REPORT

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September 2009

REPORT ON

Hydrogeological Information Review and Assessment Russell Findlay Lands 940 Old Montreal Road Ottawa, Ontario

Submitted to:
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Report Number: 09-1127-0086

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Table of Contents

1.0 BACKGROUND

As part of the approval process for a proposed subdivision to be located at 940 Old Montreal Road, also known at the Russell Findlay lands (hereafter referred to as "the site"), the City of Ottawa has requested that a "well interference study" be undertaken by the proponents. Formal terms of reference for this study have not been provided, but it is understood that the report is to demonstrate "the impact that the proposed development may have on the neighbouring private wells (well interference) and septic systems of those residences situated on both Gerald Street and Trim Road". The report is to be completed by a professional hydrogeologist licensed in the province of Ontario.

Potential impacts to private wells would include the impairment of the quality and/or quantity of the water available to the residents. Impacts to septic systems would be restricted to issues associated with drainage.

1.1 Information Sources

Existing information sources were reviewed in order to gather relevant geological and hydrogeological data to help determine the potential for interference with the water supply servicing the adjacent houses on Gerald Street. These sources included topographic and geology maps, the Ministry of the Environment (MOE) water well record database, drawings of the proposed development and previously issued geotechnical reports for the site and nearby locations.

The following reports previously issued by Golder Associates Ltd. (Golder Associates) were reviewed:

- Golder Associates Ltd., September 2004. *Geotechnical Investigation, Proposed Residential Development, Russell Findlay Lands, Trim Road, Queen Street, Watters Road, Ottawa, Ontario.* Report 04-1120-146.
- Golder Associates Ltd., April 2004. *Karst Assessment, Proposed Residential Lots 59 to 62, Springridge Subdivision, Watters Road, Ottawa, Ontario.* Report 04-1120-021.
- Golder Associates Ltd., December 2003. *Geotechnical Investigation, Proposed Watermain and Reconstruction of Watters Road, Ottawa, Ontario.* Report 03-1120-186.
- Golder Associates Ltd., August 2002. *Geotechnical Investigation, Karst Area Assessment, Proposed Housing Development, Cardinal Creek and Watters Road, Ottawa, Ontario.* Report 021-2110.
- Golder Associates Ltd., July 2002. *Preliminary Geotechnical Assessment, Trim Road Realignment, Ottawa, Ontario.* Report 011-2224.
- Golder Associates Ltd., December 2001. *Geotechnical Planning Map, Trim Road Realignment, Ottawa, Ontario.* Letter Report 011-2224.
- Golder Associates Ltd., June 1995. *Preliminary Geotechnical Investigation, Proposed Trim Road Trunk and Ottawa River Subtrunk Sewers, Township of Cumberland, Ontario.* Report 951-2025.
- Golder Associates Ltd., July 1991. *Soil Survey, Proposed Widening of Regional Road 57, South of Regional Road 34, Township of Cumberland, Ontario.* Report 911-2082.
- Golder Associates Ltd., June 1991. *Geotechnical Evaluation, Cardinal Creek Karst Area, Watters Road, Township of Cumber land, Ontario.* Report 901-2063.

- Golder Associates Ltd., January 1990. *Geotechnical Investigation, Proposed Storm Sewer, Watters Road, Township of Cumberland, Ontario.* Report 891-2310.
- Golder Associates Ltd., July 1988. *Preliminary Geotechnical Investigation, Proposed Reconstruction of Regional Road 57, Cumberland, Ontario.* Report 881-2108.
- Golder Associates Ltd., October 1984. *Subsurface Investigation, Proposed Residential Development, Brothers Property, Twp. Of Cumberland, Ontario.* Report 841-2393.

2.0 SITE DESCRIPTION

The proposed subdivision is located to the southeast of the intersection of Trim Road and Old Montreal Road (Figures 1 and 2). The topography of the northern part of the site is quite steep, and the elevation rises towards the south from about 67 masl at Old Montreal Road to about 74 masl at a distance of 75 metres south of Old Montreal Road. The remaining southern part of the site rises more gently to about 86 masl at the southern property boundary. A ravine is located along the southern border of the site.

2.1 Surficial Geology

Available mapping of the area indicates that the surficial geology of the site consists primarily of offshore marine deposits of geotechnical sensitive silty clay (Figure 3). Mapping indicates landslide areas at the north end of the site and along Cardinal Creek, east of the site. Bedrock is indicated to be at ground surface in an area surrounding the south end of Gerald Street and trending northeast towards Old Montreal Road.

A review of boreholes, test pits and auger holes completed during previous Golder Associates investigations in the area indicates that the surficial geology generally consists of a weathered crust of sensitive silty clay underlain by unweathered silty clay, glacial till and bedrock.

Six test pits were put down across the site as described in Golder Associates report 04-1120-146. The test pits were excavated to depths of 3.5 to 3.9 metres and the material encountered was stiff to very stiff silty clay with a weathered crust. Occasional silty sand pockets within the weathered crust were observed in the southernmost test pits (TP04-4, TP04-5 and TP04-6).

The top of the glacial till deposit was encountered at about 8-9 metres below ground surface in two boreholes completed in the central part of the site (951-2025 BH95-3 and 881-2108 BH-1).

In several nearby boreholes along Watters Road and just west of Trim Road, the silty clay deposit is weathered for its entire depth to the top of the glacial till deposit. Fine sand seams within the weathered and unweathered silty clay were noted in several boreholes located across the area; between the weathered and unweathered silty clay deposits, sand deposits of 0.4 metres to 1.5 metres in thickness were encountered in three boreholes located along Watters Road.

2.2 Bedrock Geology

Available bedrock mapping of the area indicates that the site is underlain by limestone of the Bobcaygeon Formation and interbedded limestone and dolomite of the Gull River Formation. Bedrock is indicated to be exposed at ground surface in an area surrounding the south end of Gerald Street and trending northeast towards Old Montreal Road. Apart from this area, the depth to bedrock is mapped to range from 10 to 50 metres across the site (Figure 4).

A bedrock fault is mapped passing approximately east-west across the site.

Of the nearby boreholes completed during previous Golder Associates investigations, four were completed through the overburden into the bedrock. In BH95-3 completed for project 951-2025, located in the central part

of the site, the bedrock is described as fine grained thinly bedded limestone and was found at a depth of 11.7 metres. In boreholes 04-201, 04-202 and 04-203 completed for report 04-1120-021, located along Watters Road near Cardinal Creek, the bedrock is described as highly weathered to fresh fine crystalline limestone with occasional mud seams and was found at a depth of 9.2 to 10.5 metres.

2.2.1 Karst Features

The presence of an area of karst features (i.e., underground voids/caves, formed by the dissolution of the limestone bedrock by flowing groundwater) was noted in the Golder Associates reports dated June 1991, August 2002 and April 2004. Sinkhole areas and subterranean channels are found within a subsurface bedrock escarpment. The delineated area of karst is located from about 100 metres south to about 150 metres north of Watters Road and is bounded to the east by Cardinal Creek, as shown on Figure 5. Karst features were not observed on the proposal development site.

2.3 Groundwater Conditions

Water table depths measured in boreholes and auger holes completed during previous Golder Associates investigations ranged from 1.1 metres to 5.5 metres below ground surface in the weathered crust and silty clay deposits, and 4.6 metres to more than 11.7 metres below ground surface in the glacial till deposits. Only two multilevel groundwater monitors were found in the information review; in both, the vertical hydraulic gradient was indicated to be downwards through the silty clay.

Regional groundwater flow is anticipated to be northwestwards towards the Ottawa River.

Deposits of coarse and permeable overburden, capable of supplying sufficient quantities of groundwater for domestic use, are not prevalent in the vicinity of the site. For this reason, the bedrock aquifer is considered the principal aquifer for water supply.

2.3.1 Private Wells

Existing homes near the development site (i.e. along Gerald Street and Old Montreal Road) are primarily serviced by private wells and septic systems. The MOE Water Well Information System (WWIS) had information on 28 wells on and near the development site. The version of the MOE WWIS referenced for the study included information on wells drilled up to June 2003.

One overburden well was identified near the development site, and the remaining 27 water supply wells were completed into the bedrock. The following table summarizes the distribution of the water supply well depths:

Well Depth (metres)	Number of Water Supply Wells
0 – 10	0
10.1 - 20	0
20.1 - 30	6
30.1 - 40	12

Well Depth (metres)	Number of Water Supply Wells
40.1 - 50	9
50.1 - 60	1
Total	28

The above table indicates that all of the water supply wells near the development site are completed to a depth between 20 metres and 60 metres below ground surface. With the exception of the one overburden well, all of these wells are interpreted to obtain groundwater from the Gull River Formation aquifer. The depth to water-bearing zones ranged from about 20 metres to 50 metres depth in these wells. The single identified overburden well is interpreted to draw water from a deep sand and gravel deposit found at a depth of about 37 metres below ground surface, beneath a thick clay deposit.

Information provided in the MOE WWIS indicates that wells completed along Gerald Street are capable of supplying enough water for domestic purposes (i.e., recommended pumping rates are typically above 18 L/min).

No information was available for review on the groundwater quality of the wells along Gerald Street.

2.4 Site Servicing

The deepest service proposed for the site is the sanitary sewer, which will outlet to the existing sanitary sewer at Old Montreal Road. The sanitary sewer inverts generally range from about 2 metres to 7 metres below existing grade, and more typically range from about 3 metres to 5 metres below existing grade. The deepest sewer invert below existing grade is found along the steep slope in the northern part of the site; the sewer invert is proposed at 7 metres below existing grade, and surficial materials would be removed so that the final road surface is at about 3 metres below existing grade.

A deep watermain connection is proposed at Trim Road, about 125 metres south of Old Montreal Road. The watermain invert is proposed at about 8 metres below existing grade.

A centralized underground storage facility is proposed to handle stormwater flow. The location of the facility is along the entrance road to the development, about 80 metres south of Old Montreal Road and adjacent to the eastern site boundary. The bottom of the tank is proposed at an elevation of 67.2 masl, about 7 metres below existing grade.

Clay seals are proposed to be installed in the sewer and watermain trenches as per the City of Ottawa standard S-8, consisting of 1.0 m wide weathered dry silty clay compacted in thin lifts to 95% standard Proctor density. The seals will extend from trench wall to trench wall, and from sewer/watermain subgrade level to terminate either within the native soil backfill or the top of the existing subsurface rock. These seepage barriers will be installed across the site at an approximate spacing of 35-150 metres along the main site road (Street No. 1) and at the ends of each of the side roads (Streets Nos. 2 and 3).

3.0 POSSIBLE IMPACTS TO SURROUNDING PROPERTIES

3.1 Potential Causes of Impacts to Surrounding Properties

The potential causes of impacts to the surrounding properties are:

- Groundwater control activities during site servicing; and,
- Alteration of the existing hydrogeological flow regime due to the presence of site services.

3.1.1 Groundwater control activities during site servicing

The sewer and watermain servicing trenches proposed for the site are expected to be completed mainly in the silty clay layer and in the northern half of the site are unlikely to encounter the underlying bedrock. Groundwater control activities for the proposed development would therefore likely be conducted in the weathered and unweathered silty clay layers. Due to the typically low hydraulic conductivity of silty clay, the groundwater control requirements during site servicing activities in the northern part of the site are expected to be minor.

Bedrock may be encountered in servicing trenches proposed in the southern part of the site where available mapping indicates bedrock at or near ground surface (Figure 3). No information is available on the hydraulic conductivity of the bedrock in this area; groundwater control requirements are likely to be more significant in this area.

During groundwater control activities in sewer and watermain servicing trenches proposed to be constructed in the silty clay, groundwater level drawdown is expected in the immediate vicinity of the trenches. The thick silty clay overburden on the site is expected to prevent the horizontal migration of groundwater level drawdown far beyond the trenches. Although scattered fine sand seams within the weathered and unweathered silty clay were noted in several boreholes located across the area, the seams are unlikely to be well-connected to one another and are not expected to significantly increase the horizontal extent of groundwater level drawdown.

Sand deposits of 0.4 metres to 1.5 metres in thickness were found within the silty clay in three previous boreholes located along Watters Road; site services are not planned to be installed in this area. Since these deposits are larger in thickness than the above-noted scattered sand seams, groundwater control in this area could have the potential to affect off-site groundwater levels. Since no site servicing is proposed in this area, no impacts to groundwater levels are expected.

The horizontal extent of groundwater level drawdown may be more significant if servicing trenches are constructed through bedrock in the southern part of the site.

3.1.2 Alteration of the existing hydrogeological flow regime

In the Golder Associates report dated September 2004, it was recommended that impervious dykes or cut-offs should be constructed in the service trenches at about 150 metre intervals to reduce groundwater lowering at the site due to the "french drain" effect of the granular bedding and surround for the service pipes. This groundwater lowering would have the potential to affect groundwater levels off-site. It is important that these barriers extend from trench wall to trench wall and that they fully penetrate the granular materials to the trench bottom. As noted

in Section 2.4, clay seals are proposed to be installed in the sewer and watermain trenches at an approximate spacing of 35-150 metres. The clay seals will minimize the potential for drainage to occur along this potential pathway and therefore minimize potential groundwater level lowering by drainage along the granular bedding and backfilling.

3.2 Impairment to Groundwater Quantity or Quality

The vast majority of the water wells identified near the site are completed into the bedrock, and draw water from depths of about 20 metres to 50 metres below ground surface. Since all site servicing is expected to be completed in the upper 7 to 8 metres of subsurface materials, no impairment to groundwater quantity is expected due to site servicing.

Site servicing activities are not anticipated to cause changes to groundwater quality.

3.3 Impacts to Septic Systems

Since groundwater control requirements during site servicing are expected to be of a short-term nature and the extent of groundwater drawdown in the silty clay is expected to be small, the groundwater control activities are not expected to cause impacts to groundwater levels off-site. Due to the installation of clay plugs in the sewer bedding and backfill, permanent groundwater level lowering in the overburden is not expected off-site. No impacts to nearby septic systems are expected.

3.4 Structure Settlement

Due to the presence of sensitive silty clay in the study area and beneath nearby homes on Gerald Street, there exists the potential for structure settlement if groundwater levels are lowered across the area.

Since groundwater control requirements during site servicing are expected to be of a short-term nature and the extent of groundwater drawdown in the silty clay is expected to be small, the groundwater control activities are not expected to cause impacts to groundwater levels off-site. Due to the installation of clay plugs in the sewer bedding and backfill, permanent groundwater level lowering in the overburden is not expected off-site. No impacts to nearby structures are expected.

4.0 CONCLUSIONS

A hydrogeological review has been undertaken to assess the potential impact that a proposed development on the Russell Findlay lands may have on neighbouring private wells and septic systems of those residences situated on both Gerald Street and Trim Road. Potential impacts to private wells could include the impairment of the quality and/or quantity of the water available to the residents. Impacts to septic systems would be restricted to issues associated with drainage. The potential causes of impacts to the surrounding properties are:

- Groundwater control activities during site servicing; and,
- Alteration of the existing hydrogeological flow regime due to the presence of site services.

Due to the typically low hydraulic conductivity of silty clay, the groundwater control requirements during site servicing activities in the northern part of the site are expected to be relatively low. Bedrock may be encountered in servicing trenches proposed in the southern part of the site where available mapping indicates bedrock at or near ground surface (Figure 3). No information is available on the hydraulic conductivity of the bedrock in this area; groundwater control requirements may be more significant in this area.

The vast majority of the water wells identified near the site are completed into the bedrock, and draw water from depths of about 20 metres to 50 metres below ground surface. Since all site servicing is expected to be completed in the upper 7 to 8 metres of subsurface materials, no impairment to groundwater quantity is expected due to site servicing. Site servicing activities are not anticipated to cause changes to groundwater quality that would affect potability.

Due to the installation of clay plugs in the sewer bedding and backfill, permanent groundwater level lowering in the overburden is not expected off-site. No impacts to nearby septic systems are expected. No impacts to nearby structures due to settlement are expected.

5.0 LIMITATIONS

This report was prepared for the exclusive use of Claridge Homes. The report, which specifically includes all tables, figures and appendices, is based on data gathered by Golder Associates Ltd., and information provided to Golder Associates Ltd. by others. The information provided by others has not been independently verified or otherwise examined by Golder Associates Ltd. to determine the accuracy or completeness. Golder Associates Ltd. has relied in good faith on this information and does not accept responsibility for any deficiency, misstatements, or inaccuracies contained in the information as a result of omissions, misinterpretation or fraudulent acts.

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The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

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This report provides a professional opinion in light of the information available at the time of this report and therefore no warranty is either expressed, implied, or made as to the conclusions, advice, or recommendations offered in this report.

Report Signature Page

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REFERENCES

Golder Associates Ltd., September 2004. *Geotechnical Investigation, Proposed Residential Development, Russell Findlay Lands, Trim Road, Queen Street, Watters Road, Ottawa, Ontario.* Report 04-1120-146.

Golder Associates Ltd., April 2004. *Karst Assessment, Proposed Residential Lots 59 to 62, Springridge Subdivision, Watters Road, Ottawa, Ontario.* Report 04-1120-021.

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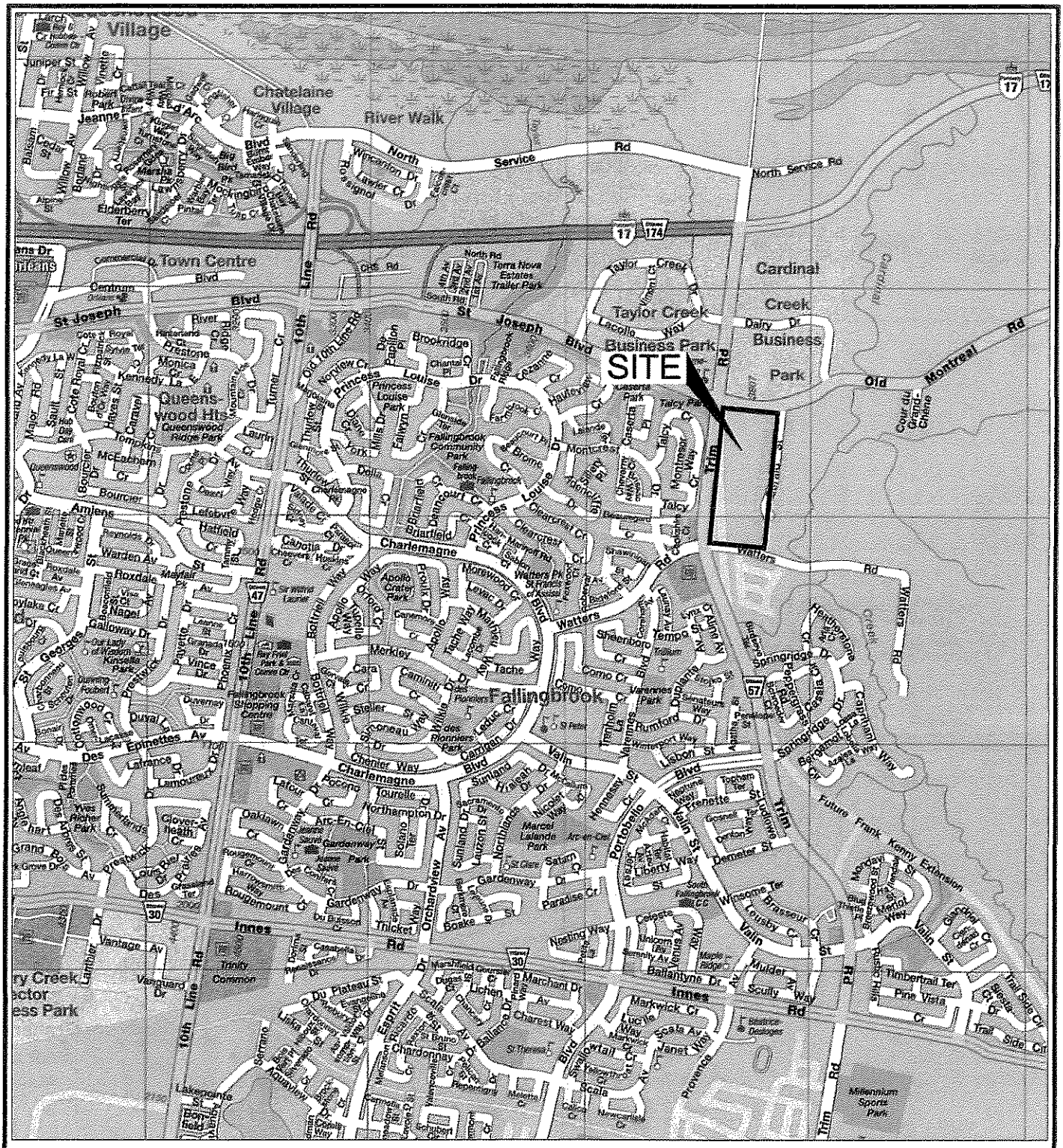
Golder Associates Ltd., October 1984. *Subsurface Investigation, Proposed Residential Development, Brothers Property, Twp. Of Cumberland, Ontario.* Report 841-2393.



NOTE

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 09-1127-0086

Golder Associates
Ottawa, Ontario, Canada

SCALE	AS SHOWN
DATE	Aug. 6, 2009
DESIGN	
CAD	A.B.
CHECK	CAMC
REVIEW	SW

TITLE

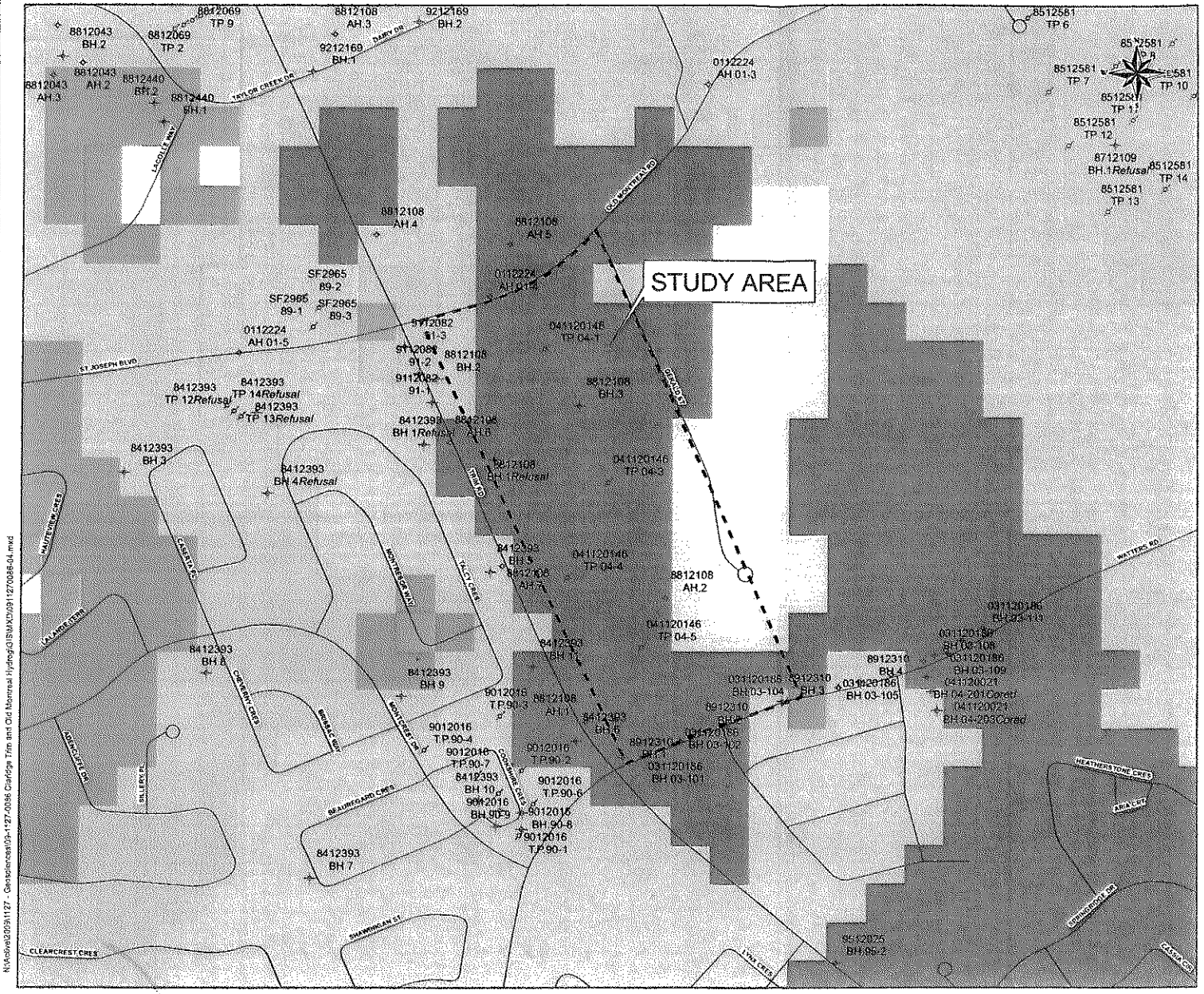
KEY PLAN

FILE No. 0911270086-01.dwg		
PROJECT No. 09-1127-0086	REV.	

RUSSELL FINDLAY LANDS

FIGURE 1

PLOT DATE: September 15, 2009
FILENAME: N:\Active\2009\1127 - Geosciences\09-1127-0086 Claridge Trim and Old Montreal Hydrog\ACAD\0911270086-01.dwg



LEGEND

- ROADWAY
- RIVER OR STREAM
- STUDY AREA

BOREHOLE TYPE

- AUGERHOLE
- BOREHOLE
- CONE PENETRATION
- DRINKING WELL
- MONITORING WELL
- NO DATA
- ROCK PROBE
- TEST PIT

TREND IN DEPTH TO BEDROCK METRES

- 0 to 2
- 2 to 3
- 3 to 5
- 5 to 10
- 10 to 15
- 15 to 25
- 25 to 50
- 50 to 150

NOTE:
This figure is to be read in conjunction with the accompanying Golder Associates Ltd. report No. 09-1127-0086

REFERENCE
BELANGER, J. R., URBAN GEOLOGY OF THE NATIONAL CAPITAL AREA, GEOLOGICAL SURVEY OF CANADA, OPEN FILE D3256, 2001
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 18

500 0 500
1: 5,000 METRES

PROJECT
RUSSEL FINDLAY LANDS

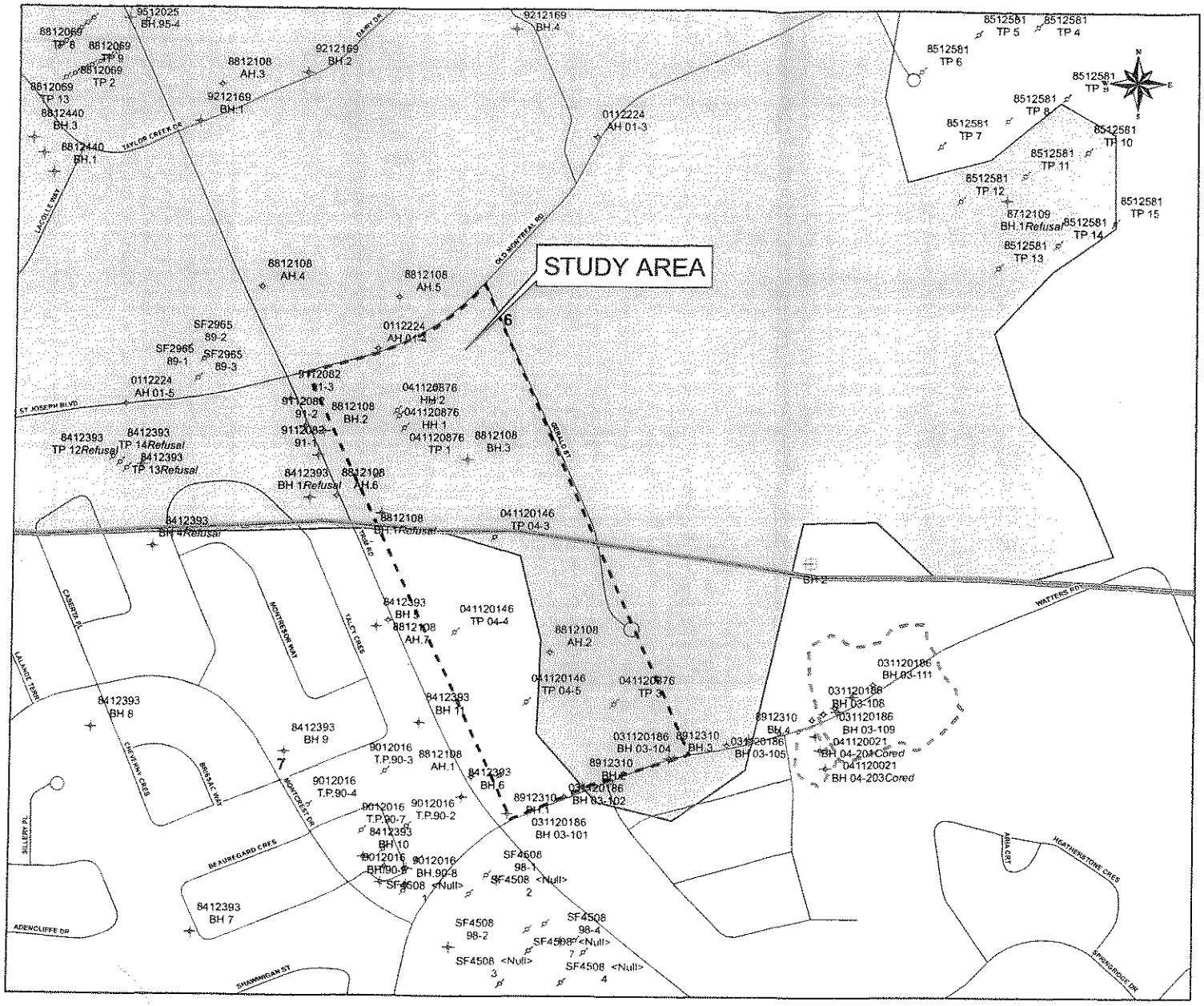
TITLE
TRENDS IN DRIFT THICKNESS

Golder Associates
Ottawa, Ontario

PROJECT No. 09-1127-0086		SCALE AS SHOWN REV. 0
DESIGN	CAMC	12 Aug. 2009
GIS	BT	12 Aug. 2009
CHECK	CAMC	11 Sept. 2009
REVIEW	SW	11 Sept. 2009

FIGURE: 4

N:\Active\2009\1127 - Geotechnical\09-1127-0086 Claridge Trim and Old Montreal Hydrog\GIS\MXD\09112700086-04.mxd



LEGEND

- ROADWAY
- RIVER OR STREAM
- FAULT
- STUDY AREA
- APPROXIMATE LOCATION OF POTENTIAL KARST AREA
- APPROXIMATE LOCATION OF KARST AREA

BOREHOLE TYPE

AUGERHOLE	MONITORING WELL
BOREHOLE	NO DATA
CONE PENETRATION	ROCK PROBE
DRINKING WELL	TEST PIT

7 BOBCAYGEON FORMATION: INTERBEDDED SILTY DOLOMITE, LITHOGRAPHIC TO FINE CRYSTALLINE LIMESTONE, OOLITIC LIMESTONE, SHALE, AND FINE-GRAINED CALCAREOUS QUARTZ SANDSTONE

6 GULL RIVER FORMATION: INTERBEDDED SILTY DOLOMITE, LITHOGRAPHIC TO FINE CRYSTALLINE LIMESTONE, OOLITIC LIMESTONE , SHALE, AND FINE-GRAINED CALCAREOUS QUARTZ SANDSTONE

NOTE:

This figure is to be read in conjunction with the accompanying Golder Associates Ltd. report No. 09-1127-0086

REFERENCE

BÉLANGER, J. R., URBAN GEOLOGY OF THE NATIONAL CAPITAL AREA, GEOLOGICAL SURVEY OF CANADA, OPEN FILE D3256, 2001

Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 18

500 0 500

1:5,000 METRES

PROJECT

RUSSEL FINDLAY LANDS

TITLE

BEDROCK GEOLOGY

Golder Associates Ottawa, Ontario

PROJECT No. 09-1127-0086			SCALE AS SHOWN	REV. 0
DESIGN	CAMC	6 AUG 2009		
GIS	BT	6 AUG 2009		
CHECK	CAMC	11 SEPT 2009		
REVIEW	SW	11 SEPT 2009		

FIGURE: 5

N:\Active\2009\1127 - Geosciences\09-1127-0086 Claridge Trim and Old Montreal Hydrogl\GIS\MXD\09112770086-05.mxd

APPENDIX A

Borehole Records,
Previous Golder Associates Ltd. Investigations

841-2393

RECORD OF BOREHOLE 1

LOCATION See Figure 2 BORING DATE SEPT. 17, 1984 DATUM GEODETIC

SAMPLER HAMMER, 63.5 kg.; DROP, 760 mm PENETRATION TEST HAMMER, 63.5 kg.; DROP, 760 mm

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m
POWER AUGER 200mm DIAM. (HOLLOW STEM)	85.62	GROUND SURFACE				
	0.00	TOPSOIL				
	0.18 / 85.16	BROWN CLAYEY SILT		1	50 mm D.O.	13
	0.46	VERY STIFF GREY BROWN SILTY CLAY, OCCASIONAL SILT LAYERS (WEATHERED CRUST)		2	"	17
				3	"	15
				4	"	15
				5	"	13
				6	"	10
				7	"	12
	80.10			8	"	>100
	5.52 / 79.40	DENSE BROWN SILTY SAND, TRACE CLAY (GLACIAL TILL)		9	A.S.	
	6.22	END OF HOLE AUGER REFUSAL POSSIBLY BEDROCK				

ELEVATION SCALE: 86, 85, 84, 83, 82, 81, 80, 79

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa NAT. V.- + Q.-● REM. V.- ⊕ U.-○

HYDRAULIC CONDUCTIVITY, k, cm/sec. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUND SURFACE
SURFACE SEAL
PLASTIC TUBING
NATIVE BACKFILL
STANDPIPE

STANDPIPE DRY TO ELEV. 80.78 SEPT. 26, 1984

15 10 0 5 Percent axial strain at failure

VERTICAL SCALE 1:50

Golder Associates

DRAWN DN

CHECKED

841-2393

RECORD OF BOREHOLE 5

LOCATION See Figure 2 BORING DATE SEPT 18 / 19, 1954 DATUM GEODETIC

SAMPLER HAMMER, 63.5 kg., DROP, 760 mm PENETRATION TEST HAMMER, 63.5 kg., DROP, 760 mm

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	ELEVATION SCALE
POWER AUGER 140 mm DIAM. (UNCASED)	86.96 GROUND SURFACE						87
	0.00 TOPSOIL						
	0.12	VERY STIFF GREY BROWN SILTY CLAY (WEATHERED CRUST)		1	50 mm DO	12	86
				2	"	4	85
				3	"	4	84
				4	"	2	83
	81.78						82
	5.18	FIRM TO STIFF GREY SILTY CLAY		5	"	2	81
	79.64						80
	7.32	END OF HOLE					79

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa NAT. V.- + Q.-● REM. V.- ⊕ U.-O

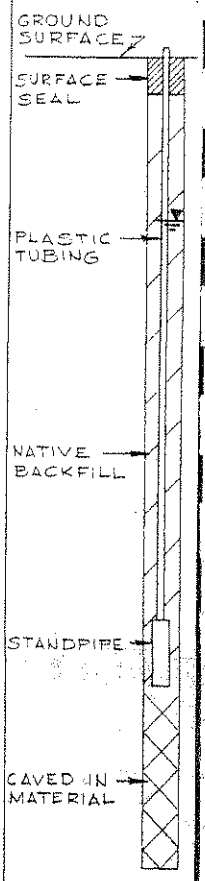
20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/sec. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



W.L. IN STANDPIPE AT ELEV. 85.50 SEPT. 26, 1984

15 0 5 10 Percent axial strain at failure

VERTICAL SCALE 1:50

Golder Associates

DRAWN DN

CHECKED

841-2393

RECORD OF BOREHOLE 6

LOCATION See Figure 2 | BORING DATE SEPT. 19, 1984 | DATUM GEODETIC

SAMPLER HAMMER, 63.5 kg., DROP, 760 mm | PENETRATION TEST HAMMER, 63.5 kg., DROP, 760 mm

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m
200mm DIAM. (HOLLOW STEM) AUGER	87.15 / 0.00	GROUND SURFACE				
	0.15	TOPSOIL				
		VERY STIFF GREY BROWN SILTY CLAY (WEATHERED CRUST)		1	50 mm SS	14
	85.02 / 2.13	LOOSE BROWN SILTY FINE SAND		2	SS	9
	84.10 / 3.05	SOFT TO FIRM GREY TO REDDISH BROWN SILTY CLAY		3	SS	1
				4	75 mm TW	PM
				5	50 mm SS	1
	79.83 / 7.32	END OF HOLE				

ELEVATION SCALE: 88, 87, 86, 85, 84, 83, 82, 81, 80, 79

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa — NAT. V.- + Q.-● REM. V.- ⊕ U.-○

HYDRAULIC CONDUCTIVITY, k, cm/sec. — 1x10 | 1x10 | 1x10 | 1x10

WATER CONTENT, PERCENT — Wp | W | WL — 20 | 40 | 60 | 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUND SURFACE

SURFACE SEAL

PLASTIC TUBING

NATIVE BACKFILL

STANDPIPE

CAVED IN MATERIAL

W.L. IN STANDPIPE AT ELEV. 55.78 SEPT. 26, 1984

15 — 0 — 5 — 10 Percent axial strain at failure

VERTICAL SCALE 1:50

Golder Associates

DRAWN DN

CHECKED

841-2393

RECORD OF BOREHOLE 11

LOCATION See Figure 2 BORING DATE SEPT. 20, 1984 DATUM GEODETIC

SAMPLER HAMMER, 63.5 kg.; DROP, 760 mm PENETRATION TEST HAMMER, 63.5 kg.; DROP, 760 mm

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION SCALE
POWER AUGER 140 mm DIAM (UNCASED)	87.24	GROUND SURFACE					88
	0.00	TOPSOIL					
	0.26	BROWN CLAYEY SILT					87
		VERY STIFF TO STIFF GREY BROWN SILTY CLAY, OCCASIONAL SILT LAYER (WEATHERED CRUST)		1	SS	10	86
				2	SS	4	85
	83.13						84
	4.11			3	SS	1	83
		FIRM GREY TO REDDISH BROWN SILTY CLAY					82
				4	SS	2	81
	79.92						80
	7.32	END OF HOLE					79

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa — NAT. V.- + Q.-● REM. V.- ⊕ U.-○

20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/sec. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

0 / 15 5 / 10 Percent axial strain at failure

VERTICAL SCALE 1:50

Golder Associates

DRAWN ---- CHECKED ----

RECORD OF BOREHOLE 1

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE May.6,1988

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat.V.- + Q.- ●, rem.V.- ⊕ U.- ○)	HYDRAULIC CONDUCTIVITY, k, CM/SEC; WATER CONTENT, PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		84.15							
		Grey CRUSHED STONE		0.00							Bentonite Seal
		Brown sand and gravel (FILL)		0.12							
				83.69							Backfill
				0.46							
1					1	50 DO	5				
2		Very stiff to stiff grey brown and red brown SILTY CLAY (Weathered Crust)			2	50 DO	6				
3					3	50 DO	4				
4								⊕ +			
				79.73							Bentonite Seal
				4.42	4	50 DO	2	⊕ +			Backfill
5	Power Auger 200mm Diam (Hollow Stem)										Standpipe B
											Bentonite Seal
6		Stiff grey SILTY CLAY, with occasional scattered trace fine sand seams			5	50 DO	1	⊕ + ⊕ +			
7								⊕ +			
								⊕ +			
8					6	50 DO	1				
				75.83							Bentonite Seal
				8.32							
9		Compact to very dense grey sandy silt, some gravel, numerous cobbles and boulders (GLACIAL TILL)			7	50 DO	29				
10					8	50 DO	73				
				73.94							Standpipe A
		End of Hole		10.21							
		Auger Refusal									
11											
12											

W.L in Standpipe A at Elev.79.68
Standpipe B at Elev.80.92
May.19,1988

15 ⊕ 10 0 6 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE 1 : 60

Golder Associates

LOGGED S.L

CHECKED CY

PROJECT 881-2108

RECORD OF BOREHOLE 2

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE May.9,1988

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 881-2108

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, CM/SEC	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		72.60							
		Brown sand and gravel (Roadway Fill)		0.00 / 72.05							Bentonite Seal
				0.55	1	50 DO	4				Backfill
1		Very stiff to stiff grey brown and red brown SILTY CLAY (Weathered Crust)			2	50 DO	4				
2											
3					3	50 DO	4				Bentonite Seal / Backfill
				68.94 / 3.66							
4	Power Auger 200mm Diam (Hollow Stem)										Standpipe B / Bentonite Seal
5					4	50 DO	1				
6					5	50 DO	2				
7		Stiff grey SILTY CLAY									
8					6	50 DO	1				
9					7	50 DO	1				Bentonite Seal
10											Standpipe A
		End of Hole		62.24 / 10.36							
11											
12											

SHEAR STRENGTH Cu, kPa — nat.V.- + O.- ● rem.V.- ⊕ U.- O — 20 40 60 80

WATER CONTENT, PERCENT — Wp W Wl — 20 40 60 80

0 15 ⊕ 6 10 PERCENT AXIAL STRAIN AT FAILURE

W.L in Standpipe A at Elev.66.87
Standpipe B at Elev.71.50
May.9,1988

DEPTH SCALE 1 : 60

Golder Associates

LOGGED S.L

CHECKED

RECORD OF BOREHOLE 3

SHEET 1 of 2

LOCATION See Figure 2

BORING DATE Apr.22&25,1988

DATUM GEODETIC

SAMPLER HAMMER, 63.6kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.6kg, DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, CM/SEC	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		77.91 / 0.00				SHEAR STRENGTH Cu, kPa; nat.V.- + O.- ●; rem.V.- ⊕ U.- O; 20 40 60 80	WATER CONTENT, PERCENT Wp W Wl; 20 40 60 80		Backfill
1					1	50 DO	10				
2					2	50 DO	7				
3		Very stiff red brown and grey brown SILTY CLAY, some silty fine sand seams (Weathered Crust)			3	50 DO	9				
4					4	50 DO	6				
5					5	50 DO	4				
6	Power Auger 200mm Diam (Hollow Stem)				6	50 DO	4				
				72.73 / 5.18							
7		Stiff grey SILTY CLAY, some silty fine sand layers			7	50 DO	3				
8				70.14 / 7.77	8	50 DO	1				
		Stiff red brown SILTY CLAY		69.38 / 8.53							Backfill
9					9	50 DO	1				Bentonite Seal
10		Stiff grey and red brown, trace black mottling SILTY CLAY, occasional silt band									Backfill
11					10	50 DO	1				
12		Hole Continued		65.91 / 12.00				0 16 6 10 PERCENT AXIAL STRAIN AT FAILURE			

DEPTH SCALE 1 : 60

Golder Associates

LOGGED S.L

CHECKED

RECORD OF BOREHOLE 3

SHEET 2 of 2

LOCATION See Figure 2

BORING DATE Apr.22&25,1988

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 881-2108

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, CM/SEC	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
12	Power Auger 200mm Diam (Hollow Stem)	Hole Continued		66.91 / 12.00				SHEAR STRENGTH Cu, kPa nat.V.- + O.- ● rem.V.- ⊕ U.- O	WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)		Backfill
13		Stiff grey and red brown SILTY CLAY, some black organic mottling			11	50 DO	2				Bentonite Seal
14					12	50 DO	1				Backfill
15		End of Hole		62.97 / 14.94							Standpipes Destroyed
16											
17											
18											
19											
20											
21											
22											
23											
24											

0 / 15 ⊕ 6 / 10 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE

1 : 60

Golder Associates

LOGGED S.L

CHECKED CS

RECORD OF BOREHOLE AH-1

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE April22,1988

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 881-2108

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, CM/SEC	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam. (Hollow Stem)	Ground Surface		86.53				SHEAR STRENGTH Cu, kPa; nat.V.- + Q.- ● rem.V.- ⊕ U.- O	WATER CONTENT, PERCENT Wp W Wl; 20 40 60 80		
		TOPSOIL		0.00							
		Very stiff red brown and grey brown SILTY CLAY, some silty fine sand layers (Weathered Crust)		0.18	1	AS	-				
1				85.01							
		End of Hole		1.52							
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

0
15-⊕-5 PERCENT AXIAL STRAIN AT FAILURE
10

DEPTH SCALE

1 : 60

Golder Associates

LOGGED S.L

CHECKED CY

RECORD OF BOREHOLE AH-2

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE April 22, 1988

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 881-2108

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, CM/SEC	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam (Hollow Stem)	Ground Surface		83.70				SHEAR STRENGTH Cu, kPa nat.V.- + Q.- ● rem.V.- ⊕ U.- O	WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)		
		TOPSOIL		0.00 / 0.08							
1		Very stiff red brown SILTY CLAY, grey silty fine sand (Weathered Crust)			1	AS	-				
				82.18							
		End of Hole		1.52							
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

16 (0 / 10) 6 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE 1 : 60

Golder Associates

LOGGED SL

CHECKED CY

RECORD OF BOREHOLE AH-4

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE May.9,1988

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 881-2108

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH Cu, kPa (nat.V.- + O.- ● rem.V.- ⊕ U.- O)	HYDRAULIC CONDUCTIVITY, k, CM/SEC / WATER CONTENT, PERCENT (Wp, W, Ws; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam (Hollow Stem)	Ground Surface		62.51							
		TOPSOIL		0.00							
		Grey brown SILTY CLAY (Weathered Crust)		0.20							
1				60.99							
		End of Hole		1.52							
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

16 — 0 / 10 — 6 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE

1 : 60

Golder Associates

LOGGED S.L

CHECKED CS

RECORD OF BOREHOLE AH-5

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE May.9,1988

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 881-2108

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, CM/SEC	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam (Hollow Stem)	Ground Surface		64.43				SHEAR STRENGTH Cu, kPa nat.V.- + Q.- ● rem.V.- ⊕ U.- ○	WATER CONTENT, PERCENT Wp W Wl 20 40 60 80		
		TOPSOIL		0.00 64.13							
1		Grey brown SILTY CLAY (Weathered Crust)		0.30							
				62.91							
		End of Hole		1.52							
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

0 16-⊕-6 PERCENT AXIAL STRAIN AT FAILURE 10

DEPTH SCALE

1 : 60

Golder Associates

LOGGED S.L

CHECKED CJK

RECORD OF BOREHOLE AH-6

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE May.9,1988

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	SHEAR STRENGTH Cu, kPa (nat.V.- + O.- ● rem.V.- ⊕ U.- O)	HYDRAULIC CONDUCTIVITY, k, CM/SEC	WATER CONTENT, PERCENT (Wp, W, Wl; 20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		79.07									
		Brown sand and gravel (FILL)		0.00 / 78.77									
				0.30									
1	Power Auger 200mm Diam (Hollow Stem)	Grey brown and red brown SILTY CLAY (Weathered Crust)											
2													
3													
4													
5													
6				73.13									
		Grey sandy silt GLACIAL TILL, with numerous cobbles and boulders		5.94									
7													
		End of Hole		71.45 / 7.62									
8													
9													
10													
11													
12													

0 / 15 / 10 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE

1: 60

Golder Associates

LOGGED S.L

CHECKED

RECORD OF BOREHOLE AH-7

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE May.9,1988

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 881-2108

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat.V.- + Q.- ● rem.V.- ⊕ U.- O)	HYDRAULIC CONDUCTIVITY, k, CM/SEC; WATER CONTENT, PERCENT (Wp, W, Wl; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		87.20							
		Brown sand and gravel (FILL)		0.00 / 86.90							
				0.30							
1	Power Auger 200mm Diam (Hollow Stem)	Grey brown and red brown SILTY CLAY (Weathered Crust)									
2											
3											
				83.54							
4				3.66							
5											
6		Grey SILTY CLAY									
7											
8											
9				78.06							
		End of Hole		9.14							
10											
11											
12											

16 (0 / 10) 6 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE

1 : 60

Golder Associates

LOGGED S.L

CHECKED

RECORD OF BOREHOLE 1

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE Aug.24,1989

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3M
0		Ground Surface		85.78			
		Grey crushed stone (ROADWAY FILL)		0.00			
		Dark brown TOPSOIL, some gravel		0.24			
				0.37			
1							
2	Power Auger 200mm Diam (Hollow Stem)	Very stiff red brown SILTY CLAY, occasional fine sand seam (Weathered Crust)			1	50 DO	12
					2	50 DO	7
3					3	50 DO	4
4				81.67			
				4.11	4	50 DO	WH
5							
6		Firm grey SILTY CLAY			5	50 DO	PM
7							
8					6	50 DO	PM
				76.94			
9		End of Hole		8.84			
10							

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa — nat.V.- + Q.- ● rem.V.- ⊕ U.- ○

20 40 60 80

HYDRAULIC CONDUCTIVITY, k, CM/SEC

WATER CONTENT, PERCENT

Wp W Wl

20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Bentonite Seal

Backfill

Bentonite Seal

Granular Filter

Bentonite Seal

Backfill

W.L in Standpipe at Elev. 82.25 Oct. 2, 1989

0 16 10 6 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED S.Leighton

CHECKED

RECORD OF BOREHOLE 2

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE Aug.24,1989

DATUM GEODETIC

SAMPLER HAMMER, 63.6kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 891-2310

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3M
0	Power Auger 200mm Diam (Hollow Stem)	Ground Surface		85.63			
		Brown sand and gravel (ROADWAY FILL)		0.00			
		Dark brown TOPSOIL		0.24			
		Brown SANDY SILT		0.46			
				84.75			
1				0.88			
2		Very stiff grey brown to red brown SILTY CLAY, occasional fine sand seams and sand layers with depth (Weathered Crust)			1	50 DO	8
					2	50 DO	5
3					3	50 DO	7
4							
				80.91			
5		Compact grey SILTY fine SAND		4.72	4	50 DO	10
				80.51			
				5.12			
6					5	50 DO	1
7		Firm grey SILTY CLAY, occasional sand seams					
8					6	50 DO	WH
				76.79			
9		End of Hole		8.84			
10							

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa — nat.V.- + Q.- ● rem.V.- ⊕ U.- ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, CM/SEC

WATER CONTENT, PERCENT — Wp W Wl — 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Bentonite Seal

Backfill

Bentonite Seal

Granular Filter

Bentonite Seal

Backfill

W.L in Satndpipe at Elev. 82.40 Oct. 2, 1989

0 15-⊕-5 10 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE 1 : 50

Golder Associates

LOGGED S.Leighton

CHECKED

RECORD OF BOREHOLE 3

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE Aug.24,1989

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 891-2310

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3M
0		Ground Surface		82.87			
	Power Auger 200mm Diam (Hollow Stem)	Brown SANDY SILT, occasional silty sand seam		0.00 / 82.17			
1				0.70			
2		Very stiff to stiff grey brown SILTY CLAY, occasional sand seam (Weathered Crust)			1	50 DO	6
					2	50 DO	5
3					3	50 DO	3
4				78.60 / 4.27			
5		Firm grey SILTY CLAY, occasional sand seam			4	50 DO	WH
6					5	50 DO	PM
7				75.55			
		End of Hole		7.32			
8							
9							
10							

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa — nat.V.- + O.- ● rem.V.- ⊕ U.- O — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, CM/SEC

WATER CONTENT, PERCENT — Wp W Wl — 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Bentonite Seal

Backfill

Bentonite Seal

Granular Filter

Bentonite Seal

Backfill

W.L in Standpipe at Elev.79.49 Oct.2,1989

0 / 16 / 10 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED S.Leighton

CHECKED

RECORD OF BOREHOLE 4

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE Aug.25,1989

DATUM GEODETIC

SAMPLER HAMMER, 63.6kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP 760mm

PROJECT 891-2310

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, CM/SEC	SHEAR STRENGTH Cu, kPa (nat.V.- + Q.- ● rem.V.- ⊕ U.- ○)	WATER CONTENT, PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		84.20									
		Brown sand and gravel (ROADWAY FILL)		0.00									
		Dark brown TOPSOIL		0.24									
				0.43									
1	Power Auger 200mm Diam (Hollow Stem)				1	50 DO	13						
2					2	50 DO	8						
3		Very stiff grey brown and red brown silty clay, occasional fine sand seam (Weathered Crust)			3	50 DO	6						
4													
5					4	50 DO	5						
6													
7					5	50 DO	4						
				76.88									
		End of Hole		7.32									
8													
9													
10													

Bentonite Seal

Backfill

Bentonite Seal

Granular Filter

Bentonite Seal

W.L in Standpipe at Elev.78.79 Oct.2,1989

0 15 10 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE 1 : 50

Golder Associates

LOGGED S.Leighton

CHECKED

RECORD OF BOREHOLE 5

SHEET 1 of 1

LOCATION See Figure 2

BORING DATE Aug.25,1989

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 891-2310

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3M
0		Ground Surface		85.69			
		Brown sand and gravel (ROADWAY FILL)		0.00			
		Grey brown silty clay, trace gravel (FILL)		0.15			
		Dark brown TOPSOIL		85.08			
1	Power Auger 200mm Diam (Hollow Stem)	Very stiff grey brown SILTY CLAY (Weathered Crust)		0.61	1	50 DO	8
					2	50 DO	7
3					3	50 DO	6
4							
5					4	50 DO	5
				80.05			
6		Very dense brown sandy silt, some gravel, clay and cobbles (GLACIAL TILL)		5.64	5	50 DO	56
7							
				78.10			
8		End of Hole Auger Refusal		7.59			
9							
10							

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa nat.V.- + Q.- ● rem.V.- ⊕ U.- ○

20 40 60 80

HYDRAULIC CONDUCTIVITY, k, CM/SEC

WATER CONTENT, PERCENT Wp W Wl

20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Bentonite Seal

Backfill

Bentonite Seal

Backfill Filter

W.L in Standpipe at Elev. 79.95 Oct. 2, 1989

0 / 16 ⊕ 6 / 10 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE 1 : 50

Golder Associates

LOGGED S.Leighton

CHECKED

PROJECT: 911-2082

RECORD OF BOREHOLE 91-1

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: JUNE 3, 1991

Geodetic

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat.V ○·●, rem.V ⊕, U ·○)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT, PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		74.32							
0	Power Auger 200mm Diam. (Hollow Stem)	ASPHALT		0.00 74.10							
		Brown sand and gravel, trace silt (FILL)		0.22 73.94	1	GS				M	
		Brown silty clay, some sand and gravel (FILL)		0.38 73.79							
				0.53	2	SS	7				
1		Stiff to very stiff brown SILTY CLAY (Weathered Crust)			3	SS	6				
				72.80 1.52							
		End of Hole									
2											
3											
4											
5											

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m — SHEAR STRENGTH Cu, kPa (nat.V ○·●, rem.V ⊕, U ·○): 20, 40, 60, 80

HYDRAULIC CONDUCTIVITY, k, cm/s — WATER CONTENT, PERCENT (Wp, W, Wl): 20, 40, 60, 80

0
15 5 PERCENT AXIAL STRAIN AT FAILURE
10

DATA INPUT: J.COBISA, DISC 7

DEPTH SCALE

1 to 25

Golder Associates

LOGGED: A.C.H.

CHECKED: AC

PROJECT: 911-2082

RECORD OF BOREHOLE 91-2

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: JUNE 3, 1991

Geodetic

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam. (Hollow Stem)	Ground Surface		70.21				SHEAR STRENGTH Cu, kPa: nat.V - + Q - ● rem.V - ⊕ U - O; 20 40 60 80	WATER CONTENT, PERCENT: Wp W Wl; 20 40 60 80		
				0.00							
		ASPHALT		70.04							
		Brown sand and gravel, trace silt (FILL)		0.17	1	GS				M	
				69.91							
		Brown sand and gravel and silty clay (FILL)		0.30							
				69.68							
1		Stiff to very stiff brown SILTY CLAY (Weathered Crust)		0.53	2	SS DO	5				
					3	SS DO	3				
				68.69							
		End of Hole		1.52							
2											
3											
4											
5											

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

HYDRAULIC CONDUCTIVITY, k, cm/s

SHEAR STRENGTH Cu, kPa: nat.V - + Q - ● rem.V - ⊕ U - O; 20 40 60 80

WATER CONTENT, PERCENT: Wp W Wl; 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

0 / 15 / 10 — 5 PERCENT AXIAL STRAIN AT FAILURE

DATA INPUT: J.COBISA, DISC 7

DEPTH SCALE

1 to 25

Golder Associates

LOGGED: A.C.H.

CHECKED: ACH

PROJECT: 911-2082

RECORD OF BOREHOLE 91-3

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: JUNE 3, 1991

Geodetic

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat.V - +, rem.V - ⊕)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT, PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam. (Hollow Stem)	Ground Surface		66.53							
		ASPHALT		0.00 66.41							
		Brown sand and gravel, trace silt (FILL)		0.12 66.23	1	GS				M	
		Compact brown to grey sand and gravel, trace silt (FILL)		0.30 65.77	2	50 DO	11			M	
1		Mottled silty clay and sand and gravel (FILL)		0.76 65.57							
		Stiff grey brown SILTY CLAY (Weathered crust)		0.96 65.01	3	50 DO	4				
		End of Hole		1.52							
2											
3											
4											
5											

PERCENT AXIAL STRAIN AT FAILURE: 0, 5, 10, 15

DATA INPUT: J.COBISA, DISC 7

DEPTH SCALE

1 to 25

Golder Associates

LOGGED: A.C.H.

CHECKED: ACH

PROJECT: 951-2025

RECORD OF BOREHOLE 95-3

SHEET 1 OF 1

LOCATION: See Plan

BORING DATE: Mar. 30, 1995

DATUM: Geodetic

SAMPLER HAMMER, 21.1kg; DROP, 760mm

PENETRATION TEST HAMMER, 21.1kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, k, cm/s	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		80.83				SHEAR STRENGTH Cu, kPa: nat.V - + Q - ● rem.V - ⊕ U - O (20, 40, 60, 80)	WATER CONTENT, PERCENT Wp W Wl (20, 40, 60, 80)		
0		TOPSOIL		0.07							
1											Native Backfill
2					1	50 DO	12				
3	Power Auger 150mm Diam (Hollow Stem)	Very stiff to stiff brown to grey brown SILTY CLAY (Weathered Crust), trace sand			2	50 DO	9				
4											
5					3	50 DO	2	⊕ +			
6					4	50 DO	PM	⊕ +			
7				73.21				⊕ +			
8		Stiff grey SILTY CLAY		7.62	5	50 DO	PM	⊕ +			
9								⊕ +			
10		Dense grey-brown silty sand and gravel, occasional cobbles (GLACIAL TILL)		71.46 9.37	6	50 DO					Bentonite Seal
11					7	50 DO	35				Granular Filter; Standpipe
12	Rotary Drill NQ Core	Fresh grey fine grained thinly bedded LIMESTONE		69.15 11.68	8	NQ RC	1	T.C.R. 100% S.C.R. 74% R.Q.D. 74%			Bentonite Seal
13		End of Hole		67.76 13.07							
14											Standpipe Dry to Elev.70.47m Mar. 31, 1995
15											

DEPTH SCALE

1 to 75

Golder Associates

LOGGED: D.W.M

CHECKED:

PUT: S.Leigh

TABLE 1

RECORD OF AUGERHOLES

Auger Hole Number	Depth (metres)	Description	Sample (metres)
AH 01-2	0.00-0.22	Asphaltic Concrete	
	0.22-0.39	Grey crushed stone base, trace silt (FILL)	0.22 - 0.39
	0.39-1.15	Grey crushed stone subbase, trace silt (FILL)	
	1.15-1.50	Grey brown SILTY CLAY (Weathered Crust)	1.20 - 1.50
	1.50	End of Auger Hole	
		Note: Auger hole dry upon completion	
AH 01-3	0.00-0.45	Asphaltic Concrete	
	0.45-0.94	Coarse grey crushed stone subbase material (FILL)	0.50- 0.90
	0.94-1.50	Very stiff grey brown SILTY CLAY (Weathered Crust)	1.20-1.50
	1.50	End of Auger Hole	
		Note: Auger hole dry upon completion	
AH 01-4	0.00-0.22	Asphaltic Concrete	0.22-0.40
	0.22-0.41	Grey brown sand and gravel, inferred crushed pit run (FILL)	
	0.41-1.30	Grey brown SILTY CLAY, trace organic material, some gravel, some red clay tile at 1.2-1.3m (FILL).	1.10-1.30
	1.30-1.50	Grey brown SILTY CLAY (Weathered crust)	
	1.50	End of Auger Hole	
		Note: Auger hole dry upon completion	
AH 01-5	0.00-0.40	Asphaltic Concrete	
	0.40-0.50	Mix of clay and gravel with asphaltic coating (FILL)	0.40-0.50
	0.50-0.76	Grey crushed stone subbase (FILL).	
	0.76-1.11	Grey brown, SILTY CLAY (Weathered crust)	
	1.11-1.50	Weathered shaley limestone bedrock	
	1.50	End of Auger Hole	
		Note: Auger hole dry upon completion	
AH 01-6	0.00-0.20	Asphaltic Concrete	
	0.20-0.40	Brown sand and gravel with fragments of recycled asphalt (FILL)	0.20-0.40
	0.40-0.70	Mix of crushed stone and silty clay (FILL)	0.40-0.70
	0.70-0.79	Asphalt	
	0.79-1.05	Crushed stone, sand and gravel (FILL)	
	1.05-1.50	Very stiff, grey brown SILTY CLAY (Weathered Crust)	1.20-1.50
	1.50	End of Auger Hole	
		Note: Auger hole dry upon completion	

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-101

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 3, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		86.17							
0	Power Auger 200 mm Diam. (Hollow Stem)	Grey crushed stone (FILL)		0.00							
				85.50							
1		Very stiff grey brown silty clay, trace gravel, organic matter and brown sand pockets (FILL)		0.67							
2					1	50 DO	5				
3					2	50 DO	2				
				82.51							
		End of Borehole		3.66							
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: ———

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 11/11/03

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-102

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 3, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		86.16							
0	Power Auger 200 mm Diam. (Hollow Stem)	Grey crushed stone (FILL)		0.00							
		Brown sand and gravel (FILL)		0.12 85.96							
		Brown silty clay (FILL)		0.30							
		Dark brown silty TOPSOIL		0.46							
		Light brown CLAYEY SILT		0.61 85.34							
1		Very stiff grey brown and red brown SILTY CLAY, occasional sandy silt seam (Weathered Crust)		0.62							
2					1	50 DO	8				
3					2	50 DO	2				
				82.50							
		End of Borehole		3.66							
4											
5											
6											
7											
8											
9											
10											

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 6/11/03

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: ———

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-103

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 5, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		64.71							
0	Power Auger 200 mm Diam. (Hollow Stem)	Grey crushed stone (FILL)		0.00							
		Brown sand and gravel (FILL)		0.12							
				64.25							
		Very stiff to stiff grey brown and red brown SILTY CLAY (Weathered Crust)		0.46							
1											
2					1	50 DO	6				
3				61.66							
		Firm to stiff grey SILTY CLAY		3.05							
					2	50 DO	1				
				61.05							
		End of Borehole		3.66							
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: ———

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 11/11/03

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-104

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 3, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		83.64							
0		ASPHALTIC CONCRETE		0.03							Asphalt Seal
		Grey crushed stone (FILL)		0.12							
		Brown sand and gravel (FILL)		83.21							
		Very stiff grey brown and red brown SILTY CLAY (Weathered Crust)		0.43							
1											
	Power Auger 200 mm Diam. (Hollow Stem)				1	50 DO	5				Native Backfill
2											
				80.90							
		Firm to stiff grey SILTY CLAY with occasional red brown layer		2.74							Silica Sand
3					2	50 DO	WH				Standpipe
				79.74							
4		Probably grey SILTY CLAY with silt layers		3.90							Native Backfill
				79.37							
		End of Borehole		4.27							
5											W.L. in Standpipe at Elev. 81.04 m Oct. 14, 2003
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: ———

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 6/11/03

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-105

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 3, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp — W — Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		*GROUND SURFACE*		83.76									
0	Power Auger 200 mm Diam. (Hollow Stem)	ASPHALTIC CONCRETE		0.08									
		Grey crushed stone (FILL)		0.15									
		Brown sand and gravel (FILL)		83.30									
		Dark grey brown silty clay, some gravel, organic matter and crushed limestone, occasional cobble (FILL)		0.46									
1													
2					1	50 DO	67						
				81.47									
		Very stiff grey brown SILTY CLAY (Weathered Crust)		2.29									
3					2	50 DO	5						
				80.10									
		End of Borehole		3.66									
4													
5													
6													
7													
8													
9													
10													

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: ———

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 6/11/03

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-106

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 2, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		84.78							
0	Power Auger 200 mm Diam. (Hollow Stem)	Grey crushed stone (FILL)		0.00							
		Brown sand and gravel (FILL)		0.15							
		Brown silty clay, some gravel (FILL)		84.41							
		Grey brown silty clay, trace organic matter (FILL)		0.37							
				84.02							
1		Very stiff grey brown and red brown SILTY CLAY (Weathered Crust)		0.76							
					1	50 DO	12				
2				82.49							
		Loose brown fine SAND, trace silt		2.29							
					2	50 DO	9				
3				80.94							
		Very stiff grey brown SILTY CLAY (Weathered Crust)		3.84	3	50 DO	6				
				80.51							
4		End of Borehole		4.27							
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: _____

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 6/11/03

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-107

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 2, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diam. (Hollow Stem)	GROUND SURFACE		85.23							
		ASPHALTIC CONCRETE		0.12							
		Grey crushed stone (FILL)		84.83							
		Brown sand and gravel (FILL)		0.30							
		Grey brown silty clay, some gravel, trace organic matter (FILL)		84.29							
1		Very stiff grey brown SILTY CLAY, occasional very thin silt seam (Weathered Crust)		0.94							
2					1	50 DO	6				
3					2	50 DO	5				
				61.57							
		End of Borehole		3.66							
4											
5											
6											
7											
8											
9											
10											

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 6/11/03

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: ———

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-108

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 2, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		85.52							
0	Power Auger 200 mm Diam. (Hollow Stem)	ASPHALTIC CONCRETE		85.43							Asphalt Seal
		Grey crushed stone (FILL)		0.09							
		Brown sand and gravel (FILL)		0.24							
		Brown silty clay, some gravel, trace wood and cobbles (FILL)									
1				84.51							
		Very stiff grey brown and red brown SILTY CLAY (Weathered Crust)		1.01							
					1	50 DO	8				Native Backfill
2											
3					2	50 DO	7				Silica Sand
				81.86							Standpipe
		End of Borehole		3.66							
4											W.L. in Standipe at Elev. 82.23 m Oct. 14, 2003
5											
6											
7											
8											
9											
10											

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 11/11/03

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: ---------

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-109

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 2, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		85.86							
0	Power Auger 200 mm Diam. (Hollow Stem)	ASPHALTIC CONCRETE									
		Grey crushed stone (FILL)		0.12							
		Brown sand and gravel (FILL)		0.24							
		Brown sand and gravel with clay (FILL)		85.31							
		Dark brown silty clay TOPSOIL		0.55							
		Very stiff grey brown SILTY CLAY (Weathered Crust)		0.70							
1					1	50 DO	7				
2								+			
3								+			
					2	50 DO	5				
4								+			
								+			
				80.98							
5		End of Borehole		4.88							
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: ———

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 11/11/03

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-110

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 2, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diam. (Hollow Stem)	GROUND SURFACE		85.47							
		Dark grey treated sand and gravel (FILL)		0.06							
		Red brown silty clay (FILL)		0.21							
		Brown sand and gravel with clay (FILL)		0.30							
1		Grey brown SILTY CLAY (Weathered Crust)									
2				83.03							
		Brown sandy silt with cobbles and boulders (GLACIAL TILL)		2.44							
3				82.36							
		End of Borehole Auger Refusal		3.11							
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: ———

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 6/11/03

PROJECT: 03-1120-186

RECORD OF BOREHOLE: 03-111

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 2, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		84.03							
	Power Auger 200 mm Diam. (Hollow Stem)	Dark grey treated sand and gravel (FILL)		0.00							
		Grey crushed stone (FILL)		0.15							
		Grey brown silty clay (FILL)		0.30							
		Brown sand and gravel (FILL)		0.46							
1		Very stiff grey brown SILTY CLAY, occasional very fine sand seam (Weathered Crust)									
					1	50 DO	15				
2											
3					2	50 DO	11				
				80.37							
		End of Borehole		3.66							
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: ----------

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 6/11/03

RECORD OF BOREHOLE: 04-201

PROJECT: 04-1120-021
LOCATION:
INCLINATION: -90° AZIMUTH: —

DRILLING DATE: 2/13/2004
DRILL RIG:
DRILLING CONTRACTOR:

SHEET 1 OF 1
DATUM: Geodetic

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		85.74												
0	POWER AUGER 100 mm Diam. (Hollow Stem)	Possibly Clay		0.00												
2																
4																Native Backfill
6																
8				77.51												
		Possibly Glacial Till		8.23												
				75.74												
10	Rotary Drill NW Casing	Moderately weathered to fresh grey medium to fine crystaline LIMESTONE BEDROCK		10.00	2		100									
12					3		90									
					4		100									
14					5		0									
					6		0									
16					7		0									Bentonite Seal
					8		0									
18					9		0									
20	Rotary Drill NQ Core				10		0									
22					11		0									
				61.90												
24		End of Borehole		23.84												
26																
28																
30																

DRILLHOLE 04-1120-021.GPJ GLDR_CAN.GDT 14/4/04

DEPTH SCALE
1 : 150

Golder Associates

LOGGED: W.C.
CHECKED: J.F.B.

PROJECT: 04-1120-021

RECORD OF BOREHOLE: 04-202

SHEET 1 OF 1

LOCATION:

DRILLING DATE: 2/13/2004

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG:

DRILLING CONTRACTOR:

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. / DEPTH (m)	RUN No	PENETRATION RATE (m/min)	FLUSH COLOUR / % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE	86.24												
0	POWER AUGER 100 mm Diam. (Hollow Stem)	Possibly Silty Clay	0.00												
2															
4															Native Backfill
6															
8		Possibly Glacial Till	78.16 8.08												
10	Rotary Drill NW casing			1		100									
		Moderately weathered grey LIMESTONE BEDROCK with vertical mud seams	75.74 10.50	2		0									
			74.72	3		0									
12		Fresh grey medium to fine crystaline LIMESTONE BEDROCK with occasional mud seams	11.52	4		100									
14				5		0									
16				6		0									Bentonite Seal
	Rotary Drill NQ Core			7		0									
18				8		0									
20				9		0									
22				10		0									
			62.50	11		0									
24		End of Borehole	23.74												
26															
28															
30															

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DRILLHOLE 04-1120-021.GPJ GLDR.CAN.GDT 14/4/04

DEPTH SCALE
1 : 150

Golder Associates

LOGGED: W.C.
CHECKED: J.F.B.

PROJECT: 04-1120-021

RECORD OF BOREHOLE: 04-203

SHEET 1 OF 1

LOCATION:

DRILLING DATE: 2/13/2004

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE F-FAULT SM-SMOOTH PL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH / COLOUR % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		86.00												
0	POWER AUGER 100 mm Diam. (Hollow Stem)	Possibly Silty Clay		0.00												
2																
4																Native Backfill
6																
		Possibly Glacial Till		78.75 7.25												
8				76.80												
10	Rotary Drill NW casing	Highly weathered LIMESTONE BEDROCK		9.20	1		100									
					2		100									
					3		100									
					4		100									
					5		100									
12				73.84	6		100									
	Rotary Drill NQ Core	Fresh grey fine to medium crystaline LIMESTONE BEDROCK with occasional mud seam		12.16	7		100									
14					8		100									
16					9		100									Bentonite Seal
18					10		100									
					11		50									
20					12		0									
22					13		0									
					14		0									
24				62.07												
		End of Borehole		23.93												
26																
28																
30																

DRILLHOLE 04-1120-021.GPJ GLDR_CAN.GDT 1/14/04

DEPTH SCALE
1 : 150

Golder Associates

LOGGED: W.C.

CHECKED: J.F.B.

RECORD OF TEST PITS

Test Pit Number	Elevation	Description	
TP 04-1	0.00 – 0.05	TOPSOIL	
(Elev. 73.98)	0.05 – 3.50	Very stiff red brown SILTY CLAY (weathered crust)	
	3.50	End of test pit No free water Cu > 130 kPa throughout	
TP 04-2	0.00 – 0.05	TOPSOIL	
(Elev. 75.34)	0.05 – 3.80	Very stiff red brown SILTY CLAY (weathered crust), trace gravel to 3.0 metres	
	3.80	End of test pit No free water Cu > 130 kPa throughout	
TP 04-3	0.00 – 0.08	TOPSOIL	
(Elev. 82.67)	0.08 – 2.40	Very stiff red brown SILTY CLAY, trace small cobbles, occasional grey silty sand pockets (weathered crust)	
	2.40 – 3.45	Very stiff red brown silty clay (weathered crust)	
	3.45	End of test pit No free water Cu > 130 kPa throughout	
TP 04-4	0.00 – 0.05	TOPSOIL	
(Elev. 84.58)	0.05 – 3.50	Very stiff red brown SILTY CLAY, occasional grey silty sand pockets, trace gravel (weathered crust)	Cu > 130 kPa throughout
	3.50 – 3.90	Stiff red brown SILTY CLAY, occasional grey silty sand seams (weathered crust)	Cu = 90 kPa @ 3.7 m Cu = 90 kPa @ 3.9 m
	3.90	End of test pit No free water	

RECORD OF TEST PITS (continued)

Test Pit Number	Elevation	Description	
TP. 04-5	0.00 – 0.30	TOPSOIL	
(Elev. 82.91)	0.30 – 3.50	Very stiff red brown SILTY CLAY, occasional grey silty sand pockets below 3.3 metres (weathered crust)	
	3.50	End of test pit No free water Cu = 120 kPa throughout	
TP 04-6	0.00 – 0.16	TOPSOIL	
(Elev. 85.80)	0.16 – 3.70	Very stiff to stiff red brown SILTY CLAY, occasional grey silty sand pockets, (weathered crust)	Cu > 130 kPa @ 2.1 m Cu = 110 kPA @ 2.4 m Cu = 100 kPa @ 2.8 m Cu = 86 kPa @ 3.1 m Cu = 110 kPa @3.4 m
	3.70 – 3.90	Stiff grey SILTY CLAY	Cu = 56 kPA @ 3.90 m
	3.90	End of test pit No free water	