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**FOUNDATION INVESTIGATION REPORT
DETROIT – WINDSOR TRUCK FERRY ROAD
INFRASTRUCTURE IMPROVEMENTS
CITY OF WINDSOR
GWP 3071-06-00, PURCHASE ORDER NO. 3006-E-0065
MINISTRY OF TRANSPORTATION, ONTARIO
– SOUTHWESTERN REGION**

Submitted to:

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LIST OF ABBREVIATIONS

LIST OF SYMBOLS

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

RECORD OF BOREHOLE SHEETS

FIGURE 1 - Site Location Map

FIGURE 2 - Proposed Site Layout

DRAWING 1 - Borehole Locations

APPENDIX A - Laboratory Test Data (Figures A-1 to A-17)

APPENDIX B - Site Photographs

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Stantec Consulting Ltd. (Stantec) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out a foundation investigation as part of the detail design for the improvements to the Detroit – Windsor Truck Ferry facility, GWP 3071-06-00. The project includes the construction of a new access road, provision of a truck parking area, new illumination, dredging of the riverbed, installation of a sheet pile wall, installation of a single bumper dolphin and construction of an adjustable ramp to facilitate on and off loading of the ferry/barge.

This report addresses the foundation aspects of the installation of a Truck Ferry Administration Kiosk, sheet pile walls, dredging of the riverbed, the bumper dolphin, the construction of an adjustable ramp and a high mast light. The purpose of the foundation investigation is to determine the subsurface conditions at the locations of the proposed docking facility improvements by drilling boreholes and carrying out in situ testing and laboratory testing on selected samples. The original terms of reference for the scope of work are outlined in the MTO's Request for Proposal, in Golder's proposal P71-3011 dated April 18, 2007 and in Golder's letter for additional foundation engineering services dated July 25, 2007. The foundation investigation was conducted, as originally proposed in July 2007, and the preliminary results reported. Following a series of design revisions, the scope of work was modified to reflect the original terms of reference and the current preferred design concept, Option 6. An additional foundation investigation was carried out in October 2007 as outlined in our letter dated October 4, 2007. The work was carried out in accordance with our Quality Control Plan for Foundation Engineering dated June 21, 2007.

Stantec provided Golder with original design drawings, survey information and the proposed layout for the Truck Ferry facility.

2.0 SITE DESCRIPTION

The Truck Ferry facility is located at 5550 Maplewood Road in Windsor, Ontario and transports trucks across the Detroit River to Detroit, Michigan by way of a tug boat propelled ferry barge. The site has been in use as a truck ferry terminal since 1994. According to the results of a recent Phase 1 Environmental Site Assessment, significant amounts of infilling into the Detroit River have occurred. The existing facility consists of a gravel parking lot and access road, a floating dock, a one-storey customs building, two sheds, a water well and a steel container. The concrete surfaced floating dock is approximately 52.8 metres long by 12.0 metres wide. Access to the dock is provided by a steel ramp located along the northeast side of the dock. An existing steel sheet pile wall runs along the northwest shoreline.

The International Great Lakes Datum (IGLD) for this site is elevation 174.0 metres.

The site location is shown on Figure 1 and select site photographs taken during the investigation are provided in Appendix B.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out in two stages. Initially, boreholes 1 to 5 were drilled between July 23 and 31, 2007 and subsequent boreholes 6 to 13 were drilled between October 9 and 15, 2007. Boreholes 2, 3, 10, 12, and 13 were drilled using a timber platform with safety rails cantilevered over a barge and the floating dock to depths between about 1.7 and 28.3 metres below the river water level. The remaining boreholes were advanced on land to depths between about 5.0 and 29.9 metres below the existing ground surface.

The tug and barge utilized to drill borehole 3 were provided by a specialist marine contractor.

The investigation was carried out using all-terrain vehicle and truck mounted CME-750 drill rigs supplied and operated by specialist drilling contractors. The boreholes were advanced using a combination of power auger, rotary mud drilling techniques in NW size casing and coring of the bedrock in NQ size in boreholes 1, 3, and 9. The remaining boreholes were advanced using a power auger, with the exception of boreholes 10, 12, and 13, which were advanced using manual drilling techniques. In the boreholes, samples of the overburden were obtained at regular intervals of depth using 50 millimetre outside diameter split-spoon samplers in accordance with the standard penetration test procedures. In situ vane shear testing was also carried out in the softer cohesive materials. In addition, thin walled tube samples were obtained from the cohesive soils, where feasible. Groundwater conditions in the boreholes were observed throughout the drilling operations and standpipes were installed in boreholes 5 and 7. The boreholes were backfilled using MTO recommended procedures and as required by Ontario Regulation 903 (amended by Ontario Regulation 128/03). The artesian flows in boreholes 1, 3 and 9 were sealed at their source in the bedrock.

The field work was supervised on a full-time basis by members of our engineering staff who located the boreholes in the field, directed the drilling, sampling and in-situ testing operations and logged the boreholes. The soil and rock samples were identified in the field, placed in labeled containers and transported to our laboratory in London, Ontario for further examination. Index and classification tests consisting of grain size analyses, Atterberg limits tests, consolidation testing and water content determinations were carried out on selected samples. The rock core and thin walled tube samples were transported to our laboratory in Mississauga, Ontario for additional examination of the rock core and triaxial testing. Triaxial testing was carried out on thin walled tube samples from boreholes 1 and 2. The results of the field and laboratory testing are given on the Record of Borehole sheets and in Appendix A.

The locations of the boreholes are shown on the Record of Borehole sheets and on Drawing 1. The table below summarizes the borehole locations, ground surface elevations at the borehole locations and borehole depths:

<u>BOREHOLE</u>	<u>LOCATION (m)</u>		<u>GROUND SURFACE ELEVATION</u>	<u>BOREHOLE DEPTH</u>
	<u>Northing</u>	<u>Easting</u>	<u>(m)</u>	<u>(m)</u>
1	4 681 695.5	326 636.1	176.43	29.14
2	4 681 717.2	326 635.8	174.78	22.71
3	4 681 705.2	326 604.2	174.76	28.25
4	4 681 681.4	326 647.5	176.63	5.03
5	4 681 674.5	326 639.4	176.98	6.55
6	4 681 640.5	326 616.7	177.23	5.03
7	4 681 677.9	326 691.3	177.47	11.13
8	4 681 673.1	326 622.3	176.97	17.22
9	4 681 658.5	326 615.2	176.99	29.87
10	4 681 672.7	326 611.4	174.60	1.68
11	4 681 647.4	326 634.3	177.24	5.79
12	4 681 664.7	326 599.9	174.60	3.35
13	4 681 668.1	326 604.9	174.60	3.05

4.0 SUBSURFACE CONDITIONS

4.1 Site Geology

The area of the Truck Ferry facility lies in the physiographic region of southern Ontario known as the St. Clair Clay Plains as identified in "The Physiography of Southern Ontario" by Chapman and Putnam (1984). The clay plains are described as till plains smoothed by shallow deposits of lacustrine clay which settled in the depressions.

Based on the Ontario Department of Mines and Northern Affairs Preliminary Map P.749 entitled "Quaternary Geology of the Windsor-Essex Area", the project site is located in an area of surficial gravel and gravely sand.

The bedrock is reported to be dolomite and limestone of the Dundee Formation of Middle Devonian Age (Geological Survey of Canada, Map 1263A entitled "Geology, Toronto-Windsor Area", dated 1969).

4.2 Site Stratigraphy

The detailed subsurface water, soil and rock conditions encountered in the boreholes together with the results of the field and laboratory testing are shown on the Record of Borehole sheets following the text of this report and in Appendix A. The stratigraphic boundaries shown on the borehole sheets are inferred from non-continuous sampling and, therefore, may represent transitions between soil types rather than exact planes of geological change. Subsoil conditions will vary between and beyond the borehole locations.

In summary, the subsoils generally consist of variable but generally granular fill with miscellaneous debris (wood, bricks, concrete, etc.) overlying an upper layer of clayey silt, underlain by silty clay and an extensive layer of clayey silt which overlies clayey silt to sandy silt till and shaley limestone bedrock at about elevation 151 metres. Within the Detroit River, the river bed is composed of sandy silt, silt, silty sand or fill materials.

The locations and elevations of the borings are shown on the attached Drawing 1. A detailed description of the subsurface conditions encountered in the boreholes for this investigation is provided on the Record of Borehole sheets and a summary of the soil stratigraphy is provided in the following paragraphs.

4.2.1 Fill

Boreholes 1, 4, 5, 6, 7, 8, 9 and 11 encountered 3.7 to 5.2 metres of variable but generally granular fill at the ground surface. The fill consisted of layers of sand and gravel, sand, sandy silt, silty sand and gravel, crushed rock and clayey silt. Pieces of concrete, bricks, cobbles, boulders, glass and organics were also encountered throughout the fill layers. Boreholes 10, 12, and 13 encountered similar fill layers beneath about 1.2 to 1.7 metres of water. Boreholes 10 and 13 were terminated within the fill layers at depths of 1.7 and 3.1 metres, respectively.

Standard penetration tests in the fill gave N values ranging from 6 to about 50 blows per 0.3 metres depth indicating loose to dense relative density. Some higher values were obtained on rubble debris within the fill. Further, it should be noted that the initial attempt to drill borehole 9 resulted in practical auger refusal at a depth of 0.9 metres and larger pieces of concrete are also exposed on the river bank.

The natural water contents of the fill ranged from about 7 to 57 per cent. The higher water contents are attributable to the presence of organic materials. Grain size distribution curves for samples of the fill obtained from the standard penetration testing are shown on Figures A-1 and A-2.

The cohesive fill layers were of intermediate plasticity with liquid limits of 36 and 43 per cent, plastic limits of 19 and 23 per cent and plasticity indices of 17 and 20 per cent. The results of the Atterberg limits testing are presented on Figure A-9.

4.2.2 Silt

Beneath about 4.2 metres of water, a layer of very loose silt with trace amounts of organics was encountered in borehole 3 from elevation 170.6 metres. The silt deposit was about 0.9 metres thick and extended to elevation 169.7 metres. The natural water content of the silt was about 66 per cent.

4.2.3 Sandy Silt

Beneath about 1.9 metres of water, a layer of very loose sandy silt with wood was encountered in borehole 2 from elevation 172.9 metres. The sandy silt deposit was about 1.0 metres thick and extended to elevation 171.9 metres. Borehole 12 encountered and was terminated in a layer of compact sandy silt containing clay and gravel from elevation 171.6 to 171.3 metres. The natural water contents of the sandy silt were 25 and 126 per cent.

4.2.4 Silty Sand

A layer of very loose to loose silty sand with variable amounts of gravel was encountered beneath the silt in borehole 3 and beneath the granular fill in borehole 4 from elevations 169.7 and 172.5 metres, respectively. Borehole 3 also encountered bricks and borehole 4 encountered organics within the silty sand deposit. A grain size distribution curve for a sample of the silty sand is shown on Figure A-3. The natural water contents of the silty sand ranged from about 29 to 33 per cent with an average water content of about 31 per cent.

4.2.5 Clayey Silt

From elevations 174.9 to 172.6 metres, an upper layer of clayey silt was encountered beneath the fill in boreholes 7, 8, 9, 11 and 12. The upper clayey silt layer ranged in thickness from about 0.5 to 2.7 metres. From elevations 169.0 to 166.6 metres, a lower layer of clayey silt was encountered beneath the silty clay in boreholes 1, 2, 7, 8, and 9, and beneath the silty sand in borehole 3. Boreholes 7 and 8 were terminated within the lower clayey silt deposit. The lower clayey silt ranged in thickness from about 13.9 to 15.3 metres in the remaining boreholes. Grain size distribution curves for samples of the clayey silt are shown on Figures A-4 and A-5.

The clayey silt had N values ranging from 1 to 16 blows per 0.3 metres penetration. The results of in situ vane testing indicated undrained shear strengths ranging from 14 to over 144 kilopascals (kPa) but generally below 65 kPa. The in situ vane sensitivities ranged from 1.2 to 3.7. The testing indicated that the clayey silt has a soft to stiff consistency. The natural water contents of the clayey silt ranged from about 15 to 47 per cent with an average water content of about 24 per cent. Atterberg limits testing indicated plastic limits ranging from 13 to 18 per cent, liquid limits ranging from 21 to 35 per cent and plasticity indices of 8 to 15 per cent. The results of the Atterberg limits testing are presented on Figure A-9.

The results of consolidated, undrained triaxial laboratory testing carried out on two specimens of the clayey silt (sample 8) from borehole 1 are provided on Figures A-14 to A-17. The laboratory testing indicated that the sample had an effective angle of internal friction of 27 degrees and an effective cohesion of nil.

4.2.6 Silty Clay

From elevations 173.1 to 170.0 metres, a layer of silty clay was encountered beneath the fill in boreholes 1, 5, and 6, beneath the sandy silt in borehole 2, beneath the silty sand in borehole 4, and beneath the clayey silt in boreholes 7, 8, 9, and 11. Boreholes 4, 5, 6, and 11 were terminated within this deposit. Where fully penetrated, the silty clay ranged in thickness from about 1.7 to 5.3 metres. Grain size distribution curves for samples of the silty clay are shown on Figure A-6.

The silty clay had N values of 1 to 5 blows per 0.3 metres penetration. The results of in situ vane testing indicated undrained shear strengths ranging from 15 to 29 kPa with an average undrained shear strength of about 22 kPa. The in situ vane sensitivities ranged from 1.4 to 4.0. The testing indicated that the silty clay has a soft to firm consistency. The natural water contents of the silty clay ranged from about 23 to 53 per cent with an average water content of about 40 per cent. Atterberg limits testing indicated an intermediate to high plasticity soil with plastic limits ranging from 17 to 25 per cent, liquid limits ranging from 37 to 57 per cent and plasticity indices of 19 to 32 per cent. The results of the Atterberg limits testing are presented on Figure A-9.

The results of consolidated, undrained triaxial laboratory testing carried out on sample 5 of the silty clay from borehole 2 are provided on Figures A-10 to A-13. The laboratory testing indicated that the sample had an effective angle of internal friction of 21 degrees and an effective cohesion of nil.

4.2.7 Sand

A 1.4 metre thick layer of sand containing cobbles was encountered beneath the clayey silt in borehole 3 from elevation 153.0 metres. The sand had an N value of greater than 100 blows per 0.3 metres indicating a very dense deposit. The natural water content of the sand was about 20 per cent. A grain size distribution curve for a sample of the sand is shown on Figure A-7.

4.2.8 Sandy Silt Till

Beneath the clayey silt in borehole 1, a layer of sandy silt till was encountered from elevation 154.2 metres. The sandy silt till extended to the bedrock surface at elevation 152.4 metres. The sandy silt till had an N value of 31 blows per 0.3 metres indicating a dense deposit. A grain size distribution curve for a sample of the sandy silt till obtained from the standard penetration testing is shown on Figure A-8. The natural water content of the sandy silt till was about 11 per cent. Atterberg limits testing on a single sample indicated a borderline silt and clay of low plasticity with a plastic limit of 11 per cent, a liquid limit of 17 per cent and a plasticity index of 6 per cent. The results of the Atterberg limits testing are presented on Figure A-9.

Although cobbles and boulders were not specifically encountered in the sandy silt till deposit, their presence should be anticipated.

4.2.9 Clayey Silt Till

Beneath the lower clayey silt in boreholes 2 and 9, and beneath the sand in borehole 3, a layer of clayey silt till was encountered from elevations 153.1 to 151.6 metres. The clayey silt till extended to the bedrock surface at elevations 152.2 to 150.5 metres.

The clayey silt till had N values of from 9 blows per 0.3 metres to 80 blows for 25 millimetres of penetration indicating a stiff to hard but typically hard deposit. The natural water content of the clayey silt till was about 9 per cent.

Although cobbles and boulders were not specifically encountered in the boreholes advanced in the clayey silt till, the presence of these materials should be expected due to the depositional history of the glacial tills.

4.2.10 Bedrock

The bedrock surface was encountered between elevations 152.4 and 150.5 metres in boreholes 1, 2, 3 and 9, some 24.1 to 25.0 metres below the ground surface or 22.6 to 24.2 metres below the river water level. Approximately 3.5 to 4.0 metres of the bedrock below elevation 151.0 metres was cored in NQ size in boreholes 1, 3 and 9. The bedrock was identified as pale grey to brown, medium strong, laminated, shaley limestone with bituminous partings of the Dundee formation. The total rock core recoveries (TCR) recorded were 0 to 100 per cent, with measured solid core recoveries (SCR) of 0 to 98 per cent and rock quality designations (RQD) of 0 to 98 per cent. The rock was found to be highly weathered above elevation 150.5 metres in boreholes 1 and 9. Based on the RQD values, the bedrock is typically of fair to excellent quality.

<u>BOREHOLE</u>	<u>ELEVATION (m)</u>		<u>RQD</u> (%)	<u>TCR</u> (%)	<u>SCR</u> (%)
	<u>From</u>	<u>To</u>			
1	151.0	150.3	0	56	8
	150.3	148.9	85	90	85
	148.9	147.3	90	93	90
3	150.5	149.6	74	74	74
	149.6	148.1	98	100	98
	148.1	146.5	93	95	93
9	150.6	150.2	0	0	0
	150.2	148.6	73	77	73
	148.6	147.1	93	98	93
AVERAGE			67	76	68

4.3 Water Conditions and River Bed Elevations

4.3.1 Groundwater Conditions

Groundwater conditions were observed in the boreholes during and upon completion of drilling. Groundwater was encountered from elevation 171.6 to 174.3 metres at the time of drilling. Artesian conditions were encountered within the shaley limestone in boreholes 1, 3, and 9 at elevations of about 151.0, 148.0 and 150.5 metres, respectively. The artesian flows in the borehole casings were measured with 2.2 metres of head above ground surface in borehole 1, 2.3 metres of head above river level in borehole 3, and 1.7 metres of head above ground surface in

borehole 9. The average water level in the Detroit River was at elevation 174.8 metres during the period July 23 to 30, 2007.

Standpipes were installed in boreholes 5 and 7 to monitor groundwater levels. Groundwater was measured in the standpipe installed in borehole 5 at elevation 174.6 metres in the surficial till on August 17, 2007. Groundwater was measured in the standpipe piezometer installed in borehole 7 at elevation 176.1 metres in the clayey silt at depths of about 9 metres on October 15, 2007.

The long term groundwater level is inferred at elevation 175 metres in the near surface soil and at elevation 179 metres in the bedrock. The groundwater levels are expected to fluctuate seasonally and are expected to be higher during periods of sustained precipitation or during spring melt conditions.

The groundwater levels observed in the boreholes are shown on the attached Record of Borehole sheets and are summarized below:

BOREHOLE NUMBER	GROUND OR WATER SURFACE ELEVATION (m)	ENCOUNTERED WATER LEVEL		MEASURED GROUNDWATER LEVELS					
				July 31, 2007		August 17, 2007		October 15, 2007	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
1	176.43	2.13	174.30	-	-	-	-	-	-
		+2.23	178.66*						
3	174.76	+2.29	177.05*	-	-	-	-	-	-
4	176.63	2.74	173.89	-	-	-	-	-	-
5	176.98	2.29	174.69	5.36	171.62	2.35	174.63	-	-
6	177.23	Dry	Dry	-	-	-	-	-	-
7	177.47	4.27	173.20	-	-	-	-	1.40	176.07
8	176.97	3.96	173.01	-	-	-	-	-	-
9	176.99	+2.01	178.67*	-	-	-	-	-	-
11	177.24	Dry	Dry	-	-	-	-	-	-

* Flowing artesian groundwater conditions encountered in boreholes 1, 3 and 9 from elevation 148.0 to 151.0 metres.

4.3.2 River Bed Elevations

The measured water levels and river bed elevations are shown on the attached Record of Borehole sheets and are summarized below:

BOREHOLE NUMBER	RIVER WATER ELEVATION (m)	RIVER BED ELEVATION (m)
2	174.78	172.86
3	174.76	170.61
10	174.60	173.38
12	174.60	172.92
13	174.60	173.08

The monitoring station closest to the site is at Fort Wayne, Michigan, USA and is operated by the National Oceanic Atmospheric Administration (NOAA). According to NOAA records, the minimum and maximum recorded water levels for the Detroit River since 1970 are 173.81 and 175.79 metres above the IGLD, respectively. The mean water level for the month of July 2007 was 174.66 metres above IGLD. The river water level is subject to seasonal fluctuations.

5.0 MISCELLANEOUS

The investigation was carried out using equipment supplied and operated by Lantech Drilling Services Inc. and Aardvark Drilling Inc. both of whom are Ontario Ministry of the Environment licensed well contractors. The tug and barge required for borehole 3 were provided by Cobby Marine & Crane Services. The field operations were supervised by Mr. David J. Mitchell and Mr. Brent Gusba. The routine laboratory testing was carried out at Golder's London laboratory under the direction of Mr. Chris M. Sewell. The laboratory is an accredited participant in the MTO Soil and Aggregate Proficiency Program and is certified by the Canadian Council of Independent Laboratories for testing Types C and D aggregates.

The triaxial testing was conducted in Golder's Mississauga laboratory. In addition to also being a participant in the MTO Soil and Aggregate Proficiency Program, the Mississauga laboratory is an MTO registered laboratory in the Specialty of Soil and Rock Including Testing for Foundation Engineering - Low and High Complexity.

This report was prepared by Ms. Dirka U. Prout, P. Eng. under the direction of the Project Manager, Mr. Philip R. Bedell, P. Eng. This report was reviewed by Mr. Fintan J. Heffernan, P. Eng., the Designated MTO Contact and Quality Control Auditor for this assignment.

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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

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split spoon sampler for a distance of 300 mm (12 in.)

Consistency

	<u>kPa</u>	<u>psf</u>
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

(b) Cohesive Soils

Dynamic Cone Penetration Resistance; N_d :

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

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

LIST OF SYMBOLS

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

I. General

π	3.1416
$\ln x$,	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
ν	poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity index $= (w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index $= (w - w_p) / I_p$
I_C	consistency index $= (w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index $= (e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction $= \tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 + \sigma_3)$
S_t	sensitivity

- Notes:**
- 1 $\tau = c' + \sigma' \tan \phi'$
 - 2 shear strength = (compressive strength)/2
 - * density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE

Fresh: no visible sign of weathering.

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.
Completely weathered: rock is wholly decomposed and in a friable condition but the rock texture and structure are preserved.

BEDDING THICKNESS

<u>Description</u>	<u>Bedding Plane Spacing-</u>
Very thickly bedded	>2 m
Thickly bedded	0.6 m to 2m
Medium bedded	0.2 m to 0.6m
Thinly bedded	60 m to 0.2 m
Very thinly- bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	< 6 mm

JOINT OR FOLIATION SPACING

<u>Description</u>	<u>Spacing</u>
Very wide	> 3 m
Wide	1 – 3 m
Moderately close	0.3 – 1 m
Close	50 – 300 mm
Very close	< 50 mm

GRAIN SIZE

<u>Term</u>	<u>Size*</u>
Very Coarse Grained	> 60 mm
Coarse Grained	2 – 60 mm
Medium Grained	60 microns – 2 mm
Fine Grained	2 – 60 microns
Very Fine Grained	< 2 microns

Note: *Grains >60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid sticks.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to (W.R.T.) Core Axis

The angle of the discontinuity relative to the axis (length) of the core, In a vertical borehole a discontinuity with a 90° angle is horizontal.

Description and Notes

An abbreviated description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces

Abbreviations

B – Bedding	P - Polished
FO - Foliation Schistosity	S - Slickensided
CL - Cleavage	SM - Smooth
SH - Shear Plane Zone	R - Ridged / Rough
VN - Vein	ST - Stepped
F - Fault	PL - Planar
CO - Contact	FL - Flexured
J - Joint	UE - Uneven
FR - Fracture	W - Wavy
M F - Mechanical Fracture	C - Curved
- Parallel To	
⊥ - Perpendicular To	

RECORD OF BOREHOLE No 1

1 OF 3

METRIC

PROJECT 07-1130-109-0
G.W.P. 3071-06-00 LOCATION N 4681695.5 ; E 326636.1 ORIGINATED BY DM
DIST 1 HWY BOREHOLE TYPE Power Auger (Hollow Stem), Rotary Drilling (NW Casing) COMPILED BY BRS/LMK
DATUM GEODETIC DATE July 23, 2007 - July 24, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _P W W _L			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)				
176.43	GROUND SURFACE							20 40 60 80 100		10 20 30			GR SA SI CL
0.00	FILL, sand and gravel, trace silt Brown							✱ Artesian water level at elev. 178.66m					
175.79							176						
0.64	FILL, silty fine sand, Compact Brown		1	SS	17					○			0 72 23 5
175.06							175						
1.37	FILL, sandy silt, trace organics Loose Black		2	SS	6					○			
174.30							174			○			
2.13	FILL, sand and gravel, trace silt, trace glass, trace clay, bricks and concrete, cobbles and boulders Very Dense to Compact Black		3	SS	65/ 100mm								
			4	SS	24		173			○			44 48 8 0
172.77							172				○		
3.66	SILTY CLAY, trace sand Soft Grey		5	SS	3							49	1 6 28 65
			6	SS	2		171					49	
								4.0 2.3					
			7	SS	2		170						
								2.2 2.5					
169.00							169						
7.43	CLAYEY SILT, some sand, trace to some gravel with fine sand and silt seams Soft to Stiff Grey		8	TO	PH								CIU 2 10 46 42
							168						
								2.3 3.2					
			9	SS	2		167			○			
							166						
			10	SS	3			2.3 2.2					15 20 39 26
							165						
								1.4 1.5					
			11	TO	PH		164						
							163						
								2.1 1.9					
			12	SS	8		162			○			

Continued Next Page

Grout Filled

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

METRIC

PROJECT 07-1130-109-0

G.W.P. 3071-06-00

LOCATION N 4681695.5 ;E 326636.1

ORIGINATED BY DM

DIST 1 HWY

BOREHOLE TYPE Power Auger (Hollow Stem), Rotary Drilling (NW Casing)

COMPILED BY BRS/LMK

DATUM GEODETIC

DATE July 23, 2007 - July 24, 2007

CHECKED BY _____

[illegible] Grout Filled

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 2

1 OF 2

METRIC

PROJECT 07-1130-109-0

G.W.P. 3071-06-00

LOCATION N 4681717.2 ; E 326635.8

ORIGINATED BY DM

DIST 1 HWY

BOREHOLE TYPE Rotary Drilling (NW Casing)

COMPILED BY BRS/LMK

DATUM GEODETIC

DATE July 25, 2007 - July 26, 2007

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		w _p	w	w _L		
								○ UNCONFINED + FIELD VANE	WATER CONTENT (%)					
							● QUICK TRIAXIAL × LAB VANE							
							20 40 60 80 100							
174.78 0.00	RIVER WATER LEVEL WATER													GR SA SI CL
172.86 1.92	SANDY SILT, with wood Very Loose Grey to black		1	SS	WR		174						126	
171.88 2.90	SILTY CLAY, trace sand, trace gravel Soft to Firm Grey		2	SS	1		172						53	
							171	2.0						
			3	SS	1		170						53	2 12 31 55
							169	2.4 24.9						
			4	TO	PH		168	2.1 2.3						
							167						59 57	CIU 0 3 19 78
166.55 8.23	CLAYEY SILT, trace to some sand, trace gravel with sand seams Soft to Very Stiff Grey						166	2.1 2.1						
			6	SS	3		165	1.6 1.5						0 9 41 50
							164							
			7	SS	5		163	1.3 1.3						
							162	1.6 1.4						
			8	SS	8		161							
							160							
			9	SS	7									

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 2

2 OF 2

METRIC

PROJECT 07-1130-109-0 LOCATION N 4681717.2 ; E 326635.8 ORIGINATED BY DM
G.W.P. 3071-06-00 DIST 1 HWY BOREHOLE TYPE Rotary Drilling (NW Casing) COMPILED BY BRS/LMK
DATUM GEODETIC DATE July 25, 2007 - July 26, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT LIMIT CONTENT LIMIT w _p w w _L			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%) 20 40 60 80 100				10 20 30	GR	SA	SI	CL
			10	SS	16		159								3	34	43	20
			11	SS	7		158											
			12	SS	8		157											
			13	SS	7		156											
			14	SS	10		155											
			15	SS	80/		154											
			16	WS	25mm		153											
152.62																		
22.16																		
152.22																		
22.56																		
22.71																		
	CLAYEY SILT, trace sand, trace gravel (TILL) Grey																	
	Pale grey, to brown, laminated SHALEY LIMESTONE with bituminous partings and vuggy bands END OF BOREHOLE																	

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

PROJECT 07-1130-109-0
G.W.P. 3071-06-00 LOCATION N 4681681.4 ; E 326647.5 ORIGINATED BY DM
DIST 1 HWY BOREHOLE TYPE Power Auger (Hollow Stem) COMPILED BY BRS/LMK
DATUM GEODETIC DATE July 31, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p W W _L						
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)						
176.63 0.00	GROUND SURFACE FILL, sand and gravel with concrete, trace silt Very Dense Brown					▽	176							7 75 12 6		
175.56 1.07	FILL, sand, trace gravel, some silt, trace clay, concrete Loose Brown to black		1	SS	60/ 150mm		175									60 32 6 2
			2	SS	9											
			3	SS	9		174									
173.73 2.90	FILL, sand and gravel, trace silt, bricks Very Dense to Compact Grey and brown		4	SS	91		173									
172.52 4.11	SILTY SAND, some gravel, trace organics Loose Brown to black		5	SS	12											
172.21 4.42	SILTY CLAY, trace sand and gravel Firm Grey END OF BOREHOLE Groundwater encountered at elev. 173.89m during drilling on July 31, 2007.	6	SS	5	172											

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

PROJECT 07-1130-109-0
G.W.P. 3071-06-00 LOCATION N 4681674.5 ; E 326639.4 ORIGINATED BY DM
DIST 1 HWY BOREHOLE TYPE Power Auger (Hollow Stem) COMPILED BY BRS/LMK
DATUM GEODETIC DATE July 31, 2007 CHECKED BY

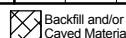
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p W W _L				
176.98	GROUND SURFACE							20 40 60 80 100						
0.10	FILL, crushed rock													
	FILL, sand, trace clay, some silt, trace gravel, bricks and glass		1	SS	34									
	Loose to Dense		2	SS	20									
	Brown to black													
			3	SS	9									
			4	SS	10									
			5	SS	7									
			6	SS	8									
171.80	SILTY CLAY, trace sand		7	SS	4									
5.18	Firm													
	Grey		8	TO	PH									
170.43	END OF BOREHOLE													
6.55	Groundwater encountered at elev. 174.69m during drilling on July 31, 2007.													
	Water level measured in Standpipe at elev. 171.62m following drilling on July 31, 2007													
	Water level measured in Standpipe at elev. 174.63m on August 17, 2007													



Bentonite Seal



Sand Fill



Backfill and/or Caved Material

+ 3, x 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

PROJECT 07-1130-109-0 LOCATION N 4681640.5 ; E 326616.7 ORIGINATED BY DM
G.W.P. 3071-06-00 DIST 1 HWY BOREHOLE TYPE Power Auger (Hollow Stem) COMPILED BY WDF
DATUM GEODETIC DATE October 9, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
								WATER CONTENT (%)									
177.23	GROUND SURFACE							20	40	60	80	100					
0.00	FILL, crushed sand and gravel Grey						177										
176.83																	
0.40	FILL, silty fine sand Brown																
0.61	FILL, clayey silt, trace sand Firm Black		1	SS	7												
175.86							176										
1.37	FILL, fine to medium sand Loose Brown		2	SS	10												
175.40																	
1.83	FILL, sandy silt, trace clay, with concrete, wood, bricks and topsoil Compact to Dense Black and Grey						175										
			3	SS	45												
			4	SS	17		174										
173.12			5	SS	6												
4.11	SILTY CLAY, trace sand Very Soft to Stiff Grey						173										
172.20			6	SS	1												
5.03	END OF BOREHOLE																
	Borehole dry during drilling October 9, 2007																

RECORD OF BOREHOLE No 7

1 OF 1

METRIC

PROJECT 07-1130-109-0

G.W.P. 3071-06-00

LOCATION N 4681677.9 ; E 326691.3

ORIGINATED BY DM

DIST 1 HWY

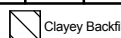
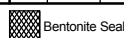
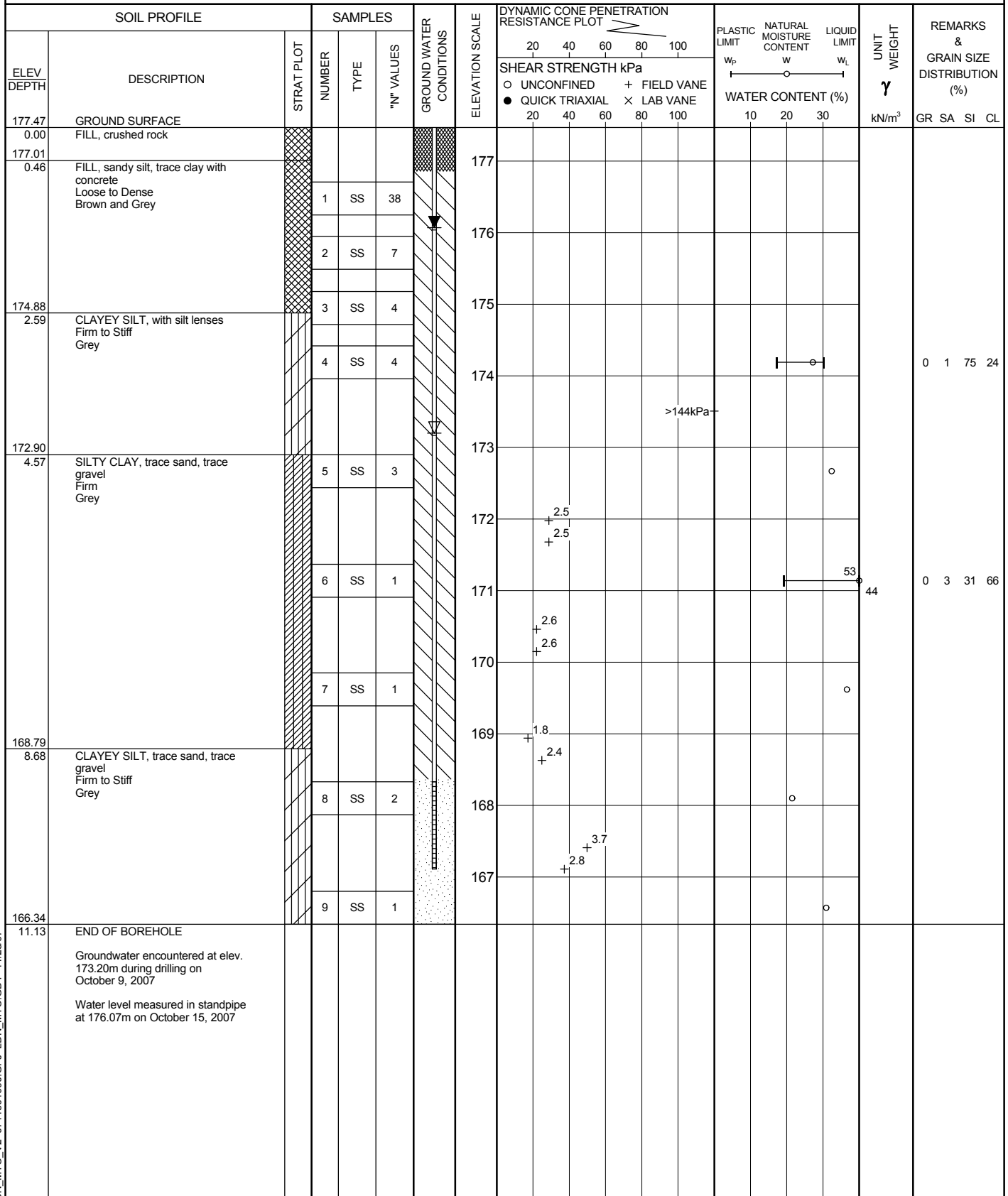
BOREHOLE TYPE Power Auger (Hollow Stem)

COMPILED BY WDF

DATUM GEODETIC

DATE October 9, 2007

CHECKED BY



+ 3, x 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 8

1 OF 2

METRIC

PROJECT 07-1130-109-0
G.W.P. 3071-06-00 LOCATION N 4681673.1 ; E 326622.3 ORIGINATED BY DM
DIST 1 HWY BOREHOLE TYPE Power Auger (Hollow Stem) COMPILED BY WDF
DATUM GEODETIC DATE October 9, 2007 - October 10, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				W _P	W	W _L		GR	SA	SI	CL
176.97	GROUND SURFACE																		
0.00	FILL, sandy silt some gravel Brown		1	AS	-														
176.21	FILL, silty sand, some gravel, trace to some clay, wood, bricks and concrete Loose to Compact Brown and Black		2	SS	9														
0.76			3	SS	10														
			4	SS	14														
			5	SS	8														
173.31	FILL, silty sand, trace gravel Loose Black		6	SS	4														
3.66	CLAYEY SILT, trace sand, trace gravel, with silt seams Very Soft to Soft Grey		7	SS	2														
172.55			8	SS	WH														
4.42																			
170.27	SILTY CLAY, trace sand Soft Grey		9	SS	WH														
6.70																			
167.67	CLAYEY SILT, trace sand, trace gravel, with silt seams Firm to Stiff Grey		10	SS	1														
9.30			11	SS	2														
			12	SS	2														
					13	SS	3												

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No 9

1 OF 3

METRIC

PROJECT 07-1130-109-0
G.W.P. 3071-06-00 LOCATION N 4681658.5 ; E 326615.2 ORIGINATED BY DM
DIST 1 HWY BOREHOLE TYPE Power Auger (Hollow Stem) - Rotary (Nw Casing) COMPILED BY WDF
DATUM GEODETIC DATE October 10, 2007 - October 12, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
176.99 0.00	GROUND SURFACE		1	AS	-									
176.23 0.76	FILL, fine sand, sandy silt, some fine to coarse gravel Brown		2	SS	7		176							
			3	SS	6		175							
			4	SS	36		174							
			5	SS	50/ 50mm		173							
			6	SS	50		172							
172.72 4.27	CLAYEY SILT, trace to some sand, trace gravel, with silt seams Soft to Firm Grey		7	SS	4		171							
			8	SS	WH		170							
169.98 7.01	SILTY CLAY, trace sand Firm Grey		9	SS	WH		169							
			10	SS	1		168							
168.31 8.68	CLAYEY SILT, trace sand, trace gravel Firm to Stiff Grey		11	SS	2		167							
			12	SS	1		166							
			13	SS	1		165							
							164							
							163							

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Grout Filled

+ 3, x 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 9

2 OF 3

METRIC

PROJECT 07-1130-109-0
G.W.P. 3071-06-00 LOCATION N 4681658.5 ; E 326615.2 ORIGINATED BY DM
DIST 1 HWY BOREHOLE TYPE Power Auger (Hollow Stem) - Rotary (Nw Casing) COMPILED BY WDF
DATUM GEODETIC DATE October 10, 2007 - October 12, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)					
							20	40	60	80	100						
			14	SS	2												
			15	SS	5												
			16	SS	4												
			17	SS	3												
			18	SS	4												
			19	SS	5												
153.06																	
23.93	CLAYEY SILT, trace sand, trace gravel (TILL) Stiff Grey		20	SS	9												
152.00																	
24.99	Light brown highly weathered SHALEY LIMESTONE																
			21	SS	65												
			22	NQ RC	-												
150.32			23	NQ RC	-												
26.67	Light brown to grey laminated SHALEY LIMESTONE with bituminous partings and vuggy bands		24	NQ RC	-												
147.12																	

Continued Next Page

Grout Filled

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE


RECORD OF BOREHOLE No 9

3 OF 3

METRIC

PROJECT 07-1130-109-0 LOCATION N 4681658.5 ; E 326615.2 ORIGINATED BY DM
 G.W.P. 3071-06-00 DIST 1 HWY BOREHOLE TYPE Power Auger (Hollow Stem) - Rotary (Nw Casing) COMPILED BY WDF
 DATUM GEODETIC DATE October 10, 2007 - October 12, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED	● QUICK TRIAXIAL	+	×	FIELD VANE					LAB VANE						
29.87	END OF BOREHOLE Artesian groundwater conditions encountered at elev. 150.47m during drilling on October 12, 2007. Estimated elev. head of 178.67m.																						

 Grout Filled

+ ³, × ³: Numbers refer to Sensitivity



○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 10

1 OF 1

METRIC

PROJECT 07-1130-109-0 G.W.P. 3071-06-00 LOCATION N 4681672.7 ; E 326611.4 ORIGINATED BY DM
DIST 1 HWY BOREHOLE TYPE Manual Drilling COMPILED BY WDF
DATUM GEODETIC DATE October 15, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							WATER CONTENT (%)
174.60 0.00	RIVER WATER LEVEL WATER					▽	174								
173.38 1.22	FILL, silty sand with bricks, some gravel Compact Black and Grey END OF BOREHOLE		1	SS	36										
172.92 1.68			2	SS	40/ 150mm										

RECORD OF BOREHOLE No 11

1 OF 1

METRIC

PROJECT 07-1130-109-0
G.W.P. 3071-06-00 LOCATION N 4681647.4 ; E 326634.3 ORIGINATED BY DM
DIST 1 HWY BOREHOLE TYPE Power Auger (Hollow Stem) COMPILED BY WDF
DATUM GEODETIC DATE October 15, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
177.24	GROUND SURFACE														GR SA SI CL
0.00	FILL, crushed sand and gravel, trace silt Brown						177								
0.30															
176.63	FILL, clayey silt, some sand, some gravel Brown		1	SS	15										
0.61	FILL, silty sand and gravel, with clayey silt lumps Compact Brown and Grey		2	SS	17		176								30 41 20 9
175.11															
2.13	FILL, sandy silt, some gravel, with clayey silt layers, concrete Compact Black		3	SS	24		175								
			4	SS	50/75mm		174								24 26 27 23
173.43															
3.81	CLAYEY SILT, trace sand, trace gravel Firm Black and Grey		5	SS	4		173								
172.97	SILTY CLAY, trace sand Soft to Very Soft Grey		6	SS	2										
4.27							172								
171.45			7	SS	1										
5.79	END OF BOREHOLE														
	Borehole dry during drilling on October 15, 2007														

RECORD OF BOREHOLE No 12

1 OF 1

METRIC

PROJECT 07-1130-109-0
G.W.P. 3071-06-00 LOCATION N 4681664.7 ;E 326599.9 ORIGINATED BY DM
DIST 1 HWY BOREHOLE TYPE Manual Drilling COMPILED BY WDF
DATUM GEODETIC DATE October 15, 2007 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							WATER CONTENT (%)					
174.60 0.00	RIVER WATER LEVEL WATER					▽	ELEVATION SCALE	20 40 60 80 100		10 20 30										
172.92								174												
1.68	FILL, sandy silt, trace clay, trace organic material and glass Loose Black		1	SS	6			173												
1.98	CLAYEY SILT, trace sand Soft Grey							172												
171.55 3.05	SANDY SILT, some clay, trace gravel Compact Grey		2	SS	22															
3.35	END OF BOREHOLE																			

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 13

1 OF 1

METRIC

PROJECT 07-1130-109-0 G.W.P. 3071-06-00 LOCATION N 4681668.1 ; E 326604.9 ORIGINATED BY DM
DIST 1 HWY BOREHOLE TYPE Manual Drilling COMPILED BY WDF
DATUM GEODETIC DATE October 15, 2007 CHECKED BY


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
174.60 0.00	RIVER WATER LEVEL WATER							20	40	60	80	100					
							174										
173.08 1.52 172.77	FILL, sandy silt, some clay, trace gravel Very Loose Grey		1	SS	2		173										
1.83	FILL, clayey silt, some sand, trace organic material Very soft Grey and black																
171.70 2.90	FILL, sandy silt, some clay, with bricks Grey		2	SS	2		172										
3.05	END OF BOREHOLE																



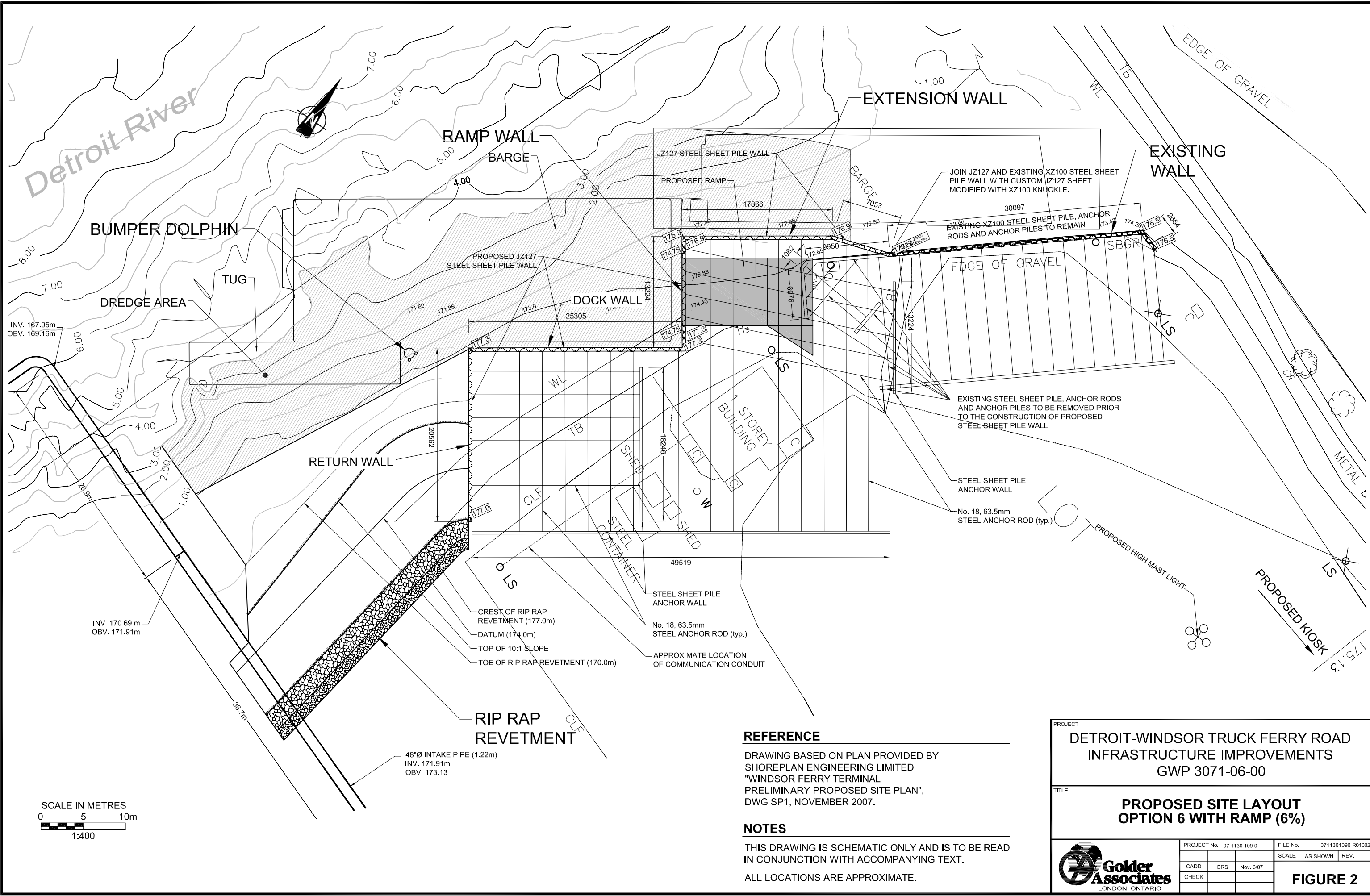
SCALE IN METRES
0 500 1000m

NOTE

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH
ACCOMPANYING TEXT.

PROJECT		DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVMENTS GWP 3071-06-00			
TITLE		SITE LOCATION MAP			
 Golder Associates LONDON, ONTARIO		PROJECT No. 07-1130-109-0		FILE No. 0711301090-R01001	
		CADD BRS Nov, 6/07		SCALE AS SHOWN REV. 0	
		CHECK		FIGURE 1	

Drawing file: 0711301090-R01002.dwg Nov 28, 2007 - 2:51pm




REFERENCE

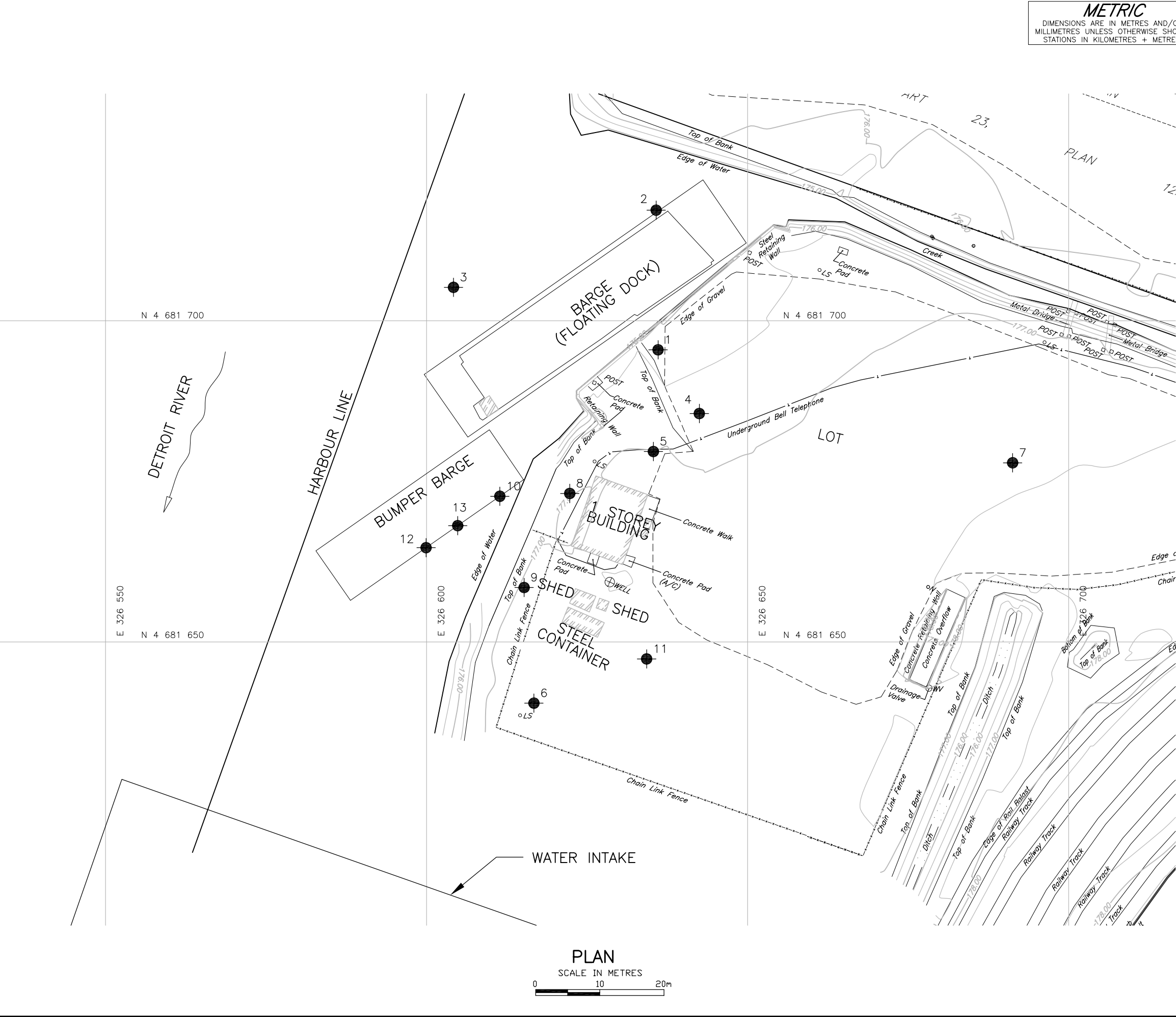
DRAWING BASED ON PLAN PROVIDED BY
SHOREPLAN ENGINEERING LIMITED
"WINDSOR FERRY TERMINAL
PRELIMINARY PROPOSED SITE PLAN",
DWG SP1, NOVEMBER 2007.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ
IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT				DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVEMENTS GWP 3071-06-00			
TITLE				PROPOSED SITE LAYOUT OPTION 6 WITH RAMP (6%)			
 Golder Associates LONDON, ONTARIO		PROJECT No. 07-1130-109-0		FILE No. 0711301090-R01002		SCALE AS SHOWN REV.	
		CADD	BRS	Nov, 6/07			
		CHECK					
FIGURE 2							



METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 3071-06-00

DETROIT-WINDSOR TRUCK FERRY ROAD
INFRASTRUCTURE IMPROVMENTS

BOREHOLE LOCATION



SHEET



Golder Associates Ltd.
LONDON, ONTARIO, CANADA



KEY PLAN

SCALE
1000 0 1000m

LEGEND

● Borehole - Current Investigation

No.	ELEVATION	CO-ORDINATES (UTM NAD83 ZONE17)	
		NORTHING	EASTING
1	176.43	4 681 695.5	326 636.1
2	174.78	4 681 717.2	326 635.8
3	174.76	4 681 705.2	326 604.2
4	176.63	4 681 681.4	326 647.5
5	176.98	4 681 674.5	326 639.4
6	177.23	4 681 640.5	326 616.7
7	177.47	4 681 677.9	326 691.3
8	176.97	4 681 673.1	326 622.3
9	176.99	4 681 658.5	326 615.2
10	174.60	4 681 672.7	326 611.4
11	177.24	4 681 647.4	326 634.3
12	174.60	4 681 664.7	326 599.9
13	174.60	4 681 668.1	326 604.9

NOTES

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

The boundaries between soil strata have been established only at borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

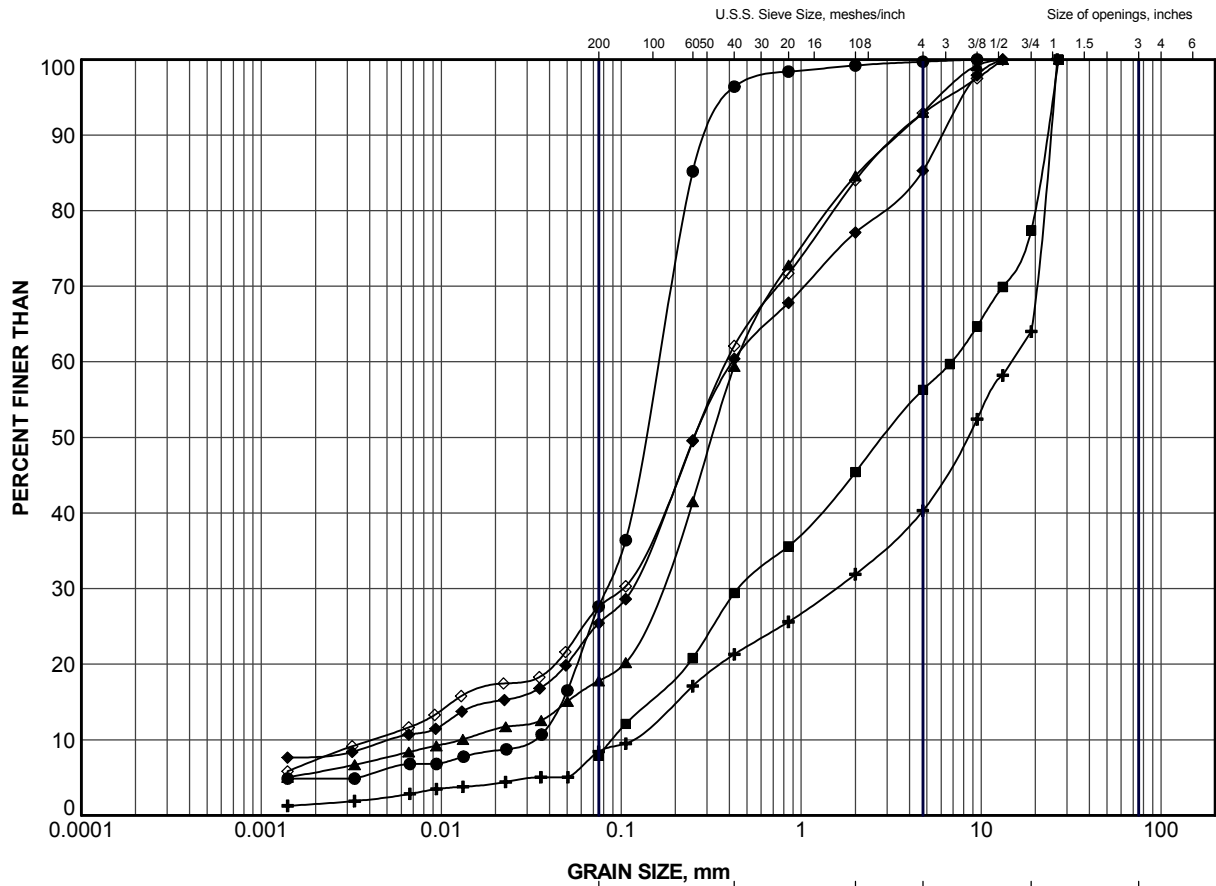
REFERENCE

Base plans provided in digital format by Stantec consulting limited.

NO.	DATE	BY	REVISION
Geocres No.	40J6-19		
HWY.	N/A	PROJECT NO.	07-1130-109-0
SUBM'D.	PRB	CHKD.	DATE: OCT 22/07
DRAWN:	WDF/BRS	CHKD.	APPD.
DWG.	1		

APPENDIX A

LABORATORY TEST DATA
(FIGURES A1 TO A17)



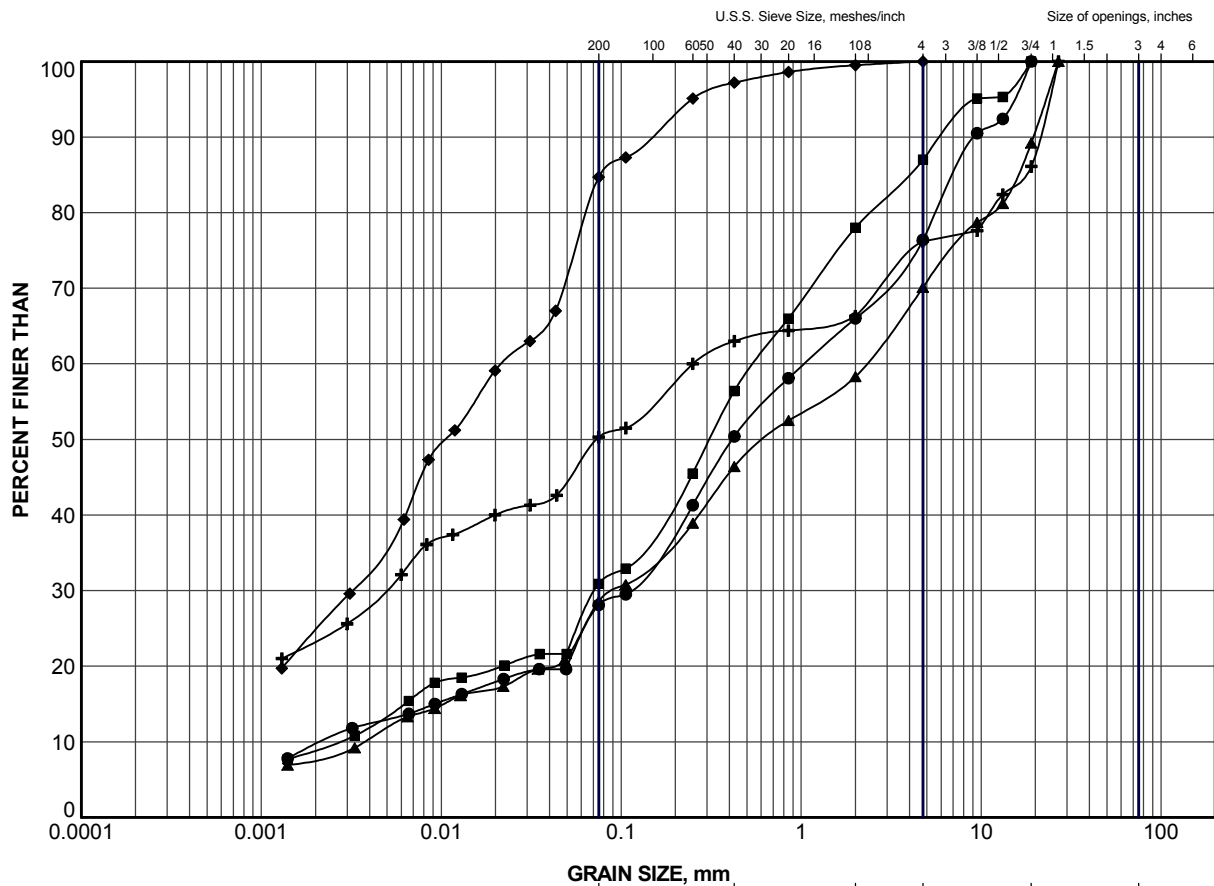
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	1	1	175.4
■	1	4	173.2
▲	4	2	175.0
+	4	4	173.4
◆	5	2	175.4
◇	5	5	172.9

PROJECT				DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVEMENTS GWP 3071-06-00			
TITLE				GRAIN SIZE DISTRIBUTION FILL			
PROJECT No.		07-1130-109-0		FILE No.		0711301090.GPJ	
DRAWN		BRS		Nov 06/07		SCALE N/A REV.	
CHECK						FIGURE A-1	




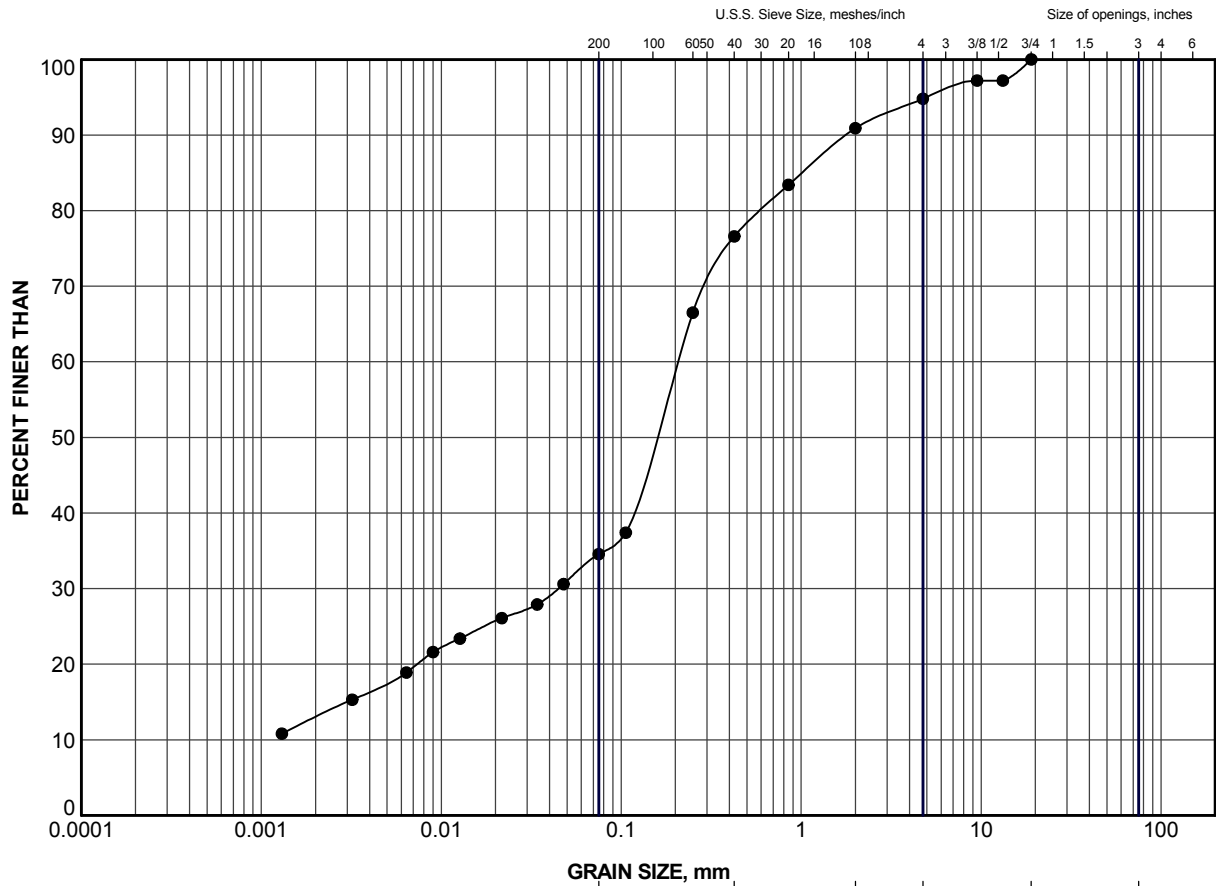


CLAY AND SILT	SAND SIZE, mm			GRAVEL SIZE, mm		Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND


SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	8	3	175.2
■	8	4	174.5
▲	11	2	175.5
+	11	4	174.0
◆	13	2A	172.1

PROJECT		DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVEMENTS GWP 3071-06-00			
TITLE		GRAIN SIZE DISTRIBUTION FILL			
 Golder Associates LONDON, ONTARIO		PROJECT No.		07-1130-109-0	
		FILE No.		0711301090.GPJ	
		SCALE		N/A	
DRAWN		BRS		Nov 06/07	
CHECK					
		FIGURE A-2			

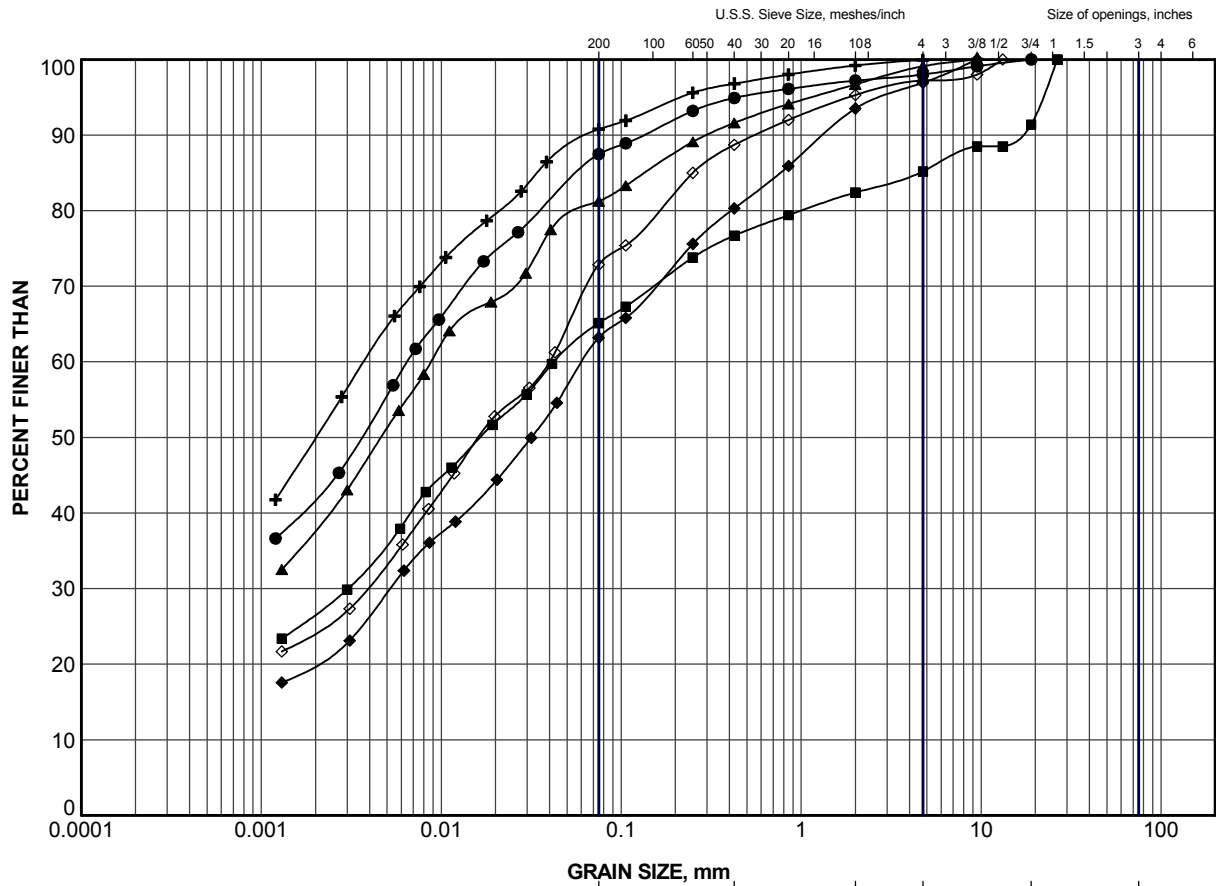


CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	3	2	169.4

PROJECT					DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVEMENTS GWP 3071-06-00						
TITLE					GRAIN SIZE DISTRIBUTION SILTY SAND						
 Golder Associates LONDON, ONTARIO		PROJECT No.		07-1130-109-0		FILE No.		0711301090.GPJ			
		DRAWN		BRS		Nov 06/07		SCALE		N/A	
		CHECK						REV.			
FIGURE A-3											

LDN_MTO_NEW_GLDR_LDN.GDT



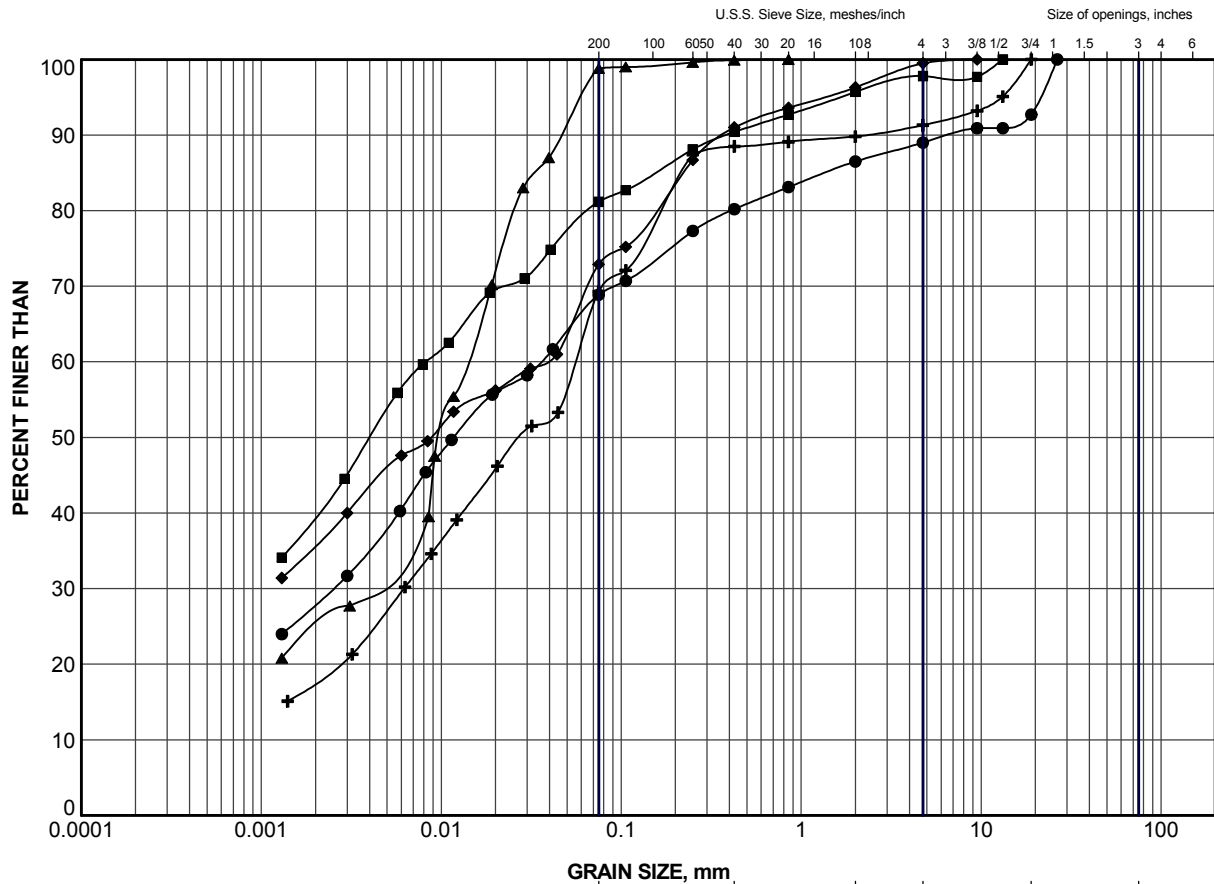
CLAY AND SILT	SAND SIZE, mm			GRAVEL SIZE, mm		Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	1	8	168.6
■	1	10	165.5
▲	1	14	159.4
+	2	6	165.6
◆	2	10	159.5
◇	3	4	166.0

PROJECT				DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVEMENTS GWP 3071-06-00			
TITLE				GRAIN SIZE DISTRIBUTION CLAYEY SILT			
PROJECT No.		07-1130-109-0		FILE No.		0711301090.GPJ	
DRAWN		BRS		Nov 06/07		SCALE N/A REV.	
CHECK						FIGURE A-4	





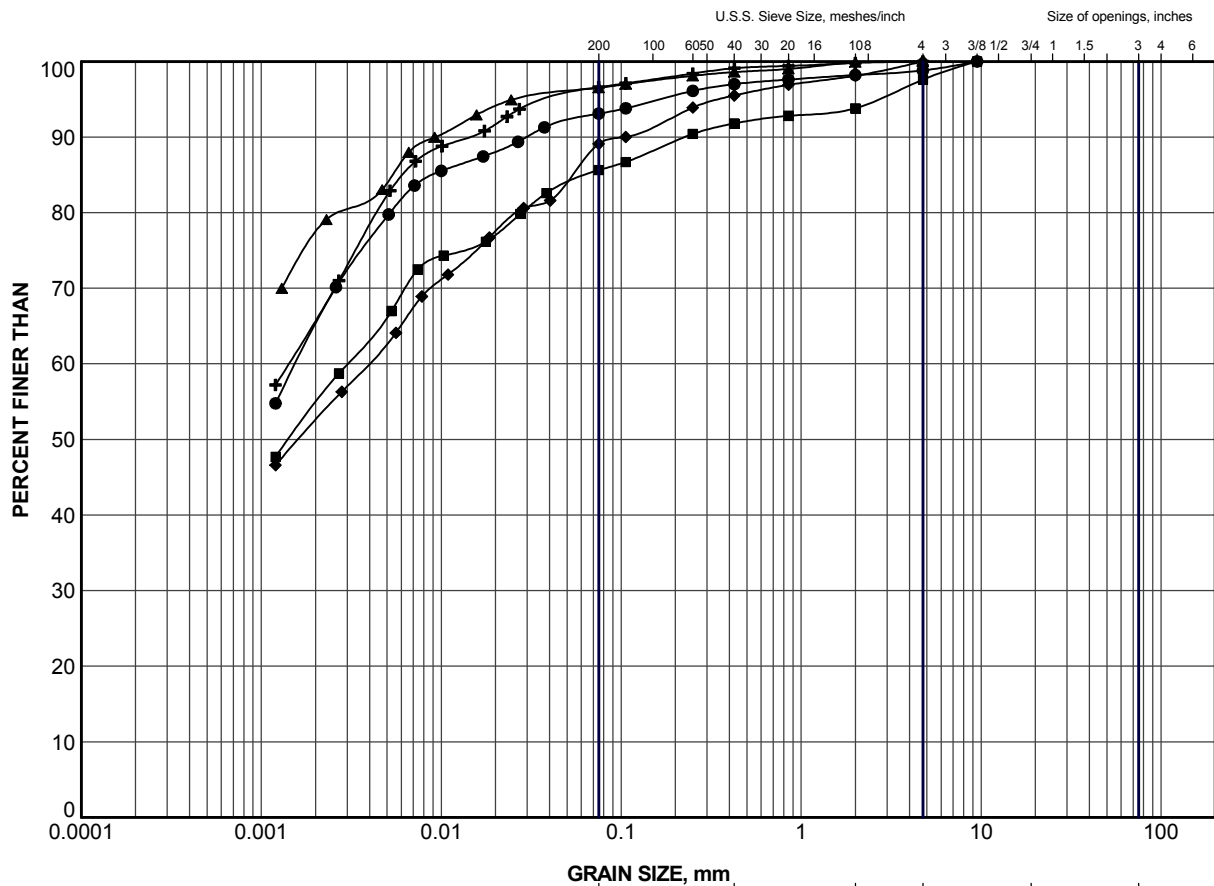
CLAY AND SILT	SAND SIZE, mm			GRAVEL SIZE, mm		Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	3	7	161.4
■	3	10	156.9
▲	7	4	174.2
+	8	7	172.2
◆	9	8	170.7

PROJECT				DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVEMENTS GWP 3071-06-00			
TITLE				GRAIN SIZE DISTRIBUTION CLAYEY SILT			
PROJECT No.		07-1130-109-0		FILE No.		0711301090.GPJ	
DRAWN		BRS		Nov 06/07		SCALE N/A REV.	
CHECK						FIGURE A-5	





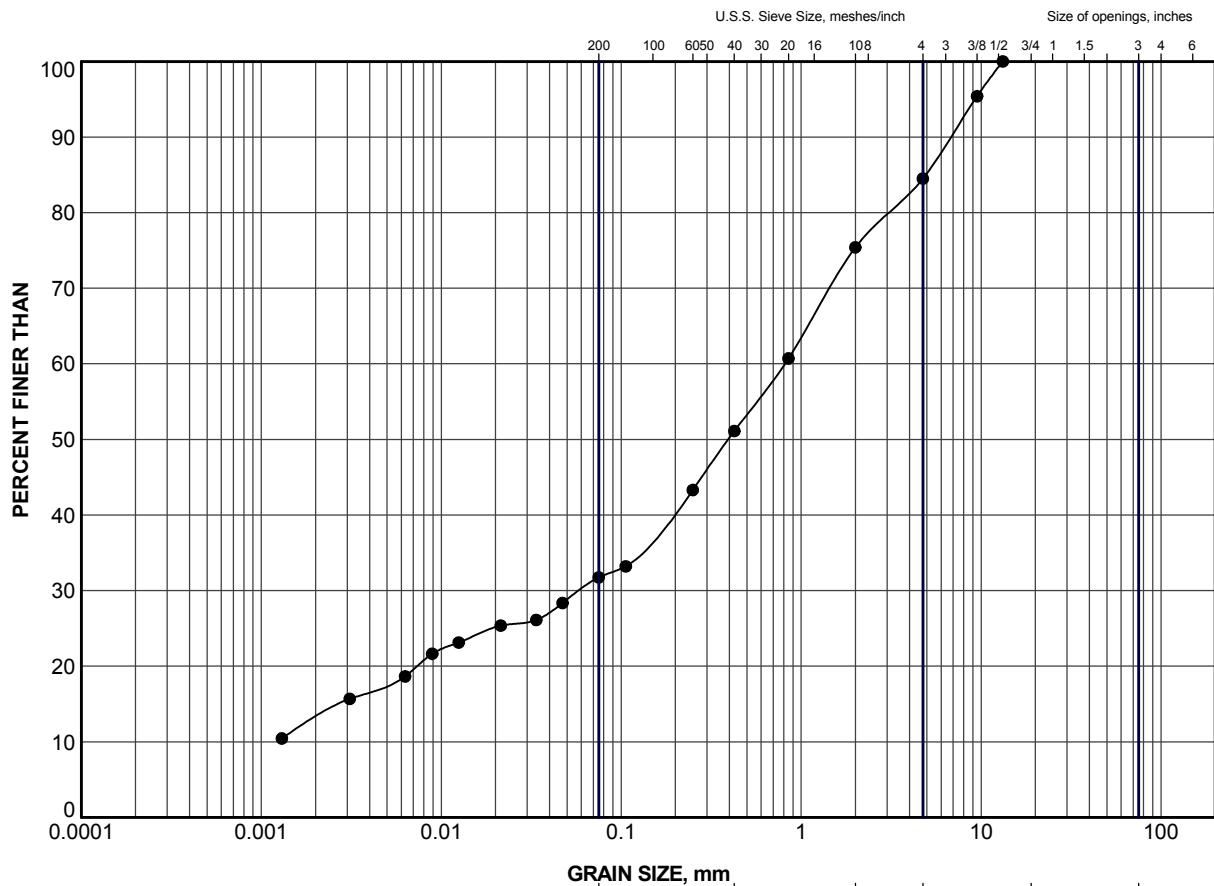
CLAY AND SILT	SAND SIZE, mm			GRAVEL SIZE, mm		Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	1	6	171.6
■	2	3	170.1
▲	2	5	167.1
+	7	6	171.1
◆	8	9	169.1

PROJECT				DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVEMENTS GWP 3071-06-00			
TITLE				GRAIN SIZE DISTRIBUTION SILTY CLAY			
PROJECT No.		07-1130-109-0		FILE No.		0711301090.GPJ	
DRAWN		BRS		Nov 12/07		SCALE N/A REV.	
CHECK						FIGURE A-6	



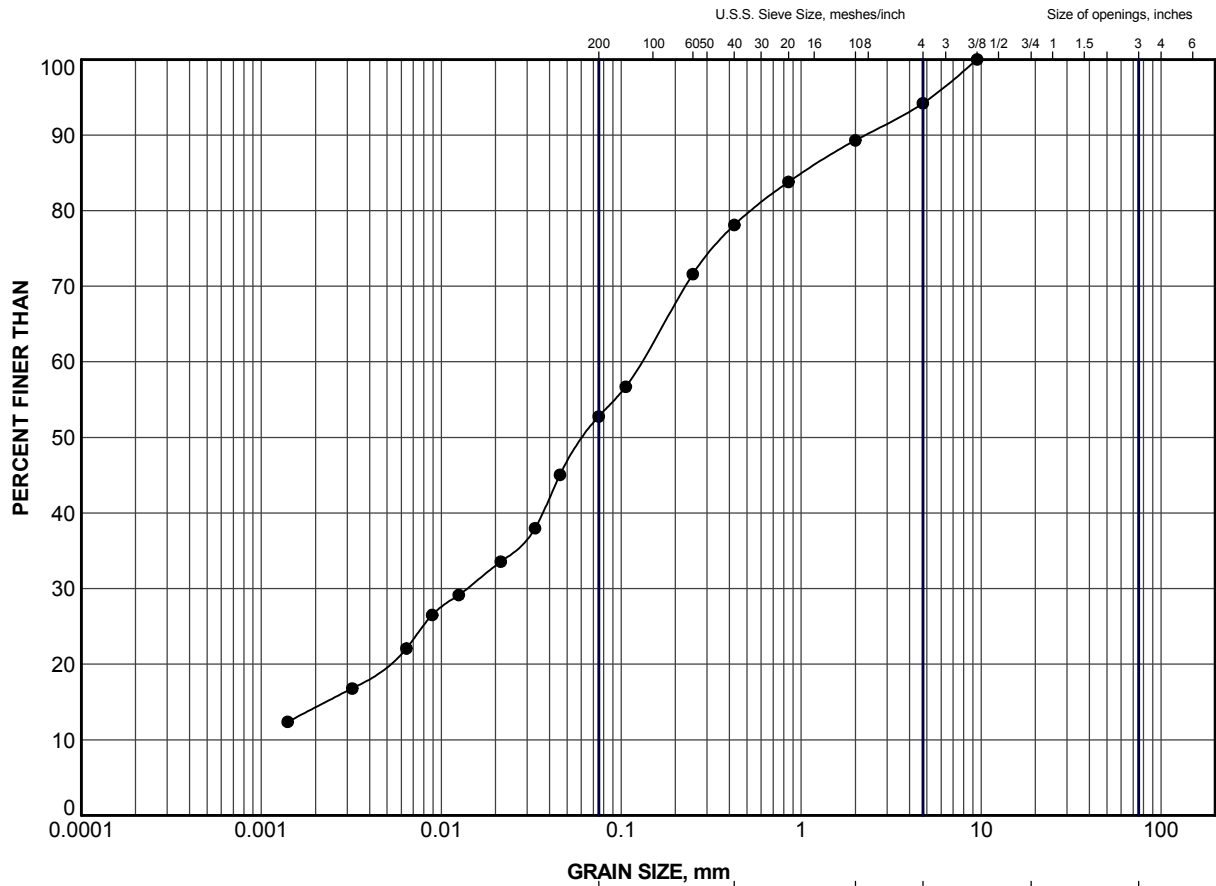


CLAY AND SILT	SAND SIZE, mm			GRAVEL SIZE, mm		Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND


SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	3	12	152.3

PROJECT	DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVEMENTS GWP 3071-06-00					
TITLE	GRAIN SIZE DISTRIBUTION SAND					
 Golder Associates LONDON, ONTARIO	PROJECT No.	07-1130-109-0	FILE No.	0711301090.GPJ		
	DRAWN	BRS	Nov 06/07	SCALE	N/A	REV.
	CHECK					
FIGURE A-7						

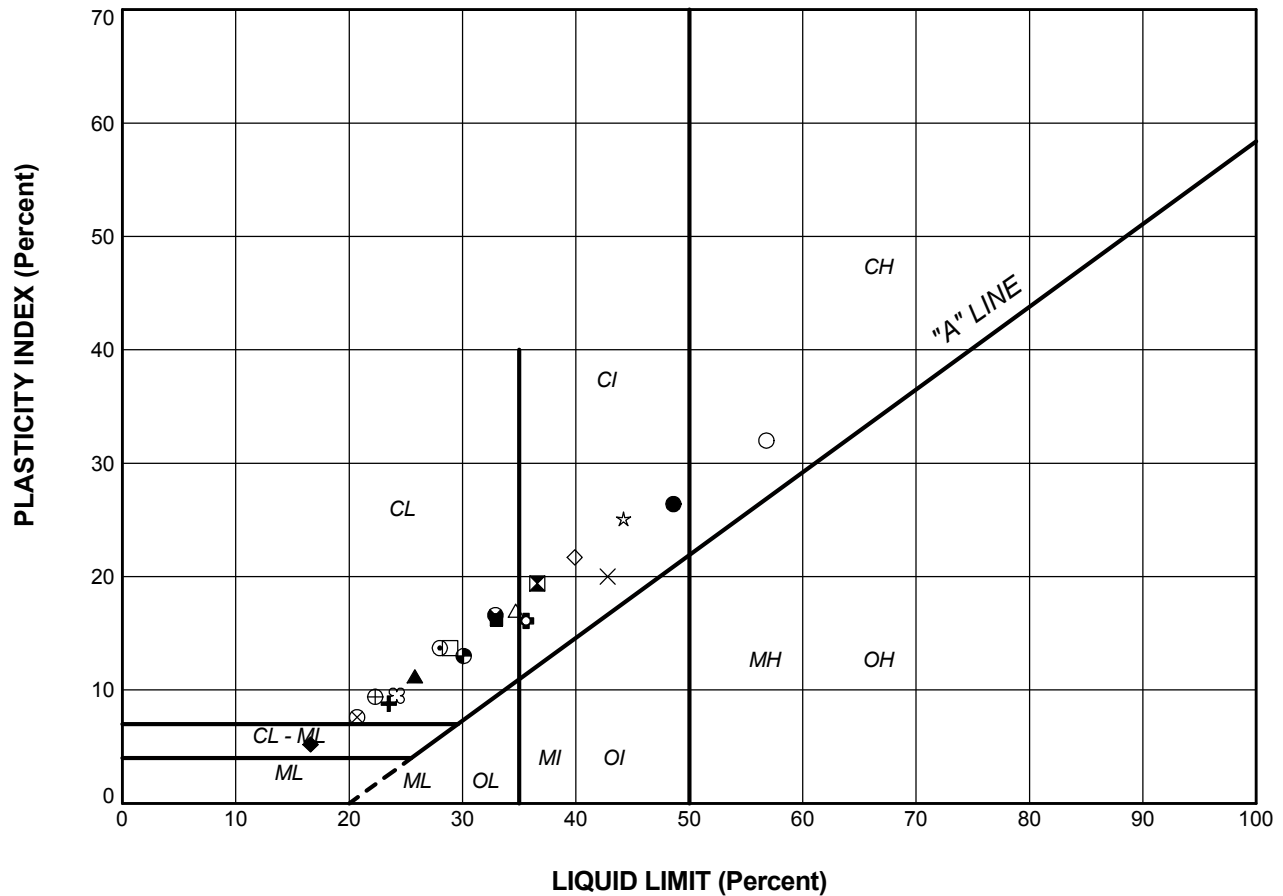


CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	1	18	153.3


PROJECT					DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVEMENTS GWP 3071-06-00						
TITLE					GRAIN SIZE DISTRIBUTION SANDY SILT (TILL)						
		PROJECT No.		07-1130-109-0		FILE No.		0711301090.GPJ			
		DRAWN		BRS		Nov 06/07		SCALE		N/A	
		CHECK						REV.			
					FIGURE A-8						

LDN_MTO_NEW_GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
<u>SILTY CLAY</u>					
●	1	6	48.6	22.2	26.4
◇	2	3	39.9	18.2	21.7
○	2	5	56.8	24.8	32.0
☆	7	6	44.2	19.1	25.1
⊠	8	9	36.6	17.2	19.4
<u>CLAYEY SILT</u>					
■	1	8	33.0	16.8	16.2
▲	1	10	25.8	14.6	11.2
+	1	14	23.5	14.7	8.8
△	2	6	34.7	17.7	17.0
⊗	2	10	20.7	13.1	7.6
⊕	3	4	22.3	12.9	9.4
□	3	7	28.9	15.2	13.7
⊙	3	10	32.9	16.3	16.6
⊛	7	4	30.1	17.1	13.0
⊞	8	7	24.2	14.7	9.5
⊟	8	8	28.0	14.3	13.7
<u>SANDY SILT TILL</u>					
◆	1	18	16.6	11.4	5.2
<u>FILL</u>					
⊕	11	4	35.6	19.5	16.1
×	13	2A	42.8	22.8	20.0

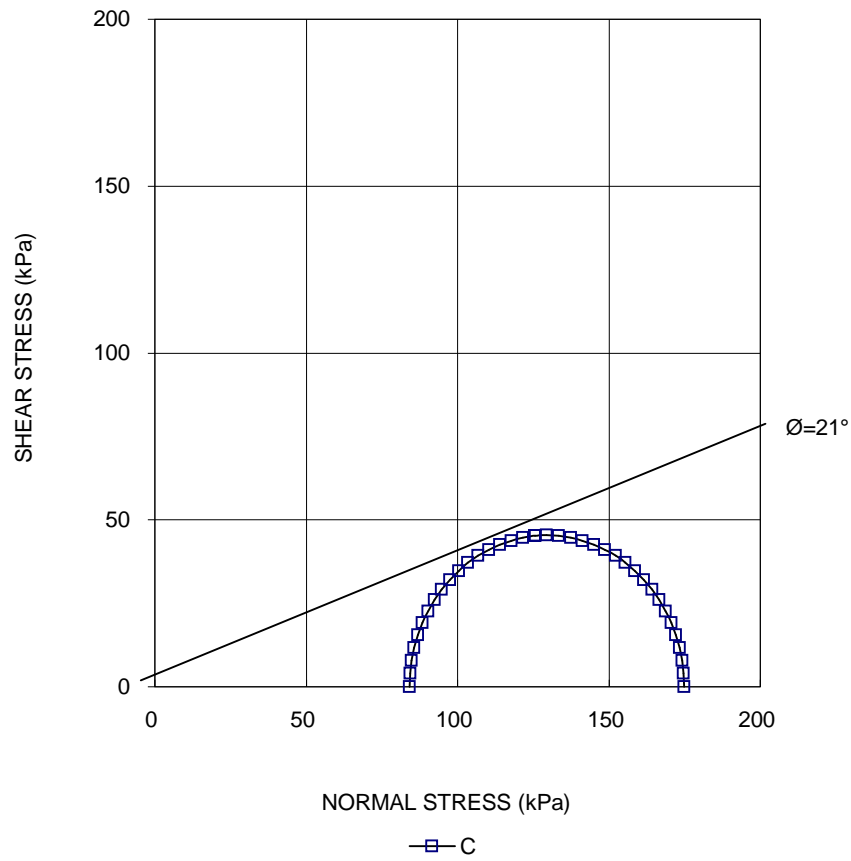
PROJECT				DETROIT-WINDSOR TRUCK FERRY ROAD INFRASTRUCTURE IMPROVEMENTS GWP 3071-06-00			
TITLE				PLASTICITY CHART			
PROJECT No.		07-1130-109-0		FILE No.		0711301090.GPJ	
DRAWN	BRS	Nov 06/07		SCALE	N/A		
CHECK				FIGURE A-9			
 Golder Associates LONDON, ONTARIO							

CONSOLIDATED UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENTS SHEET 1 OF 4		FIGURE A-10
TEST STAGE	C	
BOREHOLE NUMBER	2	
SAMPLE	5	
SPECIMEN DIAMETER, cm	0.00	
SPECIMEN HEIGHT, cm	0.00	
WATER CONTENT BEFORE CONSOLIDATION, %	64.2	
CELL PRESSURE, σ_3 , kPa	0.0	
BACK PRESSURE, kPa	0.0	
PORE PRESSURE PARAMETER "B"	0.97	
CONSOLIDATION PRESSURE, σ_c , kPa	0.0	
VOLUMETRIC STRAIN DURING CONSOLIDATION, %	0.0	
WATER CONTENT AFTER CONSOLIDATION, %	51.4	
AVERAGE RATE OF STRAIN, %/hr	0.5	
TIME TO FAILURE, DAYS	1	
WATER CONTENT AFTER TEST, %	53.9	
MAX. DEVIATOR STRESS, $(\sigma_1 - \sigma_3)$, kPa	17.4	
AXIAL STRAIN AT $(\sigma_1 - \sigma_3)$ MAXIMUM, %	4.5	
MAX EFFECTIVE PRINCIPAL STRESS		
RATIO, (σ_1 / σ_3) MAXIMUM	75.5	
DEVIATOR STRESS AT (σ_1 / σ_3) MAXIMUM, kPa	15.7	
AXIAL STRAIN AT (σ_1 / σ_3) MAXIMUM, %	11.6	
PORE PRESSURE PARAMETER, Af, AT $(\sigma_1 - \sigma_3)$ MAXIMUM	1.28	
PORE PRESSURE PARAMETER, Af, AT (σ_1 / σ_3) MAXIMUM	1.94	
NATURAL WATER CONTENT, %	59.3	
DRY DENSITY, Mg/m ³	1.03	
FILTER DRAINS USED, y/n	y	
TEST NOTES:		
CHANGED RATE OF STRAIN, %/hr	-	
AXIAL STRAIN WHERE RATE OF STRAIN WAS CHANGED, %	-	
FAILURE PLANE NUMBER	1.0	
ANGLE OF FAILURE, DEGREES	50.0	
<div> <div> Date: 08/16/2007 Project No. 07-1130-1090 </div> <div> Golder Associates </div> <div> Prepared By: MM Checked By: RO </div> </div>		

CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
SHEET 2 OF 4

FIGURE A-11

BH 2 SA 5
Silty Clay



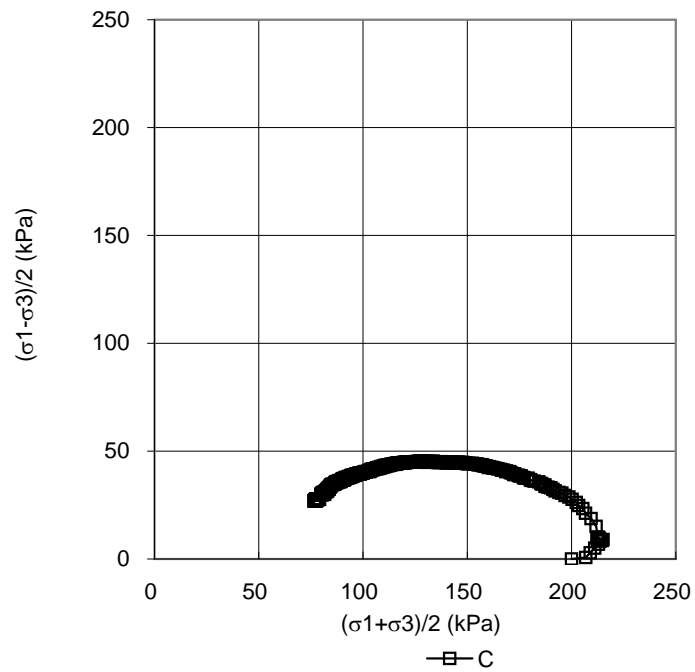
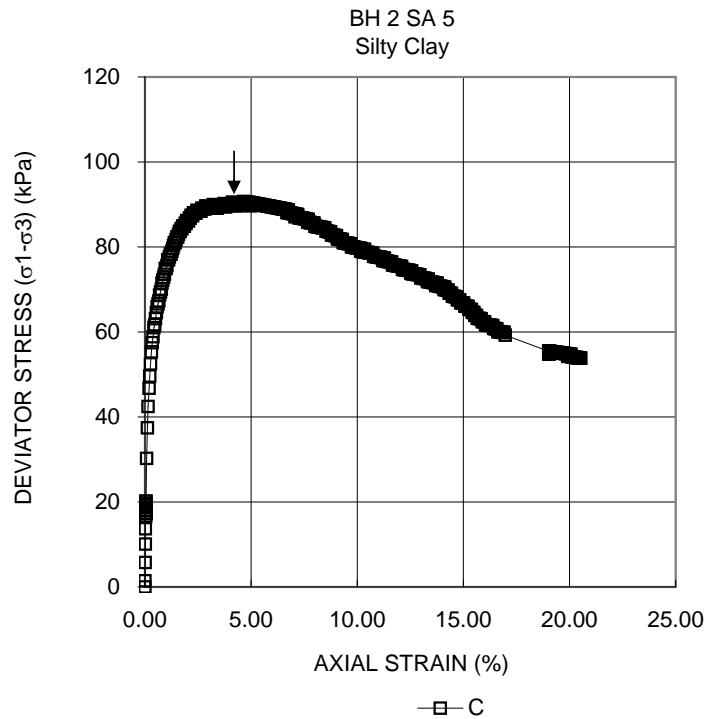
Date: 08/16/2007
Project No. 07-1130-1090

Golder Associates

Prepared By: MM
Checked By: RO

CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
SHEET 3 OF 4

FIGURE A-12



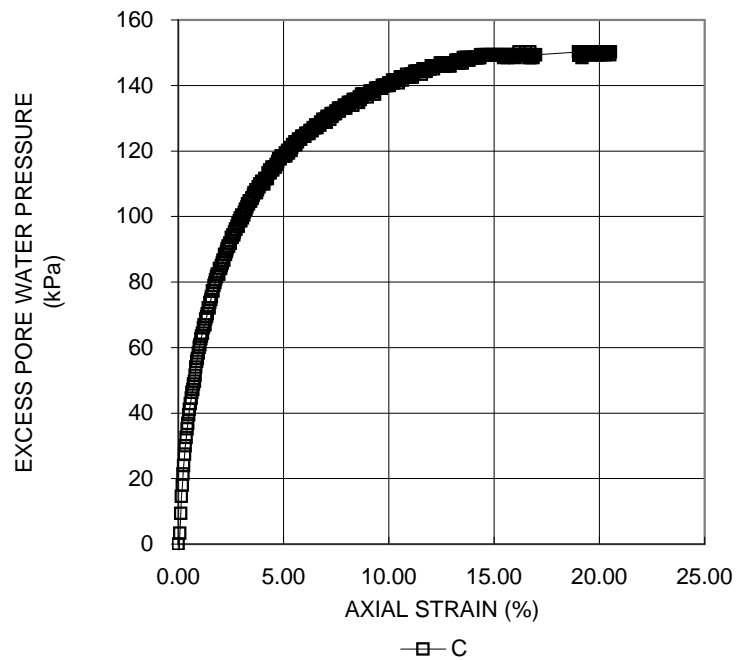
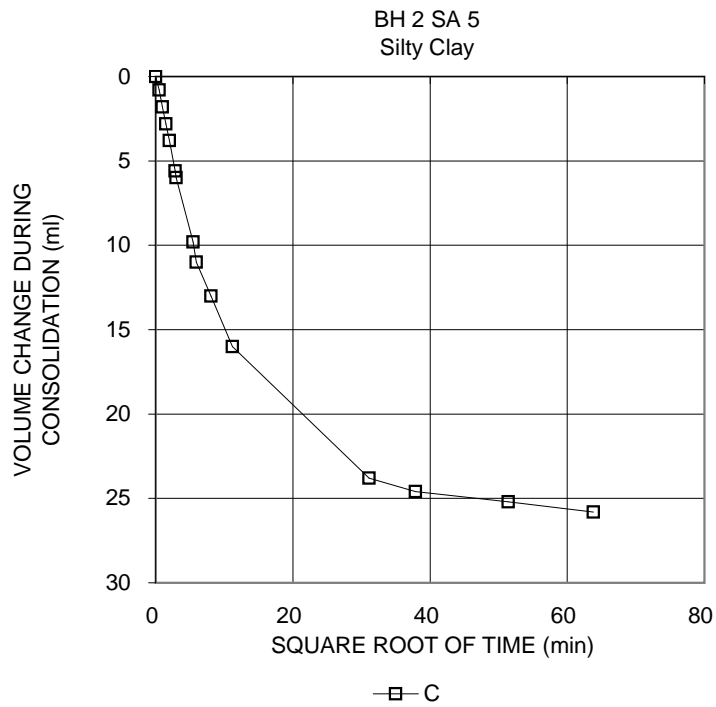
Date: 08/16/2007
Project No. 07-1130-1090

Golder Associates

Prepared By: MM
Checked By: RO

**CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
SHEET 4 OF 4**

FIGURE A-13



Date: 08/16/2007
Project No. 07-1130-1090

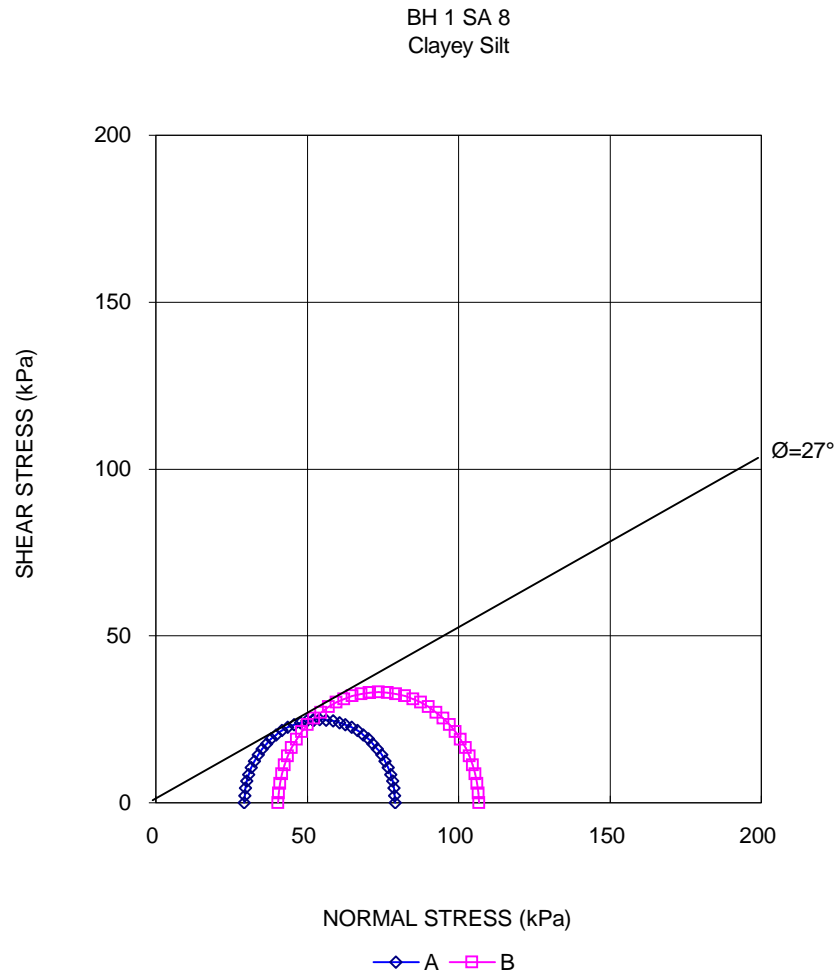
Golder Associates

Prepared By: MM
Checked By: RO

CONSOLIDATED UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENTS		FIGURE A-14	
SHEET 1 OF 4			
TEST STAGE	A	B	
BOREHOLE NUMBER	1	1	
SAMPLE	8	8	
SPECIMEN DIAMETER, cm	5.18	4.97	
SPECIMEN HEIGHT, cm	9.65	9.81	
WATER CONTENT BEFORE CONSOLIDATION, %	32.2	42.0	
CELL PRESSURE, σ_3 , kPa	605.0	515.0	
BACK PRESSURE, kPa	555.0	415.0	
PORE PRESSURE PARAMETER "B"	0.96	0.96	
CONSOLIDATION PRESSURE, σ_c , kPa	50.0	100.0	
VOLUMETRIC STRAIN DURING CONSOLIDATION, %	4.7	6.8	
WATER CONTENT AFTER CONSOLIDATION, %	29.0	36.7	
AVERAGE RATE OF STRAIN, %/hr	0.5	0.5	
TIME TO FAILURE, DAYS	1	1	
WATER CONTENT AFTER TEST, %	25.5	37.0	
MAX. DEVIATOR STRESS, $(\sigma_1 - \sigma_3)$, kPa	58.6	66.2	
AXIAL STRAIN AT $(\sigma_1 - \sigma_3)$ MAXIMUM, %	19.9	4.2	
MAX EFFECTIVE PRINCIPAL STRESS			
RATIO, (σ_1 / σ_3) MAXIMUM	2.7	2.8	
DEVIATOR STRESS AT (σ_1 / σ_3) MAXIMUM, kPa	49.8	62.7	
AXIAL STRAIN AT (σ_1 / σ_3) MAXIMUM, %	9.0	7.5	
PORE PRESSURE PARAMETER, A_f , AT $(\sigma_1 - \sigma_3)$ MAXIMUM	0.21	0.90	
PORE PRESSURE PARAMETER, A_f , AT (σ_1 / σ_3) MAXIMUM	0.42	1.04	
NATURAL WATER CONTENT, %	32.0	39.6	
DRY DENSITY, Mg/m^3	1.47	1.30	
FILTER DRAINS USED, y/n	y	y	
TEST NOTES:			
CHANGED RATE OF STRAIN, %/hr	-	-	
AXIAL STRAIN WHERE RATE OF STRAIN WAS CHANGED, %	-	-	
FAILURE PLANE NUMBER	bulged	1.0	
ANGLE OF FAILURE, DEGREES	-	55.0	
<div> <div>Date: 08/16/2007</div> <div>Project No. 07-1130-1090</div> </div> <div> <div>Golder Associates</div> </div> <div> <div>Prepared By: MM</div> <div>Checked By: RO</div> </div>			

CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
SHEET 2 OF 4

FIGURE A-15



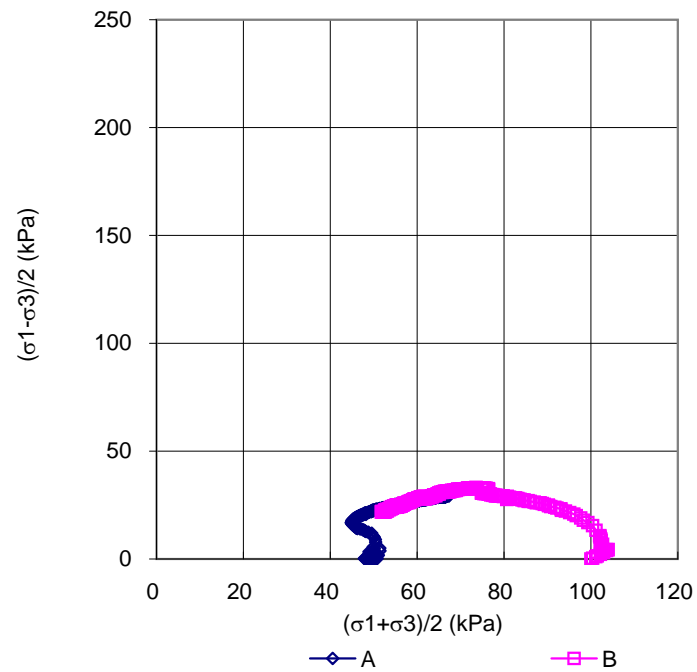
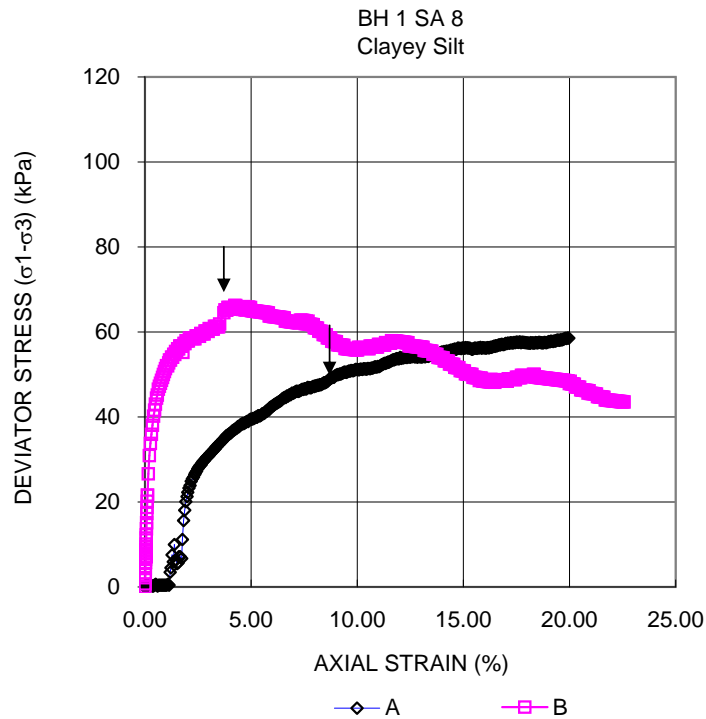
Date: 08/16/2007
Project No. 07-1130-1090

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Prepared By: MM
Checked By: RO

CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
SHEET 3 OF 4

FIGURE A-16



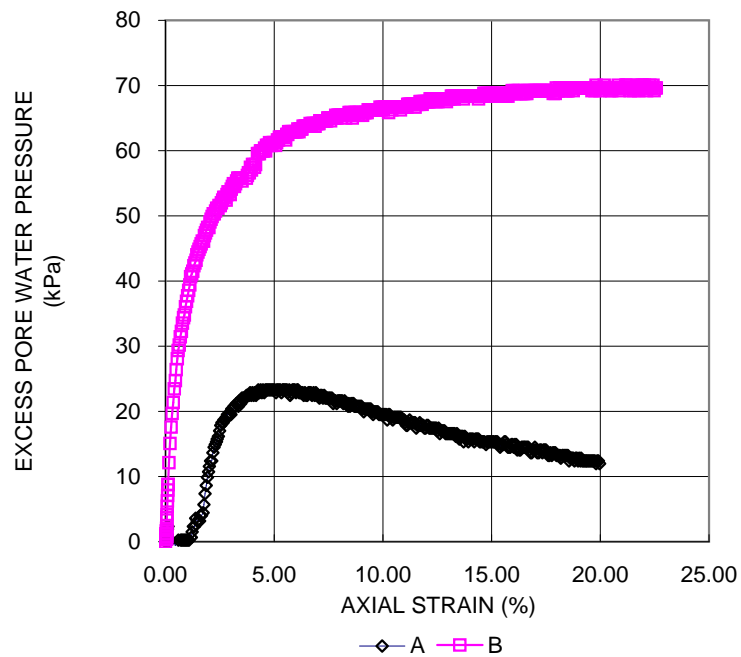
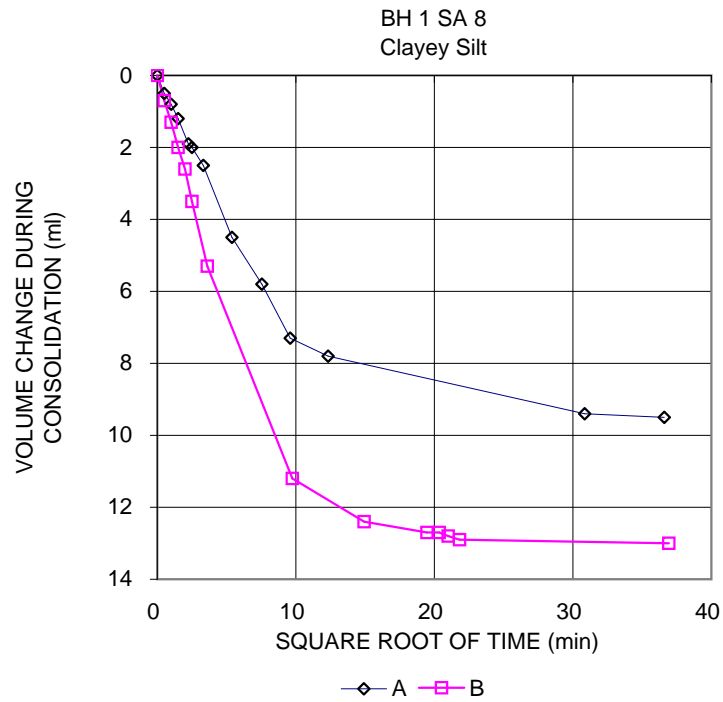
Date: 08/16/2007
Project No. 07-1130-1090

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**CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
SHEET 4 OF 4**

FIGURE A-17



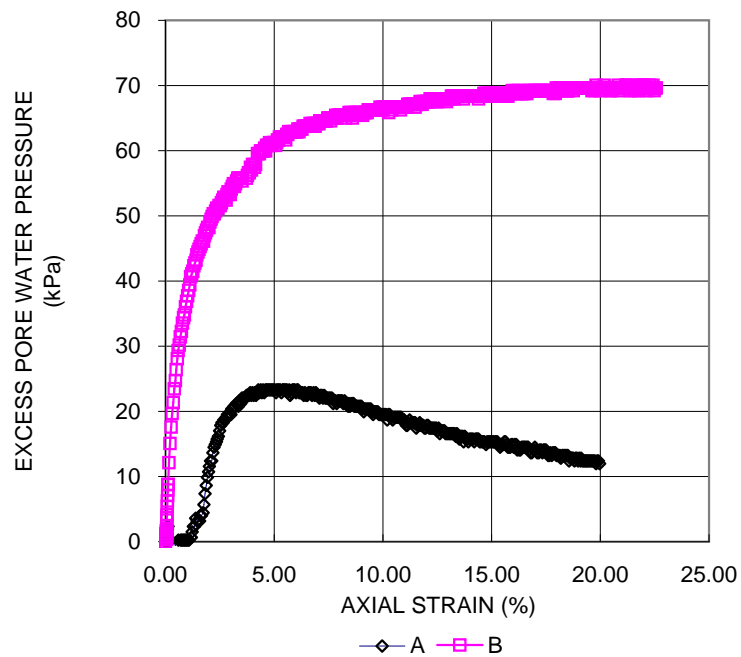
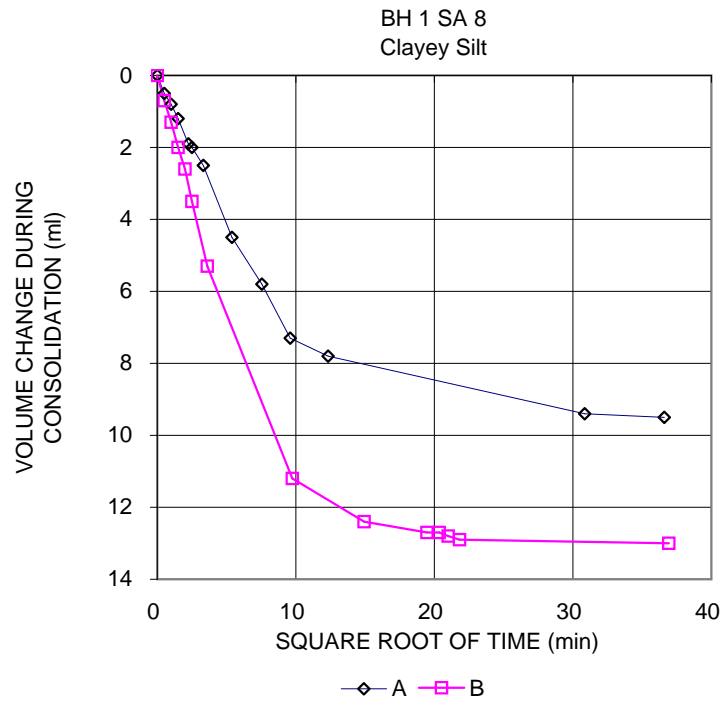
Date: 08/16/2007
Project No. 07-1130-1090

Golder Associates

Prepared By: MM
Checked By: RO

**CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
SHEET 4 OF 4**

FIGURE A-17



Date: 08/16/2007
Project No. 07-1130-1090

Golder Associates

Prepared By: MM
Checked By: RO

APPENDIX B
SITE PHOTOGRAPHS

November 2007

07-1130-109-0

SITE PHOTOGRAPHS



Photo 1: Ferry getting ready to unload using existing ramp.



Photo 2: View of northwest corner of dock during drilling of borehole 3.

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SITE PHOTOGRAPHS



Photo 3: Existing retaining wall and shoreline northwest of custom building.



Photo 4: Existing shoreline near borehole 9.