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July 22, 2008

Ministry of Transportation
Northeastern Region
3rd Floor, 447 McKeown Avenue
Suite 301
North Bay, Ontario
P1B 9S9

Attention: Mr. Andrew Alkins, P. Eng.

Dear Sirs:

Re: Assignment No. 5007E-0052
Addendum to Foundation Investigation and Design Report 31E-278
Parry Sound Patrol Yard
File 03080770.04

Further to our Foundation Investigation and Design Report 31E-278 for the Parry Sound Patrol Yard, dated July 14, 2008, we are pleased to provide the following clarifications with respect to Sections 10.0 and 12.1 of the report.

REPORT SECTION 10.0

We recommend that footings be insulated with high density Styrofoam board with the following minimum specifications:

- compressive strength of 215 kPa
- thermal resistance of 0.87 m²°C/W
- water absorption less than 0.7 % by volume





We recommend that the Sytrofoam insulation board be at least 75 mm thick. For a footing depth of 0.6 m below final grade, the insulation should be placed at a depth of 0.45 m and extend horizontally at least 1.5 m from both faces of the footing or grade beam. The insulation board should also be placed on both vertical sides of the footing or grade beam, extending from the ground surface to a depth of at least 0.6 m below final grades. The horizontal insulation board should abut the vertical board to form a tightly sealed joint.

REPORT SECTION 12.1

Provided the clay layer is preloaded, as discussed in Section 6.3, the subsoil below the structure is competent to support the stockpile and foundation loadings, and total foundation settlement under the combined loadings is expected to be less than 25 mm. We recommend that the subgrade soil below the interior floor of the structure be compacted with a minimum of eight (8) passes of a heavy (at least 25 tonne), vibratory roller prior to building construction, to consolidate any looser material. Compaction should generally be in accordance with OPSS 206, 501 and 514, as stated in the report.

Please note that this addendum should be submitted and read in conjunction with the original Foundation Investigation and Design Report 31E-278. Please contact us if you have any questions about this information.

Yours truly,
JAGGER HIMS LIMITED

A handwritten signature in blue ink, appearing to read 'J. Stephen Ash'.

J. Stephen Ash, P. Eng.
Branch Manager

A handwritten signature in blue ink, appearing to read 'Stuart E. Baird'.

Stuart E. Baird, P. Eng.
Project Engineer

**MTO AGREEMENT NO. 5007-E-0052
FOUNDATION INVESTIGATION
AND DESIGN REPORT 31E-278
PROPOSED DOME STRUCTURE
PARRY SOUND PATROL YARD
2 QUEBEC STREET,
PARRY SOUND, ONTARIO**

*Prepared for
MTO Northeastern Region*

July 2008

File 03080770.04

Distribution:

4 c Client

1 c File

294 Rink Street, Suite 103
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April 23, 2018

Ministry of Transportation
Northeastern Region
3rd Floor, 447 McKeown Avenue
Suite 301
North Bay, Ontario
P1B 9S9

Attention: Mr. Andrew Alkins, P. Eng.

Dear Sirs:

Re: Assignment No. 5007E-0052
Foundation Investigation and Design Report 31E-278
Proposed Sand/Salt Dome, Parry Sound Patrol Yard
File 03080770.04

We are pleased to submit our Foundation Investigation and Design Report for the proposed construction of a new storage dome at the MTO Parry Sound patrol yard. The report is based on a borehole investigation and laboratory testing program, and addresses the Terms of Reference requirements for the assignment.

The report is relatively straightforward, but if you have any questions please contact us.

Yours truly,
JAGGER HIMS LIMITED



J. Stephen Ash, B.Sc., P.Eng.
Project Engineer – Branch Manager





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1.0 INTRODUCTION

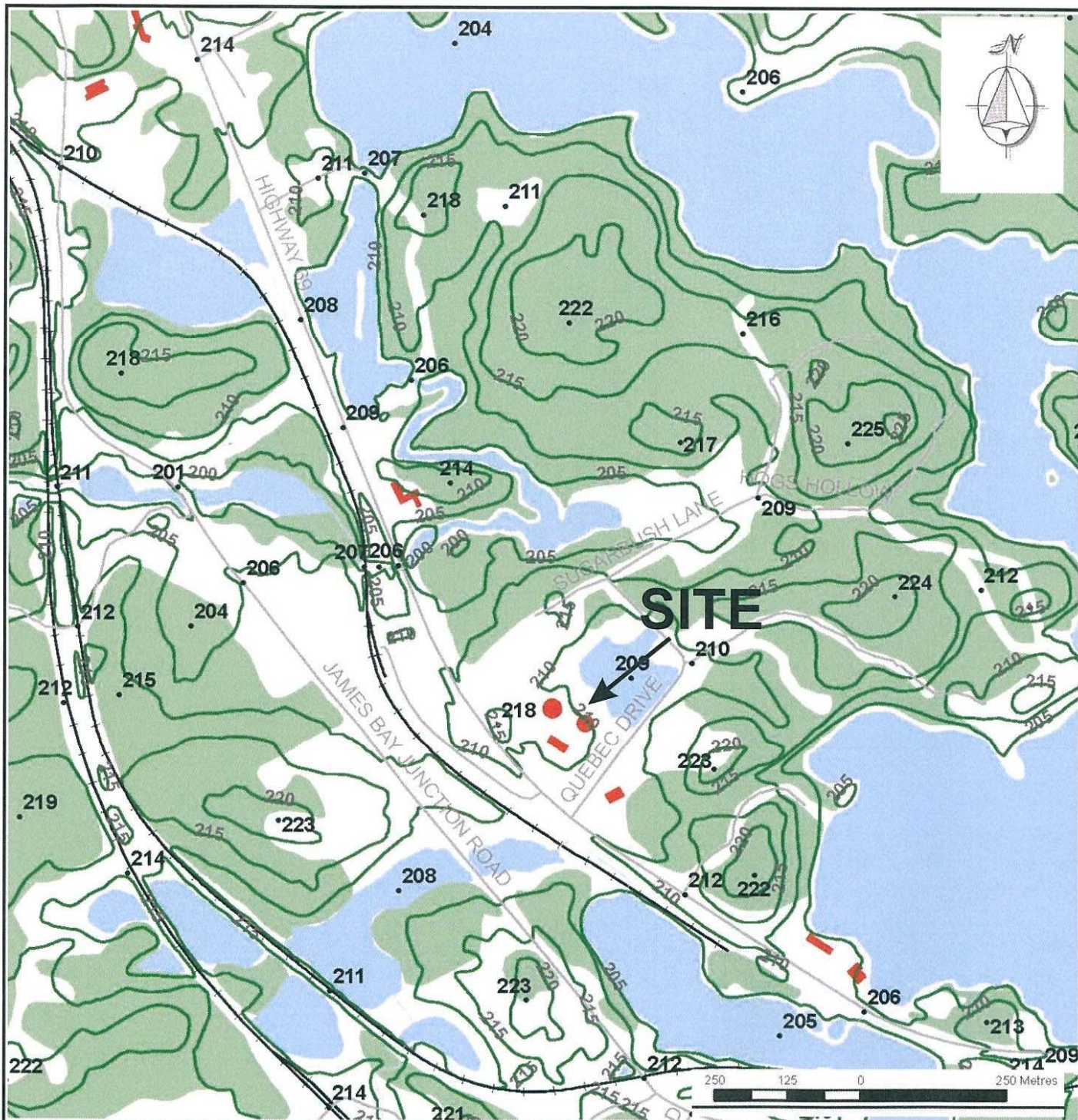
Jagger Hims Limited was retained by the Ontario Ministry of Transportation (MTO) Northeastern Region to investigate and report on subsurface conditions to design a foundation for a new storage dome at the Parry Sound Patrol Yard. The work was conducted under MTO Agreement Number 5007-E-0052, and included buried utility clearances, drilling and sampling of boreholes at the proposed structure location, soil sample review and routine laboratory tests, and geotechnical assessments for foundation design and construction considerations. Site details and our findings and recommendations are discussed in subsequent report sections.

2.0 SITE DESCRIPTION

The Parry Sound patrol yard (site) is located at No. 2 Quebec Drive, north of Osler Park Drive (formerly Highway 69), on Lot 138, Concession B of Foley Township, in the District of Parry Sound. A site location map is included as Figure 1.

The site has an area of 4.2 ha, based on a plan provided by MTO, and is currently occupied by a sand shed (18 m by 61 m area), a 30 m diameter salt dome, a storage shed, and a 7-bay maintenance garage/office. Floor grade elevations of the existing buildings are in the order of 210.5 m (geodetic datum).

The site area surrounding the existing buildings is asphalt paved, while other traveled areas are mainly gravel surfaced. The patrol yard also contains a 9,100 L (2000 gal) propane tank for the garage/office heating system, a dug water supply well, an in-ground septic bed, and stockpiles of sand and gravel for use on MTO projects. A general site plan is included as Figure 2.



LEGEND

SITE LOCATION MAP

GEOTECHNICAL INVESTIGATION
 PARRY SOUND PATROL YARD
 Parry Sound, Ontario
 For: Ministry of Transportation

DATE: JULY, 2008

SCALE: 1 : 10,000

PROJECT: 03080770.04

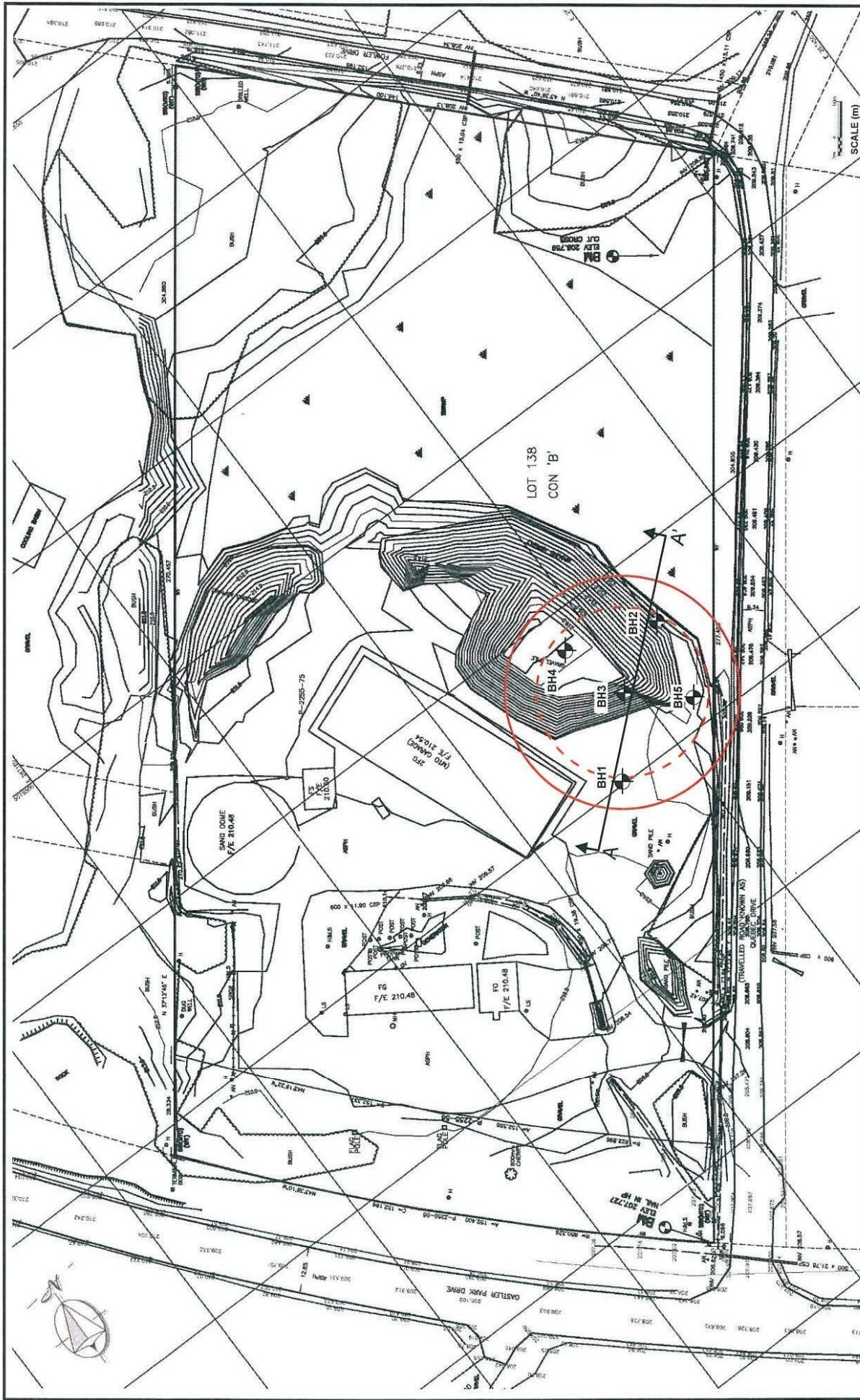
REF. NO.: 0308077004F1

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Environmental Consulting Engineers

FIGURE

1



<p>LEGEND</p> <p>BH1 Borehole Designation and Approximate Location - 2008</p> <p>Proposed Dome and Asphalt Perimeter</p> <p>Cross Section A-A'</p>	<p>SITE PLAN</p> <p>SCALE: AS SHOWN</p> <p>REF. NO.: 0308077004F2</p> <p>DATE: JULY, 2008</p> <p>PROJECT: 03080770.04</p> <p>JAGGER HIMSLIMITED Environmental Consulting Engineers</p> <p>FIGURE 2</p> <p>GEOTECHNICAL INVESTIGATION PARRY SOUND PATROL YARD Parry Sound, Ontario For: Ministry of Transportation</p>
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The site topography is relatively flat, with a slight northerly slope towards adjacent marsh and bush areas. Drainage ditches exist along the edges of the site and generally direct runoff toward the marsh. No bedrock outcrops were observed on the site, and existing vegetation includes perimeter trees with some grass lawn areas behind the garage/office building.

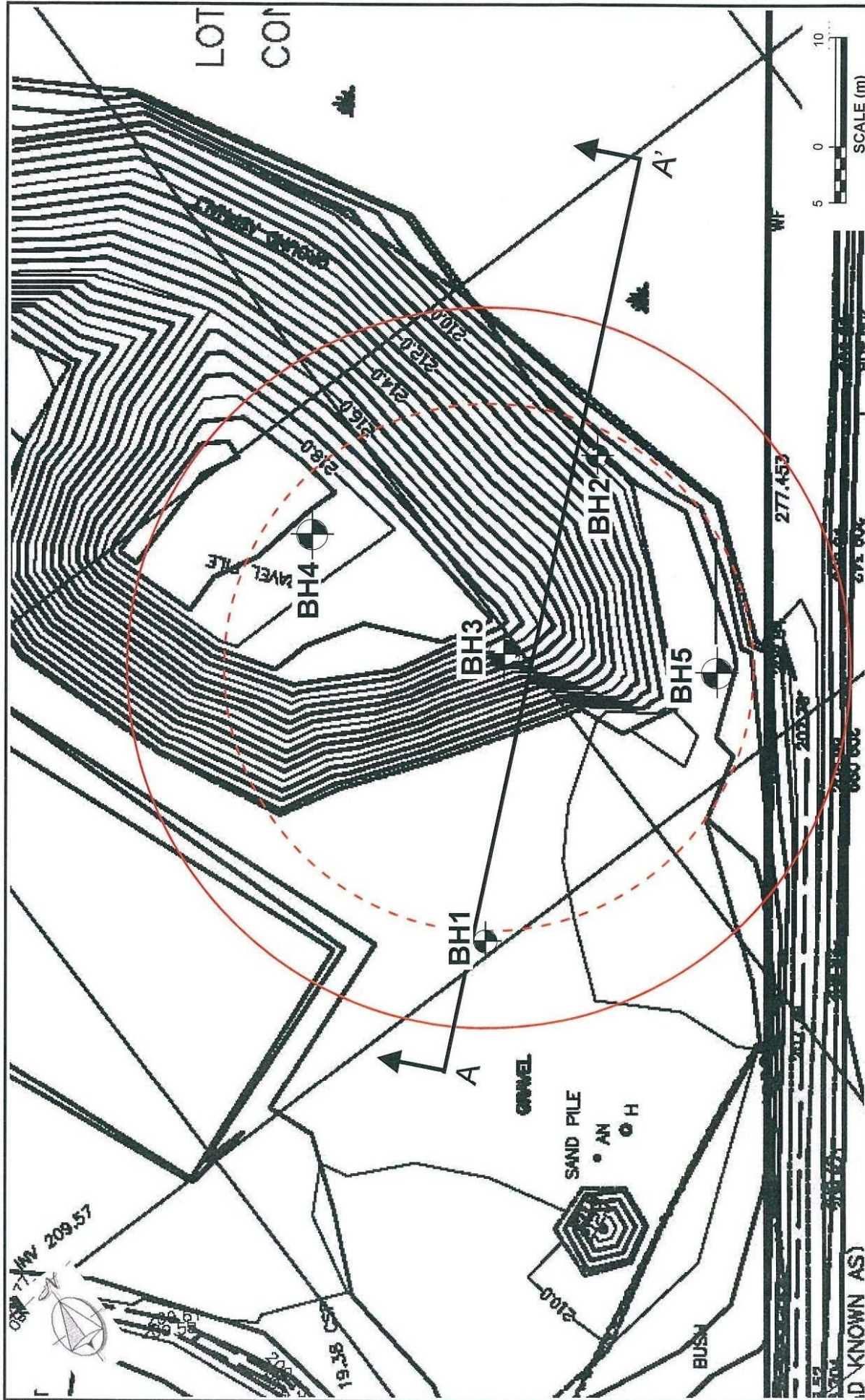
The proposed dome location is indicated on Figure 2, near the east end of an existing gravel stockpile area. Part of the stockpile was recently moved to facilitate the site borehole investigation. It is understood that the proposed dome is a 31 m diameter Bulk-Store structure with an approximate capacity of 6,120 tonnes. The interior area of the dome and the exterior perimeter apron within 10 m surrounding the structure will be asphalt paved.

3.0 INVESTIGATION PROCEDURES

3.1 SUBSURFACE INVESTIGATION

Subsurface conditions at the proposed sand/salt dome location were investigated on April 23 and 24, 2008. Five (5) boreholes, designated as BH1 through BH5, were drilled with a truck-mounted soils investigation rig equipped with 110 mm outside diameter (OD) hollow-stem augers, 51 mm outside diameter (OD) split-spoon samplers, and various other soil testing/sampling apparatus including field vane, dynamic cone penetrometer, and thin wall tube samplers. The rig also had capability for NQ size (48 mm diameter) rock coring. All drilling and sampling was conducted under the supervision of a Jagger Hims Limited soils technologist. Borehole locations in the proposed building area are plotted on Figure 3.

Prior to undertaking the borehole investigation, existing buried utilities on the site were cleared with a private locator and Ontario One-Call services. MTO site supervisors accompanied field staff on the initial site inspection to stake out borehole locations and clear buried service conflicts.



<p>LEGEND</p> <p>BH1 </p> <p></p> <p></p>	<p>Borehole Designation and Approximate Location - 2008</p> <p>Proposed Dome and Asphalt Perimeter</p> <p>Cross Section A-A'</p>
<p>SCALE: 1:500</p>	<p>REF. NO.: 0308077004BAP</p>
<p>DATE: JULY, 2008</p>	<p>PROJECT: 03080770.04</p>
<p> JAGGER HIMSLIMITED Environmental Consulting Engineers</p>	<p>BUILDING AREA PLAN</p> <p>GEOTECHNICAL INVESTIGATION</p> <p>PARRY SOUND PATROL YARD</p> <p>Parry Sound, Ontario</p> <p>For: Ministry of Transportation</p> <p>FIGURE 3</p>

MTO's minimum requirements for the borehole investigation included the following.

- Five boreholes in the area of the structure, unless justification for additional boreholes was authorized by the MTO Project Manager.
- Boreholes advanced to a minimum of 3 m below refusal depth, as defined by material for which Standard Penetration Test (SPT) N values exceed 100 blows per 0.3 m.
- A maximum drilling depth of 15 m, unless refusal was encountered at shallower depth or justification for deeper drilling was authorized by the MTO Project Manager.
- When bedrock exists in foundation element locations, obtain a minimum 3 m core sample from below the bedrock surface. Determine the bedrock/soil interface by geological definition.
- Semi-continuous soil sampling at 0.75 m intervals within critical foundation zones and a maximum sampling interval of 1.5 m within the investigated depth.
- Backfilling of boreholes with bentonite sealant, and repair of holes in asphalt in accordance with abandonment procedures and regulations. Artesian groundwater pressure, if encountered, to be sealed at the source.

Soil samples were taken mainly using split spoon/standard penetration test procedures (ASTM D1586). Soil samples collected during drilling operations were inspected and logged, and then placed in labeled bags for transport and storage. Jars with tight-sealing Teflon-lined lids were used for laboratory moisture content specimens.

In addition to the general sampling, the following sampling procedures were undertaken at this site.

- A 3 m bedrock core sample was taken at BH2. The bedrock sample was stored in a wooden core box for shipment.

- Dynamic cone penetration tests were conducted at BH3 and BH5.
- A thin wall tube sample was taken at BH4, starting at a depth of 3.4 m. The sample was labeled and preserved with wax in the field, in accordance with ASTM D1587 procedures.

3.2 LABORATORY TESTING

Soil samples from the borehole investigation were reviewed by the project geotechnical engineer, to confirm field descriptions and assess laboratory testing requirements.

The following routine laboratory testing was conducted on selected soil samples:

- Natural Moisture Content (LS-701): 10
- Particle Size Distribution Analysis (LS-602, LS-702): 10
- Atterberg Limits Tests (LS-703/704): 1

No complex level soil or rock testing was completed for this site.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL PROFILE SUMMARY

The subsurface profile in the investigated area consists of up to 2.9 m of sand and gravel (presumed fill), overlying layers of sand, silty sand, and clayey silt to clay and silt, extending to the borehole termination depths. The boreholes met refusal on presumed bedrock at depths of 4.9 m to 7.2 m below the existing ground surface. Gneissic bedrock was cored for a depth of 3 m at BH2. Wet to saturated soils and groundwater seepage were encountered in the boreholes at depths of 1.1 m to 1.9 m below the ground surface, which approximates the adjacent marsh elevation. Individual soil units and details are described in the following subsections, and the subsurface profile is shown on Figure 4.

4.1.1 Presumed Fill Material

Mottled grey and brown to grey sandy gravel to sand and gravel fill was encountered in all of the boreholes, to a maximum depth of 2.9 m below the existing ground surface. Based on laboratory particle size distribution analyses, included in the appendix, this material contains 42 % to 64 % gravel, 31 % to 42 % sand, 5 % to 14 % silt, and 0 to 2 % clay. The presumed fill is moist and compact to very dense based on penetration resistance (N) values of 16 to over 100 blows per 305 mm.

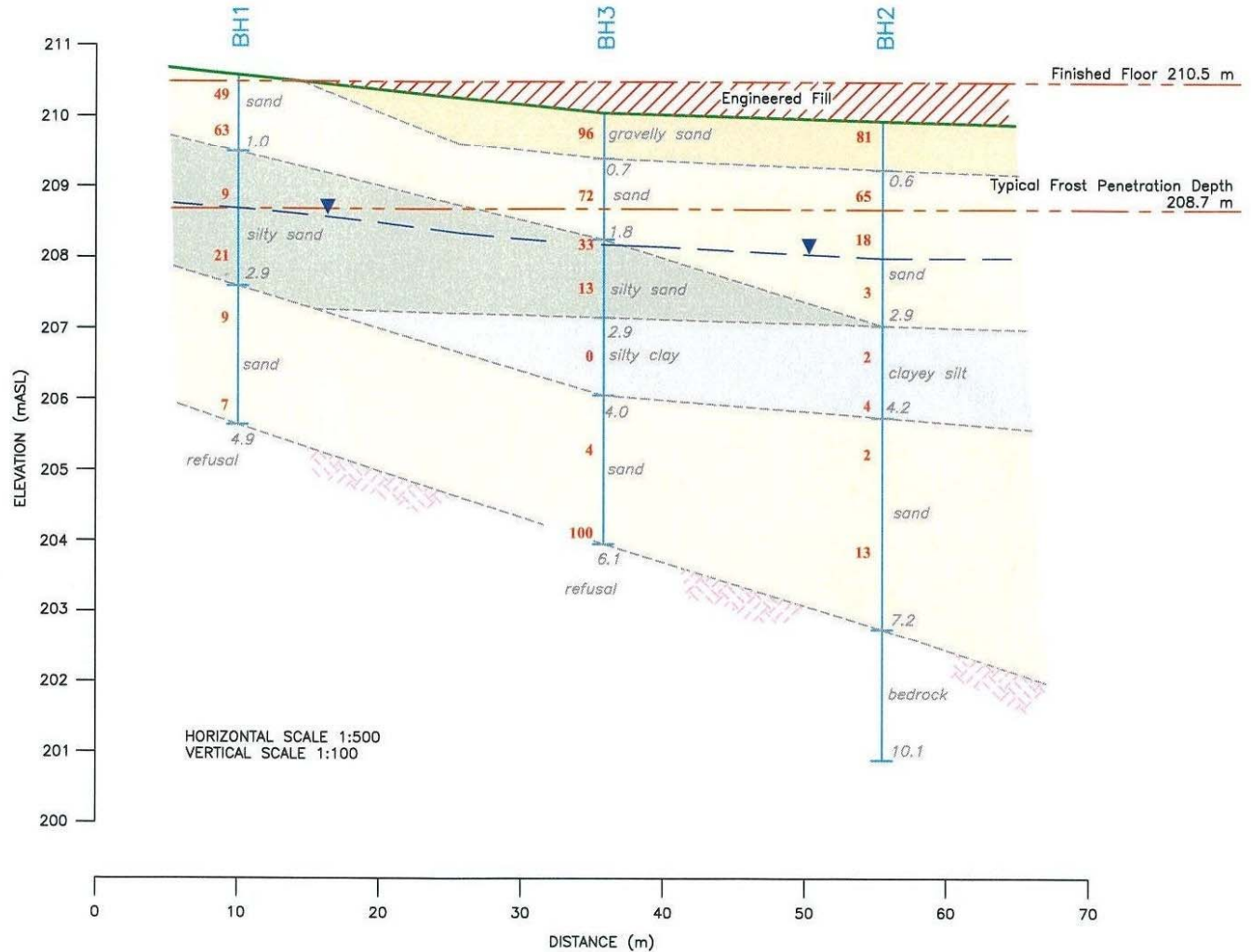
Grey to brown sand was encountered below the gravelly sand fill in borehole BH3. This material extended to a depth of 1.8 m below existing ground level at BH3. The sand contains some silt and traces of gravel and clay, and is moist within the investigated depth. Based on N values ranging from 72 to 33 blows per 305 mm, the sand is very dense to dense. A laboratory particle size distribution test of sample SS2 from BH3 indicates that the sand contains approximately 7 % gravel, 80 % sand, 11 % silt, and 2 % clay. This material is considered to have a low susceptibility to frost heaving (LSFH). The natural moisture content of sample SS2 was approximately 6 %, based on a laboratory test.

4.1.2 Silty Sand

A layer of brown to dark brown silt to silty sand, 0.2 m to 1.9 m thick, was penetrated at boreholes BH1, BH3, BH4 and BH5. Samples from the latter three holes contained organic matter and roots, and the silty sand at these locations is inferred to be original topsoil material. The silty sand is generally saturated, and is loose to compact based on N values ranging from 9 to 21 blows per 305 mm. Laboratory particle size distribution tests indicate that the silty sand contains 0 to 8 % gravel, 60 % to 74 % sand, 15 % to 32 % silt, and 3 % to 8 % clay. This material is considered to have a low to medium susceptibility to frost heaving (LSFH to MSFH). The natural moisture content of sample SS4 from this layer in BH1 was approximately 54 %, based on a laboratory test.

A
Southwest

A'
Northeast



NOTE:
THE ACTUAL SOIL STRATIFICATION HAS BEEN VERIFIED FROM DATA OBTAINED AT THE BOREHOLE LOCATIONS ONLY. THE INFERRED CONTACTS SHOWN ARE BASED ON GEOLOGICAL EVIDENCE AND THESE MAY VARY FROM THOSE SHOWN BETWEEN BORINGS.

CROSS SECTION A-A'

GEOTECHNICAL INVESTIGATION
PARRY SOUND PATROL YARD
Parry Sound, Ontario
For Ministry of Transportation

DATE: JULY 2008

SCALES: AS SHOWN

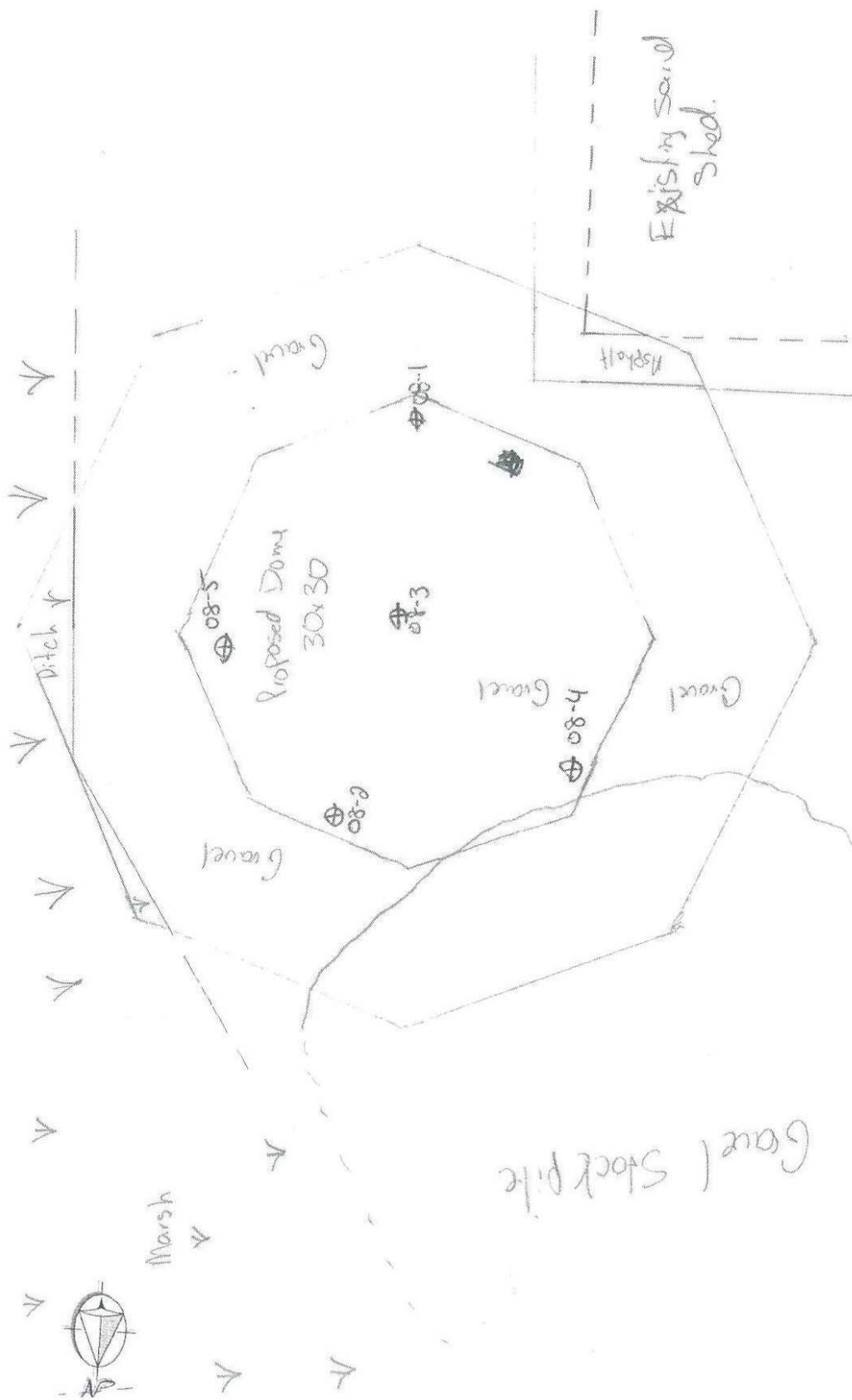
PROJECT: 3-080770.04

REF. NO.: 3-08077004F4-CR

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FIGURE

4



LEGEND

SCALE: 1:400

REF. NO.: 0308077004F5

DATE: JULY, 2008

PROJECT: 03080770.04

J JAGGER HIMES
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Environmental Consulting Engineers

PEDOLOGICAL FIELD SKETCH

GEOTECHNICAL INVESTIGATION
PARRY SOUND PATROL YARD
Parry Sound, Ontario
For: Ministry of Transportation

FIGURE

5

4.1.3 Clayey Silt

A layer of clayey silt to silt and clay was penetrated in boreholes BH2 through BH4, starting at 2.9 m depth and extending down to 4.0 m to 4.3 m below existing ground. A similar layer 0.2 m thick was encountered in borehole BH5 at a depth of 1.6 m below existing ground. Based on a laboratory particle size distribution test of sample SS5 from BH3, the silt and clay material contains less than 1 % gravel, and approximately 5 % sand, 38 % silt, and 57 % clay. This material is considered to have a high susceptibility to frost heaving (HSFH). The clayey silt to silty clay is very soft based on N values of 0 to 2 blows per 305 mm. The natural moisture content of sample SS5 from this layer in BH3 was approximately 54 %, based on a laboratory test.

4.1.4 Sand

The deepest soil unit encountered in the drilling program was a brown to grey fine to medium sand layer extending to the bedrock surface. This sand unit was typically 1.3 m to 3.0 m in boreholes BH1 to BH4, and 4.9 m thick in BH5. The sand contains trace to some silt and trace clay. Borehole BH3 encountered gravelly sand above the bedrock and a laboratory particle size distribution test indicates that this material contains approximately 23 % gravel and 77 % sand. The sand layer is typically saturated and samples collected from this unit in BH3 and BH5 had natural moisture contents of 20 % and 19 % respectfully, based on laboratory tests. Standard penetration resistance values indicate that the sand is loose to compact, however drilling disturbance may have affected the N values. Dynamic cone penetration resistance values advanced in undisturbed materials at boreholes BH3 and BH4 indicate that the sand is generally dense.

4.1.5 Bedrock

The boreholes met refusal on presumed bedrock at depths of 4.9 m to 7.2 m below existing ground level. The bedrock surface is inferred to have an easterly slope. The bedrock was cored for a depth of 3 m at BH2. Based on the core sample inspection, the bedrock is grey-

black speckled, medium to coarse grained dioritic gneiss with black, fine-grained diabase intrusions parallel to a strong foliation at approximately 45 degrees to the core axis. The core recovery was 100 %, and the Rock Quality Designation for the sample is excellent (92 %).

4.1.6 Groundwater

Wet to saturated soils and groundwater seepage was encountered in the boreholes at depths of 1.1 m to 1.9 m below the ground surface. The maximum groundwater elevation of 208.9 m occurred at BH4. It is inferred that the shallow groundwater table at the site is controlled by the adjacent marsh level. No artesian groundwater pressures were encountered, but the saturated cohesionless soils were generally unstable and sloughed into the open boreholes when auger casings were removed. Based on a bailer sample taken from BH4, the groundwater has the following basic chemical properties:

- pH: 6.97
- Temperature: 11.7 °C
- Conductivity: 1557 µS

5 MISCELLANEOUS INFORMATION

5.1 BURIED UTILITY LOCATOR

Buried utility clearances were performed by Cable Master of Newmarket, Ontario (ph: 905-715-7305).

5.2 DRILLING COMPANY IDENTIFICATION

The drilling company used on the assignment was Abraflex of Lively, Ontario (ph: 705-222-2272).

5.3 LABORATORY IDENTIFICATION

Medium complexity laboratory tests were conducted by Golder Associates of Mississauga, Ontario (ph: 905-567-4444), under a subcontract with Jagger Hims Limited.

5.4 SITE INVESTIGATORS

Mr. David Lembke of Jagger Hims Limited supervised the field drilling program. Mr. Stephen Ash, P. Eng. and Mr. Ben McWade, EIT, of Jagger Hims Limited, completed the geotechnical assessments and prepared the reports. Mr. Ash was the project manager and lead contact for the assignment.

6.0 STRUCTURE FOUNDATION DESIGN

6.1 TYPE AND DEPTH OF FOUNDATION

Based on the subsurface profile determined by the borehole investigation, it is considered feasible to use conventional shallow foundations to support the structure provided that frost concerns and deeper clay layer settlement potential as discussed in Section 6.3, are addressed.

Most of the subsoils in the upper 2 m of the soil profile are not highly frost susceptible but there is some potential for heave and seasonal soil loosening. Consequently, it is recommended that footings set above 1.6 m depth be insulated to minimize frost penetration, or alternatively that footings be set on 19 mm diameter clear stone fill that extends to at least twice 1.6 m depth. The clear stone fill should be at least twice as wide as the footing and the stone fill should be wrapped in a non-woven geotextile (Terrafix 270 or equal) to prevent mixing with the adjacent sand.

It is recommended that the native soils exposed at footing grade, or at the bottom of the proposed clear stone layer, be compacted with several passes of a large vibratory plate

compactor. Several passes of the compactor are also recommended at the surface of the clear stone layer. The compaction will reduce overall settlement potential.

6.2 BEARING RESISTANCE

In accordance with the MTO Terms of Reference, foundation design for the sand/salt storage dome is based on the procedure stated in Section 6 of the Canadian Highway Bridge Design Code (CHBDC), published by the Canadian Standards Association (CSA/CAN-S6-00). It is understood that shallow depth foundations are preferred, if possible, to minimize the amount of excavation disturbance.

6.2.1 Geotechnical Resistance at ULS

The unfactored geotechnical resistance at Ultimate Limit State (ULS) for a concentrically loaded footing founded in uniform soil is calculated from the following formula:

$$q_u = c'N_c s_c i_c + q'N_q s_q i_q + 0.5\gamma'BN_\gamma s_\gamma i_\gamma$$

where,

q_u is the ultimate geotechnical pressure resistance (kPa),

c' is the effective cohesion of the soil (kPa),

q' is the effective overburden pressure at the foundation level (kPa),

γ' is the effective unit weight of the soil (kN/m³),

B is the footing width (m),

N_c , N_q , N_γ are dimensionless bearing coefficients based on the effective angle of internal friction (degrees),

s_c , s_q , s_γ are foundation shape factors, and

i_c , i_q , i_γ are load inclination factors.

Table 1

MTO Assignment 5007-E-0052
Shallow Foundation Design (CH8DC CAN/CSA-S6-00 Method)
Our File: 3080770.04

Calculated Geotechnical Resistance at ULS: $q_u = c'N_{cs} + \gamma' D N_{ds} + \gamma' B N_{bs} + i q_u$

Case No. : 1

Foundation Design Variables			Soil Strength Properties				Bearing Coefficients			Foundation Shape Factors				Load Inclination Factors				
Footings Width, B (m)	Footings Length, L (m)	Footings Depth, D (m)	Overburden γ' (kN/m ³)	ϕ' (degrees)	c_u (kPa)*	Soil Below Footing γ' (kN/m ³)	Nc	Nq	N γ	eb	el	Effective Width, B' (m)	Effective Length, L' (m)	$s_c = s_q$	s_y	δ^*	$i_c = i_q$	i_y
0.75	5	0.30	19.00	35.00	0.00	0.00	46.12	33.30	33.92	0.00	0.00	0.75	5.00	1.11	0.94	15.00	0.69	0.33

*Note: For $\phi = 0$, Input $c_u = c'$

$q_u =$ 214 kPa
 $H_{1s} =$ 450 kN
 $H_{1s} =$ FALSE kN (short term ,clays only)
 $H_{1s} =$ 172 kN

Case No. : 2

Foundation Design Variables			Soil Strength Properties				Bearing Coefficients			Foundation Shape Factors				Load Inclination Factors				
Footings Width, B (m)	Footings Length, L (m)	Footings Depth, D (m)	Overburden γ' (kN/m ³)	ϕ' (degrees)	Soil Below Footing c (kPa)*	γ' (kN/m ³)	Nc	Nq	N γ	eb	el	Effective Width, B' (m)	Effective Length, L' (m)	$s_c = s_q$	s_y	δ^*	$i_c = i_q$	i_y
0.45	5	0.60	19.00	35.00	0.00	0.00	46.12	33.30	33.92	0.00	0.00	0.45	5.00	1.06	0.96	15.00	0.69	0.33

*Note: For $\phi = 0$, Input $c_u = c'$

$q_u =$ 323 kPa
 $H_{1s} =$ 407 kN
 $H_{1s} =$ FALSE kN (short term ,clays only)
 $H_{1s} =$ 156 kN

Case No. : 3

Foundation Design Variables			Soil Strength Properties				Bearing Coefficients			Foundation Shape Factors				Load Inclination Factors					
Footings Width, B (m)	Footings Length, L (m)	Footings Depth, D (m)	Overburden γ' (kN/m ³)	ϕ' (degrees)	c (kPa)*	Soil Below Footing c (kPa)*	γ' (kN/m ³)	Nc	Nq	N γ	eb	el	Effective Width, B' (m)	Effective Length, L' (m)	$s_c = s_q$	s_y	δ^*	$i_c = i_q$	i_y
0.45	5	1.20	18.00	34.00	0.00	0.00	17.50	42.16	29.44	28.77	0.00	0.00	0.45	5.00	1.06	0.96	15.00	0.69	0.31

*Note: For $\phi = 0$, Input $c_u = c'$

$q_u =$ 503 kPa
 $H_{1s} =$ 611 kN
 $H_{1s} =$ FALSE kN (short term ,clays only)
 $H_{1s} =$ 243 kN

An analysis of three design cases is presented in Table 1. Case 1 presents a 0.75 m wide strip footing situated at a depth of 0.3 m below final grade, Case 2 presents a 0.45 m wide strip footing situated at a depth of 0.6 m below final grade, and Case 3 presents a 0.45 m wide strip footing situated at a depth of 1.2 m below final grade. All cases assume a footing length (L) of 5 m, which is conservative since the strip footing will be continuous around the building perimeter. A 15° inclined load is also assumed for the dome loading. The effective angle of internal friction used in the first 3 design cases was 35°, which is based on very dense sandy soil conditions within the foundation influence zone. Case 3 uses an internal friction angle of 34°, based on the loose to compact soils in this zone. The effective cohesion is zero for granular soil.

The unfactored bearing resistances at ULS for the shallow Case 1 is 214 kPa, and for Case 2 is 323 kPa. Based on Table 6.6.2.1 of the CHBDC, the factored bearing resistances are 107 kPa and 180 kPa, respectively. Case 3 has an unfactored bearing resistance of 503 kPa. The same bearing capacities can be used for footings set on the 19 mm clear stone fill, discussed in Section 6.1.

6.2.2 Settlement Considerations and SLS

An estimate of the settlement (s_i) of the sandy and silty sand layers can be made from the following equation:

$$s_i = q B^{0.7} I_c$$

where,

s_i is the settlement (mm)

q is the foundation pressure (kPa)

B is the footing width,

I_c is an influence factor equal to $1.71/N^{1.4}$, and

N is the average standard penetration resistance.

For a serviceability limit state (SLS) settlement of 25 mm, using a footing width of 0.45 m and the minimum standard penetration resistance value of 9 ($I_c = 0.08$) within the foundation soil zone, the maximum allowable loading is 547 kPa. This value is greater than that obtained for the ULS calculation and, therefore, does not govern. Estimated settlement at the governing factored loading of 180 kPa, using the 0.45 m footing width, is 8 mm.

6.3 CLAY LAYER COMPRESSION

Stress from the proposed material stockpile is expected to cause some settlement of the clayey layer located at an approximate depth of 1.6 m to 2.9 m below ground surface. Part of the proposed building area has been pre-loaded by at least 8 m of sand and gravel for many years, which will have at least partially pre-consolidated the clayey soil. This strata is located between layers of sand creating a double drainage path, and permitting relatively rapid consolidation.

In the absence of direct tests, consolidation settlement (s_c) of the silty clay layer under the stockpile loading can be estimated from the following formula:

$$s_c = [C_c \log(\sigma_1'/\sigma_0')/(1+e_o)]H$$

where,

s_c is the settlement (mm)

C_c is the coefficient of compression, (Approximate $C_c = 0.008$ (Liquid Limit – 10)

σ_0' and σ_1' are the initial and final effective stresses (kPa),

e_o is the initial void ratio, and

H is the thickness of the settlement layer (mm)

Based on estimated soil compression parameters and the maximum estimated stockpile loading, the total consolidation settlement potential of the silty clay layer is estimated to be 130 mm. The maximum loading from the stockpile will occur below the centre of the proposed dome; however, settlement effects below the perimeter building foundation area, where loads are lower, will be less.

To reduce the settlement potential of this clayey layer, it is recommended that the proposed location be preloaded with at least 10 m of fill. The deviation of loading could be determined by monitoring settlement. In the absence of such monitorings a minimum duration of 12 months of pre-loading is recommended.

An alternative to the pre-loading would be to relocate the dome approximately 25 m north, to an area where an existing pile of fill is located. It is understood that this fill pile, which is approximately 10 m high, has been in place for several years.

A third option is to support the foundation on piles driven to the bedrock. The pile option will be considerably more costly but alleviates the need for foundation insulation and pre-loading. Steel H-Pile capacities driven to refusal on sound bedrock are governed by the capacity of the pile when it is considered as a fully supported structural column. The maximum allowable pile capacity is estimated as one third of the yield strength (f_y) of the pile material. For design considerations using A-36 grade steel, the maximum allowable stress in the lower pile region is approximately 69 MPa (10 ksi).

6.4 LATERAL RESISTANCE

Factored horizontal resistances (H_{rs} and H_{ri}) at the ULS design loadings are provided on Table 1. The short term loading case ($\phi'=0$) does not apply to this site.

7.0 EARTH PRESSURE DESIGN

No shoring or earth retaining systems are anticipated for this project, so lateral earth pressure design requirements are minimal.

The following active (K_a) and passive (K_p) earth pressure coefficients are recommended, using a resistance factor of 0.5 applied to the estimated 35° internal friction angle for the foundation soil:

- $K_a = 0.5$
- $K_p = 1.9$

8.0 SEISMIC DESIGN

Seismic surveys were beyond the scope of the assignment. However, based on Table 4.1.8.4.A of the Ontario Building Code and the inferred compact soil and bedrock conditions to a depth of 30 m below ground, we recommend that Site Class C be used for seismic design (if required). Acceleration and velocity based site coefficients can be obtained from Tables 4.1.8.4.B and 4.1.8.4.C.

9.0 UNWATERING AND SUBDRAINAGE

The ground water table was encountered 1.1 m to 1.9 m below existing grades, at an approximate elevation of 209 m. With the exception of removing accumulated precipitation and runoff from the foundation excavation, no groundwater unwatering is required for dome construction.

The foundation grade as detailed in this report is above the groundwater table, so no subdrains are recommended.

10.0 FROST PENETRATION

Based on the MTC report RR225 “Aspects of Prolonged Exposure of Pavements to Sub-Zero Temperatures”, the depth of frost penetration for Parry Sound is 1.8 m. Laboratory particle size distribution test results indicate that the existing subgrade soils have low to medium susceptibility to frost heaving. The clayey layer indicated in Section 4.1.3 has a high susceptibility to frost heaving. Use of insulation is recommended for shallow foundation design, as discussed in Section 6.1, to protect the dome footings from frost heave.

11.0 BEDROCK EXCAVATION

No bedrock excavation is required for shallow foundation construction at this site.

12.0 CONSTRUCTION CONCERNS

12.1 SITE PREPARATION

Trenching will be required for the foundation excavation. Depending on the final foundation design selected, trench width needs to be sufficient to accommodate 3.2 m width of perimeter insulation board. Trenching should be conducted in accordance with OPSS 206 and the Occupational Health and Safety Act (OHSA). Type 3 cohesionless material is expected and trenches must be sloped at 1:1, or be temporarily supported in accordance with OHSA.

Site preparation will involve leveling and grading of the dome area to the design elevations. A finished floor/exterior grade elevation of 210.5 m is recommended, which is consistent with the existing onsite structures. Grading will involve stripping loose surficial material and placement of granular engineered fill to the design elevations. Fill should consist of Granular B (Type I or II) per OPSS 1010, and fill should be placed and compacted in accordance with OPSS 206, 501 and 514, as applicable.

12.2 FOUNDATION BACKFILL

Foundation backfill must be free-draining, non-frost susceptible granular material such as OPSS 1010 Granular B (Type I or II), or approved equivalent. Backfill must be placed and compacted in accordance with OPSS 501.

12.3 PAVEMENT DESIGN

The interior floor of the dome and the exterior perimeter within approximately 10 m of the structure will be paved with asphalt. The pavement structure consists of 90 mm of Superpave asphalt and 150 mm of OPSS 1010 Granular A base and a Granular B subbase. Design details are provided in our pavement design memorandum dated June 23, 2008.

12.4 SPECIAL REQUIREMENTS

In portions of the site, the groundwater table may be within 0.5 m of footing grade. Precautions must be taken during construction to limit subgrade soil disturbance, and maintain dry and stable conditions.

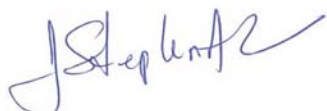
The insulated foundation option will require a foundation trench at least 4 m wide, not including setbacks for side slopes.

A specialty contractor is required for pile foundations driven to bedrock in accordance with standard practices. Geotechnical engineering supervision of pile installation is recommended, should this option be selected.

13.0 CLOSURE

This concludes the foundation investigation and design report for the proposed structure. Please direct any questions to the undersigned.

JAGGER HIMS LIMITED



J. Stephen Ash, P. Eng.
Branch Manager



Stuart E. Baird, P. Eng.
Project Engineer

APPENDIX

**BOREHOLE LOGS
GRAIN SIZE ANALYSES
ATTERBERG LIMIT RESULTS**

BOREHOLE LOG EXPLANATION FORM

This explanatory section provides the background to assist in the use of the borehole logs. Each of the headings used on the borehole log, is briefly explained.

DEPTH

This column gives the depth of interpreted geologic contacts in metres below ground surface.

STRATIGRAPHIC DESCRIPTION

This column gives a description of the soil based on a tactile examination of the samples and/or laboratory test results. Each stratum is described according to the following classification and terminology.

<u>Soil Classification *</u>		<u>Terminology</u>	<u>Proportion</u>
Clay	<0.002 mm		
Silt	0.002 to 0.06 mm	"trace" (eg. trace sand)	<10%
Sand	0.06 to 2 mm	"some" (eg. some sand)	10% - 20%
Gravel	2 to 60 mm	adjective (eg. sandy)	20% - 35%
Cobbles	60 to 200 mm	"and" (eg. and sand)	35% - 50%
Boulders	>200 mm	noun (eg. sand)	>50%

* Extension of MIT Classification system unless otherwise noted.

The use of the geologic term "till" implies that both disseminated coarser grained (sand, gravel, cobbles or boulders) particles and finer grained (silt and clay) particles may occur within the described matrix.

The compactness of cohesionless soils and the consistency of cohesive soils are defined by the following:

<u>COHESIONLESS SOIL</u>		<u>COHESIVE SOIL</u>	
Compactness	Standard Penetration Resistance "N", Blows / 0.3 m	Consistency	Standard Penetration Resistance "N", Blows / 0.3 m
Very Loose	0 to 4	Very Soft	0 to 2
Loose	4 to 10	Soft	2 to 4
Compact	10 to 30	Firm	4 to 8
Dense	30 to 50	Stiff	8 to 15
Very Dense	Over 50	Very Stiff	15 to 30
		Hard	Over 30

The moisture conditions of cohesionless and cohesive soils are defined as follows.









<u>COHESIONLESS SOILS</u>		<u>COHESIVE SOILS</u>	
Dry		DTPL	- Drier Than Plastic Limit
Moist		APL	- About Plastic Limit
Wet		WTPL	- Wetter Than Plastic Limit
Saturated		MWTPL	- Much Wetter Than Plastic Limit

STRATIGRAPHY

Symbols may be used to pictorially identify the interpreted stratigraphy of the soil and rock strata.

MONITOR DETAILS

This column shows the position and designation of standpipe and/or piezometer ground water monitors installed in the borehole. Also the water level may be shown for the date indicated.

	Standpipe and Designation		Cement Seal
	Piezometer and Designation		Granular Pack
	Gas Monitor and Designation		Granular Backfill
	Borehole Seal (Peltonite, Bentonite or Hole Plug)		Native Soil Backfill/Cave

Where monitors are placed in separate boreholes, these are shown individually in the "Monitor Details" column. Otherwise, monitors are in the same borehole. For further data regarding seals, screens, etc., the reader is referred to the summary of monitor details table.

SAMPLE

These columns describe the sample type and number, the "N" value, the water content, the percentage recovery, and Rock Quality Designation (RQD), of each sample obtained from the borehole where applicable. The information is recorded at the approximate depth at which the sample was obtained. The legend for sample type is explained below.

SS = Split Spoon	GS = Grab Sample
ST = Thin Walled Shelby Tube	CS = Channel Sample
AS = Auger Flight Sample	WS = Wash Sample
CC = Continuous Core	RC = Rock Core

$$\% \text{ Recovery} = \frac{\text{Length of Core Recovered Per Run}}{\text{Total Length of Run}} \times 100$$

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundness of the rock mass. It is obtained from the rock cores by summing the length of core recovered, counting only those pieces of sound core that are 100 mm or more in length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

<u>RQD Classification</u>	<u>RQD (%)</u>
Very poor quality	< 25
Poor quality	25 - 50
Fair quality	50 - 75
Good quality	75 - 90
Excellent quality	90 - 100

TEST DATA

The central section of the log provides graphs which are used to plot selected field and laboratory test results at the depth at which they were carried out. The plotting scales are shown at the head of the column.

Dynamic Penetration Resistance - The number of blows required to advance a 51 mm diameter, 60° steel cone fitted to the end of 45 mm OD drill rods, 0.3 m into the subsoil. The cone is driven with a 63.5 kg hammer over a fall of 750 mm.

Standard Penetration Resistance - Standard Penetration Test (SPT) "N" Value - The number of blows required to advance a 51 mm diameter standard split-spoon sampler 300 mm into the subsoil, driven by means of a 63.5 kg hammer falling freely a distance of 750 mm. In cases where the split spoon does not penetrate 300 mm, the number of blows over the distance of actual penetration in millimetres is shown as $\frac{x \text{ Blows}}{\text{mm}}$

Water Content - The ratio of the mass of water to the mass of oven-dry solids in the soil expressed as a percentage.

W_P - Plastic Limit of a fine-grained soil expressed as a percentage as determined from the Atterberg Limit Test.

W_L - Liquid Limit of a fine-grained soil expressed as a percentage as determined from the Atterberg Limit Test.

REMARKS

The last column describes pertinent drilling details, field observations and/or provides an indication of other field or laboratory tests that were performed.

BOREHOLE NO. 1

PAGE 1 of 1

PROJECT NAME: PARRY SOUND PATROL YARD

PROJECT NO.: 3080770.04

CLIENT: MINISTRY OF TRANSPORTATION

DATE COMPLETED: Apr. 23, 2008

BOREHOLE TYPE: 110 mm I.D HSA / 51 mm O.D SPLIT SPOON

SUPERVISOR: DCL

GROUND ELEVATION: 210.54 m (Relative datum)

REVIEWER: JSA

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION		WATER CONTENT %		REMARKS	
				TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)	"N" VALUE					
									10	20	30	10		20
										SHEAR STRENGTH				
0.0														
0.0	<u>SANDY GRAVEL:</u> MOTTLED GREY AND BROWN SANDY GRAVEL, TRACE SILT, TRACE ASPHALT, MOIST, DENSE TO VERY DENSE			SS1	49	3	92					49		ELEVATIONS ARE RELATIVE TO THE FINISHED FLOOR ELEVATION OF THE EXISTING MTO GARAGE (210.54 m)
1.0				SS2	63	18	92					63		N45.3136 W79.9785
1.0	<u>SILTY SAND:</u> BROWN SILTY SAND TO SAND SOME SILT, TRACE GRAVEL, TRACE CLAY, WET, SATURATED BELOW 2 m, LOOSE TO COMPACT			SS3	9		83							SS1 GSA 64% GRAVEL 31% SAND 5% SILT LSFH
2.0				SS4	21	17	75							GROUNDWATER AT 1.9 m DEPTH ON COMPLETION
2.9				SS5	9		54							SS4 GSA 8% GRAVEL 74% SAND 15% SILT 3% CLAY LSFH
2.9	<u>SAND:</u> BROWN FINE TO MEDIUM SAND, TRACE SILT, SATURATED, LOOSE													
4.0														
4.9	REFUSAL AT 4.9 m ON INFERRED BEDROCK			SS6	7		96							
5.0														
6.0														
7.0														
8.0														
9.0														
10.0														
11.0														
12.0														
13.0														

BOREHOLE NO. 2

PAGE 1 of 1

PROJECT NAME: PARRY SOUND PATROL YARD

PROJECT NO.: 3080770.04

CLIENT: MINISTRY OF TRANSPORTATION

DATE COMPLETED: Apr. 23, 2008

BOREHOLE TYPE: 110 mm I.D HSA / 51 mm O.D SPLIT SPOON

SUPERVISOR: DCL

GROUND ELEVATION: 209.95 m (Relative datum)

REVIEWER: JSA

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION "N" VALUE 10 20 30 SHEAR STRENGTH	WATER CONTENT % 10 20 30 W _p W _L	REMARKS
				TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)			
0.0	GRAVELLY SAND: DARK GREY GRAVELLY SAND, SOME WASTE ASPHALT, MOIST, VERY DENSE			SS1	81		42			81	ELEVATIONS ARE RELATIVE TO THE FINISHED FLOOR ELEVATION OF THE EXISTING MTO GARAGE (210.54 m) N45.3137 W79.9782 GROUNDWATER AT 1.9 m DEPTH ON COMPLETION SS3 GSA 43% GRAVEL 46% SAND 9% SILT 2% CLAY LSFH
0.7	SAND AND GRAVEL: DARK GREY SAND AND GRAVEL, SOME TO TRACE SILT, TRACE CLAY, WET TO SATURATED, VERY DENSE TO LOOSE			SS2	65		63			65	
1.0	-COBBLES AT 1.0 m			SS3	18	14	67				
2.0				SS4	3		21				
2.9	CLAYEY SILT: GREY CLAYEY SILT, TRACE FINE SAND, WTPL, VERY SOFT TO SOFT			SS5	2	37	21				
4.0				SS6	4		88				
4.2	SAND: GREY FINE SAND, SATURATED, VERY LOOSE TO COMPACT			SS7	2		29				
5.0				SS8	13	20	54				
6.0											BOREHOLE TERMINATED AT 10.2 m IN BEDROCK
7.0											
7.2	DIORITIC GNEISS: GREY WITH BLACK SPECKLES, MEDIUM TO COARSE GRAINED, FOLIATION AT 45 DEGREES TO CORE AXIS, DIABASE INTRUSIONS PARALLEL TO FOLIATION			RC9				93			
8.0											
9.0											
10.0											
10.2	BOREHOLE TERMINATED AT 10.2 m IN BEDROCK										
11.0											
12.0											
13.0											

BOREHOLE NO. 3

PAGE 1 of 1

PROJECT NAME: PARRY SOUND PATROL YARD

PROJECT NO.: 3080770.04

CLIENT: MINISTRY OF TRANSPORTATION

DATE COMPLETED: Apr. 24, 2008

BOREHOLE TYPE: 110 mm I.D HSA / 51 mm O.D SPLIT SPOON

SUPERVISOR: DCL

GROUND ELEVATION: 210.06 m (Relative datum)

REVIEWER: JSA

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION "N" VALUE 10 20 30 SHEAR STRENGTH	WATER CONTENT % 10 20 30 W _p W _L	REMARKS
				TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)			
0.0	<u>GRAVELLY SAND:</u> GREY GRAVELLY SAND, WOOD, MOIST, VERY DENSE			SS1	96		42		96		ELEVATIONS ARE RELATIVE TO THE FINISHED FLOOR ELEVATION OF THE EXISTING MTO GARAGE (210.54 m) N45.3136 W79.9784
0.7	<u>SAND:</u> GREY TO BROWN SAND, SOME SILT, TRACE GRAVEL, TRACE CLAY, MOIST, VERY DENSE, TO DENSE			SS2	72	6.1	92		520		
1.0									72		<u>SS2 GSA</u> 7% GRAVEL 80% SAND 11% SILT 2% CLAY LSFH
1.8	<u>SILTY SAND:</u> DARK BROWN SILTY SAND, TRACE CLAY, TRACE ROOTS, WET TO SATURATED, COMPACT			SS3	33		88		510		
2.0											GROUNDWATER AT 1.8 m DEPTH ON COMPLETION
2.9	<u>SILT AND CLAY:</u> GREY SILT AND CLAY, TRACE SAND, WTPL, VERY SOFT			SS4	13		58				
3.0											<u>SS5 GSA</u> 5% SAND 38% SILT 57% CLAY HSFH
4.0	<u>GRAVELLY SAND:</u> BROWNISH GREY GRAVELLY SAND, TRACE SILT, SATURATED, VERY LOOSE TO LOOSE			SS5	0	54	100				
4.0											<u>SS6 GSA</u> 23% GRAVEL 77% SAND LSFH
5.0				SS6	4	20	83				
6.0											BOREHOLE TERMINATED AT 6.1 m ON PRESUMED BEDROCK
6.1				SS7	100						
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											

BOREHOLE NO. 4

PAGE 1 of 1

PROJECT NAME: PARRY SOUND PATROL YARD

PROJECT NO.: 3080770.04

CLIENT: MINISTRY OF TRANSPORTATION

DATE COMPLETED: Apr. 24, 2008

BOREHOLE TYPE: 110 mm I.D HSA / 51 mm O.D SPLIT SPOON

SUPERVISOR: DCL

GROUND ELEVATION: 210.01 m (Relative datum)

REVIEWER: JSA

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION "N" VALUE 10 20 30 SHEAR STRENGTH	WATER CONTENT % 10 20 30 W _p W _L	REMARKS
				TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)			
0.0	<u>GRAVELLY SAND:</u> DARK GREY GRAVELLY SAND, SOME SILT, MOIST, VERY DENSE			SS1	101		50		101		ELEVATIONS ARE RELATIVE TO THE FINISHED FLOOR ELEVATION OF THE EXISTING MTO GARAGE (210.54 m) N45.3138 W79.9785 SS2 GSA 46% GRAVEL 42% SAND 10% SILT 2% CLAY LSFH GROUNDWATER AT 1.1 m DEPTH ON COMPLETION SS4 GSA 60% SAND 32% SILT 8% CLAY MSFH
0.7	<u>SAND AND GRAVEL:</u> BROWN SAND AND GRAVEL, TRACE TO SOME SILT, TRACE CLAY, OCCASIONAL COBBLES, MOIST TO WET, DENSE TO COMPACT			SS2	49	7	58		520		
1.0									49		
2.0				SS3	16	18	75		510		
2.2	<u>SILT:</u> DARK BROWN ORGANIC SILT, ROOTS, WET, COMPACT			SS4	11		63				
2.4											
2.9	<u>SILTY SAND:</u> GREY SILTY SAND, TRACE CLAY, SATURATED, COMPACT <u>CLAYEY SILT:</u> MOTTLED GREY AND BROWN TO GREY CLAYEY SILT, WTPL, VERY SOFT			SS5	1	34	100				
4.0				SS6	0		100				BOREHOLE TERMINATED AT 5.5 m ON PRESUMED BEDROCK
4.3	<u>SAND:</u> MOTTLED GREY AND BROWN FINE SAND, SATURATED										
5.0				SS7	0		54				
5.5											
6.0											
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											

BOREHOLE NO. 5

PAGE 1 of 1

PROJECT NAME: PARRY SOUND PATROL YARD

PROJECT NO.: 3080770.04

CLIENT: MINISTRY OF TRANSPORTATION

DATE COMPLETED: Apr. 24, 2008

BOREHOLE TYPE: 110 mm I.D HSA / 51 mm O.D SPLIT SPOON

SUPERVISOR: DCL

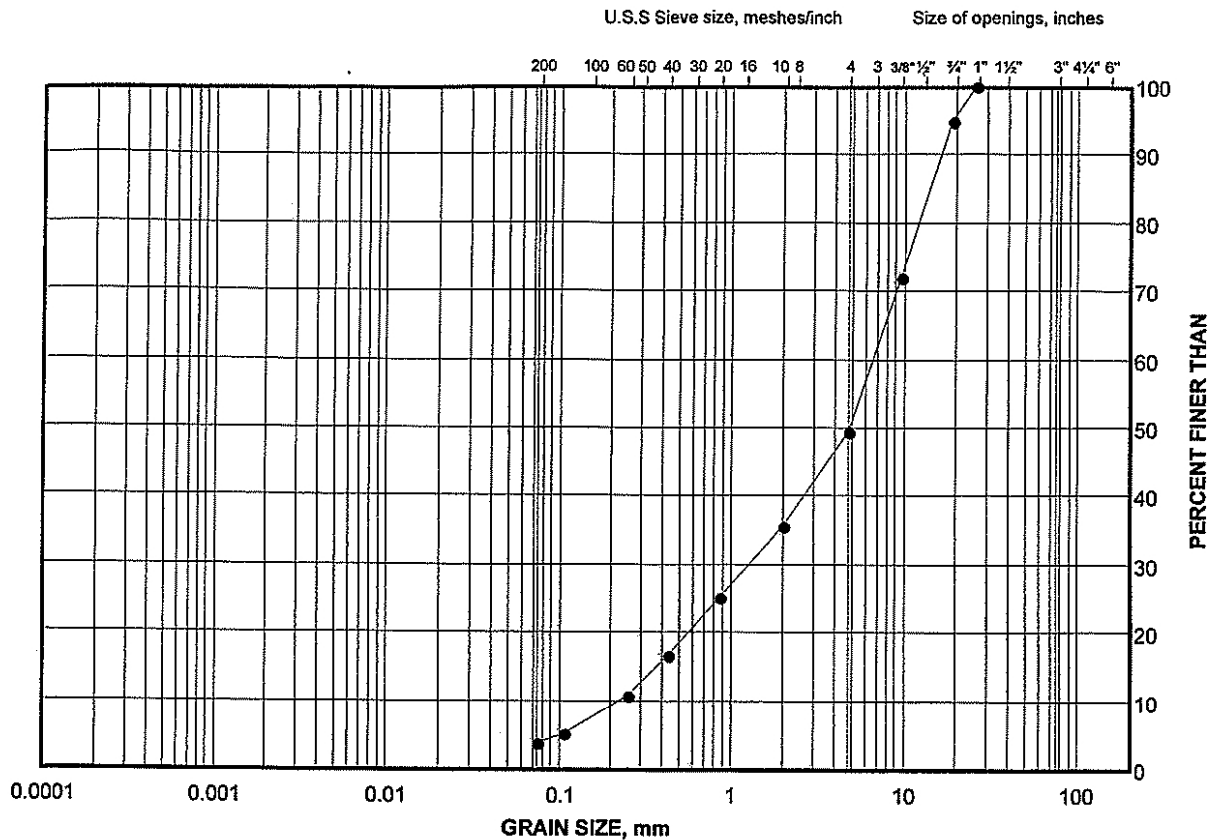
GROUND ELEVATION: 209.76 m (Relative datum)

REVIEWER: JSA

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION "N" VALUE 10 20 30 SHEAR STRENGTH	WATER CONTENT % 10 20 30 W _p W _L	REMARKS
				TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)			
0.0	GRAVELLY SAND: DARK GREY TO BROWN GRAVELLY SAND TO SAND AND GRAVEL, SOME SILT, TRACE CLAY, MOIST, COMPACT			SS1	24		54				ELEVATIONS ARE RELATIVE TO THE FINISHED FLOOR ELEVATION OF THE EXISTING MTO GARAGE (210.54 m) N45.3135 W79.9782 SS1 GSA 42% GRAVEL 42% SAND 14% SILT 2% CLAY LSFH GROUNDWATER AT 1.8 m DEPTH ON COMPLETION SS5 GSA 1% GRAVEL 82% SAND 15% SILT 2% CLAY LSFH
1.0				SS2	24	13	46				
1.4	SILTY SAND: DARK BROWN SILTY SAND, WET, COMPACT			SS3	14		42				
1.6	CLAYEY SILT: MOTTLED GREYISH BROWN CLAYEY SILT, DTPL			SS4	14	19	0				
1.8	SAND: DARK GREY SAND, TRACE TO SOME SILT, TRACE CLAY, WET TO SATURATED, LOOSE TO COMPACT			SS5	14		58				
2.0				SS6	6		38				
3.0				SS7	12		42				
4.0				SS8	100		13				
5.0											
6.0											
6.7	BOREHOLE TERMINATED AT 6.7 m ON PRESUMED BEDROCK										
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											

GRAIN SIZE DISTRIBUTION

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	08-1	1	

REMARKS
3080770.04

Project Number: 08-1116-0009

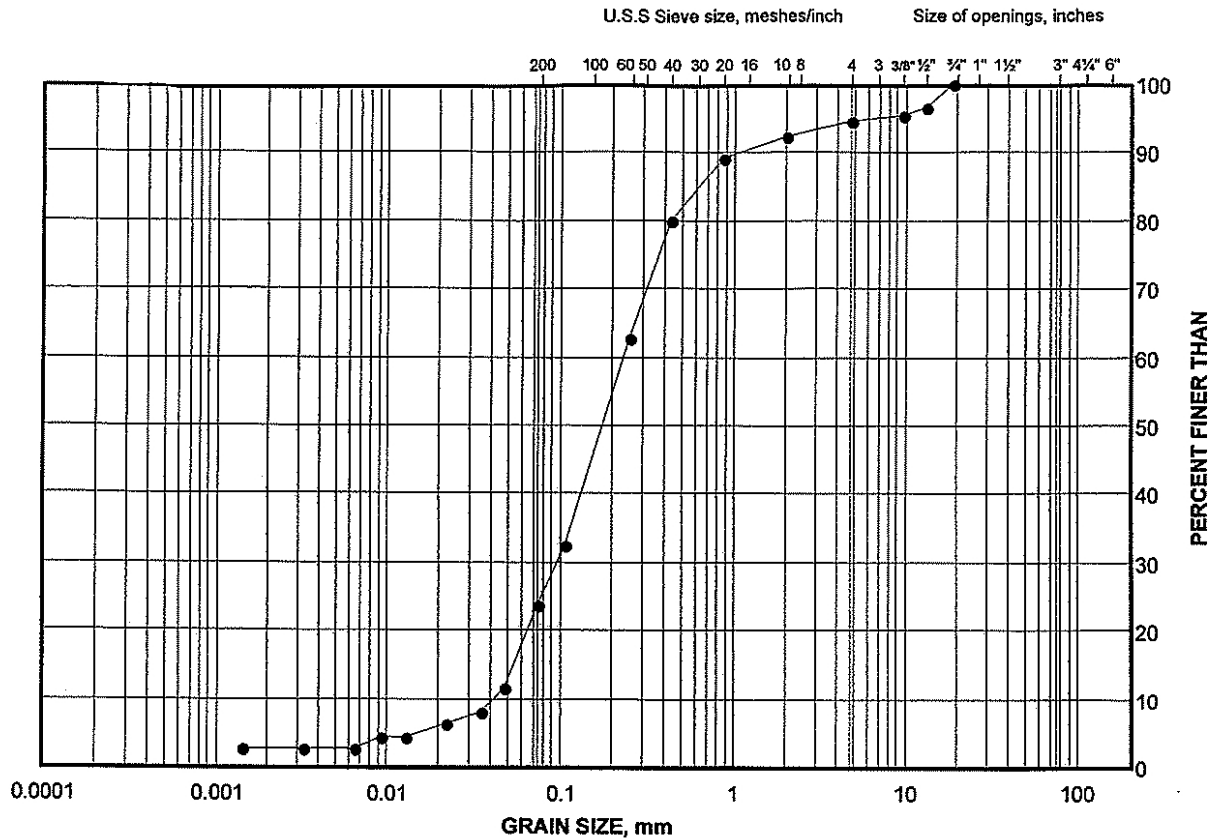
Checked By: *[Signature]*

Golder Associates

Date: 09-Jun-08

GRAIN SIZE DISTRIBUTION

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	08-1	4	

REMARKS
3080770.04

Project Number: 08-1116-0009

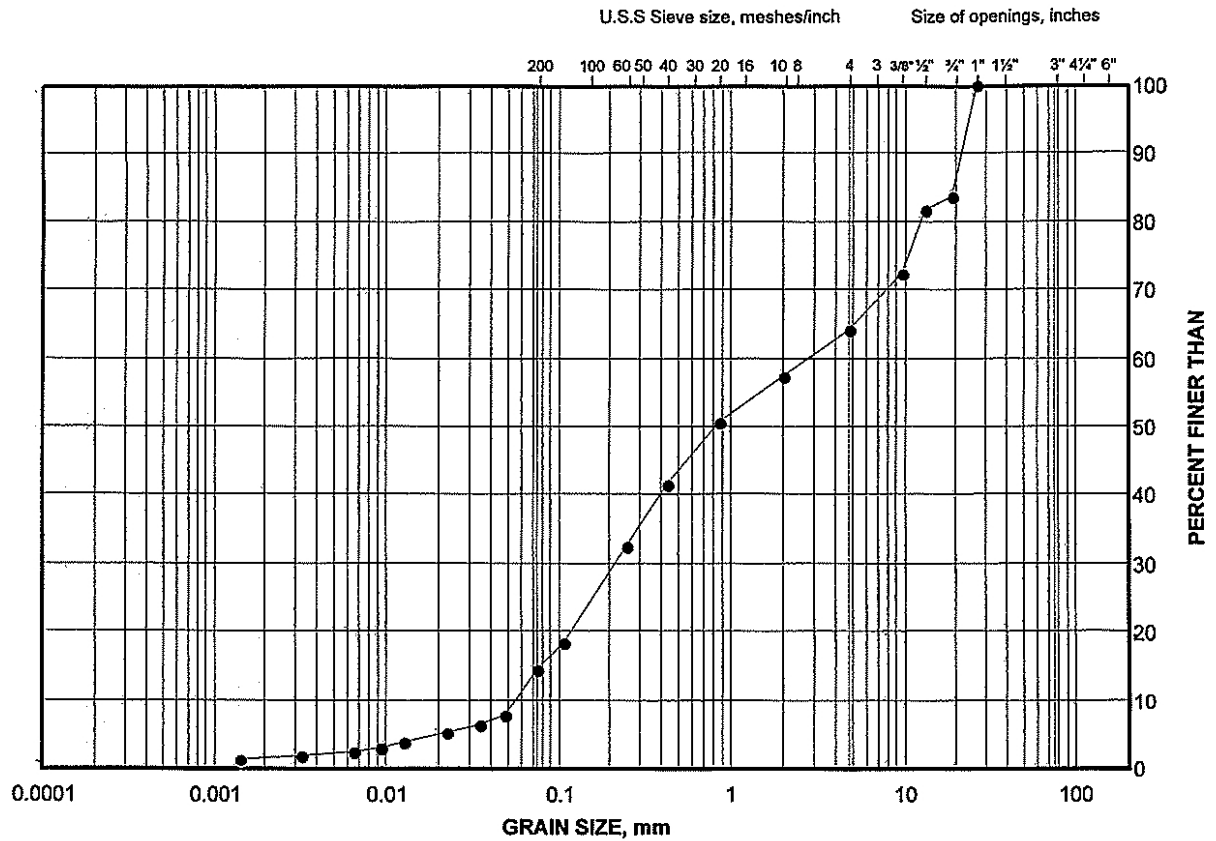
Checked By: _____

Golder Associates

Date: 09-Jun-08

GRAIN SIZE DISTRIBUTION

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	08-2	3	

REMARKS
3080770.04

Project Number: 08-1116-0009

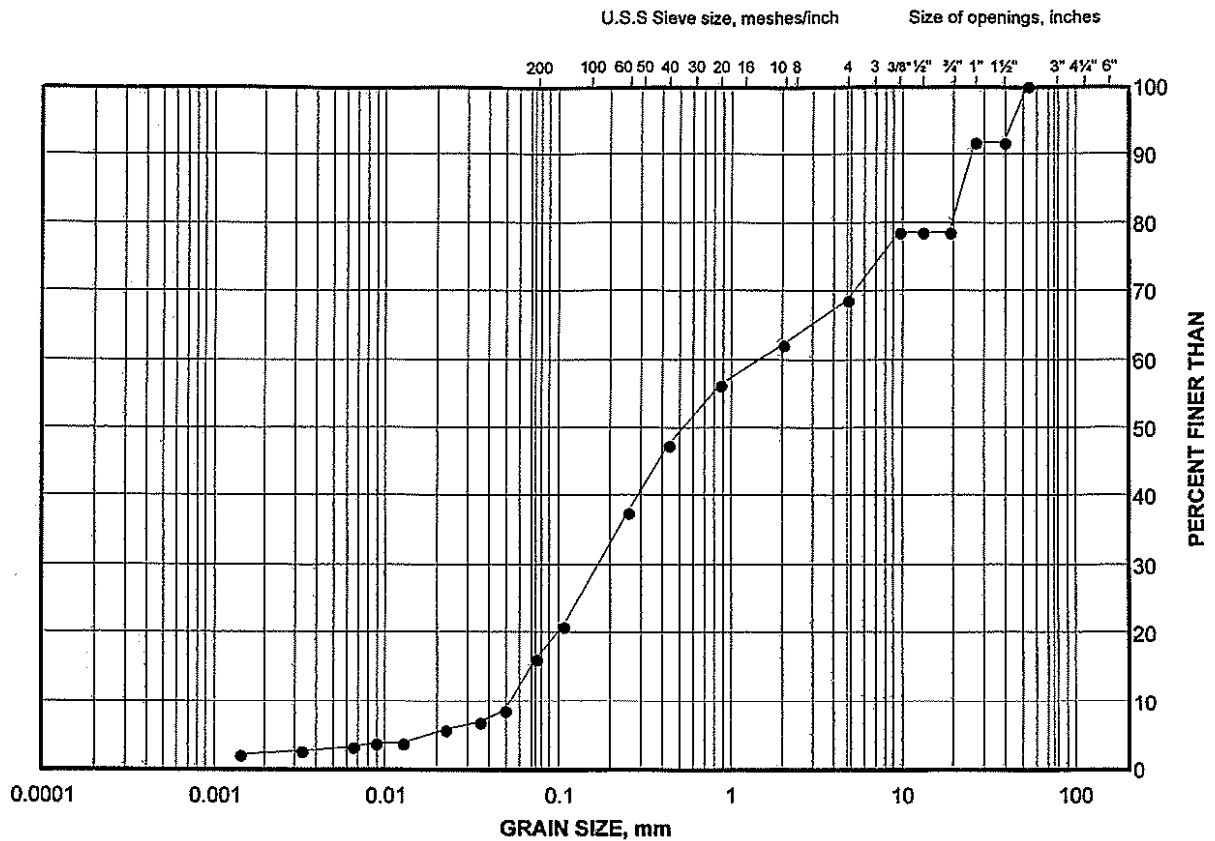
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Golder Associates

Date: 09-Jun-08

GRAIN SIZE DISTRIBUTION

FIGURE



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	08-3	2	

REMARKS
3080770.04

Project Number: 08-1116-0009

Checked By: _____

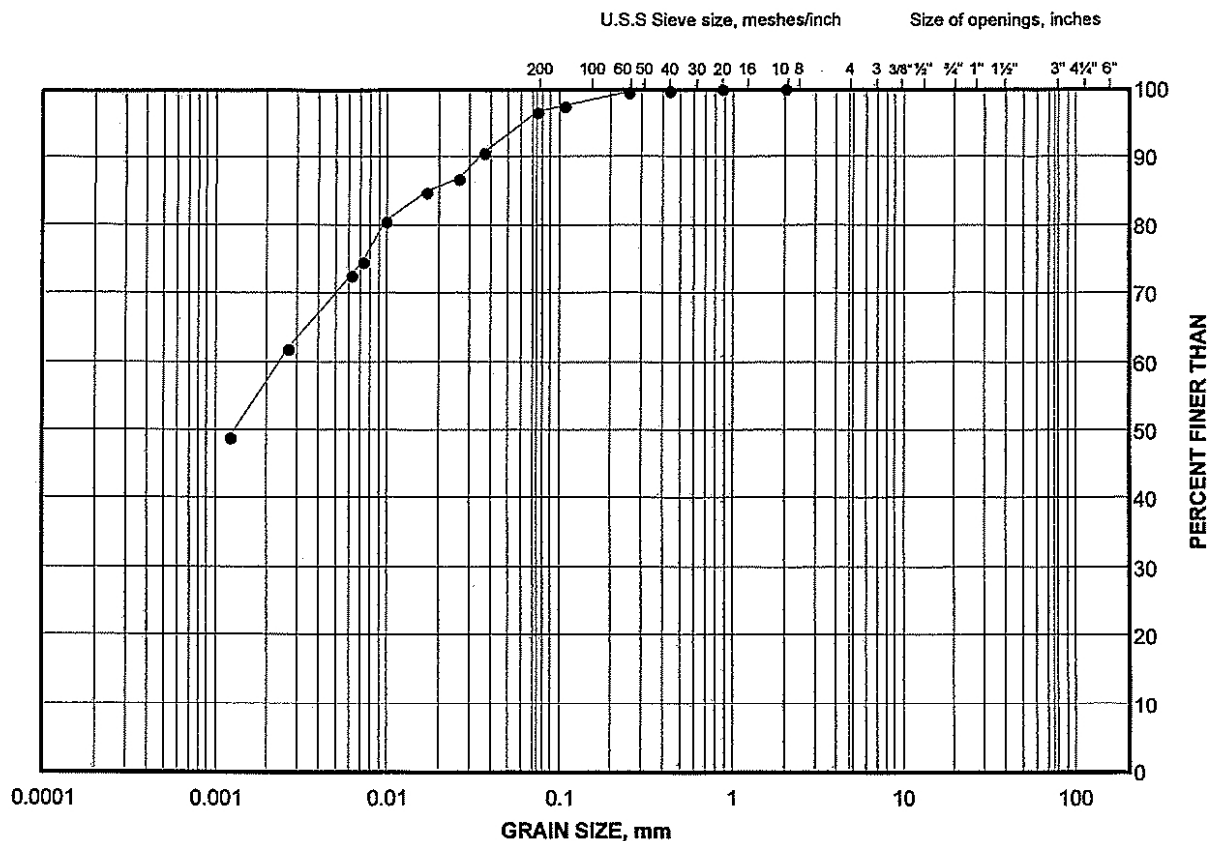
MLL

Golder Associates

Date: 09-Jun-08

GRAIN SIZE DISTRIBUTION

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	08-3	5	

REMARKS
3080770.04

Project Number: 08-1116-0009

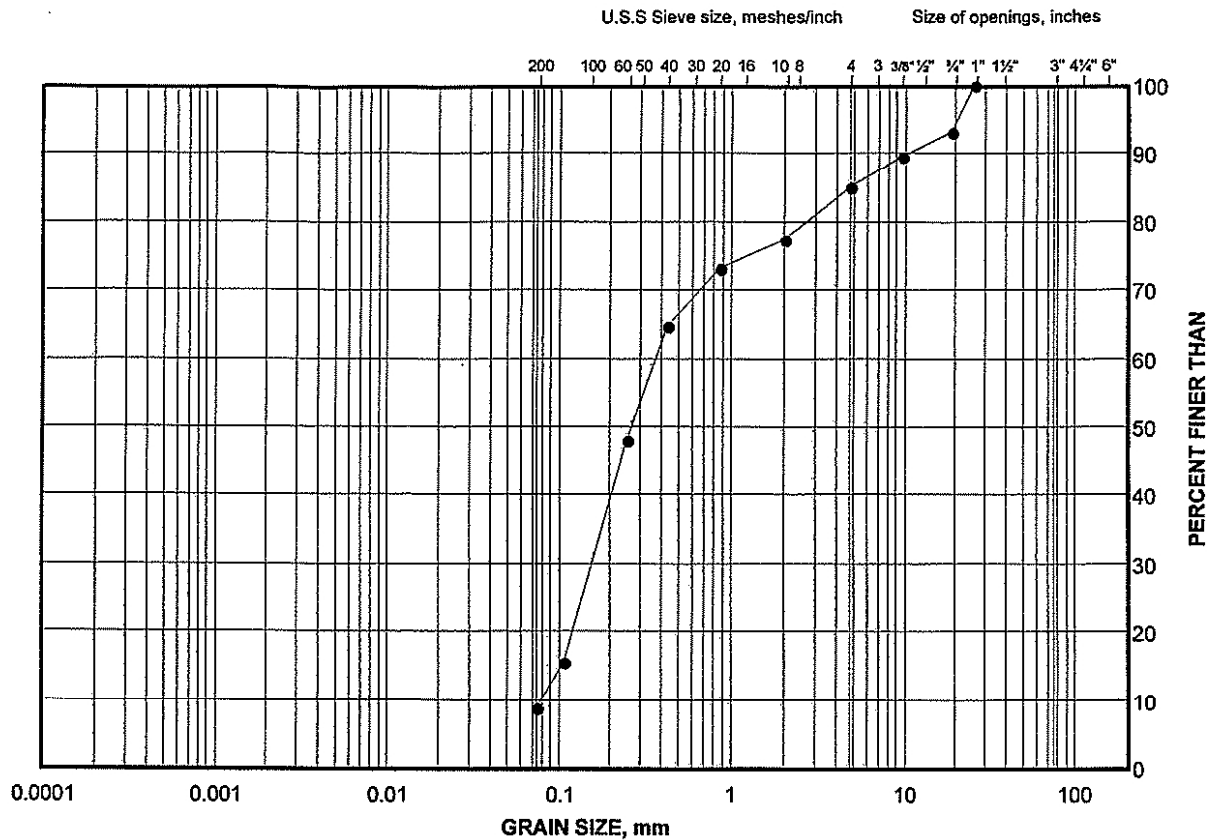
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Golder Associates

Date: 09-Jun-08

GRAIN SIZE DISTRIBUTION

FIGURE



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	08-3	6	

REMARKS
3080770.04

Project Number: 08-1116-0009

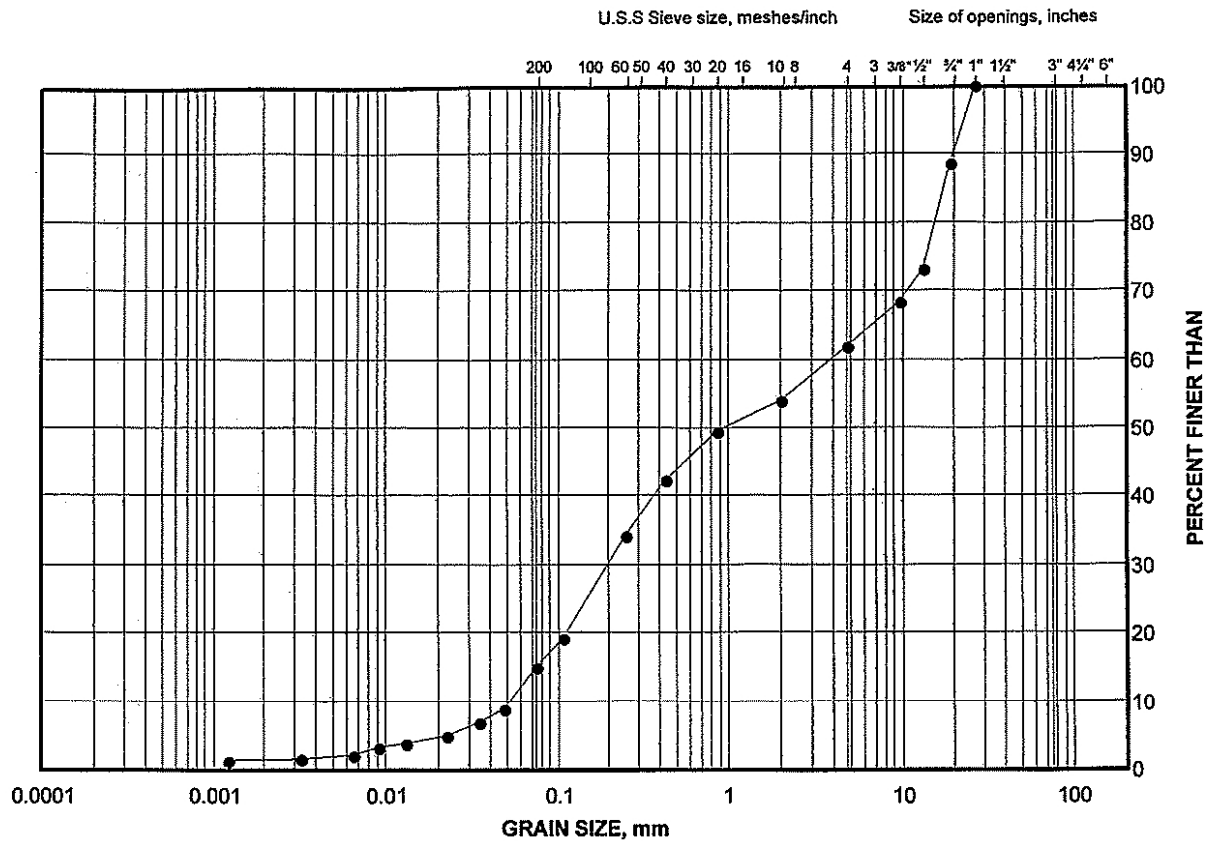
Checked By: *llh*

Golder Associates

Date: 09-Jun-08

GRAIN SIZE DISTRIBUTION

FIGURE



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	08-4	2	

REMARKS
3080770.04

Project Number: 08-1116-0009

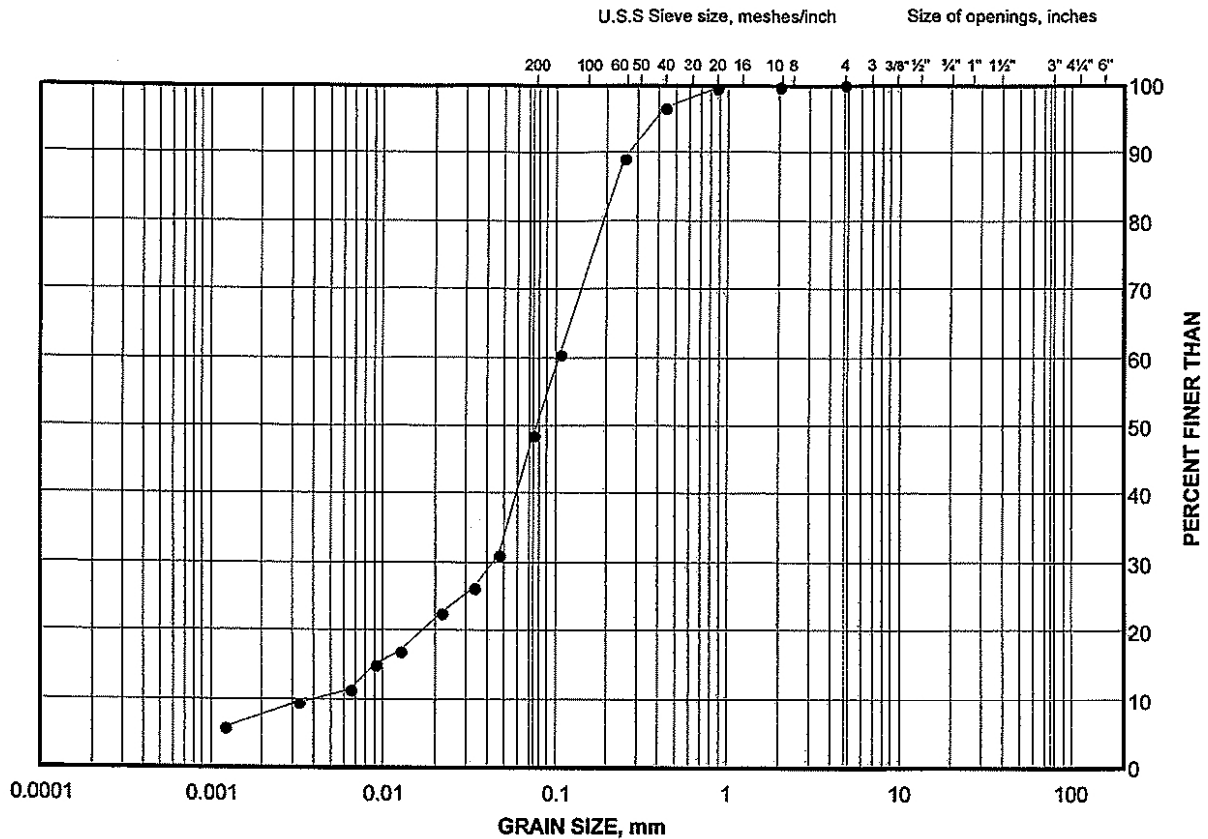
Checked By:

Golder Associates

Date: 09-Jun-08

GRAIN SIZE DISTRIBUTION

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	08-4	4	

REMARKS
3080770.04

Project Number: 08-1116-0009

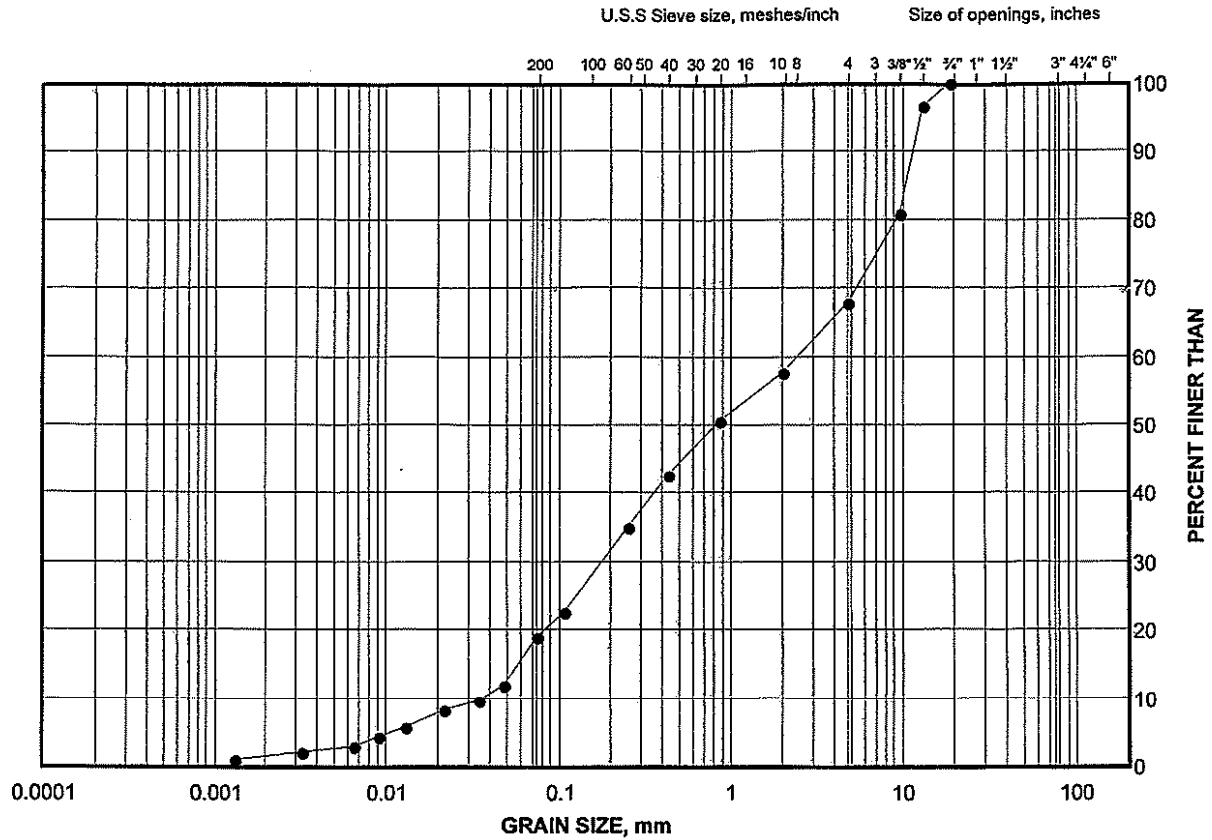
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Golder Associates

Date: 09-Jun-08

GRAIN SIZE DISTRIBUTION

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	08-5	2	

REMARKS
3080770.04

Project Number: 08-1116-0009

Checked By: _____

Golder Associates

Date: 09-Jun-08

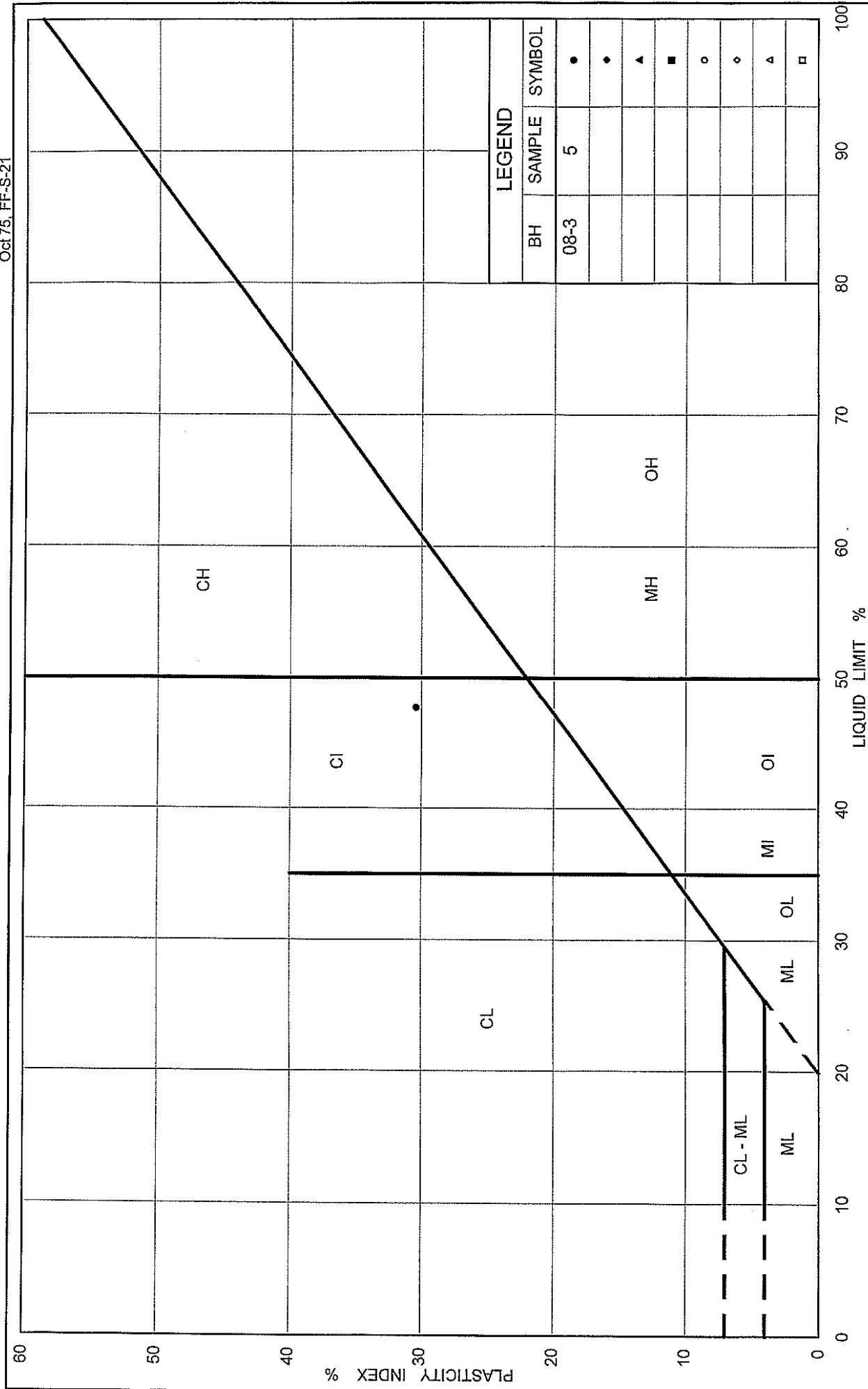
TABLE 1

SUMMARY OF ATTERBERG DETERMINATIONS

ASTM D 4318-05

PROJECT NUMBER	08-1116-0009
PROJECT NAME	Jagger Hims / Lab Testing / 3080770.04
DATE TESTED	May, 2008

Borehole No.	Sample No.	Atterberg Limits LL, PL, PI
08-3	5	LL=47.7, PL=17.3, PI=30.4



PLASTICITY CHART

Figure No.

Project No. 08-1116-0009

Checked By: *MM*

Ministry of Transportation



Ontario