pump.

1815h – Depart Site for G. Bay.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 2 September 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P1 A&B	5902908	0648228	0.3	42.7	0	0	42.7

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	7.5		3.0			10.5

Remarks (All times in Eastern Time Zone): Wx- Cloudy,

0730h – Arrive on Site. Conduct toolbox meeting.

0810h – Driller go to start pump. Do drill rig pre-op check.

0850h – Start rig and run HW casing to 42.7m. Check depth, flush BH of all cuttings and drill mud.

1110h – Begin to install deep 1" monitor well (slot 10 screen with geosock).

1420h – Grout batch mixing complete. Install tremie line and begin to grout.

1455h – Driller says he can't tag top of grout with tape. Therefore, decided to use silag up to bottom of upper well. This will be the procedure for other two locations.

1650h – LCB to order keyed-alike padlocks and give to Perry T. on Friday to get to G. Bay. Driller clening grout from casing and tremie line; flushing system. Will complete install with silag.

1710h – Driller has all HW casing out of P1. Flush all pipes, hoses, tank and pump of grout.

1825h – Driller shut down water pump and secure site for the nite. Depart for G. Bay.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 3 September 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P3 A&B	5902952	0648371	21.4	21.4	0	0	21.4

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 P3 A&B	SS				

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	7.5	3.0				10.5

Remarks (All times in Eastern Time Zone): Wx-Sun, cloud, +18C

0730h – Arrive on Site. Conduct toolbox meeting.

0815h – Driller go to start water pump. Do pre-op rig check.

0850h – Driller begins to move from P1 setup to P3 setup.

1145h – All tooling and rig now on P3 setup. Begin to run HW casing.

1320h – Call Neil Parrott. He will have a crew here in the AM to survey-in new BH locations.

1500h – HW casing at 42’ Encountered soft, med. Brown silty material at 38.1’.Full mud returns.

1645h – HW casing at 60’. Soft, med to dark grey, silty clay with interbedded fine sand layers.

1725h – HW casing at 70’. Soft, med. to dark grey, silty clay. Full mud returns.

1755h – Secure site for the nite. Shut down water pump. Depart site for G. Bay.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 4 September 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P3 A&B	5902952	0648371	18.2	39.6	0	0	39.6

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 P1 A&B	SS	1			

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	9.5					9.5

Remarks (All times in Eastern Time Zone): Wx-Sun,cloud, PM showers, +16C

0730h – Arrive Site. Conduct toolbox meeting. Driller go to start water pump.

0845h – Drilling resumes on P1. Encountered sand at 72.3'. Clean out and take SS1

0850h – Called LCB and asked him to contact Clyde MacLean at Water Resources and check on water use permit or approval from his superior, the Director of the department.

0955h – Driller stung by wasp. Complaining of burning sensation. Observe for a while. Slowly improving.

1140h – Call from Denise at Neil Parrott Surveys. Survey crew should be here after lunch to survey BHs.

1330h – Drilling HW casing continuing. Now at 105' depth.

1450h – Parrot's surveyors arrive. Conduct brief version of toolbox safety meeting. Survey in x,y,z on all well locations. Report to be provided next week.

1525h – Surveying complete. Surveyors depart site. ** Total time the surveyors are away from their office is ~ 3hrs.**

1640h – HW casing at 130'. Driller pumps heavy mud into BH for the night. Shutdown water pump

1700h – Driller departs site for G. Bay.

1755h – Secure site for the night and depart for G>Bay.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 5 September 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P3 A&B	5902952	0648371	1.2	40.8	0	0	40.8

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 P3 A&B	SS	2A, 2B			

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	6.5		1.0			7.5

Remarks (All times in Eastern Time Zone): Wx-Sunny, cool AM,

0730h – Arrive on Site. Conduct toolbox meeting. Driller go to start water pump. Noticed the third hose from the pump was split open. Make repairs.

0900h – Driller install protective casing at 2009 P1 location.

0940h – Resume running HW casing at P3. Casing tight with no mud returns for 40mins.

1035h – Driller thinks he has hit sand at 131.5'. Stop and clean out 4.8' soils inside casing in prep for SS.

1140h – Take SS2 at 133'. Sand layer from 131.6' to 133.0'. Run HW to 134'

1410h – Driller does not get back more than 10% of drill mud returns. Weight up mud in hole until tomorrow. Too late in the day to begin installation of wells.

1540h – Bob White (Nalcor) and three other guys show up for a site visit.

1545h – Driller go to shut off water pump and drain all hoses (may be frost tonite).

1620h – Secure site for the nite and depart for G. Bay

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 6 September 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P3 A&B	5902952	0648371		40.8	0	0	40.8

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech		2.0	8.5			10.5

Remarks (All times in Eastern Time Zone): Wx-Sun, cloud +15C

0730h – Arrive on Site. Conduct toolbox meeting. Take group photos. Two bears (one injured) observed about 1km from site and fresh wolf tracks.

0800h – Driller startup water pump and connect all waterline hoses. Do drill rig pre-op check.Take water level readings on new wells.

0840h – Driller ready to begin BH flush on P3 for well install.

0905h – Flushing complete. HW casing is freely moving. Drop in lower well and install silag and bentonite.

1025h – Lower well installed. Place silag up to next bentonite seal.

1145h – Drop in upper well. Place silag and upper bentonite seal.

1240h – Prepare to mix and place grout from 62’ to 2’.

1440h – Grouting completed. Prepare to clean grouting equipment. Then teardown from site P3 and move equipment and drill rig to setup P4.

1800h – All equipment and drill moved to P4 setup. Shut down water pump and secure site for the nite. Depart Site for G. Bay.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 7 September 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P4 A&B	5903123	0648378	33.1	33.1			33.1

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 P4 A&B	SS	1A&1B			

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	9.0		1.5			10.5

Remarks (All times in Eastern Time Zone): Wx-Sun, Cloud, +16C

0730h – Arrive on Site. Conduct toolbox safety meeting. P.Sullivan crew demobing from Site today.

0805h – Driller go to start water pump and do rig pre-op check.

0830h – Take WL readings on new wells.

0840h – Driller begins drilling on P4.

1030h – HW casing at 25'.

1210h – Driller reports he went from the compact, medium grained sand to a soft, med grey silty clay at 48'

1335h – Driller reports he went from the silty clay to a sand at 68.1. Stop drilling, clean out ~6' material up inside casing. Take SS1 from 68' to 70'. Recovered first 6"of wet, silty clay and the last 18" of dry, fine sand.

1450h – Resume drilling HW casing.

1525h – Driller reports he went from fine sand to soft, silty clay at 71.1'. Then he encountered the dense sand again at 78.3'. Continue drilling to find the next stratigraphic change.

1700h – HW casing at 98.5'. Interbedded fine sand and silty clay.

1740h – HW casing at 108.5'. Mix heavy mud for the nite. Shut down pump and secure for the nite.

1810h – Depart Site for G. Bay.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 8 September 2009** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of _____**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P4 A&B	5903123	0648378	12.9	46.0	0	0	46.0

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.
2009 P4 A&B	SS	2, 3			

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech	7.5		2.0			9.5

Remarks (All times in Eastern Time Zone): Wx – Sunny, +12C

0730h – Arrive Site. Conduct toolbox safety meeting. All hands go to look at water pump setup at pond. Driller do drill rig pre-op check.

0820h – Driller resumes running HW casing in P4.

0900h – Take WL readings on new wells with Nalcor guys.

1005h – HW casing at 128.5'. Driller reports he is still in a soft clay.When he connects the next piece of casing, he observes that the water pressure is increasing slightly and the casing is binding slightly.

1145h – running HW casing from 133.5' to 138.5' takes 3 tubs of drilling mud. Stop drilling. Clean out 4.8' of material inside casing in preparation for a SS sample.

1240h – Take SS2 sample from 137.7' to 139.7'. recovered saturated fine sand with silt.

1350h – HW casing at 140'. Still in sand. Water blocking occ.

1420h – Encounter clay at 146'. Run casing to 149', clean out casing and take SS from 149' – 151'. Sample is firm to stiff, dry to damp, med to dark grey silty clay.

1555h – Driller pump heavy mud in BH, drain waterline and shut down pump for the nite.

1615h – Take water level readings in new wells.

1700h – Depart Site for G. Bay.

Stassinu Stantec Limited Partnership

DAILY FIELD REPORT

Project Name: **Geotechnical Investigation – Construction of Boreholes with Monitor Well Installations**	**Date: 9 September 209** **Project No.: 1054326**
Work Location: Muskrat Falls, LABRADOR	**Supervisor: Terry Snelgrove**
Client: Nalcor Energy c/o Hatch Mott MacDonald	**Sheet 1 of**

Borehole Summary

Monitor Well No.	Location NAD 83 Zone 20		Overburden (m)		Bedrock (m)		Depth (m)
	Northing (m)	Easting (m)	Today	To Date	Today	To Date	
2009 P4 A&B	5903123	0648378	0	46.0	0	0	46.0

Sample/Testing Summary

Monitor Well No.	Type	Nos.	Borehole No.	Type	Nos.

Time Summary

Crew	Drilling	Moving	Testing	Standby	Breakdown	Total
Lantech			10.5			10.5

Remarks (All times in Eastern Time Zone): Wx – Sun, cloud, +12C

0730h – Arrive at Site. Conduct toolbox safety meeting. Trailer to be removed from site today. Concern over the poor condition of the tow bar and wheel/axle on the trailer.

0800h – Driller go to connect water hoses and start up water pump. Driller do rig safety pre-op check.

0840h – Driller start to circulate clean water into HW casing and BH to flush out drilling fluids in preparation of well installations.

0925h – Start to install lower monitor well in P4 (P4B).

1130h – Lower well installed with silag around screen and upper bentonite seal in place. Place silag up to bottom portion of upper installation. Place bentonite seal. Install 12’ for upper well, then bentonite.

1250h – Mix 150 gal. grout and tremie it down BH.

1405h – Begin pumping grout down BH.

1640h – Borehole grouting complete. Driller wash grout from hoses and equipment.

1650h – Begin to drain and coil up water lines. Shut down water pump and secure site for the nite.

1800h – Depart Site fir G. Bay.

ATTACHMENT E

Site Photos

Photo 1 Water Supply Pump

Photo 2 Drill Rig Move to P4 Setup

Photo 3 **Sample 2009 P4 SS1B**

Photo 4 **2009 P4 Sample SS3**

Photo 5 Well Install P4 (B)

Photo 6 Well Install P4 (A)

Photo 7 Mixing Grout 2009 P3

Photo 8 Grouting 2009 P3

Photo 9 Grouting 2009 P3

Photo 10 Grouting 2009 P4

Photo 11 Completed 2009 P2A

Photo 12 2009 P4 (A & B)

Photo 13 Group Picture