

3rd Floor 820 Taylor Avenue Winnipeg, Manitoba R3M 3T1 Fax: (204) 474-4947

0221-A-91-110

October 6, 2009

Ms. Elise Dagdick Environmental Licensing and Approval Branch Manitoba Conservation 160-123 Main Street Winnipeg, MB R3C 1A5

Dear Ms. Dagdick:

RE: Addendum #2 Information to the EA Report for the Keeyask Infrastructure Project

On July 31 the Keeyask Hydropower Limited Partnership, through its General Partner 5900345 Manitoba Ltd., submitted an Environment Act Proposal Form, an Environmental Assessment Report, a preliminary Environmental Protection Plan, and payment for the Class 2 Development Review Fee. An Addendum Filing was sent on August 31. Today we are providing the Second Addendum Filing with the following materials:

- Appendix A1-a: Information Regarding Wastewater Disposal.
- Appendix D15: Environmental Non-Government Organization Meeting Notes. The
 previous addendum filing had included draft notes of this meeting. Those notes have
 been edited and the final notes are now enclosed.

Should you require any additional information, please feel free to contact Mr. Ryan Kustra at 360-4334 or Mr. Nick Barnes at 360-3999.

Yours truly,

5900345 Manitoba Ltd.
As general partner of the
Keeyask Hydropower Limited Partnership

Per:

K.R.F. Adams President

Attachments

c. Ms. Tracey Braun

AECOM

99 Commerce Drive, Winnipeg, MB Canada R3P 0Y7 T 204.284.0580 F 204.475.3646 www.aecom.com

Technical Memorandum (Rev. 1)

Date:

October 2nd, 2009

To:

Brian Beyak, P.Eng, Manitoba Hydro

From:

Jamie Ellis, P. Eng, AECOM

Project Number: 0217-200-07 (3) [Hydro Ref: 243 981 0100]

Subject:

Keeyask Infrastructure Project - North Access Road Start Up Camp

Concept Design for Wastewater Disposal

Distribution:

Neil Klassen, C.E.T., AECOM

Bob Romanetz, P.Eng, AECOM

1) Introduction

A technical memorandum relating to wastewater disposal from the North Access Road Start Up Camp (SUC) was previously included as Appendix A1 to the Environment Act Proposal submission for the Keeyask Infrastructure Project (dated July 28th, 2009). This revision includes further information on the concept design, following the completion of additional fieldwork programs.

2) Executive Summary

The North Access Road Start Up Camp is located at approximately km 177 north on PR280 (refer to Figure 1). The life of the start up camp is anticipated to be 2 to 3 years, with an occupancy of up to 125 people. For design, a population of 150 persons has been used. Maximum populations are anticipated to occur in summer months. The maximum daily wastewater flow is estimated to be 60,000 litres (including backwash from the water treatment plant plus contingency allowance).

The first stage of work included a review of a number of different options for the disposal of wastewater, such as trucking, a lagoon or a drain field. The review considered lifecycle cost and other factors, such training requirements. The preferred option was an on-site septic tank with drain field. The basis for design and site tests was the Environment Act Regulation 83/2003 "Onsite Wastewater Management Systems".

As such, a preliminary geotechnical program commenced, which comprised the investigation of a site to the west of the camp. After a review of the geotechnical information, a secondary program commenced, to investigate potential sites to the north and east of the camp. The secondary program was completed in September 2009. After review, the site to the east of the proposed camp was preferred, as silty loam material was encountered at elevation 176.5m, with suitable depth to groundwater. Percolation tests were therefore conducted, which showed percolation rates of between 4 and 13 min/cm. Due to the size of the field, a conservative application rate of 12.7 litres/m²/day has been used in the design, which results in total trench length of 2150m for a chamber system. The field will be divided into four cells, each containing 19 trenches.

2) Site Layout

The camp layout is preliminary. Facilities at the start up camp will include the following:

- · Accommodation units, with washrooms and laundry facilities
- Offices and stores
- Kitchen and Dining Hall
- Fire Truck/Ambulance Garage
- Generator & fuelling area
- Electrified parking stalls
- Water Treatment Plant (WTP) with water storage tanks
- Groundwater well
- Gatehouse (on the North Access Road)
- · Septic tanks and drain field

The gatehouse will control access to the North Access Road. As the gatehouse will be in service beyond the life of the camp, it is proposed that this building is served by a small pump out tank.

3) Alternatives Considered

At the outset of the design stage, the relative merits of various alternatives for the disposal of wastewater from the start up camp were considered, as shown in the table below. The concept of greywater and blackwater separation was also considered.

Wastewater disposal alternatives considered (in order of preference)
All sewage to septic tank with drain field
Lagoon with discharge route
Black water trucked to Split Lake lagoon with upgrades
Black water trucked to Gillam Wastewater Treatment Plant (WWTP)
Black water trucked to Thompson WWTP
All sewage trucked to Split Lake lagoon with upgrades
All sewage trucked to Gillam WWTP
All sewage trucked to Thompson WWTP
All sewage to on-site mechanical WWTP with drain field
Black water trucked to Split Lake lagoon (currently overloaded – included for
comparison only)

The analysis included a comparison of technical issues, potential for disruption (weather/freezing), training requirements, schedule risks and Class D cost estimates.

The preferred option was all sewage being routed to a septic tank arrangement with a drain field, as it presented the lowest lifecycle cost, low potential for disruption and limited training requirements. This concept has also been used previously at other Manitoba Hydro facilities, including Radisson and

Henday converter stations. As such, a concept design for an engineered drain field was prepared, as shown in the attached calculations (Enclosure 5).

4) Design Criteria

The principal reference for field design criteria is The Environment Act Regulation 83/2003 "Onsite Wastewater Management Systems".

5) Geotechnical Investigation

5a) Investigation Programs

Two geotechnical investigations have been completed to evaluate three potential sites for the SUC drain field. The first investigation was completed on July 21 and 22, 2009 by AECOM to evaluate the original proposed site located west of the SUC. Six test holes were drilled at the locations shown on the Test Hole location plan (Figure 2). Test Holes 09-01, 09-02, 09-03 and 09-04 were drilled in the general vicinity of the proposed drain field. Test Holes 09-05 and 09-06 were drilled between the proposed water well and the drain field locations. Based on the results of this investigation (refer to Enclosure 4) it was recommended that two other areas on the east side of the SUC may be better suited for a drain field. The general extents of these two sites are illustrated on Figure 2 by Test Holes 09-13 to 09-15 which are located east of the SUC and Test Holes 09-16 to 09-19 which are located on the east side of the SUC but on the north side of the NAR. A second geotechnical investigation was completed at these two locations on September 11 and 12, 2009 by Manitoba Hydro (MH) based on a test hole drilling program recommended by AECOM. Percolation testing wells were installed in Test Holes 09-13, 09-14, 09-17 and 09-19 to facilitate percolation testing in accordance with Schedule D - Standards for Conducting Percolation Tests (Regulation for Onsite Wastewater Management ENV-R.M.83-2003). The wells consist of 100 mm diameter PVC pipe with a 300 mm long screened section at the bottom of each well. Construction details of the wells are provided with the attached test hole logs (Enclosure 1). Selected soil samples from the test holes were submitted to AECOM's Materials Testing Laboratory to determine the moisture content and gradation of the soils encountered, the results are also attached (Enclosure 2).

Based on the results of the second geotechnical investigation it was determined that the proposed drain field location on the north side of the NAR (Test Holes 09-16 to 09-19) is not suitable for a drain field due to high groundwater table and/or the presence of clay soils. Some of the soils encountered also appear to be affected by permafrost. The other proposed drain field located east of the SUC (Test Holes 09-13 to 09-15) is suitable for a drain field.

The general ground elevation at Test Holes 09-13, 09-14 and 09-15 is around elevation 179 m, or about 7 to 8 m higher than the groundwater elevations (Elevation 171 to 171.5m) measured in the test holes drilled at the SUC (Test Holes 09-07 to 09-12 on Figure 2). No groundwater seepage or wet soil conditions were encountered in Test Holes 09-13 to 09-15, which were drilled down to elevations ranging from 174.4 to 175.1 m. The upper 1.5 to 3 m of soil at these test hole locations generally consists of a silt with variable clay content (trace clay to clayey). Below the silt layer is a fine grained

sand layer with variable silt content. The gradation testing indicates this layer ranges from a sand with trace to some silt to a sand and silt.

Percolation testing was undertaken by MH approximately 1 week after the drilling was completed. The testing was performed in accordance with Schedule D of the Regulations (Standard Conducting Percolation Tests). The test results are provided in tabular form in Enclosure 3. The percolation rates from Test Holes 09-13 and 09-14 are approximately 13 and 4 minutes per cm, respectively. Based on the Table of soil texture, percolation rates and application rates from Schedule A of the Regulations these rates correspond to the upper bound of the silty loam soil (13 min/cm) and the mid to upper bound of the gravel / sand soil (4 min/cm) which is consistent with the gradation of the soils encountered in the test holes.

No information is available on the direction of groundwater flow on a regional scale. Locally, the groundwater table is expected to be relatively flat, from information gathered during the field programs. In the area of the drain field, it is anticipated that movement of water from the base of the drain field would flow radially outward and downward.

5b) Drain Field Design Recommendations:

- Locate the base of the field in the silty sand layer, no higher than elevation 176.5 m, to
 provide a separation distance of 5 to 5.5 m from the base of the field to the groundwater table
 which is assumed to be similar to that measured in the test holes located at the SUC (at
 elevation 171 to 171.5m),
- Assume a percolation rate slower than 13 min/cm but within the range for the silty loam soil
 provided in the Regulations to provide a factor of safety on this design parameter
- Install snow fence around the field to trap snow in winter for additional frost protection.

6) Hydraulic Loading

A consumption figure of 340 LPCD has been assumed, based on information collected from Wuskwatim camp between 2008 and 2009. Therefore, the maximum daily flow anticipated is 60,000 litres per day (a conservative estimate), which includes both domestic use, backwash from the water treatment plant, plus a contingency allowance.

7) Organic Loading

Whilst organic loading is not considered in the design criteria, the maximum organic loading is anticipated to be approximately 11.25 kg BOD per day (based on 75g BOD per person per day). It should be noted that wastewater discharge from the kitchen would first pass through a grease trap.

8) Concept Design

The concept for wastewater disposal comprises two components; the septic tanks and drain field, as discussed below.

8a) Septic Tanks

It is proposed that sewage will be collected from camp buildings via pipes within an insulated above-ground utilidor. As the site will generally slope to the west to minimize earthworks and fill volumes, sewage will be collected on the west side of the camp, where it will discharge through a splitter box, into a septic tank arrangement. Tanks shall conform to the requirements of Canadian Standards Association Standard B66–00 (Prefabricated Septic Tanks and Sewage Holding Tanks). Each tank shall be supplied with a manhole extension complete with cover and inlet and outlet fittings (to control odours and movement of floating material). Tanks will be covered with granular fill and box insulation.

The septic tank arrangement shall comprise two large sedimentation tanks and a single control tank. The sedimentation tanks may be formed from a single prefabricated unit, or smaller units joined on site. Valves shall be installed on the incoming and outgoing piping, such that tanks may be isolated for maintenance.

In accordance with the Environment Act Regulation, the tanks shall be sized such that:

- the sedimentation chambers have a combined capacity of 140% of the total daily sewage flow, and.
- the control chambers have a combined capacity of 20% of the total daily sewage flow.

The control chamber shall be fitted with two submersible sewage pumps (on a duty/standby arrangement) and a preinsulated forcemain discharging into a disposal field. Each pump shall have a nominal capacity of approximately 400 litres/minute.

The pumps shall have lifting chains to allow removal and maintenance, and a flexible discharge line connected to the tank outlet. Pumps shall be controlled by float switches within the control tank, and shall be automated to allow alternate operation, with check valve. An audible alarm and strobe light shall be installed to warn of pump failure.

Sludge would be removed from the sedimentation tanks at periodic intervals via vacuum truck, and transported to a licensed facility for disposal.

8b) Drain Field

The Regulations refer to 3 types of system, namely;

- Type 1: Trench type disposal field (using wastewater effluent chambers)
- Type 2: Trench type disposal field (using perforated distribution pipe)
- Type 3: Total area field (using either pipe/aggregate or chamber system, either on grade or above ground)

The use of a chamber style ("Type 1") trench disposal field allows for higher flows than with a perforated distribution pipe and aggregate filled trench due to larger surface area and storage capacity. Therefore, a "Type 1" system has been included in the concept design, comprising "Infiltrator" units with "Quick-4 High Capacity" Chambers, or similar. It is understood from the

manufacturer that there are a number of other installations in Manitoba, and similar work camps in northern Alberta.

Whilst the Regulation states that "the percolation rate for the proposed disposal area shall be determined by averaging the percolation rate determined for each of the test holes", a conservative approach has been taken, due to the size of the field. As such, an application rate of approximately 12.7 litres/m2/day (consistent with silty loam material) has been used in the sizing of the field, based on the geotechnical information gathered to date. A review of the design assumptions, and potential for reduction in field size shall be made during the excavation work. It is proposed that the field is divided into four cells.

The pumps shall be connected to a single preinsulated forcemain which will be routed back through the utilidor, and then buried, up to a distribution box, located in the centre of the four cells. Valves shall be placed on each of the four outgoing pipes, such that the flow to each cell may be varied manually.

The multiple trench field would comprise header pipes, each connected to a series of pipes, with perforated plastic chambers located in parallel shallow trenches, with a minimum of 2m separation. Wastewater shall be discharged into the chambers via small diameter (typically 38mm) pressure pipes. Each pipe shall be drilled with orifice diameters sized and spaced to allow even distribution. The pipes may be either suspended via straps or supported on stools within the chamber.

An access track would be constructed to the field area from the camp. Fencing shall be installed around the field to prevent vehicular traffic loading. It is anticipated that there will always be warm effluent being pumped into the field, which should provide sufficient heat to avoid freezing. Once installation is complete, it is proposed that the field area is covered with a vegetative layer, comprising peat moss and/or mulch, which would be seeded.

As can be seen from the contours in Figures 2, existing surface drainage generally; flows to the north in the camp area, and flows radially from the proposed drain field area. Surface water from the start up camp pad will be routed to perimeter ditches, which will discharge into the south ditch of the North Access Road. As shown on Figure 4, the drain field area will be graded with a 0.5% fall to the east, to achieve sheet drainage. Perimeter ditching around the field is required to avoid additional hydraulic load being added to the drainage field. Erosion and sedimentation control features may include wood slash bundles and silt fencing. Depth of cover, vegetation planting requirements, erosion control and snow capture will be further reviewed during detailed design.

As currently proposed, a distance of over 600m separation would be maintained between the discharge field and the water supply well. Two potential locations for the well have been identified; just off the borrow pit, or adjacent to the intersection of the two roads (as shown on Figure 1). The location shall be further reviewed prior to the commencement of well drilling. No other groundwater wells have been identified. Also, no watercourses have been identified within the site limits. The nearest surface water features are small lakes some 500m to the east of the existing limits of the borrow pit.

10) Anticipated construction sequence:

- Excavate from existing ground to top of trench elevation and install perimeter ditching (some material may be used beneath the camp, peat moss and other material to be stockpiled separately)
- Excavate trenches for chamber units
- Install chambers and distribution piping within trenches
- Perform tests on distribution piping with water to ensure even flow
- Backfill trenches and cover using equipment (within manufacturer's recommendations for allowable axle loads)
- Cover with vegetative layer and seed site. Install perimeter fencing and snow fences.

11) Proposed Operation, Maintenance and Monitoring

Features such as inspection ports (to confirm the field is not saturated) and cleanout ports on the chambers shall be included during the detailed design stage, along with an outline program for operation and maintenance, along with a groundwater monitoring plan.

In the event of a system failure, it is anticipated that a trucked system would be initiated, whilst repairs are carried out.

12) Decommissioning

Upon decommissioning of the wastewater system, it is anticipated that the pipes would be plugged and surface features removed from the site. Tanks would be removed from the site for future use.

Respectfully submitted,



J. D. Ellis, P.Eng Community Infrastructure AECOM Canada Ltd.

Encs:

- 1. Test hole logs
- 2. Laboratory testing data
- 3. Percolation test results
- 4. Memorandum regarding west site
- 5. Field Sizing Calculations

Figures:

- Figure 1 Location Plan & Aerial Photo
- Figure 2 Borehole Location Plan
- Figure 3 Proposed Camp and Field Layout
- Figure 4 Proposed Field Layout
- Figure 5 Proposed Cross Sections
- Figure 6 Sketch of tank and valve arrangement

Enclosure 1 Test Hole Logs

PROJECT: Keeyask Generating Station Infrastructure					CLIENT: Manitoba Hydro										TESTHOLE NO: TH-09-01 PROJECT NO.: 0217-200-07			
	LOCATION: Start-Up Camp, UTM 15 V, E - 343543, N - 62551 CONTRACTOR:																	
			CDAD	ППенен ву тире			OD: T SPO			and ⊟B		er					'ATION (m): 98.8	8
	PLE TY (FILL <u>1</u>		GRAB BENTONITE	SHELBY TUBE GRAVEL		∐STO. 725FI		ON			ROU [*]				O RECO		Y CORE SAND	
DEPTH (m)	SOIL SYMBOL		SOIL DESC		SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SP 0 2 16 1;	ENETF	RATION Becker amic C ndard I vs/300 0 6 al Unit kN/m ³ ;	N TEST r Cone Pen Te Omm) 0 8 Wt 1 Liqui	TS > est) ◆ 80 100 0 21		ED SHEA + Torvan X QU X Lab Var Pocket P Field Va (kPa)	AR STREI e + × ne □ ren. △ ne �	NGTH	COMMENTS	ELEVATION
0			ORGANICS - peat moss, rootma	at, wet				2	0 4	0 6	0 8	30 100	50	100	150	200		-
- - - -			CLAY - some silt, trace sand, trace sand, trace sand, trace some silt, trace sand, trace some silt, trace sand, tr	olasticity		G1												- - -
-			CLAY and SAND - some silt, broplasticity, fine to medium graine SAND - some silt, trace clay - light brown, moist, dense	d sand														- - 98 —
- - -	000000000000000000000000000000000000000		- clayey below 1.2 m			G2												- - -
- - -	000000000000000000000000000000000000000		- some clay below 1.5 m - trace clay, moist to wet, compa	act below 1.8 m		G3												-
2 	000000000000000000000000000000000000000		CLAY - some silt. trace sand	int sciew 1.0 iii														97 —
DGS.GPJ UMA WINN.GDT		- - - - - - - - - - - - - - - - - - -	- moist, stiff, high plasticity	1		G4												- - - 96 —
LOG OF TEST HOLE DRAFT 0217-200-07 - TEST HOLE LOGS.GPJ UMA WINN.GDT 24/7/09		11 7111	END OF TEST HOLE AT 3.0 m Notes: 1) Trace seepage observed in S ground surface. 2) Sloughing observed in SAND 3) Water level at 2.4 m below grafter drilling. 4) Installed 25 mm standpipe on J below ground surface.	AND at 1.8 m below . ound surface immediately														- - - - - 95 —
OF TES		ブ	AECOM		1	1	ı	_					ldwin binson	<u> </u>			TION DEPTH: 3.05 TION DATE: 21/7/0	
99	•		AECOM										Gil Rob	inson	CON	HE LE		ge 1 of 1

ORGANICS - peat moss, rootmat, wet ORGANICS - peat moss, rootmat, wet CLAY - sitly, trace sand, trace organics - grey, moist, firm, high plasticity - brown below 0.5 m CLAY and SAND - slity - light brown, moist, stiff, high plasticity, fine grained sand CLAY and SAND - clayey - brown, moist, stiff, intermediate to high plasticity SILT and SAND - clayey - brown, moist, stiff, intermediate plasticity, fine grained sand SAND - some clay, some silt - light brown, moist sitf, intermediate plasticity, fine grained sand G8 - SAND - some clay, some silt - light brown, moist to wet, compact to dense, fine and medium grained	PROJECT: Keeyask Generating Station Infrastructure	CLIENT: Manitoba Hydro									TESTHOLE NO: TH-09-02			
SAMPLE TYPE GRAB SILL BY TUBE SPLIT SPOON SULK NO RECOVERY CORE BACKFILL TYPE BENTONITE GRAVEL SLOUGH GROUT CORE SOIL DESCRIPTION SOIL DESCRIPTION ORGANICS - peat moss, rootmat, wet CLAY - silly, trace sand, trace organics - grey, moist, firm to stiff, intermediate to high plasticity - light brown, moist, stiff, high plasticity, fine grained sand CLAY and SAND - clayey - brown, moist, stiff, intermediate plasticity, fine grained sand SAND - Penter trace or Service or Servi	·	34								P	ROJ	ECT NO.: 02	217-200)-07
BACKFILL TYPE BENTONTE GRAVEL GRAVEL GROUT SOIL DESCRIPTION BENTONTE SOIL DESCRIPTION GRAVEL SOIL DESCRIPTION A PROMET SO A PROMET FOR A COMMENTS OF ROTH OF THE OWN OF THE O	CONTRACTOR:	ME	THO	D: 50) mn					E	LEVA			
SOIL DESCRIPTION SOIL DESCRIP	SAMPLE TYPE GRAB SHELBY TUBE	SI	SPLIT S	SP00	N				✓N	IO RECC	VERY	′ CORE		
SOIL DESCRIPTION SOIL DESCRIP	BACKFILL TYPE BENTONITE GRAVEL	∭SI	SLOUG	SH		C	ROUT		⊠c	UTTING	S	SAND)	
ORGANICS - peat moss, rootmat, wet CLAY - silty, trace sand, trace organics - grey, moist, firm, high plasticity - brown below 0.5 m CLAY and SAND - silty - light brown, moist, stilf, high plasticity, fine grained sand CLAY and SiLT - sandy - light brown, moist, firm to stilf, intermediate to high plasticity CLAY and SiLT - sandy - light brown, moist, firm to stilf, intermediate to high plasticity SILT and SAND - clayey - brown, moist, silf, intermediate plasticity, fine grained sand SAND - some clay, some silt - light brown, moist to wet, compact to dense, fine and medium grained G8 G9 G9	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N	SPT 20	** Becke Dynamic (Standard Blows/300 40 6 Total Unit (kN/m ³ 18 1	r ★ Cone ♦ Pen Test) ◀ Omm) 50 80 10 t Wt ■ 6) 9 20	000	+ Torvai X QU □ Lab Va △ Pocket I ♣ Field Va (kPa	ne + X ane □ Pen. △ ane ♣		COMMEN ⁷	ΓS	ELEVATION
	CLAY - silty, trace sand, trace organics - grey, moist, firm, high plasticity - brown below 0.5 m CLAY and SAND - silty - light brown, moist, stiff, high plasticity, fine grainer sand CLAY and SILT - sandy - light brown, moist, firm to stiff, intermediate to high plasticity SILT and SAND - clayey - brown, moist, stiff, intermediate plasticity, fine grained sand	n G	67											99 —
G10		G	G9											
END OF TEST HOLE AT 3.0 m IN SAND Notes: 1) Trace seepage observed in SILT and SAND at 1.5 m below ground surface. 2) Sloughing observed in SAND. 3) Water level at 2.1 m below ground surface immediately after drilling. 4) Installed 25 mm standpipe. 5) Water level in standpipe on July 22, 2009 was 1.69 m below ground surface. LOGGED BY: Jared Baldwin COMPLETION DEPTH: 3.05 m REVIEWED BY: Gil Robinson COMPLETION DATE: 21/7/09 PROJECT ENGINEER: Gil Robinson Page 1 of	END OF TEST HOLE AT 3.0 m IN SAND Notes: 1) Trace seepage observed in SILT and SAND at 1.5 m below ground surface. 2) Sloughing observed in SAND. 3) Water level at 2.1 m below ground surface immediatel after drilling. 4) Installed 25 mm standpipe. 5) Water level in standpipe on July 22, 2009 was 1.69 m below ground surface.	/												- - - - - -
PROJECT ENGINEER: Gil Robinson Page 1 c	/ LEGOIN											· ·		1 of 1

PROJ	PROJECT: Keeyask Generating Station Infrastructure					/lanito	ba F	lydro		TESTHOLE NO: TH-09-03				
LOCA	OCATION: Start-Up Camp, UTM 15 V, E - 343491, N - 62549 CONTRACTOR:				-								DJECT NO.: 0217-20	0-07
CONT	ΓRAC	CTOR:	M	1ETH	OD:	50 m	nm H	and A	uger			ELE	VATION (m):	
SAMF	PLE T	YPE GRAB SHELBY TUBE			T SPC			BU	LK		N	O RECOVE	RY CORE	
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SP 0 2 16 1	X E Dyna T (Star (Blow 0 40 Tota (18 7 18	vs/300m 0 60 al Unit V kN/m³) 19 MC	K ne ♦ en Test) ♦ en Test) • /t ■	0	H Torvan X QU : Lab Van △ Pocket F Field Van (kPa)	× ne □ 'en. △ ine �	COMMENTS	DEPTH
0	}	ORGANICS - peat moss, rootmat, wet					. 41	:	:		: :	150 200		
- - - - -		CLAY - silty, some sand - light brown, frozen to 0.9 m - some ice inclusions (<2 mm dia.) between 0.6 and 0.9 m.		G11										-
- - 1 -		- moist, firm, intermediate to high plasticity below 0.9 m												1-
-		- brown, high plasticity below 1.2 m												-
- - - - -2				G12										- - - - 2 —
VINN.GDT 24/7/09		- trace silt inclusions (<5 mm dia.), stiff below 2.1 m		G13 G14										-
LOG OF TEST HOLE DRAFT 0217-200-07 - TEST HOLE LOGS.GPJ. UMA WINN.GDT 247/09		END OF TEST HOLE AT 3.0 m IN CLAY Notes: 1) Seepage observed from ORGANICS. 2) No sloughing observed. 3) Water level at 2.1 m below ground surface immediately after drilling from seepage in ORGANICS. 4) Backfilled test hole with auger cuttings.												3— 3—
	-			<u> </u>		LOC	GED	BY:	Jared B	aldwin		COMPL	L ETION DEPTH: 3.05 m	
9		AECOM							: Gil Ro				ETION DATE: 21/7/09	
ဋ		0.000				PRO	JEC.	TENC	INEER	: Gil Ro	obinson		Page	1 of 1

	PROJECT: Keeyask Generating Station Infrastructure LOCATION: Start-Up Camp, UTM 15 V, E - 343558, N - 625505					CLIENT: Manitoba Hydro									TESTHOLE NO: TH-09-04			
				- 343558, N - 625505	5										PROJECT NO.: 0217-200-07 ELEVATION (m): 99.33			
	TRACT			III augustus			OD:					er						
	PLE TY		GRAB	SHELBY TUBE	_		T SPO	ON		BI		-			RECOVI			
	(FILL]	YPE	BENTONITE	GRAVEL]SL0		,	ENETF	RATION Becker amic C	* Kone ♦	rs .				∑ SAND	NO	
DEPTH (m)	SOIL SYMBOL		SOIL DESC		SAMPLE TYPE	SAMPLE	(N) LdS	0 2 16 17 P	(Blow 0 40 Tota (0 18 lastic	vs/300 0 6 al Unit kN/m³)	mm) 0 8 Wt ■) 0 20	0 100	Δ	Lab Van Pocket Pe Field Var (kPa)	en. Δ	COMMENTS	ELEVATION	
0 - -			ORGANICS - peat moss, rootm														- - - 99 —	
-			CLAY - silty, trace to some sand - brown, frozen to 1.1 m - trace ice inclusions (<1 mm dia			G15											-	
- - -1 -		·	- moist, firm, high plasticity below	w 1.1 m													-	
- - - -	0000		- stiff below 1.4 m SAND - silty, some clay			G16											98 —	
- - -2 - -	000000000000000000000000000000000000000	=	- light brown, moist to wet, grained	compact to dense, fine		G17											- - - - - 97 —	
.GPJ UMA WINN.GDT 24/7/C	000000000000000000000000000000000000000		- clayey below 2.4 m - some clay below 2.7 m			G18											- - - -	
LOG OF TEST HOLE DRAFT 0217-200-07 - TEST HOLE LOGS.GPJ UMA WINN.GDT 24/7/09			END OF TEST HOLE AT 3.0 m Notes: 1) Seepage observed from ORC 2) Sloughing observed in SAND 3) Water level at 0.2 m below grafter drilling from seepage in OF 4) Installed 25 mm standpipe. 5) Water level in standpipe on Jubelow ground surface.	SANICS. ound surface immediately RGANICS.													- - 96 — - - -	
P TES	' 	7	AFCOM		1	<u> </u>	I		GED					•		LETION DEPTH: 3.05 m)	
90	•		AECOM										oinson Gil Rob	inson	COMP	LETION DATE: 21/7/09 Page	1 of 1	

PROJ	PROJECT: Keeyask Generating Station Infrastructure			CLIENT: Manitoba Hydro									TESTHOLE NO: TH-09-05)5	
		: Start-Up Camp, UTM 15 V, E	E - 343701, N - 6254939													JECT NO.: 0217-20	0-07
CONT							<u>50 m</u>				er					VATION (m):	
DEPTH (m)	SOIL SYMBOL	YPE GRAB SOIL DESCR		YPE	SAMPLE #	SP1 (N)	◆ SP 0 2 16 1;	ENETF	Becker amic C ndard I vs/300 0 6 al Unit kN/m ³ 19 MC	N TEST	0 100 0 21		H Torv X Q □ Lab \ △ Pocke Field (kF	EAR S rane + U X √ane □ t Pen Vane €	Δ •		DEPTH
0		ORGANICS - peat moss, rootmat, we	et		1		2	0 4	0 - 6	0 8	0 100	5	0 10	00 1	150 200 :		
-		CLAY - silty, trace sand, trace rootlet - brown, moist, firm to stiff, high	s n plasticity	G	19												-
- 1 -		 sandy, soft, intermediate plasticity b trace sand, very stiff, high plasticity 		G	20												1-
- - - - - -	0000	SAND - some silt, trace clay, dry to m fine grained CLAY - silty, trace sand, brown, dry to plasticity END OF TEST HOLE AT 1.7 m IN C Notes: 1. Hand auger refusal at 1.7 m below 2. No seepage or sloughing observed 3. Backfilled test hole with auger cutti	o moist, very stiff, high LAY r ground surface.	G	521												
UMA WINN.GDT 24/7/09																	
LOG OF TEST HOLE DRAFT 0217-200-07 - TEST HOLE LOGS.GPJ UMA WINN.GDT 24/7/09		BAFT															3
Ĭ LS∃ 4		JRK!						CEP				I di sebe			:	ETION DEDTU- 1/0 ···	
OF T	\ 	AECOM					_			Jare Y: G		iawin Dinson				ETION DEPTH: 1.68 m ETION DATE: 22/7/09	1
ဗျ		/ LECOIVI					_						binso				1 of 1

PROJ	ECT:	Keeyask Generating Station In	frastructure	CL	IEN	T: M	anito	ba F	lydro)					TES	THOLE NO: TH-09-0	06
		: Start-Up Camp, UTM 15 V, E	- 343616, N - 6254945												PRC	JECT NO.: 0217-20	0-07
CON						OD:					er					VATION (m):	
SAME	PLE T	YPE GRAB	SHELBY TUBE	<u>X</u> :	SPLI	T SPO			В						ECOVE		
DEPTH (m)	SOIL SYMBOL	SOIL DESCRI	PTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SP 0 2 16 17	¥I Dyn Γ (Star (Blow) 4 ■ Tot: (18 astic	Becker amic C ndard I vs/300 0 6 al Unit kN/m ³ 3 19 MC	Cone © Pen Te Imm) 0 8 Wt 1 Liqui	est) ♦ 0 100		+ Ton X C □ Lab △ Pocke ♣ Field (kl	vane + U X Vane [et Pen. Vane (□ △ ②	COMMENTS	DEPTH
0		ORGANICS - peat moss, rootmat, wet) 4	0 - 6	0 8	0 100		50 1	00	150 200		
		CLAY - silty, trace sand, trace rootlets											: :	: : :			-
-		- brown, moist, firm to stiff, high p	plasticity										<u>:</u>	: : :	<u>:</u>		-
-													:	:			-
ŀ														:	:		-
<u> </u>													 :	} :			-
													: }	: }			
ŀ								;					: : :	: : :	<u>.</u>		-
-1		- some sand, soft below 0.9 m						:						:	:		1-
-													:				-
-		- trace sand, very stiff, high plasticity											:	: :	:		-
		END OF TEST HOLE AT 1.4 m IN CLA	NV										<u>:</u>	: :	<u>:</u>		
-		Notes:												:			-
-		 Hand auger refusal at 1.4 m below g No seepage or sloughing observed. 											:	:	:		-
-		3. Backfilled test hole with auger cuttin	gs.														-
F													: 	: }	÷		-
-								;					: : : : :	: : :			-
<u>-2</u>													:	:			2-
-								;					; :	; : :			-
<u></u>													:	: :	:		-
24/7/0													: : :	: : :	<u>.</u>		-
ĬĮ.													:	:	:		-
NN N													:	:	:		-
AMA V													:	: :			-
J GBJ (: :			-
-3 -3													: : :	: : 			3 -
														:			-
EST.								;					}	}			-
7- 1-1													; :	: : :	<u>:</u>		
-200-													: : :	: : :			-
0217													:	:	<u>:</u>		-
RAFT														- · · · · · · · · · · · · · · · · · · ·	:		-
		BAFT											:	: :	:		-
H LS		JRHI											:	: : :	<u>:</u>		
LOG OF TEST HOLE DRAFT 0217-200-07 - TEST HOLE LOGS.GPJ. UMA WINN.GDT 24/7/09		AECOM					_					ldwin oinson	<u> </u>			ETION DEPTH: 1.52 m ETION DATE: 22/7/09	l
ခို		AECOM											obinso		COIVIFL		1 of 1

MANITOBA HYDRO

CIVIL ENGINEERING MATERIALS & FIELD SERVICES

Field Overburden Log
PROJECT 09 Keeyask Geotechnical Investigation

HOLE NO.	HOLE DEPTH	PAGE
TH-09-07	3.1 m	1 OF /

CONTRACTOR

Paddock Drilling Ltd

					╜└╚	DRILLER		1,0	()od	<u></u>			
			•••			DRILLING	METHO		98/	-			
NOF	RTHING	625	5077 EASTING O	343683		ORILL NA	ME		Rang	701			
ELE	:V		DATUM			DATE STA	ARTED		3ep)	111/6	9		
AZIN	MUTH		PLUNGE			DATE CO	MPLET	ED		1111			
LINE	REF		OFFSET		_ [-	ROCK DE	:PTH						
PRC	POSED	HOLE N	IUMBER		L_v	VATER D	DEPTH	Λ	JA				
SUR	RVEY SP	EC.			╝	OLE DE	PTH		3(1 3(1				
	Т				T		SAM	IPLES			T		_ <u></u>
TOP DEPTH	BASE DEPTH	SOIL TYPE	DESCRIPTION COLOR CONSCIENCY, STRUCTURE V PLASTICITY, COMPACTNESS, WATER I	NATER CONTENT, LOSS OR GAIN, ETC.	TOP	BASE DEPTH	NO	TYPE	DIA ()	REC ()	PEN (kPa)	SPT BLOW COUNTS	VANE SHEAR (kPa)
0	0.06	Post	Reat - Fibrais		1	+		-		 		<u> </u>	
	ENCO	16.200	1000			+-	 	1	 	├	 		
<u> </u>					0,1	0.3	1	ES	 	 	1	<u> </u>	
0.06	3.1	W.	SIH-RONDY, NP.	nackt and		1		1		 	 		
2.5-		11/4	Brown	140131 / 2012	1,4	1,5	2	ES	 		 		
			(Sions ;		 	 	<u> </u>	 ``			 		
					1,2	2.3	3	43	 	 			
	 				$\uparrow \uparrow \uparrow \uparrow$			1,	 		 		1
			~ Moist to u	DOY + 2.1M	13,6	3./	4	155			†		1.
				<u> </u>	<u> </u>		-				 		
			Slovahed to	81	 			 	 	<u> </u>	†		†
			Us with	- U	†	 		 			 		
								 			 		1
			Frefalled Pizzy	2 with						<u> </u>	 		
		_	2.5' Screen		†					 	 		
												-	
												_ - -	
					†								† - -
			1-040	7 > 1	1								
			/ - () \\ @	15,1M	1			 					\vdash
								 					
													
								\top					
-								 					<u> </u>
					<u> </u>			<u> </u>					
								<u> </u>					
											Ī		
			METHOD	0.00	INCORPORA IN								
4 61			METHOD		PPING CONTAINER INSPECTOR B							 .	
ł	PLIT TUB HIN WALL		E - AUGER CUTTINGS F - WASH	N - LINER 0 - TUBE		R-PAIL S-PLIOF			DATE	: ⊴	<u>ed /</u>	111/08	7
	B - THIN WALL TUBE F - WASH 0 - TUBE C - AUGER BARREL G - BULK SAMPLE P - MOISTURE TIN D - CORE BARREL H - BLOCK SAMPLE G - GLASS JAR				TIN W-WAXED								

MANITOBA HYDRO

PROJECT	1200000000	Keeyasic
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH-09-07	3.1	

LOCATION		
		Aure.
NORTH 6255077	EAST	0343683
ELEV G/S	DATUM	
AZIMUTH	PLUNGE	
INSTRUMENT IDENTIFICATION I	NUMBERS	

CONTRACTOR	NO POEDOCK
DRILLER	wode
DRILLING METHOD	XXX SSA
DRILL NAME	Ranger
DATE STARTED	Sept /11/09
DATE COMPLETED	Spot 111/09
ROCK SURFACE	NA
GROUNDWATER	NA
END OF HOLE	3.1m

	WELL DETAILS	DEPTH (ft.)	WELL CONSTRUCTION DETAILS
PROTECTIVE CASING Diameter: Type: Interval: RISER CASING Diameter: I'/ Type: PIC		TPC 4:0 TRC 0.0 GS	
GROUT Type: Mix Ratio: Quantity:			
SEAL Type: EPM Quantity: 1 60-0 SANDPACK			
Type: Silico- Quantity: I board			
SCREEN Diameter: 1'14' Type: PVC Interval: 5'			_
TPC TOP PROTECT CASING TRC TOP OF RISER CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN EOH END OF HOLE		10 BSC	
		10 EOH	

MANITOBA HYDRO

CIVIL ENGINEERING MATERIALS & FIELD SERVICES

Field Overburden Log

PROJECT 09 Keeyask Geotechnical Investigation
HOLE NO. HOLE DEPTH PAGE

HOLE NO. HOLE DEPTH PAGE

1 OF /

		CONTRACTOR Paddock Drilling Ltd
		DRILLER Wade
		DRILLING METHOD SSA, DE
NORTHING 6255	702 EASTING 0343648	DRILL NAME ACKERS SERVEY ROYLECT
ELEV	DATUM	DATE STARTED Seb /12/09
AZIMUTH	PLUNGE	DATE COMPLETED SPP/12/04
LINE REF	OFFSET	ROCK DEPTH
PROPOSED HOLE NUM	MBER	WATER DEPTH DA
SURVEY SPEC.		HOLE DEPTH 6,1
	,	

700			DESCRIPTION			SAM	PLES			 .	SPT	VANE
TOP DEPTH	BASE DEPTH	SOIL TYPE	COLOR CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW COUNTS	SHEAR (kPa)
0	03	Post	Your Fibrova									
<u> </u>		-01										
0.2	1.5	ML			,		1 - 2					
<u> </u>			Soft, brown Trace Clay	07	0.8		ES				_	
				1:4	15	2	FR		_		<u></u>	
115	611	SM	Sand- 8:14, 76, 56,	, ,								
			Most Brown	.								
<u> </u>				2,2	2,3	3	F-8					
ļ			- WP£ & 3.1m								,	
			- 000 F F 3,1m	3.0	3,1	4	120					
				0.0	١٠٠٠	-	<u></u>					
			Slomled 40 3 ilm	-								
			0.20	3.7	3.8	.5_	8					
 -			Installed well Pitto	-								
ļ	!		to 3.8m vith 2.5 of		(1)		E٦					
-			Scien	4.5	4.6	6	C 3			-	=	
			FOH (Q (91)	5,2	5.3	7	FS					
					,	,						
	<u> </u>			1 7		- 1	-					
-				6.0	6.1	4	EG				·-·•	
 	\ 		***	1								
												
	-		·							-		
L							<u> </u>					

SAMPLING N	METHOD	SHIPPING	CONTAINER	INSPECTOR RD /CF		
A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL	E - AUGER CUTTINGS F - WASH G - BULK SAMPLE H - BLOCK SAMPLE	N - LINER 0 - TUBE P - MOISTURE TIN G - GLASS JAR	R - PAIL S - PLIOFILM W - WAXED Z - DISCARDED	DATE	Sept 12/07 Day	

Date Printed: 2007 10:24

Field: Unsigned

Lab: Unsigned

Report Unsigned



MANITOBA HYDRO INSTRUMENT COMPLETION DIAGRAM

PROJECT	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	reexas K
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH-09-08	(21)	

LOCATION	

NORTH 6255007	EAST 0343645
ELEV G/S	DATUM
AZIMUTH	PLUNGE
INSTRUMENT IDENTIFICATION N	UMBERS

CONTRACTOR	**************************************
DRILLER	wede
DRILLING METHOD	ASA.
DRILL NAME	Ranger
DATE STARTED	Sept/b/eg
DATE COMPLETED	Sept/2/09
ROCK SURFACE	NA NA
GROUNDWATER	NA
END OF HOLE	6.1

	WELL DETAILS	ОЕРТН (ft.)	WELL CONSTRUCTION DETAILS
PROTECTIVE CASING Diameter: Type: Interval: RISER CASING Diameter: 1141 Type: PVC		TPC TRC 0.0 GS	
GROUT Type: Mix Ratio: Quantity:			
SEAL Type: EPM Quantity: 2 SANDPACK			
Type: SOCK Quantity: 2.5 ' SCREEN Diameter: 11/41/			
Type: PV C Interval: 2,5 TPC TOP PROTECT CASING			
TRC TOP OF RISER CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN EOH END OF HOLE		12.5 BSC	;
		スク EOH	

MANITOBA HYDRO

CIVIL ENGINEERING
MATERIALS & FIELD SERVICES

Field Overburden Log

		****		_
PROJECT	09 Ke	eyask Geotechni	cal Inve	stigation
HOLEN	0	HOLE DEPTH	D/	VCE

HOLE NO. HOLE DEPTH PAGE

H-OA-09

Silm

L OF/

				- "	<u> </u>			<u> </u>	·		<u> </u>	
			-		CONTRAC	CTOR	Pa	addoc	k Dril	ling L	td	
					RILLER		W	ade		-		
					RILLING	METHO	DD SS	SA, 🗗	Ð			
NOR	THING	625	-4942 EASTING 0.243760		ORILL NA	ME	_Ar	Aer S	oil S	miry	- "Rona	C.F
ELE	V		DATUM		DATE STA	ARTED		SØ	/12	109	<u> </u>	
AZIN	IUTH		PLUNGE		DATE CO	MPLET	ED	50	> 1/>	10	7	
LINE	REF		OFFSET	F	ROCK DE	PTH		· • • • • • • • • • • • • • • • • • • •	١ .	•		
PRO	POSED	HOLE N	UMBER	_] [_v	VATER C	EPTH		NA			_	-,
SUR	VEY SPI	EC			OLE DE	PTH		3.1	^			
			DESCRIPTION	Γ		SAM	PLES				ep.	VANE
TOP DEPTH	BASE DEPTH	SOIL TYPE	COLOR CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTINESS, WATER LOSS OR GAIN, ETC.	TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	SPT BLOW COUNTS	VANE SHEAR (kPa)
$\overline{\bigcirc}$	0.2	Proof	Port-Films									1

1			DESCRIPTION			OAIVI	PLES				SPT	VANE
TOP DEPTH	BASE DEPTH		COLOR CONSSTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTINESS, WATER LOSS OR GAIN, ETC.	TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW COUNTS	SHEAR (kPa)
0	0.2	Pecot	'Horst - Fibracis									
										_		
クル	1.5	8M	Sand-Silty, PG, FG, COMP Compact (Intered) Aron									
		_	Compact (Inferred) Arom	0.3	0.8]	4S					
				114	1.5	<u> </u>	EC					
15	3:1	SP	Sand-PG, FG, edity. Compact (Interved), From								<u> </u>	<u></u>
			Trace Sund	٠	_				-			
				2.2	5.3	_\$_	EZ		··			
		•	Tradulat Disa to	2 7	3.1	¥	FC					
			Installed Diteo to	3,0	2/1	<u> </u>	<i>1</i> - \.					
	-		10HO 3H4								-	_
												_
							<u> </u>					

SAMPLING I	METHOD	SHIPPING	CONTAINER	INSPECTOR BP		
A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL	E - AUGER CUTTINGS F - WASH G - BULK SAMPLE H - BLOCK SAMPLE	N - LINER 0 - TUBE P - MOISTURE TIN G - GLASS JAR	R - PAIL f S - PLIOFILM W - WAXED Z - DISCARDED	DATE SHIFT	800/12/09 Day	

MANITOBA HYDRO

PROJECT	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	Keeyask
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH-09-09	3.1	

	N-A
NORTH 6254942	EAST 0343760
ELEV G/S	DATUM
AZIMUTH	PLUNGE

CONTRACTOR	MANUEL POHOCK
DRILLER	wode
DRILLING METHOD	XXX SSA
DRILL NAME	Romer
DATE STARTED	Sep/12/09
DATE COMPLETED	SED/P/09
ROCK SURFACE	A)A
GROUNDWATER	NA
END OF HOLE	21

	WELL DETAILS	ОЕРТН (ft.)	WELL CONSTRUCTION DETAILS
PROTECTIVE CASING Diameter: Type: Interval: RISER CASING Diameter: 11/4/11 Type: PV C		TPC 2US TRC 0.0 GS	
GROUT Type: Mix Ratio: Quantity:			
SEAL Type: EPM Quantity: 1669			
SANDPACK Type: SOCK Quantity: 2.5 SCREEN			
Diameter: 11/4 11 Type: PVC Interval: 2.5			
TPC TOP PROTECT CASING TRC TOP OF RISER CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN EOH END OF HOLE		10 BSC	
		10 EON	

MANITOBA HYDRO

CIVIL ENGINEERING
MATERIALS & FIELD SERVICES

Field Overburden Log

PROJECT 09 Keeyask Geotechnical Investigation

I KOBEOT OO KO	Cydok Coolcoilin	our invoorigation
HOLE NO.	HOLE DEPTH	PAGE
TH-09-10	6.1	[OF/

	CONTRACTOR Paddock Drilling Ltd
	DRILLER Wade
•••	DRILLING METHOD SSA, DE
NORTHING 6254474 EASTING 03U3838	DRILL NAME Acker-Soil Sentry Ranges
ELEV DATUM	DATE STARTED SCP/12/07
AZIMUTH PLUNGE	DATE COMPLETED SOP 1/2/09
LINE REF OFFSET	ROCK DEPTH
PROPOSED HOLE NUMBER	WATER DEPTH NA
SURVEY SPEC.	HOLE DEPTH (G:/

	_		DESCRIPTION	SAMPLES						SPT	VANE	
TOP DEPTH			TYPE CLOR CONSTIDICY, STRUCTURE WATER CONTENT, PLASTICITY, COMPACTINESS, WATER LOSS OR GAIN, ETC.		BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW COUNTS	SHEAR (kPa)
0	012	POK	Prot - Fibral						*			
03	6.1	8m	Sand-Silty FG. PG, Canied (Infirited), Riocus, change		• 2		1-0					
			(Infiered), Riow, MMP	0.7	0.8	_!	FS					
			- MOIST & 3.0M	1.4	1.5	2	ES					
				2.2	ે ઢહે	3	ES					
			- Wet & 4.5m, MC							-		
				30	3.1	Ч	£-50					
			Trefulled Pizzo +0	-						-		
			Sciren 2.5	3.7	3,8	5	Eq					
			Hole Slorghen +D	4,5	'ዛ .ይ	6	Es					
<u> </u>			3.6M							-		
				5,2	5.3	7	ES					
			EOH @ 6.1	<i>(</i> '		İ						
				6,0	6.1	8	63				<u> </u>	
		<u> </u>	2 hag EPM									
		<u> </u>				! !						
į.	I	I		l	1 (1 .		ı	l		1 1

SAMPLING N	METHOD	SHIPPING	CONTAINER	INSPEC	TOR B
A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL	E - AUGER CUTTINGS F - WASH G - BULK SAMPLE H - BLOCK SAMPLE	N - LINER 0 - TUBE P - MOISTURE TIN G - GLASS JAR	R - PAIL S - PLIOFILM W - WAXED Z - DISCARDED	DATE SHIFT	Sopt/12/09 Day
D-CORE BARREL +	H - BLOCK SAMPLE	G - GLASS JAK	Z-DISCARDED	U Oi III I	

MANITOBA HYDRO

PROJECT	XXXXXXXXXXX	KERVOS IC
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH-09-10	6:1	

LOCATION	
NORTH 6254974	EAST 0343838
ELEV G/S	DATUM
AZIMUTH	PLUNGE
INSTRUMENT IDENTIFICATION N	IUMBERS

CONTRACTOR	Market Pretholy
DRILLER	wee
DRILLING METHOD	XXX SCA
DRILL NAME	Ranger
DATE STARTED	200/12/09
DATE COMPLETED	400/12/09
ROCK SURFACE	RA
GROUNDWATER	λÀ
END OF HOLF	

		, ,	
	WELL DETAILS	DEPTH (ft.)	WELL CONSTRUCTION DETAILS
PROTECTIVE CASING Diameter: Type: Interval: RISER CASING Diameter: /// Type: WC GROUT Type:		1PC 410 TRC 0.0 GS	
Mix Ratio: Quantity:			
SEAL Type: FPM Quantity: 2 bogs			
SANDPACK Type: SOCK Quantity: 2.5'			
SCREEN Diameter: 1/4 Type: Interval:			
TPC TOP PROTECT CASING TRC TOP OF RISER CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN EOH END OF HOLE		I5 BSC	,
		ඉ <u>ර</u>	

MANITOBA HYDRO

CIVIL ENGINEERING MATERIALS & FIELD SERVICES

Field Overburden Log

PROJECT 09 Keeyask Geotechnical Investigation

HOLE NO.	HOLE DEPTH	PAGE				
TH-09-11	6.1) OF /				

		CONTRACTOR Paddock Drilling Ltd
		DRILLER Wade
	• •	DRILLING METHOD SSA, 1919
NORTHING 6256011	EASTING 0343747	DRILL NAME ACKERSON SENTER ROBET
ELEV	DATUM	DATE STARTED Sep /12 109
AZIMUTH	PLUNGE	DATE COMPLETED SED / 12/09
LINE REF	OFFSET	ROCK DEPTH
PROPOSED HOLE NUMBER		WATER DEPTH NA
SURVEY SPEC.		HOLE DEPTH 6.1M
·		

			DESCRIPTION	SAMPLES						SPT	VANE	
TOP DEPTH	BASE DEPTH	SOIL TYPE		TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW COUNTS	SHEAR (kPa)
0	50	Root	That - Fibroac									
02		SM	Sond-8:114:16, FG, Idonas Compact Conferred, Bran	Δ Δ.	6.8	· 	ES		•			
		_	SIMPOCL CHILDTEN, STAM.	())4	018		w					
		_		1,4	1.5	2	EC					
			- Moist + 1.5m	•		-						
<u></u>				2.2	<i>3</i> 13	3	ES	· · · · · ·				
			-wet & 31m	3.20	> i		ER					
		<u>-</u>	- Medium Brained & 4.6	3,0	2.1	<u> </u>	۲,\					
			Slooghed +79'	3.7	3,8	5	ES					
			Installed well to 12:5' 2.5' of Roma	4:5	4.6	6	EB					
				5.2	5,3	7-	FS					
			(0HQ) 6.12	6.0	6.1	8	ES					
										<u> </u>		

SAMPLING	METHOD	SHIPPING	CONTAINER ·	INSPECT	TOR B
A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL	E - AUGER CUTTINGS F - WASH G - BULK SAMPLE H - BLOCK SAMPLE	N - LINER 0 - TUBE P - MOISTURE TIN G - GLASS JAR	R - PAIL S - PLIOFILM W - WAXED Z - DISCARDED	DATE	SOD/D/09 Dev/ -

MANITOBA HYDRO

PROJECT	Løgtayligtøg	Keevask
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH-09-11	611	

LOCATION	

NORTH 6255011	EAST 0343747
ELEV G/S	DATUM
AZIMUTH	PLUNGE
INSTRUMENT IDENTIFICATION	NUMBERS

CONTRACTOR	PORTOCK PORTOCK
DRILLER	uade
DRILLING METHOD	38A
DRILL NAME	Ronaer
DATE STARTED	SCP/12/69
DATE COMPLETED	Sep /12/09
ROCK SURFACE	NA
GROUNDWATER	NA
END OF HOLE	61

	WELL DETAILS	DEPTH (ft.)	·	WELL CONSTRUCTION DETAILS
PROTECTIVE CASING Diameter: Type: Interval: RISER CASING Diameter: 11/4 11 Type: PV C		54,70 0.0	TPC TRC GS	
GROUT Type: Mix Ratio: Quantity:				
SEAL Type: EPM Quantity: 2 SANDPACK				
Type: SOCK Quantity: 2,51 SCREEN				
Diameter: 1"/4" Type: PVC Interval: 2,5 TPC TOP PROTECT CASING			7.17.17.17.17.17.17.17.17.17.17.17.17.17	
TRC TOP OF RISER CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN EOH END OF HOLE		<u>1215</u>	BSC	y T
		1215	ЕОН	

MANITOBA HYDRO

CIVIL ENGINEERING MATERIALS & FIELD SERVICES

Field Overburden Log

PROJECT 09 Keeyask Geotechnical Investigation
HOLE NO. HOLE DEPTH PAGE TH-09-12 3.1 OF/

			7
		CONTRACTOR Paddock	Drilling Ltd
		DRILLER Wade	
		DRILLING METHOD SSA,	
NORTHING 62	55047 EASTING 0343775	DRILL NAME - Achor So	I Sentry Ronger
ELEV	DATUM	DATE STARTED SP ///	
AZIMUTH	PLUNGE ·	DATE COMPLETED SOS///	109
LINE REF	OFFSET	ROCK DEPTH	
PROPOSED HOLE	NUMBER	WATER DEPTH	
SURVEY SPEC.		HOLE DEPTH 3.1	
	DESCRIPTION	SAMPLES	

700		2011	DESCRIPTION			SAM	PLE\$				SPT	VÂNE
TOP DEPTH	BASE DEPTH	SOIL TYPE	COLOR CONSSTENCY, STRUCTURE WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW COUNTS	SHEA (kPa)
0	0.1	Pat	Hot-Flores		-	<u></u>						
ا، ر	1.5	CI	Clav-81/ty, MP. FM. Miss									
			Clay -81/ty, MP. F.M. Moish Bronen	9	0.8	1 -	E8			0.73	-	
				1,4	115	2	£33			0.5		
15	3.1	ML	Bilt - (P.MOIS, F.M., Rosser. Trace Clay	2.2	2ス	ζ	FR					_
			Mars. Gay	ی ک	<u> </u>		1.5					-
				30	3.1	Ų	يخر					
			Installed Pizo 10° 2.5' of Screen					/				_
			1.5 of odeex									
						-						_
			i									_

SAMPLING N	METHOD	SHIPPING	CONTAINER	INSPECTOR BD/CT.		
A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL	E - AUGER CUTTINGS F - WASH G - BULK SAMPLE H - BLOCK SAMPLE	N - LINER 0 - TUBE P - MOISTURE TIN G - GLASS JAR	R - PAIL F S - PLIOFILM W - WAXED Z - DISCARDED	DATE SHIFT	seP/2/09 Day	
					/	

MANITOBA HYDRO

PROJECT	XXXXXXXXXX	Keevask
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH -09-12	3.1.	

LOCATION	

NORTH 6255048	EAST 0343775
ELEV G/S	DATUM
AZIMUTH	PLUNGE
INSTRUMENT IDENTIFICATION NU	JMBERS

CONTRACTOR	AND PACKOCK
DRILLER	aboe
DRILLING METHOD	188 A
DRILL NAME	Ramer
DATE STARTED	800/12/09
DATE COMPLETED	SCP12/09
ROCK SURFACE	NA.
GROUNDWATER	NA
END OF HOLE	10

	WELL DETAILS	DEPTH (ft.)	WELL CONSTRUCTION DETAILS
PROTECTIVE CASING Diameter: Type: Interval: RISER CASING Diameter: \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		7PC 2.5 TRC 0.0 GS	
GROUT Type: Mix Ratio: Quantity:			
SEAL Type: EPM Quantity: 1 50-9 SANDPACK Type: Silica			
Quantity: 0.5 SCREEN Diameter: 1'/y' Type: PVC Interval: 2.5			
TPC TOP PROTECT CASING TRC TOP OF RISER CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN EOH END OF HOLE		10 BSC	
		10 EOH	

MANITOBA HYDRO

CIVIL ENGINEERING MATERIALS & FIELD SERVICES

Field Overburden Log

PROJECT 09 Keeyask Geotechnical Investigation
HOLE NO. HOLE DEPTH PAGE

HOLE NO. HOLE DEPTH PAGE

TH-09-13 4.6 1 OF 1

	CONTRACTOR Paddock Drilling Ltd
	DRILLER USSC
**!	DRILLING METHOD 93
NORTHING (, 254890 EASTING 03439/2	DRILL NAME DANGET
ELEV DATUM	DATE STARTED SON DICH
AZIMUTH PLUNGE	DATE COMPLETED SONT 12/09
LINE REF OFFSET	ROCK DEPTH
PROPOSED HOLE NUMBER	WATER DEPTH NA
SURVEY SPEC.	HOLE DEPTH 14,6
	CAMPIEC

		0011	DESCRIPTION	SAMPLES			SPT	VANE				
TOP DEPTH	BASE DEPTH	FPTH TYPE PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.		TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW COUNTS	SHEAR (kPa)
Q	1,5	ML	SiH- LP: FIME-SIFF. MO: 49, Brown, Some Clay						··-			
			Brown, samp clar	07	0.8		FS			1.0		\vdash
				1.4	1.7	2	FS			1.0		
1:5	4.6	SM	Sand - PG, FG, Compact. (Interred), domp, Brown, Samo Sand									
			emo exand	スユ	23	3_	Ė					
			NO Slowazind	30	31	4	<u>E3</u>					
			Petrolating well Installed to 5'									
			Pizzo installed 10'	3,7	3,8	5	FS		<u></u>			
	-		25' of 90100U							· · · · · · · · · · · · · · · · · · ·		
				4,5	4.6	6	ES					
					-			-				

Į	SAMPLING N	METHOD	SHIPPING	CONTAINER	INSPECTOR KY / F		
	A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL	E-AUGER CUTTINGS F-WASH G-BULK SAMPLE H-BLOCK SAMPLE	N - LINER 0 - TUBE P - MOISTURE TIN G - GLASS JAR	R - PAIL F / S - PLIOFILM W - WAXED Z - DISCARDED	DATE	401. T12/09	

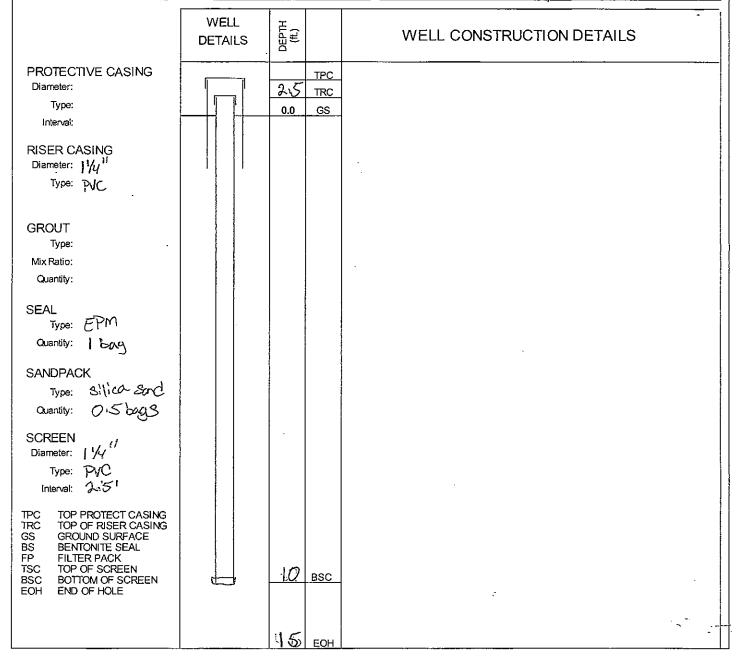


MANITOBA HYDRO

PROJECT	Keeyas K	
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH-09-13	4.6	

LOCATION		
NORTH 6254890	EAST	0343912
ELEV G/S	DATUM	•
AZIMUTH	PLUNGE	
INSTRUMENT IDENTIFICATION NU	JMBERS	,

CONTRACTOR	Paddock Drilling LTD	
DRILLER	wode	
DRILLING METHOD	88A	
DRILL NAME	Ronae	
DATE STARTED	Sep 412109	
DATE COMPLETED	Sep/12/09	
ROCK SURFACE	•	
GROUNDWATER	NA_	
END OF HOLE	4.6	



MANITOBA HYDRO

PROJECT	Keeyask	
HOLE NO.	DEPTH	No. of INSTRUMENTS
TA-60-1ZA	51	

LOCATION	180	80th of	TH-09-13
		•	•
	-		
NORTH		EAST	
ELEV G/S		DATUM	
AZIMUTH		PLUNGE	
INSTRUMENT	IDENTIFIC	ATION NUMBERS	
	_	• • • • • • • • • • • • • • • • • • • •	

CONTRACTOR	Paddock Drilling LTD	
DRILLER	Wode	
DRILLING METHOD	SSA	·
DRILL NAME	ROPORT	
DATE STARTED	Septia 109	
DATE COMPLETED	SOP/12/09	
ROCK SURFACE	<i>W</i> A	
GROUNDWATER	A X4-	
END OF HOLE	W.R.	

•	WELL E	(4)	WELL CONSTRUCTION DETAILS
PROTECTIVE CASING Diameter: Type: Interval: RISER CASING Diameter: 4" Type: PVC	0.4	TPC TRC O GS	
GROUT Type: Mix Ratio: Quantity:			
SEAL Type: EPM Quantity: 2.5			
SANDPACK Type: Silica Sand Quantity: 015 bulls			
SCREEN Diameter: Type: Interval:			
TPC TOP PROTECT CASING TRC TOP OF RISER CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN EOH END OF HOLE	31-1 Rea Grove	/Ö BSC	3
	5	EOH	

MANITOBA HYDRO

CIVIL ENGINEERING MATERIALS & FIELD SERVICES

Field Overburden Log

PROJECT 09 Keeyask Geotechnical Investigation

10000100	dyddic dddinii	cai iii octigatioi
HOLE NO.	HOLE DEPTH	PAGE
T#-09-14	4.6	1. OF /

•		CONTRACTOR	Paddock Drilling Ltd
-		DRILLER	wode
		DRILLING METHOD	8S/A
NORTHING	6254860 EASTING 0344001.	DRILL NAME	Rungei
ELEV	DATUM	DATE STARTED	Red 12 109
AZIMUTH	PLUNGE	DATE COMPLETED	SED/12/10-9
LINE REF	OFFSET	ROCK DEPTH	
PROPOSE	O HOLE NUMBER	WATER DEPTH	NA
SURVEY SI	PEC.	HOLE DEPTH	4.6

VANE	SPT				PLES	SAM			DESCRIPTION			
/ SHEAR	BLOW	PEN (kPa)	REC ()	DIA ()	TYPE	NO.	BASE DEPTH	TOP DEPTH	COLOR CONSCIENCY, STRUCTURE WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	SOIL 6	BASE DEPTH	TOP DEPTH
					ES	. !	0.8	0.7	Bilt-LP, domp. Firm, Proun, Trave Sund	M(.	3.1	0
		i i			ES	2	1.5	1,4	T			
			_		_	· · · · · · · · · · · · · · · · · · ·			Trace Clay & lism	1/1		
					FR	ર્	23	2,2	Sand-Silty, FG, PG, demo,	SM S	416	3.1
					Fa	Ÿ	3.1	3.0	amport (Tationed), 12 Tourn			
					ES	3	3,8	3.7	Freshled Percubiting Well to 5'			-
		`			EC	6	4.6	425	Installed Pieto 10 16' 5' of Scien on the	5		
									polim	b		
					£.s	3	3,8	3.7	to 5' Taskalled Piezo to ht'	Transition of the state of the		

SAMPLING METHOD		' SHIPPING	CONTAINER	INSPECTOR BD		
A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL	E - AUGER CUTTINGS F - WASH G - BULK SAMPLE H - BLOCK SAMPLE	N - LINER 0 - TUBE P - MOISTURE TIN G - GLASS JAR	R - PAIL S - PLIOFILM W - WAXED Z - DISCARDED	DATE SHIFT	300/12/09 Day	

Date Printed: 2007 10 24

Field: Unsigned

Lab: Unsigned

Report Unsigned

MANITOBA HYDRO

PROJECT	Keeyask	
HOLE NO.	DEPTH	No. of INSTRUMENTS
TU-00-111	11.6	

LOCATION	

NORTH 6254860	EAST 0344001
ELEV G/S	DATUM
AZIMUTH	PLUNGE
INSTRUMENT IDENTIFICATION N	IUMBERS

CONTRACTOR	Paddock Drilling LTD	
DRILLER	wode,	
DRILLING METHÓD	88A	
DRILL NAME	Romet	
DATE STARTED	807/12/09	
DATE COMPLETED	Scir/12/09	
ROCK SURFACE	`NA	
GROUNDWATER	NA	
END OF HOLE	4.6	

	WELL DETAILS	DEPTH (ft.)	WELL CONSTRUCTION DETAILS
PROTECTIVE CASING Diameter: Type: Interval: RISER CASING Diameter: I '/u' Type: PV C		#.○ TF	
GROUT Type: Mix Ratio: Quantity:			
SEAL Type: EPM Quantity: 1 5 ag SANDPACK Type: Silica Good	- - - - - - - - - -		
Cuantity: bdg SCREEN Diameter: Yy ¹¹ Type: 7) C Interval: 5			
TPC TOP PROTECT CASING TRC TOP OF RISER CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN EOH END OF HOLE		15 BS	<u>c</u>
		15 E	DH

MANITOBA HYDRO

PROJECT	Keeyos K	
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH OO -ILLA	<u> </u>	<u> </u>

Im south OF THHO9-1
EAST
DATUM
PLUNGE
NTIFICATION NUMBERS
_

CONTRACTOR	Paddock Drilling LTD	
DRILLER	wode	
DRILLING METHOD	88A	
DRILL NAME	Ronaet	
DATE STARTED	SCD /12/09	
DATE COMPLETED	Sep/p/09	
ROCK SURFACE	NA	
GROUNDWATER	NA	
END OF HOLE	5	

	WELL E	WELL CONSTRUCTION DETAILS
PROTECTIVE CASING Diameter: Type: Interval: RISER CASING Diameter: U11 Type: PVC	3.0 TR 0.0 GS	
GROUT Type: Mix Ratio: Quantity: SEAL		
Type: EPM Quantity: 2.5 SANDPACK Type: Silica sond Quantity: 0:5 bags		
SCREEN Diameter: Type: Interval: TPC TOP PROTECT CASING TRC TOP OF RISER CASING GS GROUND SURFACE	3-D" TS	
BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN EOH END OF HOLE	Pen govel 4'40" BSC	

MANITOBA HYDRO

CIVIL ENGINEERING
MATERIALS & FIELD SERVICES

Field Overburden Log

PROJECT 09 Keeyask Geotechnical Investigation

	-,	
HOLE NO.	HOLE DEPTH	PAGE
TH-09-151	4.6	/ OF /

		CONTRACTOR Paddock Drilling Ltd
		DRILLER Wade
		DRILLING METHOD SSA
NORTHING 625	4864 EASTING 0344/6	26 DRILL NAME ROMARY
ELEV	DATUM	DATE STARTED CON 7/1/09
AZIMUTH	PLUNGE	DATE COMPLETED SED/11/09
LINE REF	OFFSET	ROCK DEPTH
PROPOSED HOLE N	UMBER	WATER DEPTH 11/7
SURVEY SPEC.		HOLE DEPTH 46
		CAMPLES

			DESCRIPTION	SAMPLES						SPT	VANE	
TOP DEPTH	BASE DEPTH	SOIL TYPE	COLOR CONSISTENCY, STRUCTURE WATER CONTENT. PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW	SHEAR (kPa)
0	0.06	OL	organic Clay (TOPSD://									
				0.7	- 0	3	150					
0.06	1,6	ML	S: It - Clayer, very soft, LP.	O _{rt}	- O 18		ES					
			S: It :- Clayey, very soft, LP, Moist, TAW-Drown, Trace Sind), <i>U</i>	1.5	2	B					
1.6	<u>ي. ا</u>	&M	Sand - Sitty FG, PG. Dry, Brown, Consact Total	2.2	ત્રસ્	3	E3					
				ļ	311	Ц	المار					
			Slarghed to 2.3 m									
				3,7	3.8	5	ES					
				4,5	416	6	ES					
									·			

SAMPLING	METHOD	SHIPPING	CONTAINER	INSPEC	TOR BP
A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL	E - AUGER CUTTINGS F - WASH G - BULK SAMPLE H - BLOCK SAMPLE	N - LINER 0 - TUBE P - MOISTURE TIN G - GLASS JAR	R - PAIL S - PLIOFILM W - WAXED Z - DISCARDED	DATE	Sep/11/09

Date Printed; 2007 10 24 Feld: Unsigned Lab: Unsigned Report: Unsigned Report Unsigned

MANITOBA HYDRO

CIVIL ENGINEERING MATERIALS & FIELD SERVICES

Field Overburden Log

PROJECT 09 Keeyask Geotechnical Investigation
HOLE NO. HOLE DEPTH PAGE TH-09-16 OF

		CONTRACTOR Paddock Drilling Ltd	
		DRILLER Wode	
		DRILLING METHOD 89 A	
NORTHING (25:	5073 EASTING ORUYOOI	DRILL NAME ROCK	
ELEV	DATUM	DATE STARTED SED/ 12/09	
AZIMUTH	PLUNGE	DATE COMPLETED SED / 12 / 17	
LINE REF	OFFSET	ROCK DEPTH	
PROPOSED HOLE NU	MBER	WATER DEPTH NA	
SURVEY SPEC.		HOLE DEPTH 3.)	

		- 011	DESCRIPTION	SAMPLES					SPT	VANE		
TOP DEPTH	BASE DEPTH	SOIL TYPE	COLOR CONSSIENCY, STRUCTURE WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW COUNTS	SHEAR (kPa)
0	012	Peat	Prof-Fibrous									
02	3.1	CI	Clay-8: Ity, MP, Fioren				()					
			biscon '	07	0.8	!	(2)					
			- Firm, moist & li4m	1.4	1.5	2	ĖS			0.E	<u></u>	
			Grey & 2,1m.	2,2	2.3	,X	E.S			05		
			Installed 10' Pieto 2.5' of Scien	3.0	3:1	Ч	ES			0:5	-	
											-	
											-	
			6						_		_	
											_	

B-THIN WALL TUBE F-WASH 0-TUBE S-PLIOFILM DATE C-AUGER BARREL G-BULK SAMPLE P-MOISTURE TIN W-WAXED	SAMPLING METHOD		SHIPPING	CONTAINER	INSPEC	TOR 31
D-CORE BARREL H-BLOCK SAMPLE G-GLASS JAR Z-DISCARDED SHIFT		TUBE F-WASH RRREL G-BULK SAMPLE	0 - TUBE P - MOISTURE TIN	S - PLIOFILM W - WAXED	DATE	2004/12/09 12/4



INSTRUMENT COMPLETION DIAGRAM

PROJECT	XXXXXXXXXXX	Keeyask
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH -09-16	2.1	

LOCATION	

NORTH 6255073	EAST 0344001
ELEV G/S	DATUM
AZIMUTH	PLUNGE
INSTRUMENT IDENTIFICATION NUM	BERS

CONTRACTOR	MANAX Podrock
DRILLER	work
DRILLING METHOD	ABB, SBA
DRILL NAME	Ronaer
DATE STARTED	Sep/12/09
DATE COMPLETED	302/12/09
ROCK SURFACE	"NA
GROUNDWATER	NA
END OF HOLE	3.1

1			
	WELL DETAILS	DEPTH (ft.)	WELL CONSTRUCTION DETAILS
PROTECTIVE CASING Diameter: Type: Interval: RISER CASING Diameter: 1 / 4 1 Type: PV C		TPC 3.1) TRC 0.0 GS	
GROUT Type: Mix Ratio: Quantity:			
SEAL Type: EPM Quantity: 1 bag			
SANDPACK Type: Silica Sand Quantity: 0.5			
SCREEN Diameter: 1'/4' Type: PVC Interval: 2.5			
TPC TOP PROTECT CASING TRC TOP OF RISER CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN EOH END OF HOLE		10 BSC	ī
		[(`) EOR	1

人

MANITOBA HYDRO

CIVIL ENGINEERING MATERIALS & FIELD SERVICES

Field Overburden Log

PROJECT 09 Keeyask Geotechnical Investigation

1100201 00 10	oyaon ootoonin	oar mroonganc
HOLE NO.	HOLE DEPTH	PAGE
TH-09-17	3.12	/ OF /

		CONTRACTOR	Paddock Drilling Ltd
		DRILLER	wade
	* %5	DRILLING METHOD	884
NORTHING 6255103	EASTING (534 4064)	DRILL NAME	Romer
ELEV	DATUM	DATE STARTED	sept /11/07
AZIMUTH	PLUNGE	DATE COMPLETED	3001/11/09
LINE REF	OFFSET	ROCK DEPTH	
PROPOSED HOLE NUMBER		WATER DEPTH	1/2
SURVEY SPEC.		HOLE DEPTH	3,1m

700		2011	DESCRIPTION			SAM	PLES]	SPT	VÂNE
	BASE DEPTH	PTH TYPE PASTIOTY, COMPACTNESS WATER LOSS OR GAIN, ETC.		TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW	SHEAR (kPa)
0	02	food	Peat-Fibrous									
			:									
02	3.1	CI	Clay-Rilly, MP. Froton	08	0,8	- f s	FS					
				1,4	11.5	2	FS					
			Installed 4" PUC. 5'-3'0F Stirking 1'					i		}		
			of softed	2,2	2.3	3	ES			:		
			FOH@ 31m	· ろ, <i>O</i>	ڊرڊ. - ب	<u>y</u> .	(=,5					
						-						
							_		-			
							!		_			

SAMPLING N	SAMPLING METHOD SHIPPING CONTAINER			INSPECT	FOR RP	
A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL	E - AUGER CUTTINGS F - WASH G - BULK SAMPLE H - BLOCK SAMPLE	N - LINER 0 - TUBE P - MOISTURE TIN G - GLASS JAR	R - PAIL S - PLIOFILM W - WAXED Z - DISCARDED	DATE SHIFT	Sep/11/09 Day	,

Report Unsigned

INSTRUMENT COMPLETION DIAGRAM

PROJECT	XXXXXXXXXX	Keevasik
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH-09-17	3.1m	

LOCATION	<u> </u>
<u> </u>	
	5-th
NORTH 6255103	EAST 034406
ELEV G/S	DATUM
AZIMUTH	PLUNGE
INSTRUMENT IDENTIFICATION	NUMBERS

TPC

TRC

GS

CONTRACTOR	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
DRILLER	wode
DRILLING METHOD	88A
DRILL NAME	Ronaet
DATE STARTED	3est/11/09
DATE COMPLETED	300t/11/09
ROCK SURFACE	iA
GROUNDWATER	NA
END OF HOLE	3.1m

WELL DEPTH (ft.) **DETAILS** PROTECTIVE CASING Diameter: Type: 0.0 Interval: RISER CASING Diameter: UII Type: PUC **GROUT** Type: Mix Ratio: Quantity: SEAL Type: LPM Quantity: SANDPACK Type: Silica 1.5 pags Quantity: **SCREEN** Diameter: Туре: Interval: TPC TRC GS BS FP TSC BSC EOH TOP PROTECT CASING TOP OF RISER CASING GROUND SURFACE BENTONITE SEAL FILTER PACK TOP OF SCREEN BOTTOM OF SCREEN END OF HOLE 4'-10" BSC Peas drawed

WELL CONSTRUCTION DETAILS



CIVIL ENGINEERING MATERIALS & FIELD SERVICES

Field Overburden Log

PROJECT 09 Keeyask Geotechnical Investigation

HOLE NO. HOLE DEPTH PAGE

7H - 09 - 18 31 | 06 |

		CONTRACTOR Paddock Drilling Ltd
		DRILLER Wade
	***y	DRILLING METHOD SSA
NORTHING 6255031	EASTING 0344097	DRILL NAME ROSSE
ELEV	DATUM	DATE STARTED AP/11/04
azimuth	PLUNGE	DATE COMPLETED SOLVII 169
LINE REF	OFFSET	ROCK DEPTH
PROPOSED HOLE NUMBER		WATER DEPTH SUFFACE
SURVEY SPEC.		HOLE DEPTH Z,)

			DESCRIPTION			SAM		SPT	VANE			
TOP DEPTH	BASE DEPTH	SOIL TYPE	COLOR CONSISTENCY, STRUCTURE WATER CONTENT, PLASTICITY, COMPACTINESS, WATER LOSS OR GAIN, ETC.	TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW	SHEAR (kPa)
0	0,2	Poot	Peat-Filians									
			_					<u></u>				
~			011	<u> </u>	ļ							
0.2	3 11	ML	Silt-N-LP, Very soft, Wet TAN, Trace +0	-	2		7-0	<u>. </u>	ļ .			
		-	WEEL TAN, IFACE TO	0.7	03	_!_	EB					
 			Same 200	1								+
				1.4	1.5	2	F.3					 -
	-		Clay Seem (P) 2.2M	† '	1							
			Clay Sein @) 7.2n	<u> </u>								
				2.7	23	.3	FS					
								<u> </u>				
<u> </u>			Sleppled into sottice	1								<u> </u>
					71	Ч	170					
				3.77	311	<u> </u>	15					-
-				 								
						· · · · ·						
			:	†								 ,
			FAH (20) 3.1M									
			·	<u> </u>								
				<u> </u>								
 				 						<u> </u>		
											<u></u>	+
				1		· ····	-	 -		1	-	+-+
	·											+
	L .			1	1				L	<u>. </u>		

A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL D - CORE BARREL B - AUGER CUTTINGS F - WASH O - TUBE S - PLIOFILM S	SAMPLING N	METHOD	SHIPPING	CONTAINER	INSPE	CTOR BP.	
	B - THIN WALL TUBE C - AUGER BARREL	F - WASH G - BULK SAMPLE	0 - TUBE P - MOISTURE TIN	S - PLIOFILM W - WAXED		30/11/01	-

Date Printed: 2007 10 24 Field: Unsigned Lab: Unsigned

Report Unsigned



CIVIL ENGINEERING MATERIALS & FIELD SERVICES

Field Overburden Log
PROJECT 09 Keeyask Geotechnical Investigation

1000001 00 100	Cyask Ceoleciiii	icai ii wesiigalio
HOLE NO.	HOLE DEPTH	PAGE
TH - 09- 19	3.	(OF /

		CONTRACTOR Paddock Drilling Ltd
		DRILLER Wade
<u>. </u>		DRILLING METHOD SS/T
<u> </u>	015 EASTING 034396	DRILL NAME Rand CT
	DATUM	DATE STARTED SP711/09
	PLUNGE	DATE COMPLETED Sep/11/04
	OFFSET	ROCK DEPTH
UN	BER	WATER DEPTH NA
		HOLE DEPTH 3:

700	DA 05	2011	DESCRIPTION			SAM	PLES				SPT	VANE
TOP DEPTH	BASE DEPTH	SOIL TYPE		TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA ()	REC ()	PEN (kPa)	BLOW COUNTS	SHEAR (kPa)
0	1.5	ML	8:14-CP, Moist, verysit,									
-			Ton, Sine Sand						_, _,			
			- Wet 4 1.5m	0.7	0,8	_1	ÆS					
				7.Y	1.5	2	ES					
1.5	3.1	SM	Bard-Bilty, Pro, FMG.									
			Bard-Rilty, Pro, F-MG. upt. TSTOWN, COMDOCT (Inflood)	2.2	2-3	3	ES					
				,								
			4" well Installed 10 5" with 3" AF	ぶり	3.1	Ч	E. (?					
			Stickers, hotton I's									
			hole Sloughed @									
			//) ^									
		_	FOH(2) 3.1m									
								· · · · -				

SAMPLING N	METHOD	SHIPPING	CONTAINER	INSPECTOR R			
A - SPLIT TUBE B - THIN WALL TUBE C - AUGER BARREL D - CORE BARREL	E - AUGER CUTTINGS F - WASH G - BULK SAMPLE H - BLOCK SAMPLE	N - LINER 0 - TUBE P - MOISTURE TIN G - GLASS JAR	R - PAIL S - PLIOFILM W - WAXED Z - DISCARDED	DATE SHIFT	Sep/11/09	_	

Date Printed: 2007 10 24

Field: Unsigned

Lab: Unsigned

Report: Unsigned

人

MANITOBA HYDRO

INSTRUMENT COMPLETION DIAGRAM

PROJECT	XXXXXXXXXX	Keeya8K
HOLE NO.	DEPTH	No. of INSTRUMENTS
TH-09-19	3,	

LOCATION	,	
	-	÷ .
NORTH 6255015	EAST (0343961
ELEV G/S	DATUM	
AZIMUTH	PLUNGE	
INSTRUMENT IDENTIFICATION	NUMBERS	

CONTRACTOR	********** Padrick
DRILLER	wade
DRILLING METHOD	XXX SSA
DRILL NAME	Ronder
DATE STARTED	. SCP 711/09
DATE COMPLETED	Sep/11/09
ROCK SURFACE	WA
GROUNDWATER	•
END OF HOLE	3.1

WELL DEPTH (ft.) WELL CONSTRUCTION DETAILS **DETAILS** PROTECTIVE CASING TPC Diameter: TRC Type: 0.0 GS Interval: RISER CASING Diameter: 41 Type: PVC **GROUT** Type: Mix Ratio: Quantity: SEAL Type: EPM Quantity: F box SANDPACK Type: 3:1:ca 1 bod Quantity: **SCREEN** Diameter: Type: interval: 3'-10" TPC TOP PROTECT CASING TRC TOP OF RISER CASING Sow cut GROUND SURFACE BENTONITE SEAL FILTER PACE GS BS FP TOP OF SCREEN BOTTOM OF SCREEN END OF HOLE TSC 41-10" BSC BSC rea grove!

EOH

Civil Engineering

Materials And Field Services

KEEYASK

DE P.T.H	LAYER	S.	PL Moisture M.C.	LL -		Unconfined Vane Shea	ir insitu	ession (LOCATION G-2 ESKER
Н	LAYER DEPTH (ELEV)	PLEN	20 40 60 Standard Penel	80	*	20 Penetrome	(kPa) 40 60 ter (Lab)	80	GRAPHIC	nscs	TERRAN TYPE
(m)	(m)	SAM	Uncorrected Blow C		1	Penetrome	ter (Field (kPa)	} ▼	AS J	5	VEGETATION
-		$\dagger \dagger$			\dashv	20	40 50	80		ρŢ	DESCRIPTION
ŀ										SM	(0.10 - 0.40) SAND, fine, with silt, orange, oxidized, overlain by 0.10 peat
<u> </u>		1	0							CI	(0.40 - 1.20) CLAV trace cond light brown users
Ł		2	o								(0.40 - 1.20) CLAY, trace sand, light brown, varved, occasional sand pockets
F											
F-1											
F	1.20 (178.90)										
- -		3	_							SM	(1.20 - 3.80) SAND, with silt, light brown 1.20 to 3.30 - with subrounded fine gravel
-			0								1.40 to 3.80 - moist
-											
-2											
-					E		17	·M-		, ,	RY
F				И	4		┾╩	, 1		1/4	
-							A A STATE OF THE S				
-											
-3											
<u> </u>											
							***************************************				3.30 to 3.80 - sand is fine grained, and silt
+											
-4											
ļ.											
ļ.											
<u> </u>											
E											
COORDNATES			N, 343962.20 E	AZMUTH			-90.00°	START 199	1 04 25	HOLE	(CAT 229) HOLE
CC			CRD1929 TE LOG	DATUM .	180.	10 ECENT ACRES	ΜΔΝΙ	ITORA	1 04 25	G CHT DATE PRINT	700 OF 12
	***************************************						V IVI/(I V	HODA	LIU	PRUM	RED 2009 06 12 SHEET 1 0≠ 1

FIELD OVERBURDEN LOG

COMPOSITE LOG [new]

PROJECT

HOLE NO. HOLE DEPTH PAGE

G-5017 26.69 1 OF 1

LOCATION G-2 ESKER - WEST 91-213 G-2 ESKER - WEST	C
91-213	DI
	ום
NORTHING 6254671.70 N - ASKING-343882.60 E	M de
ELEV 180.20 DATUM GROUND U CL	4 8
AZIMUTH VERTICAL PLUNGE VERTICAL	D,
LINE REF OFFSET	R
PROPOSED HOLE NUMBER	W
SURVEY SPEC. UTM27-15 CRD1929 Proposed	Н

CONTRACTOR	MIDWEST-RH
DRILLER	MIDWEST-RH
DRILLING METHOD	
ARIANAMA V	Sound Dynamics
BATE STARTED	4/28/1991
DATE COMPLETED	4/28/1991
ROCK DEPTH	Bedrock not identified
WATER DEPTH 🛥	Water Table not identified
HOLE DEPTH	25.69

			DESCRIPTION		-	SAM	PLES				SPT	VANE
TOP DEPTH	BASE DEPTH	SOIL TYPE	COLOR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	TOP DEPTH	BASE DEPTH	NO.	TYPE	DIA (cm)	REC (cm)	PEN (kPa)	BLOW COUNTS	SHEAR (kPa)
0.00			(0.00 - 0.10) Peat, brown, rootlets, wet.									
0.10			(0.10 - 0.30) Clay, brown, and silt, tr.fine									
0.10	0.30	Nbn	sand, frozen, med.dense.									
0.30			(0.30 - 3.20) Sand, It.brown, and silt, fine	0.30	0.30	18	DS					
			grained, uniform, moist, med.dense.									
3.20			(3.20 - 5.40) Sand, lt.brown, tr.silt, uniform,									
***************************************			fine grained, moist, dense.									
5.40			(5.40 - 8.20) Sand, brown, medium to fine									
			grained, damp, med.dense.									
8.20			(8.20 - 10.50) Sand, grey-brown, and silt,									
			tr.clay, medium to fine grained, moist,									
			dense.									
10.50		***************************************	(10.50 - 18.70) Sand, grey, medium									
			grained, damp, medium dense.									
18.70			(18.70 - 23.60) Sand, brown, and silt,									
			tr.gravel, dmap, med.dense.									
23.60			(23.60 - 26.69) Sand, grey, and silt, tr.clay,									
			tr.gravel, damp, med.dense.									
26.69			(26.69) End of Hole.									
			NAD 27									

SAMPLING N	METHOD	SHIPPING (CONTAINER	INSPECTOR P.HILLIUS
A - SPLIT TUBE	E - AUGER CUTTINGS	N - LINER	R - PAIL	FIELD LOG FOR VERIFICATION The sail descriptions and observations are thase observed by the drill inspector and have not been compared to list besting results and are intended for review purposes only.
B - THIN WALL TUBE	F - WASH	0 - TUBE	S - PLIOFILM	
C - AUGER BARREL	G - BULK SAMPLE	P - MOISTURE TIN	W - WAXED	
D - CORE BARREL	H - BLOCK SAMPLE	G - GLASS JAR	Z - DISCARDED	

Lab: Unsigned

Enclosure 2 Laboratory testing data

AECOM

99 Commerce Drive, Winnipeg, Manitoba R3P 0Y7 T 204.477.5381 F 204.284.2040 www.aecom.com

Memorandum

Date:

September 18, 2009

To:

Gil Robinson

From:

Stephen Petsche

Subject:

Keeyask Generating Station – Infrastructure

Project number:

0217-200-07-0300

Distribution:

Attached are testing results for the above noted project. The testing included moisture contents and gradation determination on ten (10) samples collected from TH 09-13, TH 09-14 and TH 09-15. After the moisture contents were determined, the samples were washed over the 0.075 mm sieve, dried and hand sieved until refusal.

If you have any questions, please call.

Sincerely,

Stephen Petsche, C.E.T.

Coordinator, Lab and Technical Services

Attach.

MOISTURE CONTENT

JOB No.: 0217-200-07-0300 DATE: September 18, 2009

CLIENT: Manitoba Hydro TECHNICIAN: SP

PROJECT: Keeyask Generating Station - Infrastructure

HOLE NO.	09-13	09-13	09-13	09-13	09-14	09-14
DEPTH (m)	1.4 - 1.5	2.2 - 2.3	3.0 - 3.1	4.5 - 4.6	2.2 - 2.3	3.0 - 3.1
SAMPLE NO.	ES-02	ES-03	ES-04	ES-06	ES-03	ES-04
MOISTURE CONTENT %	19.2	12.7	6.5	5.1	18.6	19.6
HOLE NO.	09-14	09-15	09-15	09-15		
DEPTH (m)	3.7 - 3.8	2.2 - 2.3	3.0 - 3.1	3.7 - 3.8		
SAMPLE NO.	ES-05	ES-03	ES-04	ES-05		
MOISTURE CONTENT %	12.4	13.1	7.9	10.5		
HOLE NO.						
DEPTH (m)						
SAMPLE NO.						
MOISTURE CONTENT %						
HOLE NO.						
DEPTH (m)						
SAMPLE NO.						
SAMELL NO.						
MOISTURE CONTENT %						
WOOD TO THE CONTINUE TO						

NOTES:

AECOM

MATERIALS LABORATORY AECOM Canada Ltd.

99 Commerce Drive, Winnipeg, MB R3P 0Y7 Canada **tel** (204) 477-5381 **fax** (204) 284-2040

AECOM

MATERIALS LABORATORY

AECOM

99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7

tel (204) 477-5381 fax (204) 284-2040

Client: Manitoba Hydro

Project: Keeyask Gen. Stn. - Infrastructure

Job No: 0217-200-07-0300

Date: 18-Sep-09

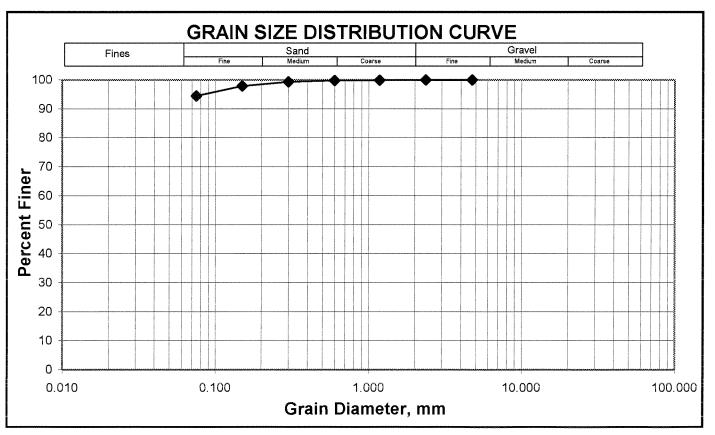
Hole No. 09-13

Sample No. ES-02

Depth: 1.4 - 1.5 m

Sample Description: Silt, Trace Fine Sand

Sieve (mm.)	Sieve No.	Total Percent Passing	Specification (min - max)
100.0	4"		
75.0	3"		
50.0	2"		
37.5	1 1/2"		
25.0	1"		
19.0	3/4"		
16.0	5/8"		
12.50	1/2"		`
9.50	3/8"		
4.75	No.4		
2.36	No.8	100.0	
1.180	No. 16	99.9	
0.600	No.30	99.8	
0.300	No. 50	99.3	
0.150	No. 100	97.9	
0.075	No. 200	94.5	



AECOM

MATERIALS LABORATORY

AECOM

99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7

tel (204) 477-5381 fax (204) 284-2040

Client: Manitoba Hydro

Project: Keeyask Gen. Stn. - Infrastructure

Job No: 0217-200-07-0300

Date: 18-Sep-09

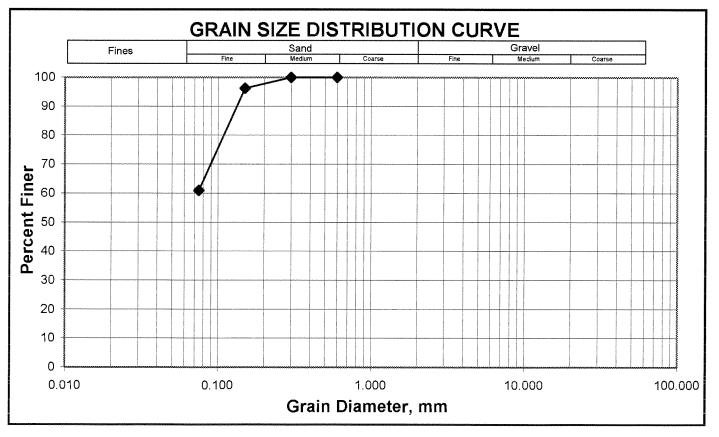
Hole No. <u>09-13</u>

Sample No. ES-03

Depth: 2.2 - 2.3 m

Sample Description: Silt and Sand

Sieve (mm.)	Sieve No.	Total Percent Passing	Specification (min - max
100.0	4"		
75.0	3"		
50.0	2"		
37.5	1 1/2"		
25.0	1"		
19.0	3/4"		
16.0	5/8"		
12.50	1/2"		
9.50	3/8"		
4.75	No.4		
2.36	No.8		
1.180	No. 16		
0.600	No.30		
0.300	No. 50	100.0	
0.150	No. 100	96.3	
0.075	No. 200	61.0	



AECOM

MATERIALS LABORATORY

AECOM

99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7 tel (204) 477-5381 fax (204) 284-2040

Manitoba Hydro

Project: Keeyask Gen. Stn. - Infrastructure

Job No: 0217-200-07-0300

Client:

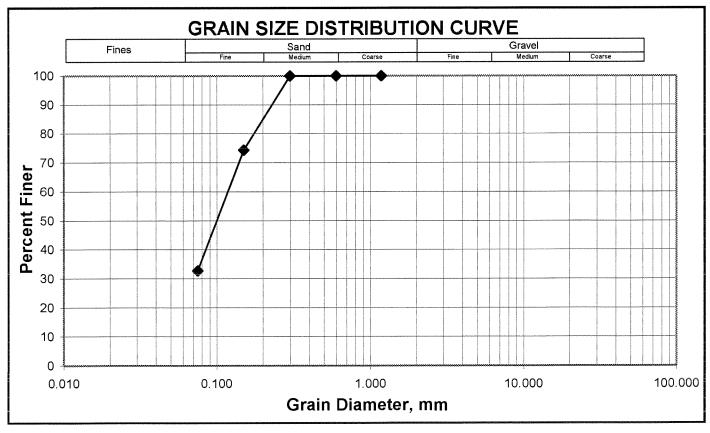
Date: 18-Sep-09

Hole No. 09-13

Sample No. ES-04

Depth: 3.0 - 3.1 m Sample Description: Silty Sand

Sieve (mm.)	Sieve No.	Total Percent Passing	Specification (min - max
100.0	4"	· · · · · · · · · · · · · · · · · · ·	
75.0	3"		
50.0	2"		
37.5	1 1/2"		
25.0	1"		
19.0	3/4"		
16.0	5/8"		
12.50	1/2"		
9.50	3/8"		
4.75	No.4		
2.36	No.8		
1.180	No. 16		
0.600	No.30	100.0	
0.300	No. 50	100.0	
0.150	No. 100	74.4	
0.075	No. 200	32.8	



AECOM

MATERIALS LABORATORY

AECOM

99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7

tel (204) 477-5381 fax (204) 284-2040

Client: Manitoba Hydro

Project: Keeyask Gen. Stn. - Infrastructure

Job No: 0217-200-07-0300

Date: 18-Sep-09

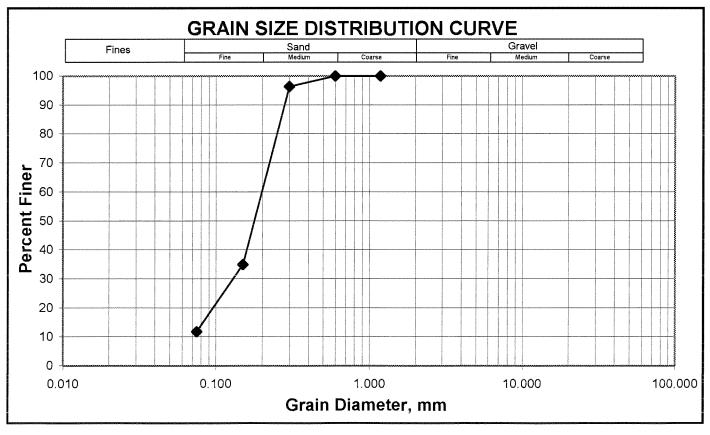
Hole No. <u>09-13</u>

Sample No. ES-06

Depth: 4.5 - 4.6 m

Sample Description: Sand, Some silt

Sieve (mm.)	Sieve No.	Total Percent Passing	Specification (min - max
100.0	4"		
75.0	3"		
50.0	2"		
37.5	1 1/2"		
25.0	1"		
19.0	3/4"		
16.0	5/8"		
12.50	1/2"		
9.50	3/8"		
4.75	No.4		
2.36	No.8		
1.180	No. 16		
0.600	No.30	100.0	
0.300	No. 50	96.4	
0.150	No. 100	35.0	
0.075	No. 200	11.8	



AECOM

MATERIALS LABORATORY

AECOM

99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7

tel (204) 477-5381 fax (204) 284-2040

Client: Manitoba Hydro

Project: Keeyask Gen. Stn. - Infrastructure

Job No: 0217-200-07-0300

Date: 18-Sep-09

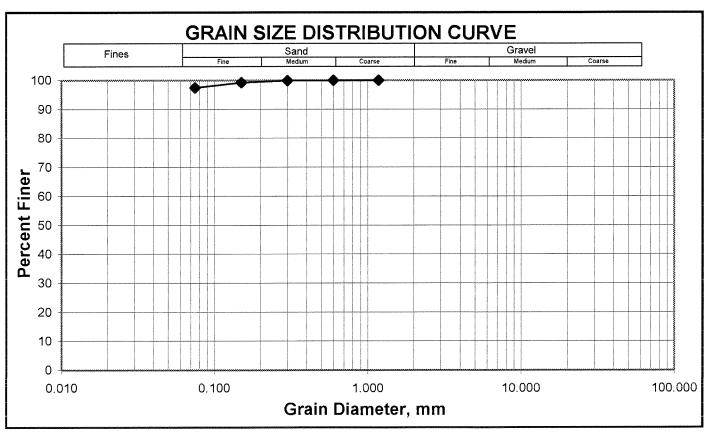
Hole No. <u>09-14</u>

Sample No. ES-03

Depth: 2.2 - 2.3 m

Sample Description: Silt, Trace Fine Sand

Sieve (mm.)	Sieve No.	Total Percent Passing	Specification (min - max)
100.0	4''		
75.0	3"		
50.0	2"		
37.5	1 1/2"		
25.0	1"		
19.0	3/4"		
16.0	5/8"		
12.50	1/2"		
9.50	3/8"		
4.75	No.4		
2.36	No.8		
1.180	No. 16		
0.600	No.30	100.0	
0.300	No. 50	99.9	
0.150	No. 100	99.3	
0.075	No. 200	97.5	



AECOM A

MATERIALS LABORATORY

AECOM

99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7 tel (204) 477-5381 fax (204) 284-2040

Client: Manitoba Hydro

Project: Keeyask Gen. Stn. - Infrastructure

Job No: 0217-200-07-0300

Date: 18-Sep-09

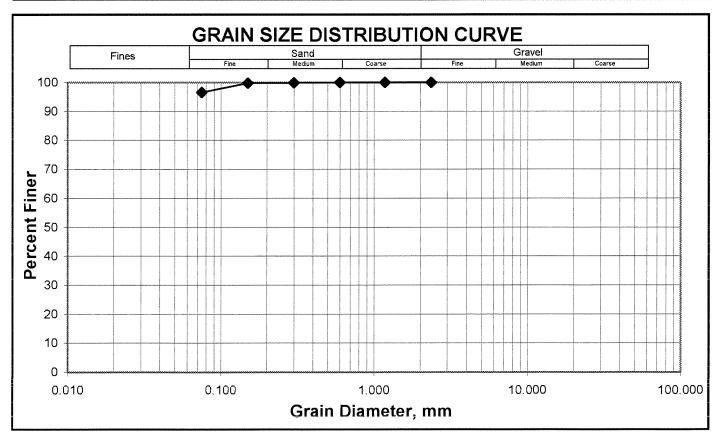
Hole No. 09-14

Sample No. ES-04

Depth: 3.0 - 3.1 m

Sample Description: Silt, Trace Fine Sand

Sieve (mm.)	Sieve No.	Total Percent Passing	Specification (min - max)
100.0	4"		
75.0	3"		
50.0	2''		
37.5	1 1/2"		
25.0	1"		
19.0	3/4"		
16.0	5/8"		
12.50	1/2"		
9.50	3/8"		
4.75	No.4		
2.36	No.8		
1.180	No. 16	100.0	
0.600	No.30	100.0	
0.300	No. 50	99.9	
0.150	No. 100	99.8	
0.075	No. 200	96.6	



AECOM

MATERIALS LABORATORY

AECOM

99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7 tel (204) 477-5381 fax (204) 284-2040

Client: Manitoba Hydro

Project: Keeyask Gen. Stn. - Infrastructure

Job No: 0217-200-07-0300

Date: 18-Sep-09

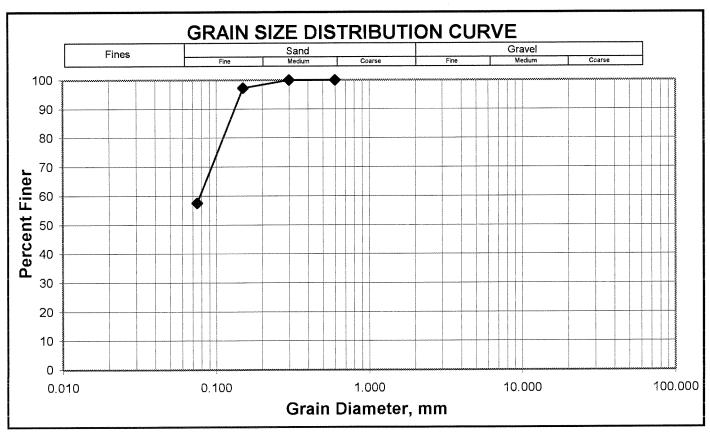
Hole No. <u>09-14</u>

Sample No. ES-05

Depth: 3.7 -3.8 m

Sample Description: Silt and Sand

Sieve (mm.)	Sieve No.	Total Percent Passing	Specification (min - max
100.0	4"		
75.0	3"		
50.0	2''		
37.5	1 1/2"		
25.0	1"		
19.0	3/4"		
16.0	5/8"		
12.50	1/2"		
9.50	3/8"		
4.75	No.4		
2.36	No.8		
1.180	No. 16		
0.600	No.30		
0.300	No. 50	100.0	
0.150	No. 100	97.2	
0.075	No. 200	57.5	



AECOM

MATERIALS LABORATORY

AECOM

99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7 tel (204) 477-5381 fax (204) 284-2040

Client: Manitoba Hydro

Project: Keeyask Gen. Stn. - Infrastructure

Job No: 0217-200-07-0300

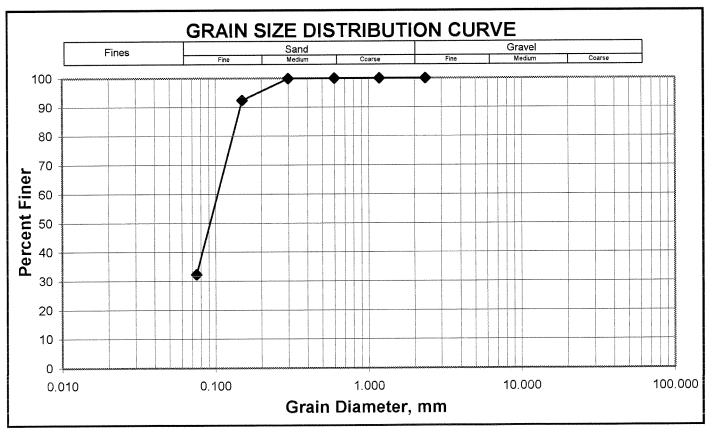
Date: 18-Sep-09

Hole No. 09-15

Sample No. ES-03

Depth: 2.2 - 2.3 m Sample Description: Silty Sand

Sieve (mm.)	Sieve No.	Total Percent Passing	Specification (min - max
100.0	4"		
75.0	3"		
50.0	2"		
37.5	1 1/2"		
25.0	1"		
19.0	3/4"		
16.0	5/8"		
12.50	1/2"		
9.50	3/8"		
4.75	No.4		
2.36	No.8		
1.180	No. 16	100.0	
0.600	No.30	100.0	
0.300	No. 50	99.9	
0.150	No. 100	92.4	
0.075	No. 200	32.3	



AECOM

MATERIALS LABORATORY

AECOM

99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7 tel (204) 477-5381 fax (204) 284-2040

Manitoba Hydro Client:

Keeyask Gen. Stn. - Infrastructure

0217-200-07-0300 Job No:

18-Sep-09 Date:

Project:

09-15 Hole No.

ES-04 Sample No.

Depth: 3.0 - 3.1 m

Silty Sand Sample Description:

Sieve (mm.)	Sieve No.	Total Percent Passing	Specification (min - max)
100.0	4"		
75.0	3"		
50.0	2"		
37.5	1 1/2"		
25.0	1"		
19.0	3/4"		
16.0	5/8''		
12.50	1/2"		
9.50	3/8"		
4.75	No.4		
2.36	No.8		
1.180	No. 16	100.0	
0.600	No.30	100.0	
0.300	No. 50	99.9	
0.150	No. 100	66.0	
0.075	No. 200	26.6	

