

# Addendum / Addenda

Project Description / Description de projet M 38 Flexible Research Facility Solicitation No./N° de solicitation Project No./N° de projet W.O. No./N° d'ordre de travail 16-22072 5044 A1-006442-01 Departmental Representative / représentant ministériel Date Allan Smith September 13, 2016 Notice: Nota: This addendum shall form part of the tender documents and all conditions Cet addenda fait partie intégrale des dossiers d'appel; toutes les conditions shall apply and be read in conjunction with the original plans and énoncées doivent être lues et appliquées en conjonction avec les plans et les specifications. devis originaux.

1 See attached (2) Files in regards to the Geotechnical Survey.

The first file is from Golder dated January 2016 and the second file is Golder- McRostie dated 2008. The 2008 file is for referance.

END / FIN







# LIMITED REPORT ON

Geotechnical Considerations NRC CO, H2 and N2 Docking and Piping Facility NRC Montreal Road Campus Blair Road Ottawa, Ontario

Submitted to: National Research Council Canada Building M-19 120 Montreal Road Ottawa, Ontario K1A 0R6

REPORT

Report Number:

08-1121-0099

Distribution:

4 copies- National Research Council Canada 2 copies- Golder Associates Ltd.



A world of capabilities delivered locally



# LIMITED REPORT ON

Geotechnical Considerations NRC CO, H2 and N2 Docking and Piping Facility NRC Montreal Road Campus Blair Road Ottawa, Ontario

Submitted to: National Research Council Canada Building M-19 120 Montreal Road Ottawa, Ontario K1A 0R6

REPORT

Report Number:

08-1121-0099

Distribution:

4 copies- National Research Council Canada 2 copies- Golder Associates Ltd.



A world of capabilities delivered locally



July 23, 2008

Project No. 08-1121-0099

Mr. Bruno Vallieres, Administrative Services and Property Branch National Research Council Canada Building M-19 120 Montreal Road Ottawa, Ontario K1A 0R6

RE: NRC CO, H2 AND N2 DOCKING AND PIPING FACILITY NRC MONTREAL ROAD CAMPUS BLAIR ROAD OTTAWA, ONTARIO

Dear Mr. Vallieres

Please find attached our limited report on geotechnical considerations for the proposed Docking and Piping Facility to be constructed at the NRC Montreal Road Campus, Blair Road, Ontario.

We trust that this limited report is sufficient for your present requirements. If you have any questions concerning this limited report or, if we can be of further assistance, please let us know.

Yours truly,

GOLDER ASSOCIATES LTD.

M.W. St-Louis, P.Eng. Senior Geotechnical Engineer T.J. Nicholas, P.Eng, Principal

MSTL/TJN/ch

n:\active\2008\1121 - geotechnical\08-1121-0099\08-1121-0099 inside ltr for rpt 23jul08\_doc







# **Table of Contents**

1.0	INTRO	DUCTION	1
2.0	DESCR		2
3.0	PROCE	EDURE	3
4.0	SUBSL	IRFACE CONDITIONS	4
	4.1	General	4
	4.2	Fill Material and Topsoil	4
	4.3	Glacial Till	4
	4.4	Limestone Bedrock	4
	4.5	Groundwater	5
5.0	PROPC	DSED DOCKING AND PIPING FACILITY	6
	5.1	General	6
	5.2	Excavations and Site Servicing	3
	5.3	Foundations	7
	5.4	Rock Anchors	7
	5.5	Frost Protection	7
	5.6	Duct Bank Route	3
	5.7	Seismic Site Response Classification	3
	5.8	Corrosion and Cement Type	3
6.0	ADDITI	ONAL CONSIDERATIONS	3

#### APPENDICES

**APPENDIX A** Abbreviations and Symbols Record of Borehole and Test Pit Sheets

APPENDIX B

Boreholes and Test Pits from Previous Studies





# 1.0 INTRODUCTION

This limited report addresses geotechnical consideration related to the site of the Docking and Piping Facility to be located on the NRC Montreal Road Campus, Blair Road, Ottawa (see Figure 1, Key Plan). Geotechnical studies had been prepared by McRostie Genest St-Louis (MGS) in 2002 and 2005 (reference reports SF-4553B and SF-4932). The results of the pertinent subsurface information from the above studies are included in this report for completeness.

The purpose of this assignment was to review the general soil and groundwater conditions in the area of the proposed duct bank routes for the docking and piping facility by means of an additional four (4) boreholes (08-1 to 08-4 inclusive) and fourteen (14) test pits (08-5 to 08-17 inclusive and 08-15A) and, based on an interpretation of factual information including that from past subsurface records obtained, to provide engineering guidelines on the geotechnical design aspects of the project, including construction considerations which could influence design decisions.

The reader is referred to the "Important Information and Limitations of this Report", which follows the text but forms and integral part of this document.





# 2.0 DESCRIPTION OF PROJECT

Plans are being prepared to construct a docking and piping facility at the NRC Montreal Road Campus (see Figure 1, Key Plan). The project will include duct banks within about 2.5 metres of the existing ground surface, foundations for a nitrogen tank that will be about 12 metres in height and 3 metres in diameter supported on three (3) legs, and 3 blast walls to be in compliance with NFP 55 requirements in the docking facility.

Geological mapping indicates that the bedrock underlying this site is sedimentary in nature and consists of limestone of the Bobcaygeon formation.

The site also falls within the Western Québec Seismic Zone (WQSZ) according to Geological Survey of Canada. The WQSZ constitutes a large area that extends from Montréal to Témiscaming, and which encompasses the Ottawa area. Within the WQSZ, recent seismic activity has been concentrated in two (2) subzones; one along the Ottawa River and another more active subzone along the Montréal-Maniwaki axis. Historical seismicity within the WQSZ from 1900 to 2000 includes the 1935 Témiscaming event which had a magnitude (i.e., a measure of the intensity of the earthquake) of 6.2 and in 1944, a Cornwall-Massena event had a magnitude of 5.6. In comparison with other seismically active areas in the world (i.e., California, Japan and New Zealand), the frequency of earthquake activity within the WQSZ is significantly lower but there still exists the potential for significant earthquake events to be generated.

Under the 2006 Ontario Building Code (OBC), a seismic hazard with a 2% probability of exceedance in 50 years has been retained for design. For the subject site, the reference (Site Class C) peak horizontal ground acceleration (PGA) is 0.42g (g = acceleration by gravity) (Adams and Halchuck, 2003).



# 3.0 PROCEDURE

The field work for this investigation was carried out on June 18, 2008 (test pits) and on July 3 and 4, 2008 (boreholes). At that time fourteen (14) test pits (numbered 08-5 to 08-17 inclusive and 08-15A) and four (4) boreholes (numbered 08-1 to 08-4 inclusive) were put down at the approximate locations shown on the Site Plan, Figure 2.

The test pits were excavated by a rubber tired backhoe. The test pits were advanced to depths of between 0.4 and 2.2 metres below the existing ground surface.

The boreholes were advanced using a track-mounted CME 45 hollow-stem auger drill rig supplied and operated by Marathon Drilling Company Ltd. of Ottawa, Ontario. The boreholes were advanced to depths of between 2.8 and 3.5 metres below the existing ground surface.

Within the boreholes, standard penetration tests (SPT) were carried out at regular intervals of depth and samples of the soils encountered were recovered using drive open sampling equipment. All four (4) boreholes were advanced through the overburden and into the underlying limestone bedrock. In all boreholes, the limestone bedrock was proven for a depth of between 1.5 and 1.7 metres by rotary core drilling in NQ size.

The field work was supervised by an experienced technician from our staff who directed the drilling operations, logged the test pits, the boreholes and samples, directed the in-situ testing and took custody of the soil samples and rock cores.

On completion of the drilling operations, the soil samples and rock cores were transported to our laboratory.

A standpipe was installed in boreholes 08-1 and 08-3 to determine the stabilized groundwater conditions at the site. The groundwater level in the standpipe was measure on July 9, 2008.

The borehole and test pit locations were selected by the National Research Council. Subsequently, the locations and ground surface elevations for the test pits and boreholes for this subsurface investigation were surveyed by Stantec Geomatics Ltd. The ground surface elevations supplied to Golder Associates are understood to be referenced to Geodetic datum.





# 4.0 SUBSURFACE CONDITIONS

### 4.1 General

The subsurface conditions encountered during the present 2008 investigation are shown on the Record of Borehole and Record of Test Pit sheets in Appendix A.

The subsurface information from previous studies was compiled as part of the present study and is included in Appendix B.

The subsurface conditions at this site can be generalized as consisting of surficial deposits of topsoil and fill material underlain by glacial till in turn underlain by limestone bedrock. The depth to bedrock is variable at this site.

The following sections provide a more detailed summary of the subsurface conditions encountered within the boreholes and test pits from the present and previous investigations.

# 4.2 Fill Material and Topsoil

Fill material and/or topsoil were encountered at the existing ground surface and found to range in thickness between 100 millimetres to about 2.15 metres (see Test Pit 08-15). The fill material generally consists of sand, gravel, topsoil, cobbles, boulders and rock blocks but at some locations also contains wood, brick, and concrete. In test pit 08-15, tires were found within the fill.

# 4.3 Glacial Till

A deposit of glacial till is often found between the surficial layer of fill and/or topsoil and the bedrock surface. The glacial till consists of a heterogeneous mixture of gravel, cobbles and boulders in a matrix of silty sand with a trace of some clay. There are a few locations where no glacial till was encountered and where the fill material and/or topsoil veneers the limestone bedrock.

# 4.4 Limestone Bedrock

Limestone bedrock underlies the fill material and the glacial till at all boreholes put down as part of the present subsurface investigation.

The bedrock surface varies from elevation 97.5 to 99.3 metres which is about 1.0 to 2.0 metres below the existing ground surface. In borehole 08-1 and 08-3, the upper layer of bedrock was weathered and was sampled using drive open soil sampling equipment over depths of 0.3 and 0.1 metres, respectively. Below this upper bedrock layer, the degree of weathering is moderate to slight.





The Total Core Recovery (TCR) varies from about 88 to 100 percent of the length drilled. The Solid Core Recovery (SCR), the percentage of core that is completely circular in section, ranges fro 67 to 98 percent. The Rock Quality Designation (RQD), the percent length of intact core longer than 100 millimetres, varies between 50 and 77 percent

# 4.5 Groundwater

The groundwater levels in the two (2) boreholes with standpipes sealed into the underlying limestone bedrock (boreholes 08-1 and 08-3) were measured on July 9, 2008. At that time, groundwater levels varied from about 2.5 to 2.6 metres below the existing ground surface (i.e. about elevations 97.1 to 97.7 metres).

It should be noted that groundwater levels are expected to fluctuate seasonally. Higher groundwater levels are expected during wet periods of the year, such as spring.





# 5.0 PROPOSED DOCKING AND PIPING FACILITY

# 5.1 General

This section of the report provides limited engineering guidelines on the geotechnical aspects of the project for the service duct banks, the foundations for the nitrogen tower and the blast wall foundations portion of the project and based on our interpretation of subsurface information and project requirements and is subject to the limitations in the "Important Information and Limitations of This Report" attachment which follows the text of this report.

The professional services retained for this project include only the geotechnical aspects of subsurface conditions at the site. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off site sources are outside the terms of reference for this project and have not been investigated nor addressed.

# 5.2 Excavations and Site Servicing

Excavations for the installation of site services (duct banks) will be through fill materials, topsoil, glacial till and at some locations will extend into bedrock.

No unusual problems are anticipated in trenching in the overburden using conventional hydraulic excavating equipment, although significant cobble and boulder removal could be required in the glacial till. Furthermore, large rock blocks should also be expected to be present in fill materials. Old concrete foundation walls and basement floor slabs may also be found at some locations as it is understood that buildings were demolished before the construction of the NRC Montreal Road Campus.

It is expected that the bedrock removal for the project will be carried out using drill and blast techniques. Should bedrock removal be carried out by drilling and blasting, special care will be required to prevent overblasting and fracturing of the bedrock below foundation levels.

The blasting should be controlled to limit the peak particle velocities at all adjacent structures such that blast induced damage will be avoided. This will require blast designs by a specialist in this field.

A pre-blast survey should be carried out on all surrounding structures. Selected existing interior and exterior cracks in the structure should be identified during the pre-blast survey and should be monitored for lateral or shear movements by means of glass telltales and/or movement telltales.

The contractor should be limited to only small controlled shots. The following frequency dependent vibration limits at the nearest structures and services are suggested

Frequency Range (Hz)	Vibration Limits (millimeters/second)
<10	5
10 to 40	5 to 50 (sliding scale)
>40	50





These limits should be practical and achievable for most of this project. In areas in close proximity to structures and services, limestone bedrock removal should be accomplished using mechanical methods such as hoe-ramming in conjunction with closely spaced line drilling to establish the limit of the excavation.

# 5.3 Foundations

It is considered that the proposed nitrogen tank structure and the three (3) blast walls will be founded on spread footings placed on limestone bedrock or by caissons extending into the limestone bedrock layers underlying the site.

For footing design purposes, footings placed directly on limestone bedrock, below any upper weathered zones, may be sized using an Ultimate Limit States (ULS) factored bearing resistance of 1000 kilopascals. Provided that the bedrock surface is properly cleaned of soil or any loose rock fragments at the time of construction, the settlement of footings sized using the above factored bearing resistance should be negligible, therefore, Serviceability Limit States (SLS) need not be considered.

Caissons, as an alternative foundation scheme, could be designed based on a rock socket to concrete bond value of 500 kilopascals (SLS); end bearing should be ignored. In addition, the bond (adhesion) in the upper weathered or fractured zone should also be ignored.

An advantage to the rock socketed caissons is their ability to be reinforced for both downward loading and uplift resistance.

# 5.4 Rock Anchors

If required, rock anchors could be provided to resist uplift loads on footing type foundations.

The anchors could consist of either grouted or mechanical anchors.

For a group of anchors or for a line of closely spaced anchors, the resistance must consider the potential overlap between the rock masses mobilized by individual anchors. Further guidance, at the final design stage, should be provided for assessing the resistance of a single anchor and the effect of a group of anchors.

# 5.5 Frost Protection

All exterior foundation elements in unheated areas should be provided with a minimum of 1.5 metres of earth cover for frost protection purposes. Isolated foundations or foundations in unheated areas which are adjacent to any surface cleared of snow cover during winter months should be provided with a minimum of 1.8 metres of earth cover.

For footings founded on competent bedrock, the requirement for 1.5 or 1.8 metres of earth cover could be waived where it could be shown by check drilling during construction that the bedrock below footing level does not contain any joints filled with frost-susceptible soil.





The concrete encased duct bank should be made to bear on the bedrock surface or within the bedrock over the entire route for this project in order to prevent conditions of differential support and potential settlement where soil supported.

Excavation of the limestone bedrock would be required at some locations where bedrock is shallow. Lean concrete infill would be required in localized areas where the bedrock surface is somewhat deeper.

# 5.7 Seismic Site Response Classification

The 2006 OBC contains an updated seismic analysis and design methodology which uses a seismic site response classification system defined by the shear stiffness of the upper 30 metres of ground of interest. Seismic response is now defined by uniform hazard spectra (UHS) corresponding to design earthquake with a probability of exceedance of 2% in 50 years. There are six site classes (from A to F), decreasing in soil stiffness from A (hard rock) to E (soft soil); Site Class F denotes problematic soils for which a site-specific evaluation is required. The site class is used to obtain soil factors ( $F_a$  and  $F_v$ ) used to modify the UHS to account for the effects of site-specific soil conditions on the seismic response of the site to the design earthquake.

To support a site class designation, a shear wave velocity of 700 metres per second was assigned to the limestone bedrock, based on actual measurements in similar bedrock formations. Interpreting the data available indicates that a Site Class C designation would be appropriate. It may be possible to achieve a higher Site Class designation by obtaining site specific shear wave velocities.

# 5.8 Corrosion and Cement Type

As part of several studies performed by McRostie Genest St.-Louis (MGS) at the NRC Montreal Road Campus over the years, groundwater samples were collected and submitted for chemical analysis related to potential corrosion of buried ferrous elements and sulphate attack on buried concrete elements.

There has not been a history of potential problems with corrosion of exposed ferrous elements or sulphate attack on buried concrete elements.

Based on the past performance of older existing foundations exposed at the time of recent additions to the NRC Montreal Road Campus, concrete made with Type GU Portland cement should be acceptable for substructures.





# 6.0 ADDITIONAL CONSIDERATIONS

All foundation areas and duct bank trenches should be inspected by experienced geotechnical personnel prior to concreting to ensure that the limestone bedrock having adequate bearing capacity has been reached and that the bearing surfaces have been properly prepared including the removal of fractured bedrock by overblasting.

At the time of writing this report, only conceptual details of the proposed docking and piping facility were available.

We trust that this limited report that only cover the geotechnical aspects within the latter is sufficient for your present requirements. If you have any questions concerning this report or require additional geotechnical recommendations, please call us.





# **Report Signature Page**

### GOLDER ASSOCIATES LTD.

Michel St-Louis, P.Eng. Senior Geotechnical Engineer Terry J. Nicholas, P.Eng Principal

MSTL/TJN/sr

n:\active\2008\1121 - geotechnical\08-1121-0099\report july 2008 08-1121-0099.doc



### IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

**Standard of Care:** Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

**Basis and Use of the Report:** This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

**Soil, Rock and Groundwater Conditions:** Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

#### IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (cont'd)

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

**Sample Disposal:** Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

**Follow-Up and Construction Services:** All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

**Changed Conditions and Drainage:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.



FILENAME: N:\Active\2008\1121 - Geotechnica\08-1121-0099\ACAD\0811210099-01.dwg Drawing file: 0811210099-01.dwg Jul 14, 2008 - 2:28pm



PLOT DATE: July 22, 2008 FILENAME: N:\Active\2008\1121 - Geotechnical\08-1121-0099\ACAD\0811210099



# **APPENDIX A**

Abbreviations and Symbols Record of Borehole and Test Pit Sheets



# **LIST OF ABBREVIATIONS**

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I.	SAMPLE TYPE	III.	SOIL	DESCRIPTION		
AS	Auger sample		(a)	Co	hesionless S	Soils
BS	Block sample					
CS	Chunk sample	Density Ir	ndex		Ν	
DO	Drive open	(Relative)	Density)		Blows/300	) mm
DS	Denison type sample				Or Blow	s/ft
FS	Foil sample	Very loose	•		0 to 4	L
RC	Rock core	Loose			4 to 1	n N
SC	Soil core	Compact			10 to 3	0 10
ST	Slotted tube	Dense			30 to 5	50
TO	Thin-walled, open	Very dense	•		over 5	0
TP	Thin-walled, piston	i erj deno			0,01,2	0
WS	Wash sample		(b)	C	ohesive Soil	c
нъ	tradit outlipto	Consisten	(U) PV	C		6
II.	PENETRATION RESISTANCE	COIBISTON	c.y	Kna	$C_{u2}O_{u}$	Def
		Very soft		0 to 12		$\frac{131}{15}$
Standard	Penetration Resistance (SPT) N.	Soft		12 to 25		250 to 500
Standart	The number of blows by a 63.5 kg $(140 \text{ lb})$	Firm		$\frac{12}{25}$ to 50		200 to 1 000
	hammer dronged 760 mm (30 in ) required	Stiff		20 to 100		$1.000 \pm 2.000$
	to drive a 50 mm (2 in ) drive open	Very stiff		100 to 200		2,000 to 2,000
	Sampler for a distance of 300 mm (12 in )	Hard		Over 200		2,000 t0 4,000
	DD- Diamond Drilling	Haru		0761 200		Over 4,000
Dynamic	Penetration Resistance: N.:	IV	SOIL TE	272		
Dynamic	The number of blows by a 63.5 kg (140 lb )	1	SOIL IL	010		
	hammer dronped 760 mm (30 in ) to drive	W	water con	tent	-	
	Lincased a 50 mm (2 in ) diameter 60 <sup>0</sup> cone	W/	nlastic lin	nited		
	attached to "A" size drill rods for a distance	wp w.	liquid lim	it		
	of 300 mm (12 in )	Č	consolidai	iton (oedometer) test		
	or 500 mm (12 m.).	CHEM	chemical	analysis (refer to text)		
₽Н∙	Sampler advanced by bydraulic pressure	CID	consolidat	ed isotropically drain	ad triavial to	et1
PM.	Sampler advanced by manual pressure	CIU	consolidat	ed isotropically undra	ined triaxial	si tect
WH.	Sampler advanced by static weight of hammer	010	with pores	voter pressure moosure	amont <sup>1</sup>	test
WR.	Sampler advanced by static weight of naminer	Da	relative de	water pressure measure	G	
***	rod	DS	direct she	ar test	$, O_{s}$	
	104	M	sieve analy	usis for narticle size		
Peizo-Co	ne Penetration Test (CPT)	MH	combined	sieve and hydrometer	(II) analysis	
1 0120-000	An electronic cone penetrometer with	MPC	modified I	Proctor compaction tag	(11) allalysis	)
	a $60^{\circ}$ conical tip and a projected end area	SPC	standard P	roctor compaction tes	f	
	of $10 \text{ cm}^2$ pushed through ground		organic co	ntent test	L	
	at a penetration rate of 2 cm/s Measurements	SO.	concentrat	ion of water-soluble of	ulnhatee	
	of tin resistance $(\Omega_{1})$ norewater pressure		unconfine	d compression test	upnacs	
	(PWP) and friction along a sleeve are recorded		unconsolic	a compression test lated undrained triavia	1 tost	
	Electronically at 25 mm nenetration intervals	v	field vone	test (I V_laboratory v	u icoi ine test)	
	Leonomouny at 25 mill penetration mer vals.	· ·	unit weigh	t	uie test)	
		T	unit weigh	ι		

Note:

1. Tests which are anisotropically consolidated prior shear are shown as CAD, CAU.

÷

#### **Golder Associates**

### LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

Ι.	GENERAL		(a) Index Properties (cont'd.)
π	= 3.1416	w	water content
ln x, natural	logarithm of x	w <sub>1</sub>	liquid limit
log <sub>10</sub> x or lo	g x, logarithm of x to base 10	Wp	plastic limit
g	Acceleration due to gravity	Ip	plasticity Index= $(w_1 - w_p)$
t	time	Ws	shrinkage limit
F	factor of safety	$I_L$	liquidity index=(w-w <sub>p</sub> )/I <sub>p</sub>
V	volume	I <sub>c</sub>	consistency index= $(w_1 - w)/I_p$
W	weight	e <sub>max</sub>	void ratio in loosest state
		$e_{min}$	void ratio in densest state
11.	STRESS AND STRAIN	ID	density index- $(e_{max}-e)/(e_{max}-e_{min})$
			(formerly relative density)
Ŷ	shear strain		
Δ	change in, e.g. in stress: $\Delta \sigma'$		(b) Hydraulic Properties
ε	linear strain	_	
$\varepsilon_v$	volumetric strain	h	hydraulic head or potential
η	coefficient of viscosity	q	rate of flow
ν	Poisson's ratio	v	velocity of flow
σ	total stress	i	hydraulic gradient
σ	effective stress ( $\sigma' = \sigma''$ -u)	k	hydraulic conductivity (coefficient of permeability)
σ' <sub>vo</sub>	initial effective overburden stress	j	seepage force per unit volume
$\sigma_1 \sigma_2 \sigma_3$	principal stresses (major, intermediate,		
	minor)		(c) Consolidation (one-dimensional)
$\sigma_{\rm oct}$	mean stress or octahedral stress		Tike.
	$= (\sigma_1 + \sigma_2 + \sigma_3)/3$	$C_{c}$	compression index (normally consolidated range)
τ	shear stress	Cr	recompression index (overconsolidated range)
u	porewater pressure	Cs	swelling index
E	modulus of deformation	$C_a$	coefficient of secondary consolidation
G V	snear modulus of deformation	m <sub>v</sub>	coefficient of volume change
K	bulk modulus of compressibility	c <sub>v</sub>	coefficient of consolidation
TTT	SOIL BROBERTIES		time factor (vertical direction)
111.	SOIL FROPERTIES	U	degree of consolidation
	(a) Index Properties	$\sigma_p$	pre-consolidation pressure
	(a) index properties	UCK	Overconsolidation ratio= $\sigma'_p / \sigma'_{v_0}$
ρ(γ)	bulk density (bulk unit weight*)		(d) Shear Strength
$\rho_{d}(\gamma_{d})$	dry density (dry unit weight)		
$\rho_w(\gamma_w)$	density (unit weight) of water	$\tau_{\rm p}\tau_{\rm r}$	peak and residual shear strength
$\rho_s(\gamma_s)$	density (unit weight) of solid particles	φ'	effective angle of internal friction
γ	unit weight of submerged soil ( $\gamma'=\gamma-\gamma_w$ )	δ	angle of interface friction
$D_R$	relative density (specific gravity) of	μ	coefficient of friction=tan $\delta$
	solid particles ( $D_R = p_s/p_w$ ) formerly ( $G_s$ )	C'	effective cohesion
e	void ratio	C <sub>u</sub> ,S <sub>u</sub>	undrained shear strength ( $\phi=0$ analysis)
n	porosity	р	mean total stress $(\sigma_1 + \sigma_3)/2$
S	degree of saturation	p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
		q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma_3)/2$
*	Density symbol is p. Unit weight	$\mathbf{q}_{u}$	compressive strength ( $\sigma_1$ - $\sigma_3$ )
	symbol is $\gamma$ where $\gamma = pg(i.e. mass)$	St	sensitivity
	density x acceleration due to gravity)		-
			Notes: 1. $\tau = c'\sigma' \tan   '$

2. Shear strength=(Compressive strength)/2

### **Golder Associates**

### PROJECT: 08-1121-0099 LOCATION: See Site Plan

# RECORD OF BOREHOLE: BH 08-1

BORING DATE: 4 July 2008

SHEET 1 OF 1

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

CALE	Ι	ЕТНОD	SOIL PROFILE	ſ	SA	MPL	ES	DYNA RESIS	MIC PE TANCE	NET , BL	RATIO OWS/ 6	ON 70,3m 0	80	HYDR 1	AULIC C k, cm/s	CONDUC 3	TIVITY, 0⁴ 1	0, [	STING	PIEZOMETER OR	
DEPTH S METR		BORING M	DESCRIPTION	STRATA PL	ELEV DEPTH (m)	NUMBER	TYPE	BLOWS/0.3	SHEAI Cu, kP	R STRE	NGT	FH n n 6	at V. + em V. € 0	- Q - • 9 U - O 80	w	μ /ATER C ρ μ 10	ONTENT		INT WI	ADDITI(	STANDPIPE INSTALLATION
- 0	Power Auger	00 mm Diam (Hollow Stem)	Ground Surface Brown sand and gravel, some cobbles and boulders (FILL) Grey brown SILTY SAND, some gravel Weathered Grey LIMESTONE		100.26 0.00 99.44 99.25 1.01	1	50 DO 50 DO	31 31													Native Backfill and Silica Sand
2	Rotary Drill	NO Core 20	BEDROCK			2	NQ RC	DD	T.C.R. (%) 00	S.C.R. (%)	RQD (%)	50									Bentonite Seal Silica Sand Slot Screen
			End of Borehole		2.83																W,L, in screen at elev, 97,73 m on July 9, 2008
		гн s	SCALE							G	ol	der	t								OGGED: J.D.

#### PROJECT: 08-1121-0099

### RECORD OF BOREHOLE: BH 08-2

SHEET 1 OF 1

DATUM:

LOCATION: See Site Plan

SAMPLER HAMMER, 64kg; DROP, 760mm

BORING DATE: July 3, 2008

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

u :	G	3	SOIL PROFILE		SA	MPL	ES	DYN. RES	AN ST		NE	TRAT	ION S/0	l 3m	2	HYDR	RAULI	C CC	NDUC	tivity,		T	.0		
METRES	BORING METH		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHE/ Cu, k	2( AR Pa	) STRE	40 ENC	ЭТН	60 nat rem	8( V. + 1 V. ⊕ 8(	0 0-0	v v	10 <sup>-6</sup> VATE ∕p	10 R C 0	) <sup>5</sup> 1 )NTEN — O <sup>W</sup>	0 <sup>-4</sup> F PERC	10 <sup>-3</sup> ENT I WI 40		ADDITIONAL	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger	200 mm Diam. (Hollow Stern)	Ground Surface FILL and GLACIAL TILL, with cobbles and boulders		100.26 0.00 99.16	1 2 3	GRAI NQ RC	9 - DD 30																	
24	Rotary Drill	ND Core	Weathered Grey LIMESTONE BEDROCK		1.10	4	NQ RC NQ RC	DD	TCR.(%) 88 8	2	8 C.R. (%) 8	2	R 0.D. (%) 22												.7
3			End of Borehole		<u>97,40</u> 2.77																				-
5																									
Ϋ́																									
8									R																
0																									ta la serie de la
DEP	тн 50	sc	ALE					(	Ĵ		G	ol	lder	r	25									LO CHE	GGED: J.D. CKED: Type

#### PROJECT: 08-1121-0099

### RECORD OF BOREHOLE: BH 08-3

SHEET 1 OF 1

DATUM:

LOCATION: See Site Plan

SAMPLER HAMMER, 64kg; DROP, 760mm

BORING DATE: July 3, 2008

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

	G	SOIL PROFILE			SA	MPL	ES	DYN		IC PE	NET	RATI	DN /0.3m	2	HYDR	AULIC C	ONDUC	TIVITY,	T	.0		
METRES	DRING METH	DESCRIPTION	RATA PLOT	ELEV. DEPTH	NUMBER	ТҮРЕ	-OWS/0.3m	SHE Cu, I	20 AR kPa	STRE	40 NG	( TH	60 hat V - em V €	80 + Q - • Đ U - O	r v w	10 <sup>-6</sup> VATER C	0 <sup>-5</sup> 1 ONTENT 	0 <sup>-4</sup>	IO <sup>3</sup> INT WI	ADDITIONAL	PIEZOMETE OR STANDPIPE INSTALLATIO	:R E DN
	B	Ground Surface	ST	(m) 99.67			ы		20		40		0	80		10	20 ;	30	40			
1	200 mm Diam (Hollow Stem)	Loose brown sand and gravel, some cobbles and boulders (FILL) Compact grey brown SILTY SAND, some gravel, cobbles, boulders, trace clay (GLACIAL TILL)	25.25	0,00 98,71 0.96 98,15	1 1A	50 DO 50 DO	13 13														Native Backfill and Silica Sand	
2	Rotary Drill ND Core	Weathered grey LIMESTONE BEDROCK, some mud seams		1,52	2	50 DO NQ RC	30 DD	T.C.R. (%)	00	SCR (%)	(%) C C Q	73									Bentonite Seal Silica Sand	
			臣臣	98.20																	Slot Screen	
4 5 6 7																					W.L. in screen at elev. 97.05 m on July 9, 2008	
8 9 10																						
 DEP 1 : :	тн : 50	SCALE	-				(	Â	)	G	ol	dei	tes		•			4 <i>/</i>		СН	DGGED: J.D. ECKED: Infu	

PF	PROJECT: 08-1121-0099 RECORD OF BOREHOLE: BH 08-4 SHEET 1 OF 1																						
LC S/			DN: See Sile Plan R HAMMER, 64kg; DROP, 760mm							BC	RIN	IG C	DAT	≣: :	3 July 20	08		PE	NETRAT	FION TE	EST HAI	D, MMER	ATUM: , 64kg; DROP, 760mm
	L	Q	SOIL PROFILE	_	_	SA	MPL	ES	DY	(NAM		PEN	ETR	ATIC	N 0.3m	)	HYDR			IVITY,	Т		
DEPTH SCALE METRES		BORING METHO	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BI,OWS/0.3m	SH Cu	2 IEAF I, kP	0 R ST a	4 REN 4		6 1 n 6	0,311 0 8( atV, + 9m V, ⊕	9-0 U-0	1 W W	6 11 ATER C	0 <sup>5</sup> 10 ONTENT OW	0 <sup>4</sup> 1 PERCE		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
•	ucer	follow Stern)	Ground Surface Loose brown sand and gravel, some cobbles and boulders (FILL)		99.44 0.00 98.59																		
	Power Al	200 mm Diam. (h	Compact grey brown SIL IY SAND, some gravel, cobbles, boulders, trace clay (GLACIAL TILL)		97.45	1A 1 2	6RAE 50 DO 50 DO	12 60															
- 2	Rotary Drill	NO Core	Weathered grey LIMESTONE BEDROCK, some mud seams		1.95	з	NQ RC	DD	T.C.R. (%)	100	S.C.R. (%)	94	R.Q.D. (%)	71									
			End of Borehole		3.47																		
DI 1	EP1 : 5	тн s 0	CALE					ĺ	G		A	Go		ler	tes							LC CH	DGGED: J.D.

BOREHOLE 0811210099.GPJ HYDROGEO.GDT 14/7/08

# TABLE 1

### **RECORD OF TEST PITS**

	Test Pit Number	Depth (Metres)	Description
-	1 tumber	(1100105)	
	TP 08-5	0.00 - 0.30	FILL – Brown SAND, GRAVEL and TOPSOIL
	(Elevation	0.30 - 1.55	Brown SANDY TILL
	100.55 m)	1.55	End of test pit. Refusal on BEDROCK.
		0.00 0.00	FILL Crushed Limestone
	TP 08-6	0.00 - 0.20	FILL – Crushed Linestone
	(Elevation	0.20 - 0.55	Medium dense brown SANDY TH I
	100.44 m)	0.35 - 1.52	End of toot nit. Defued on REDROCK
		1.32	End of test pit. Refusal on BEDROCK.
	TP 08-7	0.00 - 0.20	FILL – Crushed LIMESTONE
	(Elevation	0.20 - 1.30	FILL - Brown SAND, BOULDERS, GRAVEL, pieces of
	100.39 m)		WOOD and BRICK
		1.30 - 1.90	Brown SANDY TILL
		1.90	End of test pit. Refusal on BEDROCK.
		0.00 0.05	
	TP 08-8	0.00 - 0.25	FILL – Crushed LIMESTONE
	(Elevation	0.25 - 0.80	FILL – Brown SAIND, GRAVEL, and pieces of BRICK
	100.31 m)	0.80 - 1.50	Brown SANDY TILL
		1.50	End of test pit. Refusal on BEDROCK.
	TP 08-9	0.00 - 1.00	FILL – Black TOPSOIL, SAND, GRAVEL, and BRICK
	(Elevation	1.00	End of test pit. Refusal on BEDROCK.
	100.11 m)		
	TP 08-10	0.00 - 0.30	Black TOPSOIL
	(Elevation	0.30 - 0.70	Brown SANDY TILL
	99.89 m)	0.70	End of test pit. Refusal on BEDROCK.
	ፕ <u>ኮ ሰ</u> ջ 11	0.00 - 0.60	FILL - SAND GRAVEL and BRICK
	(Elevation	0.00 = 0.00	WEATHERED BEDROCK
	99.77  m	1 00	End of test pit. Refusal on BEDROCK.
	//// mj	1.00	Provide the second

Inel/mpu

July 2008

08-1121-0099

### TABLE 1 (continued)

TP 08-12	0.00 - 0.30	Black TOPSOIL and pieces of WEATHERED ROCK
(Elevation	0.30 - 0.50	WEATHERED BEDROCK
100.06 m)	0.50	End of test pit. Refusal on BEDROCK.
TP 08-13	0.00 - 0.15	Black TOPSOIL
(Elevation	0.15 - 0.65	Brown SANDY TILL
100.21 m)	0.65 - 0.80	WEATHERED BEDROCK
	0.80	End of test pit. Refusal on BEDROCK.
TP 08-14	0.00 - 0.30	Black TOPSOIL
(Elevation	0.30 - 0.45	WEATHERED BEDROCK
100.53 m)	0.45	End of test pit. Refusal on BEDROCK.
TP 08-15	0.00 - 0.30	Black TOPSOIL
(Elevation	0.30 - 2.15	FILL – SAND, GRAVEL, pieces of CONCRETE, BRICK,
100.18 m)		TIRES
	2.15	End of test pit. Refusal on BEDROCK.
TD 09 15 A	0.00 0.20	Plack TOPSOI
(Flevation	0.00 = 0.20	WEATHERED BEDROCK
(100.18  m)	0.20 - 0.35	End of test pit Refusal on BEDROCK
100.10 III)	0.55	End of test pit. Refusal on DEDROCK.
TP 08-16	0.00 - 0.60	FILL – Crushed LIMESTONE
(Elev.	0.60 - 1.70	Light brown SANDY TILL
100.67 m)	1.70	End of test pit. Refusal on BEDROCK.
TP 08-17	0.00 - 0.30	FILL – Crushed LIMESTONE
(Elev.	0.30 - 0.80	Dark brown SAND and GRAVEL
100.77 m)	0.80 - 2.20	Light brown SANDY TILL
	2.20	End of test pit. Refusal on BEDROCK.

N:\Active\2008\1121 - Geotechnical\08-1121-0099\Record of Test Pits - NRC Docking Facility 16Jul08.doc

Jul/mpu.

**Golder Associates** 



# **APPENDIX B**

# **Boreholes and Test Pits from Previous Studies**



NRC -	NEW ELECTRICAL SU	JB-STATIOI	N			B.M	A.( ELEV	100.20m)	geodeti	c: Floor at		TEST PIT	NO:	05	-1	
						bui	ilding M-	-10 at doo	or No. 1	1		PROJECT	NO:	E-889	0	
START	DATE: 05/09/02							(E.				ELEVATIO	)N: 97	7.54 m	I	
SAMPL	LÉ TYPE 🔤 REMOL	JLDED	Z	SHEL	BY TUB	Ε	SPL	IT-SPOON	P	ROBING	NO R	ECOVERY		CORE		
H(m)	SMALL PEN.	SPT	E TYPE	LE NO				S(	DIL			80 VANE 80	VANE ( 160 Cu REN 160	Cu (kPa) 240 10ULDED 240	320 (kPa) ▲ 320	(m)NOI
DEPT	(kPa)	(N)	SAMPL	SAMP			Ľ	)ESCR	2IPT]	ION		PLASTIC	M	•	Liquid	ELEVAT
0.0	sides stable		+				-	TOPSOIL	and	RUUIS		20	40	60	80	
	no water seepa	ge					med Bo	ium der ttom of possib	test le roo	andy TILL pit on	97.24					- 
- 2.0																- - - - - - - - - -
- 3.0																- 95.0
					Offi					) RY: JMI		Сомр		N DEPTI	H: 0.8 m	94.0
	McROSTI	s gen	ES	51	ST-	-L0	JUIS		REVIEW	ED BY: E.S		COMP	LETE:	05/09	/02	-
	(	)ttawa,	nac	la				Fig. No	: 2				1.00	Page 1	of 1	

05/09/20 08:02AM (STD-SHIP)

NRC -	NEW ELECTRICAL SUB-STATI	ОN			B.M.( ELEV 100.20m)	geodetic: Floor at		TEST PIT	N0:	05-	-2	
					building M—10, at do	or No.11		PROJECT	NO: E	=-8890	)	
START	DATE: 05/09/02							ELEVATIO	ON: 98	.02 m	_	
SAMPL	E TYPE		SHELBY	TUB	e Split-Spoon	PROBING	[]]]NO R	ECOVERY		CORE		
(m)	SMALL PEN. SPT	ТҮРЕ	ENO		S	DIL		80 A VANE 80	VANE C 160 Cu REM 160	u (kPa) 240 OULDED 240	320 (kPa) ▲ 320	(m)NO
DEPTH	(kPa) (N)	SAMPLE	SAMPL		DESCR	IPTION		PLASTIC	M.	.C.	LIQUID	ELEVATI
0.0	sides stable	-			FILL – crus	ned limestone		20	40	60	80	98.0
	no water seepage				medium der Bottom of possib	nse sandy TILL test pit on le rock	97.67					97.0
- - - - - - - - - - - - - - - - - - -												
												- 95.0
4.0						1						
	McROSTIE GE	NE	ST S	Т-	-LOUIS	LOGGED BY: JML		COM		DEPTI	1: 0.6 m	
	Atoma Atoma	ים. רי	anada	-		Fig No. 3		COMP	TLE IE:	02/09	Page	1 of 1
05/09/20 0	B-02AN (STD-SHIP)	. Ui	andua	5							ruge	

05/09	/20	08:02AM	(STD-SHIP)	

1

NRC -	NEW ELECTRICAL SUB-STATIO	N			B.M.( ELEV 100.20m) geodetic; Floor of			TEST PIT NO: 05-3					
					building M-10 at door No.11			PROJECT NO: E-8890					
START	DATE: 05/09/02							ELEVATIO	)N: 99	).43 m			
SAMPI	LE TYPE	2	SHEL	BY TUB	e Split-Spoon	PROBING	NO R	ECOVERY		CORE			
E SMALL PEN SPT			E NO		SC	)IL		80 A VANE 80	VANE ( 160 Cu REM 160	Cu (kPa) 240 IOULDED 240	320 (kPa) ▲ 320	ON(m)	
DEPTH	(kPa) (N)	SAMPLE	SAMPL		DESCR	IPTION		PLASTIC	М	•	LIQUID	ELEVATI	
0,0	sides stable	-			TOPS	SOIL	_	20	40	60	80	-	
Ť I													
							99.23			10 <b>8</b> 		-	
					medium der	ise sandy TILL						99.0	
												-	
	no water seepage				Rottom of	test nit on	98.63					-	
- 1,0					possib	le rock	50.05						
												2	
-												-	
14 - 14 14											+	98.0	
-												2	
1											ł,		
-2.0													
-								-				-	
						_				97.0			
												-	
										1			
- 3.0								_		+- +-		-	
												-	
												_	
*												- 96.0	
Ĺ												-	
-												-	
-											L I L		
4.0					LAUIC	LOGGED BY MI		Сом		N DEPT	H: 0.8 m	[]	
	MCROSTIE GEN	1E)	ST	ST-	-LOUIS	REVIEWED BY: E.S.		COM	PLETE:	05/09	0/02		
05/09/20 0	Ottawa,	Ca	inac	a		Fig. No: 🕂					Page	1 of 1	

NRC -	NEW ELECTRICAL SUE	B-STATION	ł		B.M.( ELEV 100.20m)geodetic: Floor of			TEST PIT NO: 05-4						
					building M—10 at door No. 11			PROJECT NO: E-8890						
START	DATE: 05/09/02		_					ELEVATIO	N: 100	).34 m	1			
SAMPI	LE TYPE	_DED		SHELBY TUB	e Split-Spoon	PROBING	III NO R	ECOVERY	C	ORE				
E SMALL PEN. SPT			Е ТҮРЕ	LE NO	S	SOIL			■ VANE Cu (kPa) ■ 80 160 240 3: ▲ VANE Cu REMOULDED (kP 80 160 240 3:			(IION(m)		
DEP1	(kPa)	(N)	SAMPL	SAMP	DESCR	IPTION		PLASTIC	M.C		LIQUID ————	ELEVA		
0.0	sides stable		$\left  \right $		ΤΟΟ			20	40	60	80			
-					TOPS	SUIL						~		
-							100.14					- 		
-					medio sanc	um dense Iy TILL								
- 1.0 - -									-	+++				
-	no water seepag	e			Bottom of possib	test pit on le rock	98.94					— 99.0 - -		
-														
2.0 												-		
- 												— 98.0 -		
												-		
- 3.0										1 - 11				
									1			- 97.0		
4.0					LAUIC	LOGGED BY MI		COMPL	FTION	рерти	• 1.4 m	ī		
	McROSTIE	GENI	ES	T ST-	LOUIS	REVIEWED BY: E.S.		COMPL	ETE: 0	5/09/	02			
05/09/20 08	B:02AM (STD-SHTP)	ttawa, I	Ca	nada		Fig. No: <b>5</b>					Page 1	of 1		

Ξr.

RC -	- NEW ELECTRICAL SUB-STATION	ELECTRICAL SUB-STATION B.M.( ELEV 100.20m)geodetic; Floor of TEST PIT NO: 05-5								
				building M-10 at door No.11	PF	PROJECT NO: E-8890				
ART	DATE: 05/09/02				EL	EVATION: 100.41 n	1			
AMP	LE TYPE REMOULDED	Z	SHELBY TUBE	SPLIT-SPOON PROBING	NO RECO	VERY CORE				
H(m)	SMALL PEN. SPT	E TYPE	E NO	SOIL		■ VANE Cu (kPa) 80 160 240 VANE Cu REMOULDED 80 160 240	320 (kPa) ▲ 320	lon(m)		
DEPT	(kPa) (N)	SAMPL	SAMPI	DESCRIPTION	PL	ASTIC M.C.		ELEVAT		
0.0	sides stable			TOPSOIL				-		
				100.	16			- 		
				medium dense sandy TILL				-		
1.0										
	no water seepage			Bottom of test pit on 99. possible rock	.06			- - - -		
2.0								- - - 98.0		
3.0										
								- 97.0 - -		
4.0	MOROSTIF CFI	 NF9	U ST ST_	LOUIS		COMPLETION DEPT	H: 1.35 m	-		
	MCIVODIE GEI	LN Ľik	, 	REVIEWED BY: E.S.		COMPLETE: 05/09	/02			

NRC - NEW ELECTRICAL SUB-STATION					B.M.( ELEV 100.2	TEST PIT NO: 05-6						
				building M-10 at door No.11 PROJECT NO: E-8890					0			
START	DATE: 05/09/02							ELEVATIO	DN: 10	)0.31 r	m	
SAMP	LE TYPE 🛛 🔤 REMOULDE	ED	Z	SHELBY T	BE SPLIT-SPC	OON PROBING		ECOVERY		CORE		
			ш					80	VANE C	u (kPa) 240	320	2
Ê	CHALL DEN C	DT	μ	N N		SOIL		A VANE	Cu REM	IOULDED	(kPa) ▲	N(n
H	SMALL PEN. 5.	PI	ш	Ш				80	160	240	320	19
DEP	(kPa) (1	N)	MP	AMI	DES	CRIPTION		PLASTIC	М	.C.	Liquid	EV
	X	S.C.	S	01				20	40	60	80	
0.0	sides stable		1			TOPSOIL						-
-						TOT SOIL						-
*											10 B L 1	*
1							100.01				h h h i	-100.0
-							100.01					-
100												-
*											10 h k 1	÷
E.												<b>3</b>
-					~	adium danca						-
-					п	iedium dense					1 I I I I	-
- 1.0						sandy TILL						~
<b>1</b>												
-												-
5								2.5				- 99.0
-										111		2
e -	1										1	-
-												÷:
-								- 19 - 11 -			-	-
-	no water seepage					e 1 1 41	00.54					÷.
-					Bottorr	n of test pit on	98.51					•
-2.0					ро	ssible rock			_			<i>-</i> :
-												-
												-
												98.0
2												
-												
												-
								c f p				-
												-
								1.2				
3.0												
0.0												
												07.0
												97.0
Ĩ												
												-
*												
4.0												
	MOROGTIE	CEN	۲¢	TT TT		LOGGED BY: JM	L	COM	PLETIO	N DEPT	H: 1.8 m	
		ULIN L	ЦК С	L NI		REVIEWED BY: E	.S.	COM	PLETE:	05/09	/02	af 1
05/09/20 0	UTI	iawa,	Ca	nada		Fig. No: f	-				Page	I II

NRC -	- NEW ELECTRICAL SU	)N		E	B.M.( ELEV 100.20m)geodetic; Floor of			TEST PIT NO: 05-7						
	(2 <b>4</b> .)			ł	building M-10 at door No.11				PROJECT NO: E-8890					
START	DATE: 05/09/02								ELEVATIO	DN: 100	.37 m			
SAMP	LE TYPE REMOU	JLDED		SHEL	BY TUBE			G []]NO I	RECOVERY	C	ORE	·		
E SMALL PEN. SPT			E TYPE	LE NO		SOIL			WANE Cu (kPa)   80 160 240 320   ▲ VANE Cu REMOULDED (kPa) 80 160 240 320			320 kPa) ▲ 320	ION(m)	
DEPT	(kPa)	(N)	SAMPL	SAMP		DES	CRIPTION	Ī	PLASTIC	M.C		Liquid ——-1	ELEVAT	
0.0	sides stable		+			1.	TOPSOIL		20	40	60	80		
						rr	edium dense sandy TILL	100.07	-					
- 1.0	no water seepa	ge				Bottorr po	of test pit o ssible rock	on 98.87					- 99.0	
- 2.0													- 98.0	
													- - - - - - - - -	
4.0	McROSTI	E GEN	IE:	ST	ST-I	JOUIS	LOGGED BY: . REVIEWED BY	JML : E-S.	COMP COMP	PLETION PLETE: 0	DEPTH 5/09/	: 1.5 m 02		
05/09/20 0	8:03AM (STD-SHTP)	<u>Ottawa,</u>	Ca	nac	la		Fig. No: 💍					Page	of 1	

3 8
MONTR	REAL RD. NRC M-10	& COOLING	3 TO	WER		B.M.(ELEV 328.75	5FT.)ge	odetic: Floor	of	TEST PIT	TEST PIT NO: 02-1				
NATION	NAL RESEARCH COUN	CIL CANAD	A			bldg. M—10 at d	oor No	. 11		PROJECT	NO: E	-8230	)		
START	DATE: 02/04/22									ELEVATIO	DN: 32	7.61 f	ł		
SAMPI	LE TYPE	JLDED	V	SHEL	BY TUBE	e 🔀 Split-Spo	ON	PROBING	III NO R	ECOVERY		CORE			
(tt)	SMALL PEN.	SPT	TYPE	E NO			S0	ΙL		80 A VANE 80	VANE C 160 Cu REMO 160	u (kPa) 240 DULDED 240	320 (kPa) ▲ 320	ON(ft)	
DEPT	(kPa)	(N)	SAMPLE	SAMPL		DES	CRI	PTION		PLASTIC	М.	с.	Liquid ———I	ELEVATI	
- 0.0	sides stab	le				TC	)PS0I			20	40	60	80	Ē	
-1.0							FILL		327.19					-327.0	
20					piec	es of broken	rock	in sand &	gravel 325.86					-326.0	
														-325.0	
3.0						cla	yey S	AND						-324.0	
- 4.0												_		323.0	
-5.0						med sar	lium ndy Tl	dense ILL	323.03					-323.0	
-6.0	no water seepa	ge				Botto pro	m of bable	pit on e rock	322.11					-322.0	
-7.0															
-8.0															
-9,0														319.0	
10.0														-318.0	
11.0														-317.0	
- 11.0														-316.0	
12.0															
	McROSTI	E GEN	ES	T and	ST-	LOUIS	R	OGGED BY: JML EVIEWED BY: <b>E</b>	.S.	COMF	PLETION PLETE: (	DEPTH 02/04/	1: 5.5 ft /22		
00 m 1 7 10 11	Lanu let cump)	occurra,	υu	nuu	u			19. 1101 L					1 4 9 0		

MONTR	REAL RD. NRC M-10 & COOLIN	ig to	OWER		B.M.(ELEV 328.75FT.)	geodetic: Floor of		TEST PIT	TEST PIT NO: 02-2				
NATION	NAL RESEARCH COUNCIL CANA	DA			bldg. M—10 at door M	to. 11		PROJECT	NO: E-82	30			
START	DATE: 02/04/22		7				CICI	ELEVATIO	N: 327.16	ft			
SAMPL	E TYPE REMOULDED	V	SHEL	BY TUB	e XISPLIT-SPOON	PROBING	III NO F	RECOVERY	CORE				
TH(ft)	SMALL PEN. SPT	E TYPE	LE NO		S	)IL		80 A VANE 80	VANE Cu (kPa 160 240 Cu REMOULDE 160 240	320 320 D (kPa) ▲ 320	rion(ft)		
DEP-	(kPa) (N)	SAMPL	SAMP		DESCR	IPTION		PLASTIC	M.C.	LIQUID	LEVA <sup>-</sup>		
- 0.0	aidaa atabla				700	2014		20	40 60	80			
	sides siddle			*****	IOP:	SOIL			1.11.1	н	-327.0		
							326.83						
-1.0								·	_		-		
											-326.0		
					FI	1					-		
E20				10	III argo piesos of bru	LL Non rook un	+0				-		
- 2.0				10	ange pieces of bri	oken rock up	10				-325.0		
				4		sana ana gra	avei				-		
				١	with pieces of fin	and steel rel	bar		1.0		Ē		
- 3.0											-324.0		
2											-		
											Ē		
- 4.0	no water seepage				Pattom	of pit on	323 16				223 0		
					DUIIUII	or pir on	JZJ.10				=		
					apaord	IE FOCK					E		
- 5.0											£		
											-322.0		
6.0							8				-		
											-321.0		
-			1 1							1 1			
-													
- 7.0											-320.0		
											-		
									1.1.1	2.5.8.4			
8.0											E319.0		
									1.1.1		- 515.0		
											111.0		
9.0									_		240.0		
											-518.0		
											Ē		
E-10.0													
											-317.0		
											1.1		
$E_{110}$											1.1.1		
											-316.0		
											111		
12.0											-315.0		
5													
	MCROSTIE GEN	JE?	ST	ST-	LOUIS	LOGGED BY: JML		COMP	ETION DEPT	H: 4 ft			
	Attomo	лцк С о	mod	~ 1		KEVIEWED BY: E.S		COMPI	LETE: 02/04	+/ 22 Page 1	of 1		
02/04/30 05	ES3AW (ST-SHIMP)	Ud	uidu	a		11.g. 110. J				ruye			

MONTR	EAL RD. NRC M-10 & COOL	ING.	TOWE	R	B.M.(ELEV 328.75FT.)geodetic: Floor of		BOREHOLE NO: 02-3				
NATION	AL RESEARCH COUNCIL CAN	ADA		_	bldg. M-10 at door No. 11		PROJECT	NO: E-	-8230		
START	DATE: 02/04/26						ELEVATION	1: 328	.76 ft		
SAMPL	E TYPE	UGER	Лsн	elby tubi	E SPLIT-SPOON NW-CASING	NO RE	COVERY	NO	) CORE		r
H(ft)	SMALL PEN. SPT	F TYPF	LE NO	RECOVERY	SOIL / ROCK		80 A VANE 80	VANE CI 160 Cu REMO 160	240 240 DULDED 240	320 (kPa) ▲ 320	TION(ft)
DEPT	(kPa) (N)	SAMPI	SAMPI	% CORE F	DESCRIPTION			M. 40	C. 60		ELEVA
E 0.0		+-			FNI		20	+0	00	00	
10					topsoil, sand and aravel			4			-328.0
	,	K			FILL	707 96					E-327.0
2.0	3/0	;" A			FILL	327.20 ad		P			
1 70	split barrel refusal		-		lopson, sana, gravei ana woo	226 00	1				326.0
3.0					LINESTONE	JZ0.03					705.0
4.0				85	LIMESTONE					· _ · _ ·	-323.0
											-324.0
5.0						707.74	20				
- 6.0						323.34				· · · · ·	-323.0
11111					LIMESTONE						-322.0
E- 7.0											10000
8.0				83							-321.0
1	WL				Water level April 29/02 elev 320.	34'					-320.0
9.0											
E 10.0											
		Н				318 34					E-318.0
- 11.0						510.01					11111
E-120					LIMESTONE						-317.0
12.0											-316.0
13.0				98						-	
E 14.0							-				
14.0											314.0
- 15.0											1 014.0
100						313.34			_		
10.0					LIMESTONE						312 0
- 17.0				100							512.0
E .c.											-311.0
18.0		μ	_		Dulland field	710 74	-				210.0
19.0					Bottom of hole	510.54			-		510.0
-											-309.0
= 20.0											
21.0											-308.0
1111											-307.0
22.0											
23.0											-306.0
10.0											-305.0
- 24.0											
25.0							1	FTIOL	DEDT	1 10 10	-304.0
	MCROSTIE G	ΞN	EST	ST-	-LOUIS		COMPL		DEPTH 2/04	1: 18.42	11
		'	Can	ada	Fig. No. A		COMPL	LIL	2/04,	Page	1 of 1
02/05/01	02:02PM (NQ-INP)	ia,	vall	<u>uua</u>	ד זטא אצויון					99	

MONTR	EAL RD. NRC M-10 & COOLI	NG T	TOWE	R	B.M.(ELEV 328.75FT.)geodetic: Floor of	BOREH	OLE N	10: 02	2-4	
NATION	NAL RESEARCH COUNCIL CANA	DA			bldg. M-10 at door No. 11	PROJE	CT NO	: E-82	30	
START	DATE: 02/04/26					ELEVAT	NON:	328.41	ft	
SAMPI	LE TYPE REMOULDED-AU	GER	SH	ELBY TUB	E SPLIT-SPOON NW-CASING III NO R	ECOVERY		NQ CO	RE	
TH(f†)	SMALL PEN. SPT	LE TYPE	PLE NO	RECOVERY	SOIL / ROCK	8 ▲ VA 8	■ VA1 0 1 NE Cu 0 1	NE Cu (kF 60 240 REMOULD 60 240	°a) ■ ) 320 ED (kPa) ▲ ) 320	ATION(ft)
DEP	(kPa) (N)	SAMPI	SAMF	% CORE	DESCRIPTION			M.C.	LIQUID	ELEV/
0.0		-	-		TOPSOIL	2		40 00	00	-328.0
1.0	6/6"				topsoil, sand and gravel					initia initia
11111	20/6"	·Χ	1		FILL 327.41	٩				-327.0
2.0	split barrel refusal				topsoil, sand, gravel					-326.0
3.0					sandy TILL 326.41		/			
										-325.0
- 4.0		-				-				-324.0
-5.0				100	LIMESTONE 524.10	<b>`</b>				turin.
1000					323.16					-323.0
6.0					LIMESTONE					-322.0
-7.0										
1	WL			80	Water level April 29/02 elev 320.99'					E-321 <del>2</del> 0
8.0										-320.0
9.0									· ·····	
										-319.0
- 10.0		-			318 16					-318.0
-11.0					518.10	-				
					LIMESTONE					E-317.0
E 12.0					EIMEOTORE	4	1 0	I	6 E -	
13.0				100						1
1000										-315.0
14.0										
15.0									+ + + + +	E
11111					313.16					-515.0
- 16.0					LIMESTONE					-312.0
17.0				100				#		E
										-311.0
18.0		1			Bottom of hole 310.33					-310.0
19.0										200 0
										E-309.0
20.0										-308.0
21.0										- 307 0
								3		E-307.0
22.0										-306.0
23.0							-			- 305 0
04.0										E
24.0										-304.0
25.0		<u>ا</u>			LOLITO LOGGED BY: JML	- Ico	MPLET	ION DEF	PTH: 18.08	ft
	MCKUSTIE GE	M	721	21-	LUUID REVIEWED BY: E.S.	CO	MPLET	E: 02/0	4/26	
	Ottawa	a, (	Can	ada	Fig. No: 5				Page	1 of 1

02/05/01 01:43PM (NQ-IMP)

MONTR	EAL RD. NRC M-10 & COO	Ling t	OWEF	2	B.M.(ELEV 328.75FT.)	geodetic: Floor of		TEST PIT	TEST PIT NO: 02-5				
NATION	AL RESEARCH COUNCIL CA	NADA			bldg. M—10 at door t	ło. 11		PROJECT	NO: E	-8230	)		
START	DATE: 02/04/22	-	7				(TF)	ELEVATIO	N: 328	3.93 f		_	
SAMPI	E TYPE		SHE	LBY TUB	E SPLIT-SPOON	PROBING	III NO F	RECOVERY		ORE		1	
		PF	9		CL	) I I		80	160	240	320	ŧ	
H H H	SMALL PEN. SPT	۲- ۱			20	ЛL		80	160	240	320	ION	
DEP	(kPa) (N)	IdMA	SAMP		DESCR	IPTION		PLASTIC	М.(	C.	LIQUID	EVA	
		v						20	40	60	80		
0.0	sides stable				FILL							1	
				lc	rge pieces of bro	ken rock up to				a 0			
-1.0				(	2.5'x2.5'x1.0') in	sand and grave	el			-			
		į.											
-2.0				1					-+-+	-	-	-327.0	
1.1					medium dens	e sandy TILL	326.43					E.	
- 3.0												-326.0	
	no water seepage				Bottom of	pit on 32	25.76						
					probabl	e rock						Ē	
- 4.0					·				++			-325.0	
1.6.4												-	
5.0												-324.0	
										1.1		E 797 0	
- 6.0												523.0	
F 6 1												-	
-													
- <sup>7.0</sup>												-	
								10			L ľ		
												-321.0	
8.0												E	
1.1.1			1										
- 00												-320.0	
5.0													
10													
Eino									_			-319.0	
								- 10					
11.0									-			-318.0	
1.1.1												Ē	
-12.0												-317.0	
1												Ē	
	MOROSTIE CI	FNF	CLL CLL	ST	INUS	LOGGED BY: JML		СОМР	LETION	DEPTH	ł: 3.25 fl	i i	
	MCRODIE G		U L	-1U	UTA OTD	REVIEWED BY: E.S		COMP	LETE: (	02/04,	/22	1 of 1	
02/04/30 1	ULLAN	la, Li	ana	ua		119. NO: 0					rage	1 01 I	

MONTR	REAL RD. NRC M-10 & COOLIN	G TC	WER	B.M.(ELEV 328.75FT.)	geodetic: Floor	of	TEST PI	NO:	0: 02-6				
NATION	NAL RESEARCH COUNCIL CANAD	A		bldg. M-10 at door t	lo. 11		PROJECT	NO:	E-823	0			
START	DATE: 02/04/22					1.000.00	ELEVATIO	DN: 32	8.77 f	Ť			
SAMPI	LE TYPE <b>E</b> REMOULDED	1	]SHELBY TUB	e Split-Spoon	PROBING		ECOVERY		CORE				
l(ft)	SMALL PEN. SPT	TYPE	E NO	S	)IL		80 VANE 80	VANE 0 160 Cu REM 160	u (kPa) 240 OULDED 240	320 (kPa) ▲ 320	ON(ft)		
DEPTH	(kPa) (N)	SAMPLE	SAMPL	DESCR	IPTION		PLASTIC	M	.C.	LIQUID 	ELEVATI		
0.0	sides stable	-		ТОР	SOIL		20	40	60	80	-		
-													
E 10						328.19					-328.0		
E				FIL	L						È		
				rock blocks in	sand and g	gravel							
- 2.0						326.77							
				mediu	m dense						-326.0		
-3.0	no water seepage			san	dy HLL	705 77					=		
111				Bollom	or pri on bla rock	525.77							
				propu	DIE TUCK					111	-325.0		
-4.0													
-											E		
111											-324.0		
-5.0											F.		
1.1.1													
-											-323.0		
- 6.0							1.1.1				E		
E											-		
-											-322.0		
- /.0									+ 1		1		
1.1.1											Ē		
È a a											-321.0		
- 8.0											-		
1.1.1													
Ean											-320.0		
- 3.0													
										1 I F	E 710.0		
E-10.0								_			519.0		
E													
1.1.1											E 318.0		
E-11.0										I	E		
1.1.7											Ē		
1.1.1											-317.0		
-12.0											Ē		
1											Ê		
	MCROSTIE GEN	F	ST ST-	-LOUIS	LOGGED BY: JM	L	COM	PLETIO	N DEPT	H: 3 ft			
		ים רי	e bene		REVIEWED BY: E	1.5.	COM	LEIE:	02/04	/22 Page	1 of 1		
02/04/30 0	DELAWA,	Uč	maud		111 <b>9. 110.</b> 7					ruge			

MONTR	EAL RD. NRC M-10 & COOLIN	IG TC	WER	B.M.(ELEV 328.75FT.)	geodetic: Floor of		TEST PIT	NO: 02-	-7	
NATION	AL RESEARCH COUNCIL CANA	DA		bldg. M—10 at door N	lo. 11		PROJECT	NO: E-823	0	
START	DATE: 02/04/22						ELEVATIO	N: 328.36 f	t	
SAMPL	E TYPE		SHELBY TUB	e Split-Spoon	PROBING	NO R	ECOVERY	CORE		
тн( <del>f</del> †)	SMALL PEN. SPT	LE TYPE	PLE NO	SC	)IL		80 A VANE ( 80	VANE Cu (kPa) 160 240 Cu REMOULDED 160 240	320 (kPa) ▲ 320	TION(ft)
BE	(kPa) (N)	SAMP	SAM	DESCR	IPTION		PLASTIC	M.C.	Liquid 	ELEVA
- 0.0	sides stable	+-					20	40 60	80	
100	31463 314616			FILI	-				i . i	-328.0
				topsoil with a t	race of brick	07.00		1.1.2		
-1.0					3	27.69		_		
							· · ·			-327.0
				FIL	_					
2.0				arge pieces of bro	ken rock up t	0	·			E
1.11				(2.5'x2.5'x1.0') in	sand and ara	vel				-326.0
				with traces of co	ncrete and me	etal				E
-3.0										
										-325.0
100										
-4.0							1-1-1		_	E
								1111	10.10	-324.0
1. A. A.										E
-5.0							_		_	
100				8					1.1	-323.0
				8					10.8	
- 6.0	no water seepage									E
				Bottom o	tpiton .	322.36				-322.0
0.00				probabl	e rock					
- 7.0						1				
										-321.0
- 8.0										
Ê, I							-			-320.0
										-
9.0						1				
						1		1.1.1		-319.0
-10.0							1			
										-318.0
Ē.							1.1.0	1111		
-11.0						1		4 4 4		
										-317.0
12.0										
										316.0
	MODOCTIE OEN	ער דידו	T CM	LOUIG	LOGGED BY: JML		COMPL	etion depth	: 6 ft	
	MCRUSIIE GEN	1LC	1 21-	TOOID	REVIEWED BY: E.S.		COMPL	ETE: 02/04/	'22	
2/04/30 09:	53AW (ST-SHIMP) Uttawa,	Ca	nada		tig. No: 8				Page 1	of 1

MONTR	REAL RD. NRC M-10 & COOLIN	G TO	WER	B.M.(ELEV 328.75FT.)	geodetic: Floor of		TEST PIT NO: 02-8			
NATIO	VAL RESEARCH COUNCIL CANAL	A		bldg. M—10 at door l	No. 11		PROJECT	NO: E-823	,0	
START	DATE: 02/04/22	-					ELEVATIO	1: 328.08	ft	
SAMPI		1	SHELBY TUE	IE SPLIT-SPOON	PROBING	[     NO R	ECOVERY	CORE		
TH(ft)	SMALL PEN. SPT	E TYPE	PLE NO	S	)IL		80 A VANE C 80	ANE Cu (kPa) 160 240 u REMOULDED 160 240	320 (kPa) ▲ 320	TION(ft)
DEP	(kPa) (N)	SAMP	SAMF	DESCR	IPTION		PLASTIC	M.C.	Liquid I	ELEVA
0.0	sides stable	-		TOPS	OIL		20	40 60	80	
1.0				FILL		27.41	540 			-327.0
2.0				large pieces of br (2.5'x2.5'x1.0') i	oken rock up to n sandy soil of brick	0				
- 30					of blick		в) — в -		1 1 1	
				medium sandy	dense TILL	325.08				-325.0
- 4.0	no water seepage			Bottom of probable	pit on 3 rock	24.08			ż	-324.0
-5.0										-323.0
6.0									5	-322.0
- 7.0										-321.0
-8.0										—320.0
-9.0										—319.0
- 10.0										318.0
11.0										317.0
- 12.0										-316.0
	MCROSTIF CEN	ES	T ST-	LOUIS	LOGGED BY: JML		COMPLI	TION DEPTH	1: 4 ft	
		ші. Л-	n n l –		REVIEWED BY: E.S.		COMPLI	ETE: 02/04	/22	
02/04/30 09	Uttawa,	<u>la</u>	nada		rig. No: 9				Page 1	ot 1

McROS	TIE GENES & Associationsulting I	ST ST-LOUIS ces Ltd. Ingineers	TEST PIT RECORD	Test Pit No, 99-6
+	OTTAWA, (	CANADA	Date :	JUNE II, 1999   +
		N.R.C. BLDG. MONTREA	M-IU ADDITION AL ROAD	
ELEV. 329.23	DEPTH in feet	DESCR	REMARKS	
+		TOP	SOIL	sides stable
328.41 328.23	0.82 1			
227 22	2	BOULDERS up in o sandy	o to 1.6' O lense Y TILL	
327.23	2			
326.23	3			
325.62	3.61	Bottom of pit of	on probable rock	no water seepage
				R
				14.
		,		
				Plate No. 8

McRO	STIE GENES & Associat	ST ST-LOUIS les Ltd.	TEST PIT RECORD	Test Pit No. 99-5
C	onsulting H OTTAWA, (	Ingineers CANADA	Date :	JUNE 11, 1999
		N.R.C. BLDG MONTR	. M-10 ADDITION EAL ROAD	
ELEV. 328.54	DEPTH in feet	DESC	RIPTION	REMARKS
	+	crushed	FILL limestone	sides stable
327.54	1			
327.23	1.31			
326.54	2	d san	ense dy TILL	
325.54 325.26	3 3.28	Bottom of pit	on probable rock	no water seepage
			-	
		7		
				Plate No.



July 23, 2008

Project No. 08-1121-0099

Mr. Bruno Vallieres, Administrative Services and Property Branch National Research Council Canada Building M-19 120 Montreal Road Ottawa, Ontario K1A 0R6

RE: NRC CO, H2 AND N2 DOCKING AND PIPING FACILITY NRC MONTREAL ROAD CAMPUS BLAIR ROAD OTTAWA, ONTARIO

Dear Mr. Vallieres

Please find attached our limited report on geotechnical considerations for the proposed Docking and Piping Facility to be constructed at the NRC Montreal Road Campus, Blair Road, Ontario.

We trust that this limited report is sufficient for your present requirements. If you have any questions concerning this limited report or, if we can be of further assistance, please let us know.

Yours truly,

GOLDER ASSOCIATES LTD.

M.W. St-Louis, P.Eng. Senior Geotechnical Engineer T.J. Nicholas, P.Eng, Principal

MSTL/TJN/ch

n:\active\2008\1121 - geotechnical\08-1121-0099\08-1121-0099 inside ltr for rpt 23jul08\_doc







# **Table of Contents**

1.0	INTRO	DUCTION	1
2.0	DESCR		2
3.0	PROCE	EDURE	3
4.0	SUBSL	IRFACE CONDITIONS	4
	4.1	General	4
	4.2	Fill Material and Topsoil	4
	4.3	Glacial Till	4
	4.4	Limestone Bedrock	4
	4.5	Groundwater	5
5.0	PROPC	DSED DOCKING AND PIPING FACILITY	6
	5.1	General	6
	5.2	Excavations and Site Servicing	3
	5.3	Foundations	7
	5.4	Rock Anchors	7
	5.5	Frost Protection	7
	5.6	Duct Bank Route	3
	5.7	Seismic Site Response Classification	3
	5.8	Corrosion and Cement Type	3
6.0	ADDITI	ONAL CONSIDERATIONS	3

#### APPENDICES

**APPENDIX A** Abbreviations and Symbols Record of Borehole and Test Pit Sheets

APPENDIX B

Boreholes and Test Pits from Previous Studies





# 1.0 INTRODUCTION

This limited report addresses geotechnical consideration related to the site of the Docking and Piping Facility to be located on the NRC Montreal Road Campus, Blair Road, Ottawa (see Figure 1, Key Plan). Geotechnical studies had been prepared by McRostie Genest St-Louis (MGS) in 2002 and 2005 (reference reports SF-4553B and SF-4932). The results of the pertinent subsurface information from the above studies are included in this report for completeness.

The purpose of this assignment was to review the general soil and groundwater conditions in the area of the proposed duct bank routes for the docking and piping facility by means of an additional four (4) boreholes (08-1 to 08-4 inclusive) and fourteen (14) test pits (08-5 to 08-17 inclusive and 08-15A) and, based on an interpretation of factual information including that from past subsurface records obtained, to provide engineering guidelines on the geotechnical design aspects of the project, including construction considerations which could influence design decisions.

The reader is referred to the "Important Information and Limitations of this Report", which follows the text but forms and integral part of this document.





# 2.0 DESCRIPTION OF PROJECT

Plans are being prepared to construct a docking and piping facility at the NRC Montreal Road Campus (see Figure 1, Key Plan). The project will include duct banks within about 2.5 metres of the existing ground surface, foundations for a nitrogen tank that will be about 12 metres in height and 3 metres in diameter supported on three (3) legs, and 3 blast walls to be in compliance with NFP 55 requirements in the docking facility.

Geological mapping indicates that the bedrock underlying this site is sedimentary in nature and consists of limestone of the Bobcaygeon formation.

The site also falls within the Western Québec Seismic Zone (WQSZ) according to Geological Survey of Canada. The WQSZ constitutes a large area that extends from Montréal to Témiscaming, and which encompasses the Ottawa area. Within the WQSZ, recent seismic activity has been concentrated in two (2) subzones; one along the Ottawa River and another more active subzone along the Montréal-Maniwaki axis. Historical seismicity within the WQSZ from 1900 to 2000 includes the 1935 Témiscaming event which had a magnitude (i.e., a measure of the intensity of the earthquake) of 6.2 and in 1944, a Cornwall-Massena event had a magnitude of 5.6. In comparison with other seismically active areas in the world (i.e., California, Japan and New Zealand), the frequency of earthquake activity within the WQSZ is significantly lower but there still exists the potential for significant earthquake events to be generated.

Under the 2006 Ontario Building Code (OBC), a seismic hazard with a 2% probability of exceedance in 50 years has been retained for design. For the subject site, the reference (Site Class C) peak horizontal ground acceleration (PGA) is 0.42g (g = acceleration by gravity) (Adams and Halchuck, 2003).



# 3.0 PROCEDURE

The field work for this investigation was carried out on June 18, 2008 (test pits) and on July 3 and 4, 2008 (boreholes). At that time fourteen (14) test pits (numbered 08-5 to 08-17 inclusive and 08-15A) and four (4) boreholes (numbered 08-1 to 08-4 inclusive) were put down at the approximate locations shown on the Site Plan, Figure 2.

The test pits were excavated by a rubber tired backhoe. The test pits were advanced to depths of between 0.4 and 2.2 metres below the existing ground surface.

The boreholes were advanced using a track-mounted CME 45 hollow-stem auger drill rig supplied and operated by Marathon Drilling Company Ltd. of Ottawa, Ontario. The boreholes were advanced to depths of between 2.8 and 3.5 metres below the existing ground surface.

Within the boreholes, standard penetration tests (SPT) were carried out at regular intervals of depth and samples of the soils encountered were recovered using drive open sampling equipment. All four (4) boreholes were advanced through the overburden and into the underlying limestone bedrock. In all boreholes, the limestone bedrock was proven for a depth of between 1.5 and 1.7 metres by rotary core drilling in NQ size.

The field work was supervised by an experienced technician from our staff who directed the drilling operations, logged the test pits, the boreholes and samples, directed the in-situ testing and took custody of the soil samples and rock cores.

On completion of the drilling operations, the soil samples and rock cores were transported to our laboratory.

A standpipe was installed in boreholes 08-1 and 08-3 to determine the stabilized groundwater conditions at the site. The groundwater level in the standpipe was measure on July 9, 2008.

The borehole and test pit locations were selected by the National Research Council. Subsequently, the locations and ground surface elevations for the test pits and boreholes for this subsurface investigation were surveyed by Stantec Geomatics Ltd. The ground surface elevations supplied to Golder Associates are understood to be referenced to Geodetic datum.





# 4.0 SUBSURFACE CONDITIONS

## 4.1 General

The subsurface conditions encountered during the present 2008 investigation are shown on the Record of Borehole and Record of Test Pit sheets in Appendix A.

The subsurface information from previous studies was compiled as part of the present study and is included in Appendix B.

The subsurface conditions at this site can be generalized as consisting of surficial deposits of topsoil and fill material underlain by glacial till in turn underlain by limestone bedrock. The depth to bedrock is variable at this site.

The following sections provide a more detailed summary of the subsurface conditions encountered within the boreholes and test pits from the present and previous investigations.

# 4.2 Fill Material and Topsoil

Fill material and/or topsoil were encountered at the existing ground surface and found to range in thickness between 100 millimetres to about 2.15 metres (see Test Pit 08-15). The fill material generally consists of sand, gravel, topsoil, cobbles, boulders and rock blocks but at some locations also contains wood, brick, and concrete. In test pit 08-15, tires were found within the fill.

# 4.3 Glacial Till

A deposit of glacial till is often found between the surficial layer of fill and/or topsoil and the bedrock surface. The glacial till consists of a heterogeneous mixture of gravel, cobbles and boulders in a matrix of silty sand with a trace of some clay. There are a few locations where no glacial till was encountered and where the fill material and/or topsoil veneers the limestone bedrock.

# 4.4 Limestone Bedrock

Limestone bedrock underlies the fill material and the glacial till at all boreholes put down as part of the present subsurface investigation.

The bedrock surface varies from elevation 97.5 to 99.3 metres which is about 1.0 to 2.0 metres below the existing ground surface. In borehole 08-1 and 08-3, the upper layer of bedrock was weathered and was sampled using drive open soil sampling equipment over depths of 0.3 and 0.1 metres, respectively. Below this upper bedrock layer, the degree of weathering is moderate to slight.





The Total Core Recovery (TCR) varies from about 88 to 100 percent of the length drilled. The Solid Core Recovery (SCR), the percentage of core that is completely circular in section, ranges fro 67 to 98 percent. The Rock Quality Designation (RQD), the percent length of intact core longer than 100 millimetres, varies between 50 and 77 percent

# 4.5 Groundwater

The groundwater levels in the two (2) boreholes with standpipes sealed into the underlying limestone bedrock (boreholes 08-1 and 08-3) were measured on July 9, 2008. At that time, groundwater levels varied from about 2.5 to 2.6 metres below the existing ground surface (i.e. about elevations 97.1 to 97.7 metres).

It should be noted that groundwater levels are expected to fluctuate seasonally. Higher groundwater levels are expected during wet periods of the year, such as spring.





# 5.0 PROPOSED DOCKING AND PIPING FACILITY

# 5.1 General

This section of the report provides limited engineering guidelines on the geotechnical aspects of the project for the service duct banks, the foundations for the nitrogen tower and the blast wall foundations portion of the project and based on our interpretation of subsurface information and project requirements and is subject to the limitations in the "Important Information and Limitations of This Report" attachment which follows the text of this report.

The professional services retained for this project include only the geotechnical aspects of subsurface conditions at the site. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off site sources are outside the terms of reference for this project and have not been investigated nor addressed.

# 5.2 Excavations and Site Servicing

Excavations for the installation of site services (duct banks) will be through fill materials, topsoil, glacial till and at some locations will extend into bedrock.

No unusual problems are anticipated in trenching in the overburden using conventional hydraulic excavating equipment, although significant cobble and boulder removal could be required in the glacial till. Furthermore, large rock blocks should also be expected to be present in fill materials. Old concrete foundation walls and basement floor slabs may also be found at some locations as it is understood that buildings were demolished before the construction of the NRC Montreal Road Campus.

It is expected that the bedrock removal for the project will be carried out using drill and blast techniques. Should bedrock removal be carried out by drilling and blasting, special care will be required to prevent overblasting and fracturing of the bedrock below foundation levels.

The blasting should be controlled to limit the peak particle velocities at all adjacent structures such that blast induced damage will be avoided. This will require blast designs by a specialist in this field.

A pre-blast survey should be carried out on all surrounding structures. Selected existing interior and exterior cracks in the structure should be identified during the pre-blast survey and should be monitored for lateral or shear movements by means of glass telltales and/or movement telltales.

The contractor should be limited to only small controlled shots. The following frequency dependent vibration limits at the nearest structures and services are suggested

Frequency Range (Hz)	Vibration Limits (millimeters/second)
<10	5
10 to 40	5 to 50 (sliding scale)
>40	50





These limits should be practical and achievable for most of this project. In areas in close proximity to structures and services, limestone bedrock removal should be accomplished using mechanical methods such as hoe-ramming in conjunction with closely spaced line drilling to establish the limit of the excavation.

# 5.3 Foundations

It is considered that the proposed nitrogen tank structure and the three (3) blast walls will be founded on spread footings placed on limestone bedrock or by caissons extending into the limestone bedrock layers underlying the site.

For footing design purposes, footings placed directly on limestone bedrock, below any upper weathered zones, may be sized using an Ultimate Limit States (ULS) factored bearing resistance of 1000 kilopascals. Provided that the bedrock surface is properly cleaned of soil or any loose rock fragments at the time of construction, the settlement of footings sized using the above factored bearing resistance should be negligible, therefore, Serviceability Limit States (SLS) need not be considered.

Caissons, as an alternative foundation scheme, could be designed based on a rock socket to concrete bond value of 500 kilopascals (SLS); end bearing should be ignored. In addition, the bond (adhesion) in the upper weathered or fractured zone should also be ignored.

An advantage to the rock socketed caissons is their ability to be reinforced for both downward loading and uplift resistance.

# 5.4 Rock Anchors

If required, rock anchors could be provided to resist uplift loads on footing type foundations.

The anchors could consist of either grouted or mechanical anchors.

For a group of anchors or for a line of closely spaced anchors, the resistance must consider the potential overlap between the rock masses mobilized by individual anchors. Further guidance, at the final design stage, should be provided for assessing the resistance of a single anchor and the effect of a group of anchors.

# 5.5 Frost Protection

All exterior foundation elements in unheated areas should be provided with a minimum of 1.5 metres of earth cover for frost protection purposes. Isolated foundations or foundations in unheated areas which are adjacent to any surface cleared of snow cover during winter months should be provided with a minimum of 1.8 metres of earth cover.

For footings founded on competent bedrock, the requirement for 1.5 or 1.8 metres of earth cover could be waived where it could be shown by check drilling during construction that the bedrock below footing level does not contain any joints filled with frost-susceptible soil.





The concrete encased duct bank should be made to bear on the bedrock surface or within the bedrock over the entire route for this project in order to prevent conditions of differential support and potential settlement where soil supported.

Excavation of the limestone bedrock would be required at some locations where bedrock is shallow. Lean concrete infill would be required in localized areas where the bedrock surface is somewhat deeper.

# 5.7 Seismic Site Response Classification

The 2006 OBC contains an updated seismic analysis and design methodology which uses a seismic site response classification system defined by the shear stiffness of the upper 30 metres of ground of interest. Seismic response is now defined by uniform hazard spectra (UHS) corresponding to design earthquake with a probability of exceedance of 2% in 50 years. There are six site classes (from A to F), decreasing in soil stiffness from A (hard rock) to E (soft soil); Site Class F denotes problematic soils for which a site-specific evaluation is required. The site class is used to obtain soil factors ( $F_a$  and  $F_v$ ) used to modify the UHS to account for the effects of site-specific soil conditions on the seismic response of the site to the design earthquake.

To support a site class designation, a shear wave velocity of 700 metres per second was assigned to the limestone bedrock, based on actual measurements in similar bedrock formations. Interpreting the data available indicates that a Site Class C designation would be appropriate. It may be possible to achieve a higher Site Class designation by obtaining site specific shear wave velocities.

# 5.8 Corrosion and Cement Type

As part of several studies performed by McRostie Genest St.-Louis (MGS) at the NRC Montreal Road Campus over the years, groundwater samples were collected and submitted for chemical analysis related to potential corrosion of buried ferrous elements and sulphate attack on buried concrete elements.

There has not been a history of potential problems with corrosion of exposed ferrous elements or sulphate attack on buried concrete elements.

Based on the past performance of older existing foundations exposed at the time of recent additions to the NRC Montreal Road Campus, concrete made with Type GU Portland cement should be acceptable for substructures.





# 6.0 ADDITIONAL CONSIDERATIONS

All foundation areas and duct bank trenches should be inspected by experienced geotechnical personnel prior to concreting to ensure that the limestone bedrock having adequate bearing capacity has been reached and that the bearing surfaces have been properly prepared including the removal of fractured bedrock by overblasting.

At the time of writing this report, only conceptual details of the proposed docking and piping facility were available.

We trust that this limited report that only cover the geotechnical aspects within the latter is sufficient for your present requirements. If you have any questions concerning this report or require additional geotechnical recommendations, please call us.





# **Report Signature Page**

#### GOLDER ASSOCIATES LTD.

Michel St-Louis, P.Eng. Senior Geotechnical Engineer Terry J. Nicholas, P.Eng Principal

MSTL/TJN/sr

n:\active\2008\1121 - geotechnical\08-1121-0099\report july 2008 08-1121-0099.doc



#### IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

**Standard of Care:** Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

**Basis and Use of the Report:** This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

**Soil, Rock and Groundwater Conditions:** Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

#### IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (cont'd)

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

**Sample Disposal:** Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

**Follow-Up and Construction Services:** All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

**Changed Conditions and Drainage:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.



FILENAME: N:\Active\2008\1121 - Geotechnica\08-1121-0099\ACAD\0811210099-01.dwg Drawing file: 0811210099-01.dwg Jul 14, 2008 - 2:28pm



PLOT DATE: July 22, 2008 FILENAME: N:\Active\2008\1121 - Geotechnical\08-1121-0099\ACAD\0811210099



# **APPENDIX A**

Abbreviations and Symbols Record of Borehole and Test Pit Sheets



# **LIST OF ABBREVIATIONS**

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I.	SAMPLE TYPE	III.	SOIL	DESCRIPTION		
AS	Auger sample		(a)	Co	hesionless S	Soils
BS	Block sample					
CS	Chunk sample	Density Ir	ndex		Ν	
DO	Drive open	(Relative)	Density)		Blows/30	) mm
DS	Denison type sample				Or Blow	s/ft
FS	Foil sample	Very loose			0 to 4	L
RC	Rock core	Loose			4 to 1	n N
SC	Soil core	Compact			10 to 3	0 10
ST	Slotted tube	Dense			30 to 5	50
ТО	Thin-walled, open	Very dense			over 5	0
TP	Thin-walled, piston	, erj deno	-		0,01,2	0
WS	Wash sample		(h)	C	ohesive Soil	e.
	t ush sumpro	Consisten	(U)			6
П	PENETRATION RESISTANCE	Consistent	c y	Kna	$C_{u2}O_{u}$	Def
11.	LEVEL MATION REDISTRICE	Very soft		$\frac{npa}{12}$		0 to 250
Standard	Penetration Resistance (SPT) N.	Soft		12 to 25		250 to 500
Standart	The number of blows by a 63.5 kg $(140 \text{ lb})$	Firm		12 to 25		200 to 1000
	hammer dronged 760 mm (30 in ) required	Stiff		20 to 100		1 000 to 1,000
	to drive a 50 mm (2 in ) drive open	Very stiff		100 to 200		2,000 to 2,000
	Sampler for a distance of $300 \text{ mm} (12 \text{ in})$	Hord		Over 200		2,000 10 4,000
	DD- Diamond Drilling	Haru		0761 200		Over 4,000
Dynamic	Penetration Resistance: N.:	IV	SOIL TE	272		
Dynamic	The number of blows by a 63.5 kg (140 lb)	1	SOIL IL	515		
	hammer dronped 760 mm (30 in ) to drive	W	water cont	tent	-	
	Uncased a 50 mm (2 in ) diameter $60^{\circ}$ cone	W/	plastic lim	vited		
	attached to "A" size drill rods for a distance	wp w.	liquid lim	it		
	of 300 mm (12 in )	Č	consolidai	ton (oedometer) test		
		CHEM	chemical	analysis (refer to text)		
₽Н∙	Sampler advanced by bydraulic pressure	CID	consolidat	red isotropically drain	ad triavial to	et1
PM.	Sampler advanced by manual pressure	CIU	consolidat	ed isotropically undra	ined triaxial	si tect
WH.	Sampler advanced by static weight of hammer	010	with pores	votar pressura monsur	mont <sup>1</sup>	test
WR.	Sampler advanced by weight of sampler and	D-	relative de	valer pressure measure	G	
,, IX.	rod		direct shes	nony (specific gravity)	$, \mathbf{U}_{s}$	
	104	M	eieve analy	usis for particle size		
Peizo-Co	a Panatrotian Test (CDT)	MH	sieve allary	sieve and hydrometer	(II) analysis	
1 0120-001	An electronic cone penetrometer with	MPC	modified F	Proctor compaction to:	(II) allalysis	
	a $60^{\circ}$ conical tip and a projected end area	SPC	etandard D	roctor compaction tes	6	
	of 10 $\text{cm}^2$ pushed through ground		organic co	ntent test	L	
	at a nenetration rate of 2 cm/s Massurements	SO.	concentrat	ion of water coluble of	ulphataa	
	of tip resistance $(\Omega)$ porewater pressure		unconfinat	compression test	urphates	
	(PWP) and friction along a sleeve are recorded		unconsolid	a compression test	tast	
	Electronically at 25 mm penetration intervals	v	field yorg	tact (IV laboratory vo	u iesi	
	Exectionically at 25 min penetration intervals.	*	unit waich	t	ine test)	
		r	unit weigh	ι		

Note:

1. Tests which are anisotropically consolidated prior shear are shown as CAD, CAU.

÷

#### **Golder Associates**

### LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

Ι.	GENERAL		(a) Index Properties (cont'd.)
π	= 3.1416	w	water content
ln x, natural	logarithm of x	w <sub>1</sub>	liquid limit
log <sub>10</sub> x or log	g x, logarithm of x to base 10	Wp	plastic limit
g	Acceleration due to gravity	Ip	plasticity Index= $(w_1 - w_p)$
t t	time	Ws	shrinkage limit
F	factor of safety	$I_L$	liquidity index=(w-w <sub>p</sub> )/I <sub>p</sub>
V	volume	I <sub>c</sub>	consistency index= $(w_1 - w)/I_p$
W	weight	e <sub>max</sub>	void ratio in loosest state
		$e_{min}$	void ratio in densest state
11.	STRESS AND STRAIN	ID	density index- $(e_{max}-e)/(e_{max}-e_{min})$
			(formerly relative density)
Ŷ	shear strain		
Δ	change in, e.g. in stress: $\Delta \sigma'$		(b) Hydraulic Properties
ε	linear strain		
ε <sub>v</sub>	volumetric strain	h	hydraulic head or potential
η	coefficient of viscosity	q	rate of flow
ν	Poisson's ratio	v	velocity of flow
σ	total stress	i	hydraulic gradient
σ	effective stress ( $\sigma' = \sigma''$ -u)	k	hydraulic conductivity (coefficient of permeability)
σ' <sub>vo</sub>	initial effective overburden stress	j	seepage force per unit volume
$\sigma_1 \sigma_2 \sigma_3$	principal stresses (major, intermediate,		
	minor)		(c) Consolidation (one-dimensional)
$\sigma_{\rm oct}$	mean stress or octahedral stress		TK5
	$= (\sigma_1 + \sigma_2 + \sigma_3)/3$	$C_{c}$	compression index (normally consolidated range)
τ	shear stress	Cr	recompression index (overconsolidated range)
u	porewater pressure	C <sub>s</sub>	swelling index
E	modulus of deformation	$C_a$	coefficient of secondary consolidation
G V	shear modulus of deformation	m <sub>v</sub>	coefficient of volume change
K	bulk modulus of compressibility	c <sub>v</sub>	coefficient of consolidation
III	SOIL DDODEDTIES		time factor (vertical direction)
111,	SOIL FROFER HES		degree of consolidation
	(a) Index Properties		pre-consolitation pressure
	(a) much roperties	UCK	Overconsolidation ratio= $\sigma_p / \sigma_{v_0}$
ρ(γ)	bulk density (bulk unit weight*)		(d) Shear Strength
$\rho_{d}(\gamma_{d})$	dry density (dry unit weight)		
$\rho_w(\gamma_w)$	density (unit weight) of water	$\tau_n \tau_r$	peak and residual shear strength
$\rho_s(\gamma_s)$	density (unit weight) of solid particles	φ'	effective angle of internal friction
γ	unit weight of submerged soil ( $\gamma' = \gamma - \gamma_w$ )	δ	angle of interface friction
$D_R$	relative density (specific gravity) of	μ	coefficient of friction=tan $\delta$
	solid particles ( $D_R = p_s/p_w$ ) formerly ( $G_s$ )	c'	effective cohesion
e	void ratio	C <sub>u</sub> .S <sub>u</sub>	undrained shear strength ( $\phi=0$ analysis)
n	porosity	p	mean total stress $(\sigma_1 + \sigma_2)/2$
S	degree of saturation	- p'	mean effective stress $(\sigma'_1 + \sigma'_2)/2$
		q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma_1 - \sigma_3)/2$
*	Density symbol is p. Unit weight	q.,	compressive strength $(\sigma_1 - \sigma_2)$
	symbol is $\gamma$ where $\gamma = pg(i.e. mass)$	S,	sensitivity
	density x acceleration due to gravity)	,	
			Notes: 1. $\tau = c'\sigma' \tan   '$

2. Shear strength=(Compressive strength)/2

#### **Golder Associates**

#### PROJECT: 08-1121-0099 LOCATION: See Site Plan

# RECORD OF BOREHOLE: BH 08-1

BORING DATE: 4 July 2008

SHEET 1 OF 1

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

CALE	Ι	ETHOD	SOIL PROFILE	5	1	SA	MPL	ES	DYNAI RESIS	MIC PEN TANCE	NETF , BLC 40	RATIC DWS/	0N 0_3m 0 8	30	HYDR	AULIC C k, cm/s	ONDUC 5	TIVITY, I0 <sup>,4</sup> 1	0, [	STING	PIEZOMETER OR
DEPTH SI METRI		BORING M	DESCRIPTION	STRATA PL	ELEV DEPTH (m)	NUMBER	TYPE	BLOWS/0.3	SHEAI Cu, kP	R STRE	NGT	H n re 6	atV.+ emV.⊕ D €	Q - • U - O	w w	/ATER C p /	ONTEN ONTEN		WI	ADDITIO	STANDPIPE INSTALLATION
- 0	Power Auger	00 mm Diam (Hollow Stem)	Ground Surface Brown sand and gravel, some cobbles and boulders (FILL) Grey brown SILTY SAND, some gravel Weathered Grey LIMESTONE		100.26 0.00 99.44 99.25 1.01	1 1A	50 DO 50 DO	31 31													Native Backfill and Silica Sand
2	Rotary Drill	NQ Core 2	BEDROCK			2	NQ RC	DD	TCR (%) 00	S.C.R. (%) 83	R. a. D. (%)	50									Bentonite Seal Silica Sand
			End of Borehole									4.									W.L. in screen at elev, 97.73 m on July 9, 2008
		гн s	SCALE							G		ler									OGGED: J.D.

#### PROJECT: 08-1121-0099

## RECORD OF BOREHOLE: BH 08-2

SHEET 1 OF 1

DATUM:

LOCATION: See Site Plan

SAMPLER HAMMER, 64kg; DROP, 760mm

BORING DATE: July 3, 2008

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

u :	6	3	SOIL PROFILE			SA	MPL	ES	DYN. RES	AN ST		NE	TRAT	ION S/0	l 3m	2	HYDR	RAULI k. c	C CC	NDUC	tivity,		T	.0	
METRES	BORING METH		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHE/ Cu, k	2( AR Pa	) STRE	40 ENC	ЭТН	60 nat rem	8( V. + 1 V. ⊕ 8(	0 0-0	v v	10 <sup>-6</sup> VATE ∕p	10 R C 0	) <sup>5</sup> 1 )NTEN ———————————————————————————————————	0 <sup>-4</sup> F PERC	10 <sup>-3</sup> ENT I WI 40		ADDITIONAL	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger	200 mm Diam. (Hollow Stem)	Ground Surface FILL and GLACIAL TILL, with cobbles and boulders		100.26 0.00 99.16	1 2 3	GRAI NQ RC	9 - DD 30																	
24	Rotary Drill	ND Core	Weathered Grey LIMESTONE BEDROCK		1.10	4	NQ RC NQ RC	DD	TCR.(%) 88 8	2	8 C.R. (%) 8	2	R 0.D. (%) 22												
3			End of Borehole		<u>97,40</u> 2.77																				-
5																									
Ϋ́																									
8									R																
0																									it and and and and and
DEP	тн 50	sc	ALE					(	Ĵ		G	ol	lder	r	25					1				LO	GGED: J.D. CKED: Typu

#### PROJECT: 08-1121-0099

#### RECORD OF BOREHOLE: BH 08-3

SHEET 1 OF 1

DATUM:

LOCATION: See Site Plan

SAMPLER HAMMER, 64kg; DROP, 760mm

BORING DATE: July 3, 2008

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

	B	SOIL PROFILE			SA	MPL	ES	DYN		IC PE	NET	RATI	ON /0.3m	)	HYDR	AULIC C	ONDUC	TIVITY,	T	.0		
METRES	<b>DRING METH</b>	DESCRIPTION	RATA PLOT	ELEV. DEPTH	NUMBER	ТҮРЕ	-OWS/0.3m	SHE Cu,	20 AR kPa	STR	40 ENG	TH	50 hat V - em V (	80 + Q - ● Đ U - O	r V W	0 <sup>-6</sup> 1 /ATER C p	0 <sup>-5</sup> 1 ONTENT 	0 <sup>-4</sup>	IO <sup>3</sup> INT WI	ADDITIONAL	PIEZOMETE OR STANDPIPE INSTALLATIO	E DN
	B	Ground Surface	ST	(m) 99.67			BL		20		40		50	80		10	20 ;	30	40			
1	Power Auger 200 mm Diam (Hollow Stem)	Loose brown sand and gravel, some cobbles and boulders (FILL) Compact grey brown SILTY SAND, some gravel, cobbles, boulders, trace clay (GLACIAL TILL)	25.25	0,00 98,71 0.96 98,15	1 1A	50 DO 50 DO	13 13														Native Backfill and Silica Sand	
2	Kotary Unil NQ Core	Weathered grey LIMESTONE BEDROCK, some mud seams		1,52	2	50 DO NQ RC	30 DD	TCR (%)	00	SCR (%)	88 60	2 73 2									Bentonite Seal Silica Sand	
			臣臣	98.20																	Slot Screen	
4 5 6 7																					W.L. in screen at elev. 97.05 m on July 9, 2008	
8 9 10																						
 DEP 1 : {	тн s 50	CALE					(	Â	9	G		dei	tes		•			4/1		СН	DGGED: J.D. ECKED: Infu	

PROJECT: 08-1121-0099 RECORD O							OF BOREHOLE: BH 08-4											SHEET 1 OF 1						
LC S/			DN: See Sile Plan R HAMMER, 64kg; DROP, 760mm							BC	RIN	IG C	DAT	≣: :	3 July 20	08		PE	NETRAT	FION TE	EST HAI	DATUM: AMMER, 64kg; DROP, 760mm		
	L	Q	SOIL PROFILE	_	_	SA	MPL	ES	DY	(NAM		PEN	ETR	ATIC	N 0.3m	)	HYDR		ONDUCT	TIVITY,	Т			
DEPTH SCALE METRES		BORING METHO	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BI,OWS/0.3m	SH Cu	2 IEAF I, kP	0 R ST a	4 REN 4		6 1 n 6	0,311 0 8( atV, + 9m V, ⊕	9-0 U-0	1 W W	(, cill/s 0 <sup>-6</sup> 1 /ATER C 0	0 <sup>5</sup> 10 ONTENT <u>OW</u>	0 <sup>-4</sup> 1 PERCE		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
•	ucer	follow Stern)	Ground Surface Loose brown sand and gravel, some cobbles and boulders (FILL)		99.44 0.00 98.55																			
	Power Al	200 mm Diam. (h	Compact grey brown SIL IY SAND, some gravel, cobbles, boulders, trace clay (GLACIAL TILL)		97.45	1A 1 2	6RAE 50 DO 50 DO	12 60																
- 2	Rotary Drill	NO Core	Weathered grey LIMESTONE BEDROCK, some mud seams		1.95	з	NQ RC	DD	T.C.R. (%)	100	S.C.R. (%)	94	R.Q.D. (%)	71										
			End of Borehole		3.47																			
DI 1	EP1 : 5	тн s 0	CALE					ĺ	G		A	Go		ler	tes							LC CH	DGGED: J.D.	

BOREHOLE 0811210099.GPJ HYDROGEO.GDT 14/7/08

# TABLE 1

## **RECORD OF TEST PITS**

	Test Pit Number	Depth (Metres)	Description
-	1 tumber	(1100105)	
	TP 08-5	0.00 - 0.30	FILL – Brown SAND, GRAVEL and TOPSOIL
	(Elevation	0.30 - 1.55	Brown SANDY TILL
	100.55 m)	1.55	End of test pit. Refusal on BEDROCK.
		0.00 0.00	Ell L. Crushed Lineastone
	TP 08-6	0.00 - 0.20	FILL – Crushed Linestone
	(Elevation	0.20 - 0.55	Medium dense brown SANDY TH I
	100.44 m)	0.35 - 1.52	End of toot nit. Defued on REDROCK
		1.32	End of test pit. Refusal on BEDROCK.
	TP 08-7	0.00 - 0.20	FILL – Crushed LIMESTONE
	(Elevation	0.20 - 1.30	FILL - Brown SAND, BOULDERS, GRAVEL, pieces of
	100.39 m)		WOOD and BRICK
		1.30 - 1.90	Brown SANDY TILL
		1.90	End of test pit. Refusal on BEDROCK.
		0.00 0.05	
	TP 08-8	0.00 - 0.25	FILL - Crushed LIMESTONE
	(Elevation	0.25 - 0.80	FILL – Brown SAND, GRAVEL, and pieces of BRICK
	100.31 m)	0.80 - 1.50	Brown SANDY TILL
		1.50	End of test pit. Refusal of BEDROCK.
	TP 08-9	0.00 - 1.00	FILL – Black TOPSOIL, SAND, GRAVEL, and BRICK
	(Elevation	1.00	End of test pit. Refusal on BEDROCK.
	100.11 m)		
	TP 08-10	0.00 - 0.30	Black TOPSOIL
	(Elevation	0.30 - 0.70	Brown SANDY TILL
	99.89 m)	0.70	End of test pit. Refusal on BEDROCK.
	ፕ <u>ኮ</u> በዩ 11	0.00 - 0.60	FILL - SAND GRAVEL and BRICK
	(Elevation	0.00 = 0.00	WEATHERED BEDROCK
	99.77  m	1 00	End of test pit. Refusal on BEDROCK.
	//// mj	1.00	Provide the second

Inel/mpu

July 2008

08-1121-0099

### TABLE 1 (continued)

TP 08-12	0.00 - 0.30	Black TOPSOIL and pieces of WEATHERED ROCK
(Elevation	0.30 - 0.50	WEATHERED BEDROCK
100.06 m)	0.50	End of test pit. Refusal on BEDROCK.
TP 08-13	0.00 - 0.15	Black TOPSOIL
(Elevation	0.15 - 0.65	Brown SANDY TILL
100.21 m)	0.65 - 0.80	WEATHERED BEDROCK
	0.80	End of test pit. Refusal on BEDROCK.
TP 08-14	0.00 - 0.30	Black TOPSOIL
(Elevation	0.30 - 0.45	WEATHERED BEDROCK
100.53 m)	0.45	End of test pit. Refusal on BEDROCK.
TP 08-15	0.00 - 0.30	Black TOPSOIL
(Elevation	0.30 - 2.15	FILL – SAND, GRAVEL, pieces of CONCRETE, BRICK,
100.18 m)		TIRES
	2.15	End of test pit. Refusal on BEDROCK.
TD 09 15 A	0.00 0.20	Plack TOPSOI
(Flevation	0.00 = 0.20	WEATHERED BEDROCK
(100.18  m)	0.20 - 0.35	End of test pit Refusal on BEDROCK
100.10 III)	0.55	End of test pit. Refusal on DEDROCK.
TP 08-16	0.00 - 0.60	FILL – Crushed LIMESTONE
(Elev.	0.60 - 1.70	Light brown SANDY TILL
100.67 m)	1.70	End of test pit. Refusal on BEDROCK.
TP 08-17	0.00 - 0.30	FILL – Crushed LIMESTONE
(Elev.	0.30 - 0.80	Dark brown SAND and GRAVEL
100.77 m)	0.80 - 2.20	Light brown SANDY TILL
	2.20	End of test pit. Refusal on BEDROCK.

N:\Active\2008\1121 - Geotechnical\08-1121-0099\Record of Test Pits - NRC Docking Facility 16Jul08.doc

Jul/mpu.

**Golder Associates** 



# **APPENDIX B**

# **Boreholes and Test Pits from Previous Studies**


NRC -	NEW ELECTRICAL SU	JB-STATIOI	N			B.M	A.( ELEV	100.20m)	geodeti	c: Floor at		TEST PIT	NO:	05	-1	
						bui	ilding M-	-10 at doo	or No. 1	1		PROJECT	NO:	E-889	0	
START	DATE: 05/09/02							(E.				ELEVATIO	)N: 97	7.54 m	I	
SAMPL	LÉ TYPE 🔤 REMOL	JLDED	Z	SHEL	BY TUB	Ε	SPL	IT-SPOON	P	ROBING	NO R	ECOVERY		CORE		
H(m)	SMALL PEN.	SPT	E TYPE	LE NO				S(	DIL			80 VANE 80	VANE ( 160 Cu REN 160	Cu (kPa) 240 10ULDED 240	320 (kPa) ▲ 320	(m)NOI
DEPT	(kPa)	(N)	SAMPL	SAMP			Ľ	)ESCR	2IPT]	ION		PLASTIC	M	•	Liquid	ELEVAT
0.0	sides stable		+				-	TOPSOIL	and	RUUIS		20	40	60	80	
	no water seepa	ge					med Bo	ium der ttom of possib	test ile roo	andy TILL pit on	97.24					- 
- 2.0																- - - - - - - - - -
- 3.0																- 95.0
					Offi					) RY: JMI		Сомр		N DEPTI	H: 0.8 m	94.0
	McROSTI	s gen	ES	51	ST-	-L0	JUIS		REVIEW	ED BY: E.S		COMP	LETE:	05/09	/02	-
	(	)ttawa,	Ca	nac	la				Fig. No	: 2				1.00	Page 1	of 1

05/09/20 08:02AM (STD-SHIP)

NRC -	NEW ELECTRICAL SUB-STATI	ОN			B.M.( ELEV 100.20m)	geodetic: Floor at		TEST PIT	N0:	05-	-2	
					building M—10, at do	or No.11		PROJECT	NO: E	=-8890	)	
START	DATE: 05/09/02							ELEVATIO	ON: 98	.02 m	_	
SAMPL	E TYPE		SHELBY	TUB	e Split-Spoon	PROBING	[]]]NO R	ECOVERY		CORE		
(m)	SMALL PEN. SPT	ТҮРЕ	ENO		S	DIL		80 A VANE 80	VANE C 160 Cu REM 160	u (kPa) 240 OULDED 240	320 (kPa) ▲ 320	ON(m)
DEPTH	(kPa) (N)	SAMPLE	SAMPL		DESCR	IPTION		PLASTIC	M.	.C.	LIQUID	ELEVATI
0.0	sides stable	-			FILL – crus	ned limestone		20	40	60	80	98.0
	no water seepage				medium der Bottom of possib	nse sandy TILL test pit on le rock	97.67					97.0
- - - - - - - - - - - - - - - - - - -												
												- 95.0
4.0						1						
	McROSTIE GE	NF	ST S	Т-	-LOUIS	LOGGED BY: JML		COM		DEPTI	1: 0.6 m	
	Atoma Atoma	ים. רי	anada	-		Fig No. 3		COMP	TLE IE:	02/09	Page	1 of 1
05/09/20 0	B-02AN (STD-SHIP)	. Ui	andua	5		Ing. No. J					ruge	

05/09	/20	08:02AM	(STD-SHIP)	

1

NRC -	NEW ELECTRICAL SUB-STATIO	N			B.M.( ELEV 100.20m)	geodetic; Floor of		TEST PIT	N0:	05	-3	
					building M-10 at doo	r No.11		PROJECT	N0:	E-889	0	
START	DATE: 05/09/02							ELEVATIO	DN: 99	).43 m		
SAMPI	LE TYPE	2	SHELE	BY TUB	e Split-Spoon	PROBING	NO R	ECOVERY		CORE		
(m)	SMALL PEN. SPT	TYPE	E NO		SC	)IL		80 A VANE 80	VANE ( 160 Cu REN 160	Cu (kPa) 240 10ULDED 240	320 (kPa) ▲ 320	ON(m)
DEPTH	(kPa) (N)	SAMPLE	SAMPL		DESCR	IPTION		PLASTIC	N	I.C. ●	LIQUID	ELEVATI
0,0	sides stable	-			TOPS	SOIL	_	20	40	60	80	-
Ť I					1013							
							99.23			10 ¥		-
					medium der	ise sandy TILL						99.0
	no water seepage				Rottom of	test nit on	98.63					-
- 1,0					possib	le rock	50.05			<u>.</u>		
												2
												2
												- 98.0 -
-												-
-											8	
- 2,0												
-								÷				-
-												
												97.0
										н 1 — Ш		
												-
- 3.0												-
-												-
-												-
												- 96.0
E												
_												_
4.0												-
	McROSTIE GEN	IE:	ST	ST-	-LOUIS	LOGGED BY: JML		COM		N DEPT	H: 0.8 m	
	Ottawa	Ca	anad	a		Fig. No: 4		COMP	LCIL:	03/08	Page	1 of 1
05/09/20 0	38:02AW (STD-SHTP)											

NRC -	NEW ELECTRICAL SUE	B-STATION			B.M.( ELEV 100.20m)	geodetic: Floor of		TEST PIT	N0:	05-	-4	
					building M—10 at doc	r No. 11	_	PROJECT	NO: E	-8890		
START	DATE: 05/09/02							ELEVATIO	N: 100	).34 m	1	
SAMPI	LE TYPE	.DED	4	SHELBY TUB	E SPLIT-SPOON	PROBING	III NO R	ECOVERY	C	ORE		
(m)	SMALL PEN.	SPT	E TYPE	LE NO	S	)IL		80 A VANE ( 80	VANE Cu 160 Cu REMO 160	(kPa)∎ 240 ULDED ( 240	320 (kPa) ▲ 320	(IION(m)
DEP1	(kPa)	(N)	SAMPL	SAMP	DESCR	IPTION		PLASTIC	M.C		LIQUID ————	ELEVA
0.0	sides stable				τορ			20	40	60	80	
-					TOPS	SUIL						~
-							100.14					- 
-					medio sanc	um dense ly TILL						
- 1.0 -												
-	no water seepag	e			Bottom of possib	test pit on le rock	98.94					— 99.0 -
-												-
- 2.0												-
1 4 10 4 1												— 98.0 -
- 3.0										d		
												- 97.0
4.0		CENI		<u>п</u> . Ст.	LOUIG	LOGGED BY: JML		COMPL	ETION	DEPTH	: 1.4 m	ī
	MCKUSHE	GEN1	GĽ	1 D1-	LUNI2	REVIEWED BY: E.S.		COMPL	ETE: 0	5/09/	02	of 1
05/09/20 08	B:02AM (STD-SHTP)	uawa, l	Jdl	laua		FIQ. NO: 🗃					rage	01.1

Ξr.

RC -	- NEW ELECTRICAL SUB-STATIC	ЛС		B.M.( ELEV 100.20m)geodetic; Floor of	TE	ST PIT NO: 05-	-5	
				building M-10 at door No.11	PF	ROJECT NO: E-8890	)	
ART	DATE: 05/09/02				EL	EVATION: 100.41 n	n	
AMP	LE TYPE REMOULDED	Z	SHELBY TUBE	SPLIT-SPOON PROBING	NO RECO	VERY CORE		
H(m)	SMALL PEN. SPT	E TYPE	LE NO	SOIL		■ VANE Cu (kPa) 80 160 240 ▲ VANE Cu REMOULDED 80 160 240	320 (kPa) ▲ 320	llon(m)
DEPT	(kPa) (N)	SAMPL	SAMP	DESCRIPTION	PL	ASTIC M.C.		ELEVA'
0.0	sides stable			TOPSOIL				-
				100.	16			- 
				medium dense sandy TILL				
1.0								
	no water seepage			Bottom of test pit on 99. possible rock	.06			- 
2.0								- - - 98.0 -
3.0								
					-			97.0 
4.0	Merostif Cfi		ST ST_	LOUIS		COMPLETION DEPT	H: 1.35 m	
	MCIVODIIE GEI	LN EIK	T N T	REVIEWED BY: E.S.		COMPLETE: 05/09	/02	

NRC -	NEW ELECTRICAL SUB-	STATION	1		B.M.( ELEV 100.20m)	geodetic: Floor of		TEST PI	N0:	05	-6	
					building M-10 at doo	or No.11		PROJECT	NO:	E-889	0	
START	DATE: 05/09/02							ELEVATIO	DN: 10	0.31 r	n	
SAMP	LE TYPE	ED	$\mathbb{Z}$	SHELBY TU	BE SPLIT-SPOON	PROBING	III NO R	ECOVERY		CORE		
			μ	-				80	VANE C	u (kPa) 240	320	Ê
Ê	CMALL DEN C	DT	μ	z	S	)II.		A VANE	Cu REM	OULDED	(kPa) ▲	N(
H	SMALL FEN. O.	F-1	Щ	뷥				00	100	240	320	ATIC
DEP	(kPa) (1	N)	AMP	SAM	DESCR	IPTION		PLASTIC	м	.C.	LIQUID	E
	1967 - 1977 - 19	- 18. 	S	0,				20	40	60	80	
0.0	sides stable				TOP	SOIL		10				
-					1013							-
							100.01					-100.0
-												-
5											n ()	-
-												
-,												2
					medi	um dense						Ĩ
					sano	IV TILL						-
- 1.0						/						T I
-												00.0
												- 49.0
-												
5												
											1	
Ē	na watar saanaa											
	no water seepage				Bottom of	test pit on	98.51					
2.0					possib	le rock						
2.0					I							
												30.0
Ē.								c K b				
-												-
-								1.1.2				
3.0												
-												-
												97.0
_												
												-
-												-
												-
-												-
4.0										1.0007		
1	McROSTIE	GEN	ES	ST ST-	-LOUIS	REVIEWED BY: JML		COM		05/09	H: 1.8 m /02	
	Ott	tawa	Ca	nada		Fig. No: 7				50/03	Page	1 of 1
05/09/20 0	8:02AW (STD-SHTP)	sounds.		mand								

NRC -	- NEW ELECTRICAL SU	JB-STATIO	)N		E	B.M.( ELEV 100.2	0m)geodetic; Floor	of	TEST PIT	N0:	05-	-7	
	(2 <b>4</b> .)				ł	ouilding M—10 at	door No.11		PROJECT	N0: E	-8890		
START	DATE: 05/09/02							200	ELEVATIO	DN: 100	).37 m	1	
SAMP	LE TYPE REMOU	JLDED		SHEL	BY TUBE	SPLIT-SPO		NO F	RECOVERY	C	ORE	·	
(m)H	SMALL PEN.	SPT	E TYPE	LE NO			SOIL		80 A VANE 80	VANE Cu 160 Cu REMO 160	(kPa) 240 ULDED ( 240	320 (kPa) ▲ 320	lion(m)
DEPT	(kPa)	(N)	SAMPL	SAMP		DES	CRIPTION		PLASTIC	м.с		Liquid ——-1	ELEVAT
0.0	sides stable		+			T	OPSOIL		20	40	60	80	
						m s	edium dense andy TILL	100.07	-				
- 1.0	no water seepa	ge				Bottom	of test pit on ssible rock	98.87					- - - - - - - - -
- 2.0													- 98.0
- 3.0													97.0
4.0	McROSTI	E GEN	IE:	ST	ST-I	JOUIS	LOGGED BY: JML REVIEWED BY: <b>E</b>	- .S.	COMF COMF	LETION	DEPTH 5/09/	: 1.5 m '02	<u> </u>
05/09/20 0	( 8:03AM (STD-SHTP)	<u>Ottawa,</u>	Ca	nac	la		Fig. No: 💍					Page	of 1

3 8

MONTR	REAL RD. NRC M-10	& COOLING	3 TO	WER		B.M.(ELEV 328.75	5FT.)ge	odetic: Floor	of	TEST PIT	NO:	02-	-1	
NATION	NAL RESEARCH COUN	CIL CANAD	A			bldg. M—10 at d	oor No	. 11		PROJECT	NO: E	-8230	)	
START	DATE: 02/04/22									ELEVATIO	DN: 32	7.61 f	ł	
SAMPI	LE TYPE	JLDED	V	SHEL	BY TUBE	e 🔀 Split-Spo	ON	PROBING	III NO R	ECOVERY		CORE		
(tt)	SMALL PEN.	SPT	TYPE	E NO			S0	IL.		80 A VANE 80	VANE C 160 Cu REMO 160	u (kPa) 240 DULDED 240	320 (kPa) ▲ 320	ON(ft)
DEPT	(kPa)	(N)	SAMPLE	SAMPL		DES	CRI	PTION		PLASTIC	М.	с.	Liquid ———I	ELEVATI
- 0.0	sides stab	le				TC	)PS0I			20	40	60	80	Ē
-1.0							FILL		327.19					-327.0
20					piec	es of broken	rock	in sand &	gravel 325.86					-326.0
														-325.0
3.0						cla	yey S	AND						-324.0
- 4.0												_		323.0
-5.0						med sar	lium ndy Tl	dense ILL	323.03					-323.0
-6.0	no water seepa	ge				Botto pro	m of bable	pit on e rock	322.11					-322.0
-7.0														
-8.0														
-9,0														319.0
10.0														-318.0
11.0														-317.0
- 11.0														-316.0
12.0														
	McROSTI	E GEN	ES	T and	ST-	LOUIS	R	OGGED BY: JML EVIEWED BY: <b>E</b>	.S.	COMF	PLETION PLETE: (	DEPTH 02/04/	1: 5.5 ft /22	
00 m 1 7 10 11	Lanu let cump)	occurra,	υu	nuu	u			19. 1101 L					1 4 9 0	

MONTR	REAL RD. NRC M-10 & COOLIN	ig to	OWER		B.M.(ELEV 328.75FT.)	geodetic: Floor of		TEST PIT	NO: 02	2-2	
NATION	NAL RESEARCH COUNCIL CANA	DA			bldg. M—10 at door M	to. 11		PROJECT	NO: E-82	30	
START	DATE: 02/04/22		7				CICI	ELEVATIO	N: 327.16	ft	
SAMPL	E TYPE REMOULDED	V	SHEL	BY TUB	e XISPLIT-SPOON	PROBING	III NO F	RECOVERY	CORE		
TH(ft)	SMALL PEN. SPT	E TYPE	LE NO		S	)IL		80 A VANE 80	VANE Cu (kPa 160 240 Cu REMOULDE 160 240	320 320 D (kPa) ▲ 320	rion(ft)
DEP-	(kPa) (N)	SAMPL	SAMP		DESCR	IPTION		PLASTIC	M.C.	LIQUID	LEVA <sup>-</sup>
- 0.0	aidaa atabla				700	2014		20	40 60	80	
	sides siddle			*****	IOP:	SOIL			1.11.1	н	-327.0
							326.83				
-1.0								·	_		-
											-326.0
					FI	1					-
E20				10	III argo piesos of bru	LL Non rook un	+0				-
- 2.0				10	ange pieces of bri	oken rock up	10				-325.0
				4		sana ana gra	avei				-
				١	with pieces of fin	and steel rel	bar		1.0		Ē
- 3.0											-324.0
2											-
											Ē
- 4.0	no water seepage				Pattom	of pit on	323 16				223 0
					DUIIUII	or pir on	JZJ.10				=
					apaord	IE FOCK					E
- 5.0											£
											-322.0
6.0							8				-
											-321.0
-			1 1							1 1	
-											
- 7.0											-320.0
											-
									1.1.1	2.5.8.4	
8.0											E319.0
									1.1.1		- 515.0
											111.0
9.0									_		240.0
											-518.0
											Ē
E-10.0											
											-317.0
											1.1
$E_{110}$											1.1.1
											-316.0
											111
12.0											-315.0
5					11-11-11-11-11-11-11-11-11-11-11-11-11-						
	MCROSTIE GEN	JE?	ST	ST-	LOUIS	LOGGED BY: JML		COMP	ETION DEPT	H: 4 ft	
	Atomo	лцк С о	un od	~ 1		KEVIEWED BY: E.S		COMPI	LETE: 02/04	+/ 22 Page 1	of 1
02/04/30 05	ES3AW (ST-SHIMP)	Ud	uidu	a		11.g. 110. J				ruye	

MONTR	EAL RD. NRC M-10 & COOL	ING.	TOWE	R	B.M.(ELEV 328.75FT.)geodetic: Floor of		BOREHOLE	NO:	02-	-3	
NATION	AL RESEARCH COUNCIL CAN	ADA		_	bldg. M-10 at door No. 11		PROJECT	NO: E-	-8230		
START	DATE: 02/04/26						ELEVATION	1: 328	.76 ft		
SAMPL	E TYPE	UGER	Лsн	elby tubi	E SPLIT-SPOON NW-CASING	NO RE	COVERY	NO	) CORE		r
H(ft)	SMALL PEN. SPT	F TYPF	LE NO	RECOVERY	SOIL / ROCK		80 A VANE 80	VANE CI 160 Cu REMO 160	240 240 DULDED 240	320 (kPa) ▲ 320	TION(ft)
DEPT	(kPa) (N)	SAMPI	SAMPI	% CORE F	DESCRIPTION			M. 40	C. 60		ELEVA
E 0.0		+-			FNI		20	+0	00	00	
10					topsoil, sand and aravel			4			-328.0
	,	K			FILL	707 96					E-327.0
2.0	3/0	;" A			FILL	327.20 ad		P			
1 70	split barrel refusal		-		lopson, sana, gravei ana woo	226 00	1				326.0
3.0					LINESTONE	JZ0.03					705.0
4.0				85	LIMESTONE					· _ · _ ·	-323.0
											-324.0
5.0						707.74	20				
- 6.0						323.34				· · · · ·	-323.0
11111					LIMESTONE						-322.0
E- 7.0											10000
8.0				83							-321.0
1	NL I				Water level April 29/02 elev 320.	34'					-320.0
9.0											
E 10.0											
		Н				318 34					E-318.0
- 11.0						510.01					11111
E-120					LIMESTONE						-317.0
12.0											-316.0
13.0				98						-	
E 14.0											
14.0											314.0
- 15.0											1 014.0
100						313.34			_		
10.0					LIMESTONE						312 0
- 17.0				100							512.0
E .c.											-311.0
18.0		μ	_		Dulland field	710 74	-				210.0
19.0					Bottom of hole	510.54			-		510.0
-											-309.0
= 20.0											
21.0											-308.0
1111											-307.0
22.0											
23.0											-306.0
10.0											-305.0
- 24.0											
25.0								FTIOL	DEDT	1 10 10	-304.0
	MCROSTIE G	ΞN	EST	ST-	-LOUIS		COMPL		DEPTH 2/04	1: 18.42	11
		'	Can	ada	Fig. No. A		COMPL	LIL	2/04,	Page	1 of 1
02/05/01	02:02PM (NQ-INP)	ia,	vall	<u>uua</u>	ד זטא אצויון					99	

MONTR	EAL RD. NRC M-10 & COOLI	NG T	TOWE	R	B.M.(ELEV 328.75FT.)geodetic: Floor of	BOREH	OLE N	10: 02	2-4	
NATION	NAL RESEARCH COUNCIL CANA	DA			bldg. M-10 at door No. 11	PROJE	CT NO	: E-82	30	
START	DATE: 02/04/26					ELEVAT	NON:	328.41	ft	
SAMPI	LE TYPE REMOULDED-AU	GER	SH	ELBY TUB	E SPLIT-SPOON NW-CASING III NO R	ECOVERY		NQ CO	RE	
TH(f†)	SMALL PEN. SPT	LE TYPE	PLE NO	RECOVERY	SOIL / ROCK	8 ▲ VA 8	■ VA1 0 1 NE Cu 0 1	NE Cu (kF 60 240 REMOULD 60 240	°a) ■ ) 320 ED (kPa) ▲ ) 320	ATION(ft)
DEP	(kPa) (N)	SAMPI	SAMF	% CORE	DESCRIPTION			M.C.	LIQUID	ELEV/
0.0		-	-		TOPSOIL	2		40 00	00	-328.0
1.0	6/6"				topsoil, sand and gravel					in the second
11111	20/6"	·Χ	1		FILL 327.41	٩				-327.0
2.0	split barrel refusal				topsoil, sand, gravel					-326.0
3.0					sandy TILL 326.41		/			
										-325.0
- 4.0		-				-				-324.0
-5.0				100	LIMESTONE 524.10	<b>`</b>				turin.
1000					323.16					-323.0
6.0					LIMESTONE					-322.0
-7.0										
1	WL			80	Water level April 29/02 elev 320.99'					E-321 <del>2</del> 0
8.0										-320.0
9.0									· ·····	
										-319.0
- 10.0		-			318 16					-318.0
-11.0					518.10	-				
					LIMESTONE					E-317.0
E 12.0					EIMEOTORE	4	1 0	I	6 E -	
13.0				100						1
1000										-315.0
14.0										
15.0									+ + + + + + + + + + + + + + + + + + + +	E
11111					313.16					-515.0
- 16.0					LIMESTONE					-312.0
17.0				100				#		E
										-311.0
18.0		1			Bottom of hole 310.33					-310.0
19.0										200 0
										E-309.0
20.0										-308.0
21.0										- 307 0
								3		E-307.0
22.0										-306.0
23.0							-			- 305 0
04.0										E
24.0										-304.0
25.0		<u>ا</u>			LOLITO LOGGED BY: JML	- Ico	MPLET	ION DEF	PTH: 18.08	ft
	MCKUSTIE GE	M	721	21-	LUUID REVIEWED BY: E.S.	CO	MPLET	E: 02/0	4/26	
	Ottawa	a, (	Can	ada	Fig. No: 5				Page	1 of 1

02/05/01 01:43PM (NQ-IMP)

MONTR	EAL RD. NRC M-10 & COC	ling t	OWE	R	B.M.(ELEV 328.75FT.)	geodetic: Floor of		TEST PIT	N0:	02-	-5	
NATION	VAL RESEARCH COUNCIL CA	NADA			bldg. M—10 at door l	lo. 11		PROJECT	NO: E	-8230	)	
START	DATE: 02/04/22		7		<u> </u>		(TF)	ELEVATIO	N: 32	3.93 f		
SAMPI	E TYPE		SH	ELBY TUB	E XISPLIT-SPOON	PROBING	III NO F	RECOVERY		ORE		r
		101	9	2	C	) TT		80	160	240	320	ŧ
H H H	SMALL PEN. SPT	F L			50	)1L		80	160	240	320	NOIL
DEP	(kPa) (N)	IDINY	ANP		DESCR	IPTION		PLASTIC	М.(	C.	LIQUID	EVA
		v	2					20	40	60	80	
0.0	sides stable				FILL							
				lc	arge pieces of bro	ken rock up to				a 0		Ē
-1.0				(	(2.5'x2.5'x1.0') in	sand and grave	el			-		
												E
-2.0									-+-+	-	-	-327.0
1.1					medium dens	e sandy TILL	326.43					E
- 3.0												-326.0
	no water seepage				Bottom of	pit on 32	25.76					
					probabl	e rock						E
- 4.0					·				-			-325.0
1.6.4												E
5.0									1.1			-324.0
												2
										1.1		E 797 0
- 6.0												523.0
F 6 1												Ē
												E-322 0
E 7.0												E
											1 ľ	Ē
												-321.0
8.0												Ē
1.1.1												E.
- 00												-320.0
9.0												ē
10												E I
Eino									_			-319.0
								- 10				Ē
												E
11.0									_			-318.0
				1								
1.1.1												
-12.0												-317.0
1												
	MOBUCAL	FNF	с Т	CT.		LOGGED BY: JML		СОМР	LETION	DEPTH	ł: 3.25 fl	
	MCINDATE G		NT N	-1U -	LUUIN	REVIEWED BY: E.S		COMP	LETE: (	02/04,	/22	1 of 1
02/04/30 1	ULLAN (ST-SHIMP)	Na, L	ana	lda		119. NO: 0					rage	1 01 1

MONTR	REAL RD. NRC M-10 & COOLIN	G TC	WER	B.M.(ELEV 328.75FT.)	geodetic: Floor	of	TEST PI	NO:	02	-6	
NATION	NAL RESEARCH COUNCIL CANAD	A		bldg. M-10 at door t	lo. 11		PROJECT	NO:	E-823	0	
START	DATE: 02/04/22					1.000.00	ELEVATIO	DN: 32	8.77 f	Ť	
SAMPI	LE TYPE <b>E</b> REMOULDED	1	]SHELBY TUB	e Split-Spoon	PROBING		ECOVERY		CORE		
l(ft)	SMALL PEN. SPT	TYPE	E NO	S	)IL		80 VANE 80	VANE 0 160 Cu REM 160	u (kPa) 240 OULDED 240	320 (kPa) ▲ 320	ON(ft)
DEPTH	(kPa) (N)	SAMPLE	SAMPL	DESCR	IPTION		PLASTIC	M	.C.	LIQUID 	ELEVATI
0.0	sides stable	-		ТОР	SOIL		20	40	60	80	-
-											
E 10						328.19					-328.0
E				FIL	L						È
				rock blocks in	sand and g	gravel					
- 2.0						326.77					
				mediu	m dense						-326.0
-3.0	no water seepage			san	dy HLL	705 77					=
111				Bollom	or pri on bla rock	525.77					
				propu	DIE TUCK					111	-325.0
-4.0											
-											E
111											-324.0
-5.0											F.
1.1.1											-
-											-323.0
- 6.0							1.1.1				E
E											E
-											-322.0
- /.0									+ 1		-
1.1.1											Ē
-											-321.0
- 0.0											1
11.1											
Egn											-320.0
- 5.0											
										1 I F	E 710.0
E-10.0								_			519.0
E											
1.1.1											E 318.0
E-11.0										I	E
1.1.1											
1.1.1											-317.0
-12.0											Ē
1											Ê
	MCROSTIE GEN	F	ST ST-	-LOUIS	LOGGED BY: JM	L	COM	PLETIO	N DEPT	H: 3 ft	
		ים רי	or or ebene		REVIEWED BY: E	1.5.	COM	LEIE:	02/04	/22 Page	1 of 1
02/04/30 0	DELAWA,	Uč	maud		111 <b>9. 110.</b> 7					ruge	

MONT	REAL RD. NRC M-10 & COOLIN	IG TO	WER	B.M.(ELEV 328.75FT.)	geodetic: Floor of		TEST PIT	NO: 02	-7		
NATION	NAL RESEARCH COUNCIL CANA	DA		bldg. M—10 at door No. 11 PRO.			PROJECT	ROJECT NO: E-8230			
START	DATE: 02/04/22						ELEVATIO	N: 328.36 f	t		
SAMPI	LE TYPE <b>Remould</b> ed		SHELBY TUB	e Split-Spoon	PROBING	NO R	ECOVERY	CORE			
TH(ft)	SMALL PEN. SPT	LE TYPE	PLE NO	S	)IL		80 A VANE ( 80	VANE Cu (kPa) 160 240 Cu REMOULDED 160 240	320 (kPa) ▲ 320	TION(ft)	
DEP	(kPa) (N)	SAMP	SAMI	DESCR	IPTION		PLASTIC	M.C.	LIQUID	ELEVA	
- 0.0	sides stable						20	40 60	80		
1.1.1	20022 20016			t ILI	_				0.1.1	-328.0	
101				topsoil with a t	irace of brick					E	
-1.0					52	27.69		_		-	
1.11							1	1.1.1.1		-327.0	
				FIL						-	
-2.0			l	arge nieces of bro	- oken rock un to						
			l l	(2.5'x2.5'x1.0') in	sand and aray					E-326 0	
				with traces of co	acrete and met					E	
-3.0											
										F 705 0	
100							10 DE 17			-325.0	
E										E	
4.0											
										-324.0	
5.0											
				8						-323.0	
										Ē	
-6.0	no water seepage			Battom o	f nit on 3	22 36				E	
E Y I				probabl	le rock	22.30			1.1	-322.0	
10				hionan	e TOCK					-	
-7.0										E	
									1.1	-321.0	
- 8.0						-					
							T.			-320.0	
9.0											
								1.1.1		-319.0	
-10.0										1.4	
										710.0	
										518.0	
11.0											
- 11.0											
										317.0	
12.0											
-										-316.0	
	MCROSTIE GEN	VES	T ST-	LOUIS	LOGGED BY: JML		COMPL	ETTEN DEPTH	1: 6 ft		
	Ottawa	(a	nada		Fig. No: 8		COMPL	LIL: UZ/U4/	Page 1	of 1	
02/04/30 09	53AW (ST-SHIMP)	Ju	nauu						i ugo i	01 1	

MONTR	REAL RD. NRC M-10 & COOLIN	G TO	WER	B.M.(ELEV 328.75FT.)	geodetic: Floor of		TEST PIT	NO: 02	-8	
NATIO	VAL RESEARCH COUNCIL CANAL	)A		bldg. M—10 at door l	No. 11		PROJECT	NO: E-823	0	
START	DATE: 02/04/22	-					ELEVATIO	N: 328.08	ft	
SAMPI		1	SHELBY TUE	IE SPLIT-SPOON	PROBING	[   ] NO R	ECOVERY	CORE		
TH(ft)	SMALL PEN. SPT	E TYPE	LE NO	S	)IL		80 A VANE C 80	ANE Cu (kPa) 160 240 u REMOULDED 160 240	320 (kPa) ▲ 320	TION(ft)
DEP	(kPa) (N)	SAMP	SAMF	DESCR	IPTION		PLASTIC	M.C.	Liquid I	ELEVA
0.0	sides stable			TOPS	OIL		20	40 60	80	328.0
1.0				FILL large pieces of br (2.5'v2.5'v1.0');	32 oken rock up t	27.41 o				-327.0
2.0				and traces	of brick					-326.0
- 3.0				medium sandy	dense TILL	325.08				-325.0
- 4.0	no water seepage			Bottom of probable	pit on 3 rock	24.08				-324.0
- 5.0										-323.0
6.0							and a second			
- 7.0										-321.0
8.0										—320.0
-9.0										-319.0
- 10.0						-				318.0
11.0										317.0
-12.0										-316.0
	MOBUCATE CEN	עד קו	т P	LOUIS	LOGGED BY: JML		COMPL	ETION DEPTI	H: 4 ft	
	MCROATE GEN	ĽĿС С	-16 10 ,	-TOOID	REVIEWED BY: E.S.		COMPL	ETE: 02/04	/22	
02/04/30 09	Uttawa,	Ca	nada		Fig. No: 9				Page 1	of 1

McROS	TIE GENES & Associationsulting I	ST ST-LOUIS ces Ltd. Ingineers	TEST PIT RECORD	Test Pit No, 99-6		
+	OTTAWA, CANADA   Date :					
		N.R.C. BLDG. MONTRE	M-10 ADDITION AL ROAD	+		
ELEV. 329.23	DEPTH in feet	DESCR	IPTION	REMARKS		
+	+	TOP	SOIL	sides stable		
328.41 328.23	0.82 1					
207.22	2	BOULDERS up in c sandy	o to 1.6' O lense Y TILL			
327.23	2					
326.23	3					
325.62	3.61	Bottom of pit of	on probable rock	no water seepage		
				8 		
		~				
			2	Plate No. 8		

McRO	STIE GENES & Associat	ST ST-LOUIS les Ltd.	TEST PIT RECORD	Test Pit No. 99-5
C	onsulting H OTTAWA, (	Ingineers CANADA	Date :	JUNE 11, 1999
		N.R.C. BLDG MONTR	. M-10 ADDITION EAL ROAD	
ELEV. 328.54	DEPTH in feet	DESC	RIPTION	REMARKS
		crushed	FILL limestone	sides stable
327.54	1			
327.23	1.31			
326.54	2	d san	lense Idy TILL	
325.54 325.26	3 3.28	Bottom of pit	on probable rock	no water seepage
		7		
				Plate No.