



Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

GEOCRES # 42H-29

**GEOTECHNICAL INVESTIGATION
SAND STORAGE DOME BUILDING, COCHRANE
P.O. 5001-X-002836
MTO NORTHERN REGION**

PREPARED FOR: Ontario Ministry of Transportation
447 McKeown Ave., Suite 301
North Bay, Ontario
P1B 9S9

Attention : Mr. Dale Smith, P. Eng.

File No. 001023
August 15, 2000

© **Terraprobe Limited**

DISTRIBUTION

6 copies	- MTO Northern Region, North Bay
1 copy	- Terraprobe Limited , Sudbury
1 copy	- Terraprobe Limited , Brampton

Terraprobe Limited

12 Bram Court, Unit 18
Brampton, Ontario L6W 3V1
(905) 796-2650 Fax 796-2250

220 Bayview Drive, Unit 25
Barrie, Ontario L4N 7T3
(705) 739-8355 Fax 739-8369

1012 Kelly Lake Road, Unit 1
Sudbury, Ontario P3E 5P4
(705) 670-0460 Fax 670-0558

903 Barton Street, Unit 22
Stoney Creek, Ontario L8E 5P5
(905) 643-7560 Fax 643-7559
1-800-465-2066

www.terraprobe.on.ca



Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

August 15, 2000

File No. 001023
Sudbury Office

Ontario Ministry of Transportation

447 McKeown Ave., Suite 301

North Bay, Ontario

P1B 9S9

Attention : Mr. Dale Smith, P. Eng.

**RE: GEOTECHNICAL INVESTIGATION
P.O. 5001-X-002836
SAND STORAGE DOME, COCHRANE**


Dear Sir:

Enclosed is our Geotechnical Investigation report which has been prepared in conjunction with the design of the new Salt Storage Dome building, at the existing MTO Yard in Cochrane, Ontario.

We trust that this report is satisfactory for your present requirements. If there is any point requiring further clarification, please do not hesitate to contact our office.

Yours Truly,

Terraprobe Limited

for 
Denis Paquette, P.Eng.
Sudbury Branch Manager



Michael Tanos, P.Eng.
Principal

Terraprobe Limited

12 Bram Court, Unit 18
Brampton, Ontario L6W 3V1
(905) 796-2650 Fax 796-2250

220 Bayview Drive, Unit 25
Barrie, Ontario L4N 7T3
(705) 739-8355 Fax 739-8369

1012 Kelly Lake Road, Unit 1
Sudbury, Ontario P3E 5P4
(705) 670-0460 Fax 670-0558

www.terraprobe.on.ca

903 Barton Street, Unit 22
Stoney Creek, Ontario L8E 5P5
(905) 643-7560 Fax 643-7559
1-800-465-2066

INTRODUCTION

This report presents the results of a geotechnical investigation which has been undertaken in conjunction with the design of a new Sand Storage Dome building to be constructed at the existing MTO Yard (2nd Street) in Cochrane, Ontario. The location of the site is shown on the Key Plan, Figure 1.

The project consists of the design of a new Sand Storage Dome building, circular about 30 m in diameter (plan view) and about 15 m maximum height. The sidewalls are to be about 2.5 m high above grade.

Boreholes were put down at the proposed site of the building. A native soft to firm clay stratum was encountered beneath layers of earth fill and topsoil in the boreholes, extending down to very dense silt till at depths of about 10½ m.

Foundations for the building may be supported on either a raft slab foundation (reinforced concrete) resting on a thick mat (minimum 2 m deep) of granular fill, or on driven piles and grade beams which extend to depths of more than 10½ m. The weight of the stockpiled sand on the existing ground surface will result in significant consolidation (150 to 300 mm) of the underlying soft to firm clay stratum. The rate of consolidation and associated ground settlement will depend on the amount of stored sand and the duration of storage, but can be expected to occur over several years.

TABLE OF CONTENTS

INTRODUCTION	-i-
 PART A - FOUNDATION INVESTIGATION REPORT	 -1-
1.0 SITE DESCRIPTION	-1-
2.0 INVESTIGATION METHODOLOGY AND RESULTS	-1-
3.0 SUBSURFACE CONDITIONS	-2-
3.1 Soil Conditions	-2-
3.2 Ground Water Conditions	-5-
 PART B - FOUNDATION DESIGN REPORT	 -6-
4.0 ENGINEERING DISCUSSION AND RECOMMENDATIONS	-6-
4.1 Consolidation Settlement Considerations	-6-
4.2 Raft Slab Foundation on Granular Pad	-8-
5.0 CLOSURE	-9-

APPENDIX

Abbreviations & Terminology
Logs of Boreholes 1, 2, 3
Figure 1 - Key Plan
Figure 2 - Location Plan
Laboratory Test Results

PART A - FOUNDATION INVESTIGATION REPORT

1.0 SITE DESCRIPTION

P.O. 5001-X-002836 comprises the geotechnical investigation of subsurface conditions at the site of the proposed Sand Storage Dome building, in preparation for the building design. The new Sand Storage Dome is to be located in the existing MTO Yard on 2nd Street in Cochrane, Ontario. The location of the site is shown on the Key Plan, Figure 1. There are two (2) existing Sand Storage Domes on the site already.

This report address the geotechnical aspects of the design of foundations for the new Sand Storage Dome building.

It should be noted that the subsurface soil, rock and groundwater conditions described above represent generalized conditions only, and should not be considered site specific.

2.0 INVESTIGATION METHODOLOGY AND RESULTS

The field work for this investigation was carried out at the site on July 26, 2000 at which time three (3) boreholes were drilled in the general area of the proposed Sand Storage Dome. The locations of the boreholes are shown on the attached Location Plan, Figure 2.

The boreholes were drilled using a truck mounted power auger drill rig supplied and operated by a specialist drilling contractor. The boreholes were generally advanced to depths of about 10 m to 19.5 m below the existing ground surface using hollow stem augers.

Standard Penetration Testing (SPT) and sampling were carried out at intervals of 0.75 m to 1.5 m depth in each borehole (0.75 m to 3 m depth, 1.5 m deeper) using conventional 50mm outside diameter spoon sampling equipment. Measurements of undrained shear strength were taken using

a field vane. A dynamic cone was also driven from the bottom of some boreholes. After the drilling, sampling, and logging were completed, the boreholes were backfilled with drill cuttings. The borehole samples were sealed in airtight plastic containers and transported to Terraprobe's laboratory where the samples were examined by a Senior Geotechnical Engineer samples selected for geotechnical testing.

The field work was supervised throughout by members of our engineering staff who arranged for underground service clearances, directed the drilling and sampling operations, logged the boreholes, and cared for the samples obtained. The boreholes were located in the field with respect to existing topographical features. The ground surface elevations at the borehole locations were measured relative to a temporary bench mark with assumed elevation as follows;

Existing floor at Bay Door 7 of Municipal Garage south of Boreholes	Elev. 100.00 m.
--	-----------------

3.0 SUBSURFACE CONDITIONS

The subsurface soil and groundwater conditions encountered in the boreholes are presented on the attached Log of Borehole sheets. The stratigraphic boundaries indicated on the logs of boreholes typically represent a transition from one soil type to another and should not be interpreted to represent exact planes of geological change. The subsurface conditions are confirmed at the borehole locations only, and may vary between and beyond the borehole locations.

3.1 Soil Conditions

The boreholes were located in the existing MTO Yard. The subsurface conditions encountered in the boreholes, generally consisted of a thin layer of sand and gravel fill at the ground surface over earth fill (clay/silt) extending to depths of about 1½ m, and overlying an organic topsoil layer about ½ m thick before encountering a native clay stratum. The clay stratum was soft to firm and extended to

depths of about 10½ m where very dense silt till was found. The silt till extended to depths of at least 19½ m. The ground water table was within 1 to 2 m depth below grade.

Fill and Topsoil

At the ground surface the boreholes encountered a brown sand and gravel layer about 300 mm thick. The sand and gravel was wet and compact. Beneath the sand and gravel layer, earth fill extended to depths of about 1½ m. The earth fill was typically grey, moist, firm, and mostly clay and silt, with occasional localized areas of silty sand.

Standard Penetration Test (SPT) results within the earth fill ranged with 'N values' of about 4 to 9 blows per 0.3m. The measured water contents of the earth fill samples ranged from about 26 to 30 percent by weight.

The earth fill was underlain by organic topsoil (silty) which extended to depths of about 2 m below grade. The topsoil was grey and black, moist to wet, and had a soft to firm consistency. (SPT) results within the topsoil ranged with 'N values' of about 3 to 7 blows per 0.3m. The measured water contents of the topsoil samples ranged from about 60 to 100 percent by weight.

Native Clay

Beneath the earth fill and topsoil and below depths of about 2 m, a native clay stratum was encountered to depths about 10½ m. The clay was typically grey, moist to wet, and with a soft to firm consistency.

The results of laboratory grain size analyses (sieve and hydrometer), indicate the clay is typically comprised of about 40 to 50 percent silt size particles and about 50 to 60 percent clay size particles (see attached Figures). Some occasional zones of silty to sandy material were noted in the boreholes. The measured water contents of the clay stratum samples ranged from about 24 to 33 percent by weight.

The results of Atterberg Limits Tests indicate the clay has the following properties;

Liquid Limit:	36 to 39 %	
Plastic Limit:	16 to 21 %	(in situ $w_c = 24$ to 33%)
Plasticity Index:	18 to 19 %	

Plasticity Classification: medium plasticity

Compressibility Classification: moderate/intermediate compressibility

Unified Classification: CI intermediate plasticity clay.

(SPT) results within the clay ranged with 'N values' of about 2 to 10 blows per 0.3m. Field vane measurements of undrained shear strength in the clay gave values of about 30 to 40 kPa, confirming its soft to firm consistency.

The following estimated soil parameters are recommended for analysis and design;

CI Clay

undrained shear strength:	30 to 40 kPa
initial void ratio, e_o :	0.65 to 0.75
Compression/Consolidation Index, C_c :	0.16 to 0.21

Native Silt Till

Beneath the soft to firm clay, below depths of about 10½ m, native very dense silt till was found to extend to depths of at least 19½ m. The silt till was typically grey, moist, and very dense. It should be noted that glacial till is an inherently variable material. The presence of cobbles and boulders within the till deposits at the site should be expected.

Field penetration resistance measurements of 90 to 165 blows per 0.3m (typically 120) were measured in the silt till. The measured water contents of the silt till samples ranged from about 19 to 25 percent by weight.

3.2 Ground Water Conditions

During the borehole drilling, all of the samples were wet. It is estimated that the ground water table is within 1 to 2 m of existing grade. It can be expected that ground water levels will be subject to seasonal variations.

PART B - FOUNDATION DESIGN REPORT

4.0 ENGINEERING DISCUSSION AND RECOMMENDATIONS

This section of the report provides our interpretation of the factual data obtained during this investigation and is intended for design purposes only. Comments made with respect to the construction aspects are only provided in as much as they may impact on design considerations. Contractors bidding on or undertaking these works should review the factual information, satisfy themselves as to the adequacy of the information, and make their own interpretation of the data as it affects their construction techniques, equipment selection, scheduling, and the like.

4.1 Consolidation Settlement Considerations

The summarized ground conditions consist of the following;

Depth, m	Description
0 to 1.5	Fill; sand & gravel surface, clay, wet
1.5 to 2.0	Topsoil; organic, wet
2.0 to 10.5	Clay; soft to firm, wet
10.5 to 19.5	Silt Till; very dense

It is understood the proposed Sand Storage Dome building will be about 30 m diameter in plan, with 2.5 m high side walls and roof extending to a height of about 15 m in the centre. At maximum storage, the vertical pressure resulting from the sand is estimated to be as follows;

- | | |
|-------------------------------|---------|
| a) Near side wall, 2.5 m high | 45 kPa |
| b) Centre, 15 m high | 265 kPa |
- (sand unit weight = 17.5 kN/cu.m)

The weight of the stockpiled sand on the existing ground surface will result in significant consolidation of the underlying soft to firm clay stratum which extends to depths of about 10½ m below existing grade. The rate of consolidation and associated ground settlement (estimated to be a maximum of 150 to 300 mm) will depend on the amount of stored sand and the duration of storage, but can be expected to occur over several years.

The consolidation settlement has potential to impact on the building foundations (additional loading due to down-drag, increased lateral loads). It is not likely economically feasible to support the building floor on deep foundations so as to not load the clay by the weight of the stored sand.

The potential for consolidation settlement could be reduced by surcharging or pre-loading the site area for several years prior to construction. This would typically involve stockpiling soil over the future building area to heights of 6 to 10 m, for 1 to 2 years to cause the clay consolidation to occur. The surcharge or pre-load would then be removed and the building constructed. This method can be costly and requires considerable time to complete. Monitoring of settlement is normally carried out after loading. The time for consolidation to occur can be reduced by installing sand wicks or drains through the clay prior to surcharging.

In order to proceed with design and construction without prior pre-loading of the site, the design of foundations could consist of either of the following;

- a) driven steel piles to depths of more than 10½ m to support the building walls on grade beams; pile design to allow for 'down-drag' forces; may require batter piles to resist lateral loads from clay consolidation; expected to be very costly; or
- b) floating raft slab (reinforced concrete) resting on thick granular pad; replace existing soil with compacted granular fill to depth of at least 2 m over entire building area; this is the recommended method.

4.2 Raft Slab Foundation on Granular Pad

A thick granular pad beneath the building will offer protection against excessive differential settlement from consolidation of the underlay clay stratum. The granular pad should extend to depths of at least 2 m beneath the building floor level, and should extend to below the existing earth fill and topsoil. Laterally, the granular pad should extend at least 2 m beyond the edge of the building walls at grade and should slope down at 1 to 1 (H:V) or flatter.

The granular pad should consist of well graded, free-draining material such as OPSS Granular 'A' or Granular 'B'. The granular material should be placed and compacted in thin lifts (150 mm thick or less), to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD). Full-time inspection and testing of compaction is recommended during the placement and compaction of the granular pad. The granular pad construction should be carried out during non-freezing weather and using unfrozen materials only.

The coefficient of friction between concrete and the soil may be taken as 0.6 (unfactored) for assessment of sliding resistance.

The recommended modulus of subgrade reaction appropriate for slab design is 30,000 kN/cu.m.


Consideration should be given to planning the initial floor level of the sand storage building sufficiently high, so that the anticipated future consolidation settlement can be accommodated with surrounding grades.

5.0 CLOSURE

We trust that this report is satisfactory for your present requirements. If there is any point requiring further clarification, please do not hesitate to contact our office.

Yours Truly,

Terraprobe Limited

for 

Denis Paquette, P.Eng.
Sudbury Branch Manager





Michael Tanos, P.Eng.
Principal



APPENDIX

Terraprobe Limited





ABBREVIATIONS, TERMINOLOGY, GENERAL INFORMATION

BOREHOLE LOGS

SAMPLING METHOD		PENETRATION RESISTANCE		
SS	split spoon	Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.). Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.).		
ST	Shelby tube			
AS	auger sample			
WS	wash sample			
RC	rock core			
WH	weight of hammer			
PH	pressure, hydraulic			
SOIL DESCRIPTION - COHESIONLESS SOILS		SOIL DESCRIPTION - COHESIVE SOILS		
Relative Density	'N' value	Consistency	Undrained Shear Strength, kPa	'N' value
very loose	< 4	very soft	< 12	< 2
loose	4 - 10	soft	12 - 25	2 - 4
compact	10 - 30	firm	25 - 50	4 - 8
dense	30 - 50	stiff	50 - 100	8 - 16
very dense	> 50	very stiff	100 - 200	16 - 32
		hard	> 200	> 32
SOIL COMPOSITION		TESTS, SYMBOLS		
	% by weight	MH	mechanical sieve and hydrometer analysis	
'trace' (e.g. trace silt)	< 10	w, w _c	water content	
'some' (e.g. some gravel)	10 - 20	w _l	liquid limit	
adjective (e.g. sandy)	20 - 35	w _p	plastic limit	
'and' (e.g. sand and gravel)	35 - 50	I _p	plasticity index	
		k	coefficient of permeability	
		γ	soil unit weight, bulk	
		φ'	angle of internal friction	
		c'	cohesion shear strength	
		C _c	compression index	
GENERAL INFORMATION, LIMITATIONS				
The conclusions and recommendations provided in this report are based on the factual information obtained from the boreholes and/or test pits. Subsurface conditions between the test holes may vary.				
The engineering interpretation and report recommendations are given only for the specific project detailed within, and only for the original client. Any third party decision, reliance, or use of this report is the sole and exclusive responsibility of such third party. The number and siting of boreholes and/or test pits may not be sufficient to determine all factors required for different purposes.				
It is recommended Terraprobe be retained to review the project final design and to provide construction inspection and testing.				

BOREHOLE LOGS

Terraprobe Limited



RECORD OF BOREHOLE No 1

1 OF 2

METRIC

W.P. P.O.# 5001-X-002836 LOCATION Proposed Sand Storage Dome ORIGINATED BY AB
 DIST North. Region HWY Cochrane BOREHOLE TYPE Rotary Auger, hollow stem COMPILED BY JB
 DATUM Local (Assumed) DATE 26.07.00 - 26.07.00 CHECKED BY MT

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			20	40					
100.1	Ground Surface													
0.0	Sand & Gravel		1	SS										
99.8														
0.3	EARTH FILL silty sand and clay grey, wet, soft to firm		2	SS	4									
98.6			3	SS	5									
1.5	TOPSOIL silty, black		4	SS	5									
98.1														
2.0	CLAY (CI) clay & silt grey, wet, soft to firm,		5	SS	10									
			6	SS	3									
			7	SS	4									
			8	SS	3									
			9	SS	9									
			10	SS	165									
89.7														
10.4	SILT TILL some clay grey, wet very dense,		11	SS	107									
			12	SS	90									
			13	SS	125									

ON_MOT_001023.GPJ ON_MOT_GDT_16/09/00

Continued Next Page

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

RECORD OF BOREHOLE No 1

2 OF 2

METRIC

W.P. P.O.# 5001-X-002836 LOCATION Proposed Sand Storage Dome ORIGINATED BY AB
 DIST North. Region HWY Cochrane BOREHOLE TYPE Rotary Auger, hollow stem COMPILED BY JB
 DATUM Local (Assumed) DATE 26.07.00 - 26.07.00 CHECKED BY MT

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	20 40 60 80 100					
85													
84			14	SS		135							
83	End of Borehole												
82													
81													
80.6	End of Cone Test												
19.5													

ON_MOT_001023.GPJ ON_MOT_GDT_16/09/00

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. P.O.# 5001-X-002836 LOCATION Proposed Sand Storage Dome ORIGINATED BY AB
DIST North. Region HWY Cochrane BOREHOLE TYPE Rotary Auger, hollow stem COMPILED BY JB
DATUM Local (Assumed) DATE 26.07.00 - 26.07.00 CHECKED BY MT

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								WATER CONTENT (%)		
								20 40 60 80 100										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
100.0	Ground Surface																	
0.0 99.7 0.3	Sand & Gravel		1	SS														
	EARTH FILL clay & silt grey, wet, firm		2	SS	9													
			3	SS	3													
98.5																		
1.5 98.0 2.0	TOPSOIL black, wet, soft		4	SS	10													
	CLAY (Cl) grey, wet, soft to firm clay & silt		5	SS	14													
			6	SS	6													
			7	SS	5													
			8	SS	6													
			9	SS	41													
91.1 8.9		SILT TILL some clay grey, wet, very dense,																
89.6 10.4		End of Borehole		10	SS	486/30cm												

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

RECORD OF BOREHOLE No 3

1 OF 1

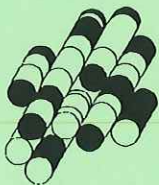
METRIC

W.P. P.O.# 5001-X-002836 LOCATION Proposed Sand Storage Dome ORIGINATED BY AB
DIST North. Region HWY Cochrane BOREHOLE TYPE Rotary Auger, hollow stem COMPILED BY JB
DATUM Local (Assumed) DATE 26.07.00 - 26.07.00 CHECKED BY MT

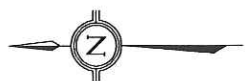
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	10	20	30				
100.1	Ground Surface		1	SS													
99.8	Sand & Gravel		2	SS	5												
99.3			3	SS	4												
98.6	EARTH FILL clay & topsoil grey & black		4	SS	6												
98.1	TOPSOIL black, wet, soft		5	SS	11												
97.6			6	SS	3												
97.1	CLAY (CI)		7	SS	2												
96.6			8	SS	2												
96.1			9	SS	10												
95.6																	
95.1																	
94.6																	
94.1																	
93.6																	
93.1																	
92.6																	
92.1																	
91.6																	
91.1																	
90.1	End of Borehole																
10.0	SILT TILL very dense, grey																
89.1																	
11.0	End of Cone Test																

ON_MOT_001023.GPJ ON_MOT.GDT 16/08/00

FIGURES



Terraprobe Limited



SECOND STREET

asphalt

Existing Sand Domes

Proposed Sand Dome

grass

gravel

asphalt

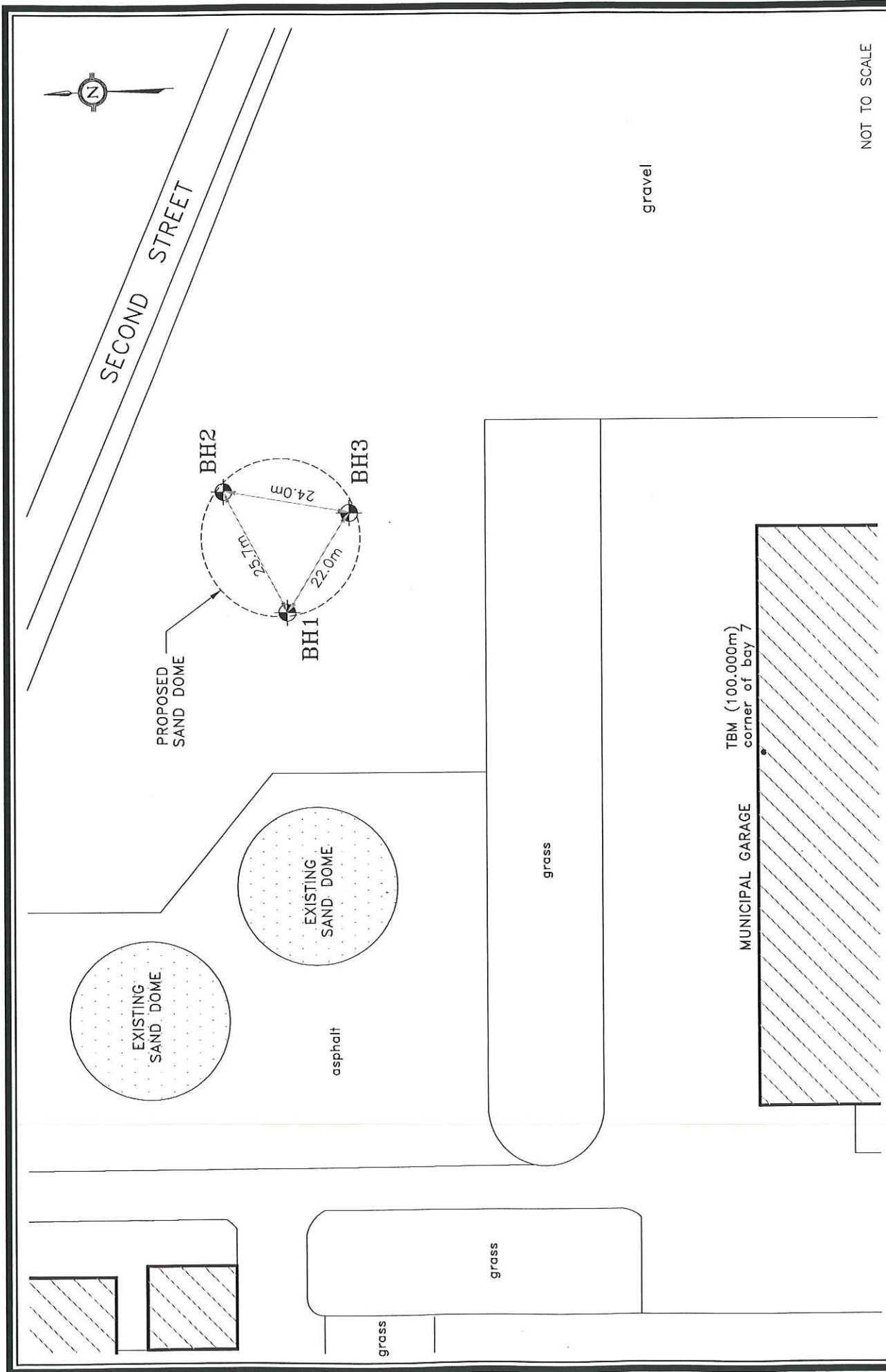
NOT TO SCALE

SITE PLAN

FIGURE 1

File No. 001023

TERRAPROBE



NOT TO SCALE

BOREHOLE LOCATION PLAN

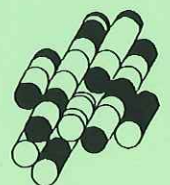
FIGURE 2

File No. 001023

TERRAPROBE

LABORATORY RESULTS

Terraprobe Limited





Terraprobe

SIEVE AND HYDROMETER ANALYSIS

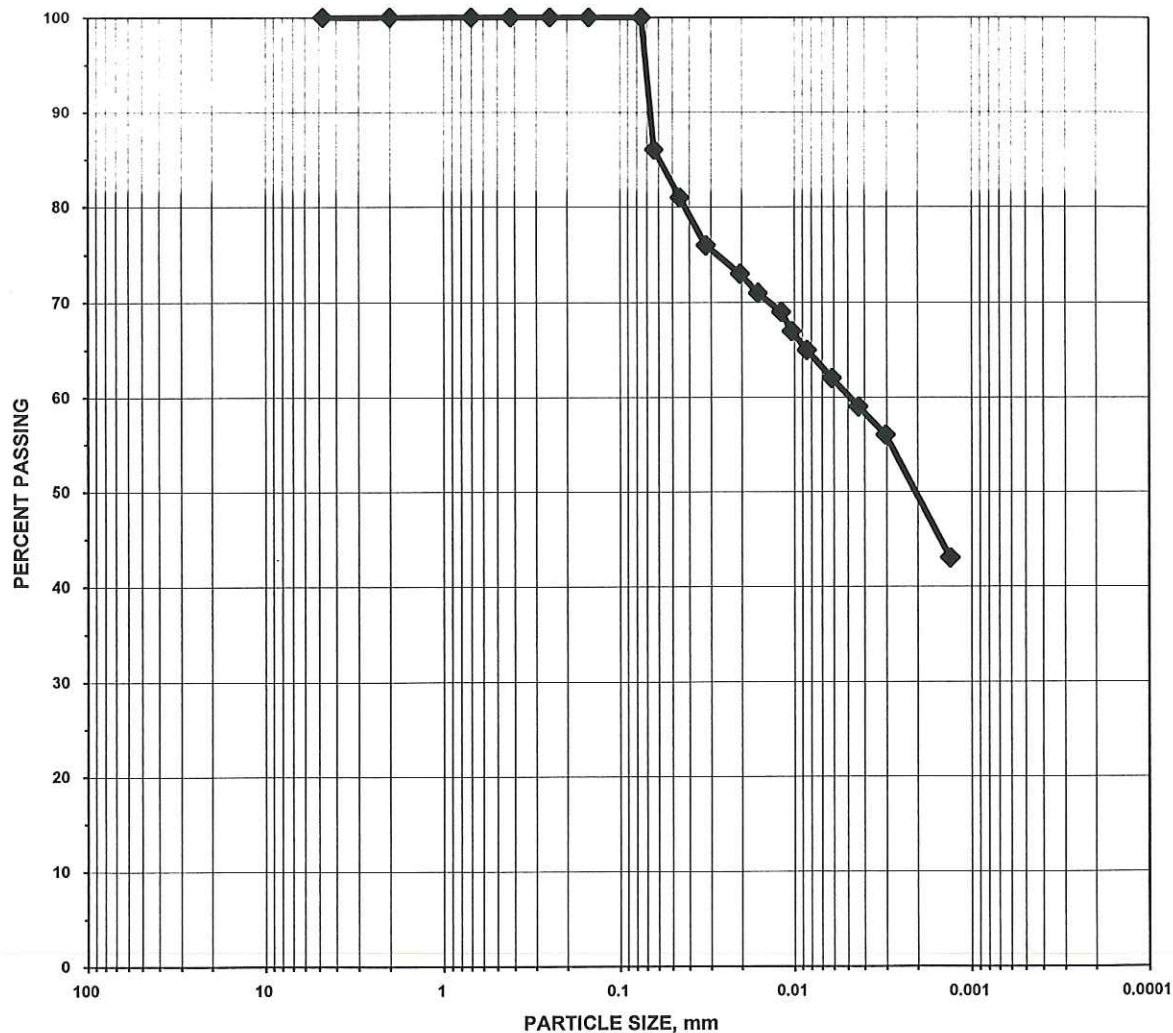
PROJECT: Sand Storage Dome
LOCATION: Cochrane, Ontario
CLIENT: MTO Northern Region

FILE No.: 001023
SAMPLE DATE: July 26, 2000
BOREHOLE No.: 2
SAMPLE No.: 4
SAMPLE DEPTH: 2.2 m

SAMPLE DESCRIPTION: Clay & Silt
medium plasticity, moderate compressibility

wl = 35.5 wp = 16.1 lp = 19.4 wn = 26.7

GRAIN SIZE DISTRIBUTION



M.I.T. SYSTEM	COARSE GRAVEL SIZE	MEDIUM FINE	COARSE SAND SIZE	MEDIUM FINE	SILT SIZE	FINE GRAINED	CLAY SIZE
UNIFIED SYSTEM	COARSE GRAVEL SIZE	FINE	COARSE SAND SIZE	MEDIUM FINE	SILT OR FINE	CLAY SIZE	GRAINED



Terraprobe

SIEVE AND HYDROMETER ANALYSIS

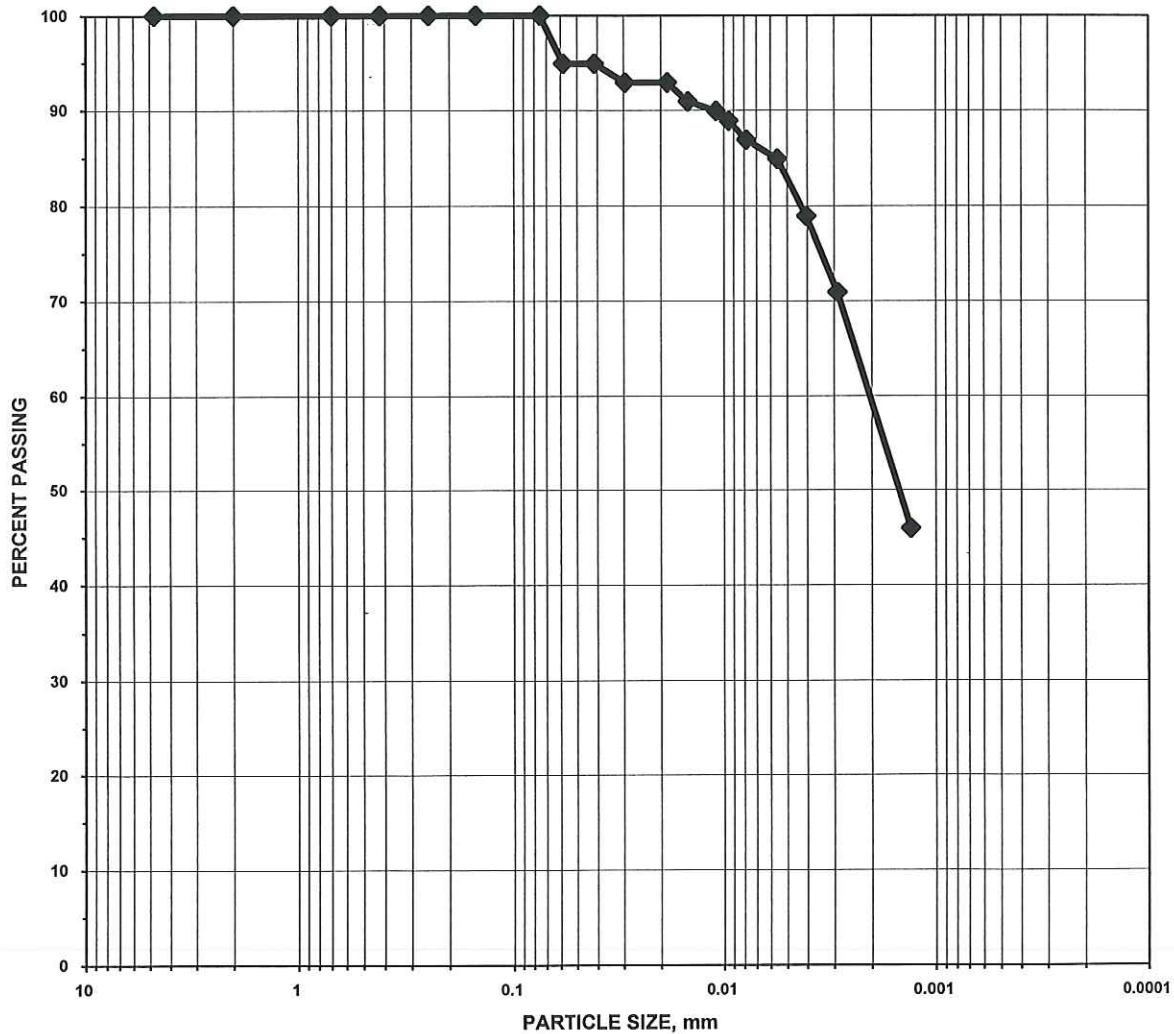
PROJECT: Sand Storage Dome
LOCATION: Cochrane, Ontario
CLIENT: MTO Northern Region

FILE No.: 001023
SAMPLE DATE: July 26, 2000
BOREHOLE No.: 2
SAMPLE No.: 5
SAMPLE DEPTH: 3 m

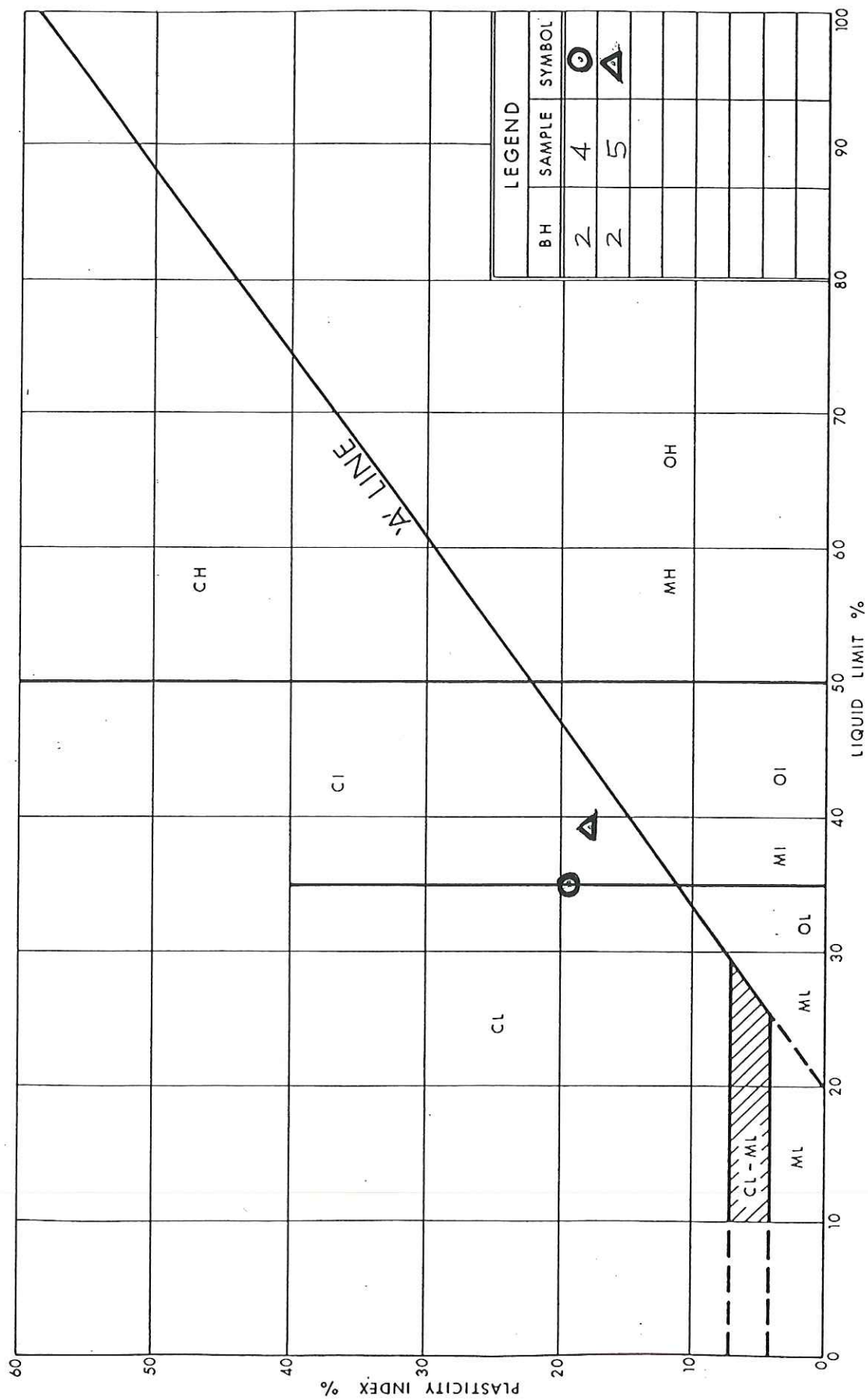
SAMPLE DESCRIPTION: Clay & Silt
medium plasticity, moderate compressibility

wl = 38.9 wp = 20.6 lp = 18.3 wn = 26.8

GRAIN SIZE DISTRIBUTION



M.I.T. SYSTEM	COARSE GRAVEL SIZE	MEDIUM GRAVEL SIZE	FINE GRAVEL SIZE	COARSE SAND SIZE	MEDIUM SAND SIZE	FINE SAND SIZE	SILT SIZE	FINE GRAINED	CLAY SIZE
UNIFIED SYSTEM	COARSE GRAVEL SIZE	FINE GRAVEL SIZE	COARSE SAND SIZE	MEDIUM SAND SIZE	FINE SAND SIZE	SILT OR FINE	OR CLAY SIZE	GRAINED	



ATTERBERG LIMITS