

PICKERING-OSHAWA SECTION
ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

FS-331 **DIST 6**
HWY GO-ALRT **STR SITE**

GO-ALRT - Durham Region Maintenance
Storage Facility

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FOUNDATION INVESTIGATION REPORT
FOR
GO-ALRT Pickering to Oshawa
Project FS-331
Durham Region Maintenance and Storage Facility
District 6, Toronto

INTRODUCTION

This report summarizes the results of the foundation investigation required for the above-noted project.

The fieldwork was conducted between 85 03 25 and 85 04 29 utilizing continuous flight auger machines equipped with hollow-stem and solid-stem augers.

This work consisted of:

- 18 dynamic cone penetration tests/sampled boreholes,
- 3 piezometer installations.

SITE DESCRIPTION

The site is located immediately north of Hwy. 401 and Champlain Avenue, between Thickson Road and Thornton Road, at the border of the Town of Whitby and the City of Oshawa. The area investigated extends from GO-ALRT chainage Sta. 27+420 to Sta. 27+640 from 65 m to 210 m right.

The area is described physiographically by Chapman and Putnam (1984) as the Iroquois Plain, which, in the vicinity of this site, consists generally of a till plain overlain by lacustrine and fluvial deposits in the lower-lying areas.

The topography at this site is rolling - sloping towards the east. The existing surface elevation of the west portion of the site is approximately elevation 96± m. The east portion of the site is located on lower ground with an existing surface elevation of 88± m. A creek flows towards the south along the eastern edge of the site.

The land use is generally farming, with some light industrial/commercial establishments to the south, and residential areas to the north.

SUBSURFACE CONDITIONS

General

The Record of Borehole Sheets, (Appendix) illustrate the conditions at the borehole locations (refer to BH #1 to BH #18). The locations and elevations of the boreholes and stratigraphical profiles based on the borehole data, are shown on the Borehole Locations & Soil Strata Drawing for this project.

The thickness of the overburden was not determined, as the boreholes were terminated before bedrock was encountered. However the overburden extends to at least elevation 70 m. (Surface elevations range from 88 m to 96 m). The overburden material is essentially a sandy till, overlain by silty clay in the lower-lying area at the east portion of the site.

Stratigraphy

Upper Silty Clay (CL); trace/some sand, trace gravel

This very soft to very stiff deposit overlies the till plain in the valley at the east portion of the site. At the borehole locations, the thickness of deposit ranges from 6.4 m near the east end of the site (Sta. 27+640±) to 2.1 m towards the central area of the site.

The material is generally low plasticity silty clay, with extensive zones of intermediate plasticity silty clay.

Physical properties of the material, as determined from field and laboratory tests, are summarized below.

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Natural Moisture Content (w)	14.5 - 40.5%	23.8%	21.8%
Liquid Limit (w_L)	14.0 - 50.0%	28.5%	25.0%
Plastic Limit (w_p)	9.5 - 20.5%	13.9%	13.0%
Unit Weight (γ)	17.4 - 18.5 kN/m ³	N/A	N/A
Shear Strength (c_u)			
-field vane	30.0 - 84.0 kPa	N/A	N/A
-unconfined compression	29.1 - 52.9 kPa	N/A	N/A
-sensitivity	3 - 10	N/A	N/A

Figure 1 illustrates a typical grain size distribution for this deposit.

Sandy Silt; some clay, trace/some gravel, occ. sandy zones

This compact to very dense till deposit is the surface material at the west portion of the site. In the central portion of the site this deposit underlies the Upper Silty Clay deposit, while it is discontinuous over the east end of the site. At the borehole locations, the thickness ranges from 9.1 m at the west end, to 1.2 m at the central areas of the site.

Although the material is slightly cohesive, its insitu behaviour is essentially non-cohesive.

Physical properties of the material, as determined from field and laboratory tests, are summarized below.

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Natural Moisture Content (w)	8.0 - 12.5%	10.0%	9.5%
Liquid Limit (w _L)	15.0 - 18.5%	16.6%	16.0%
Plastic Limit (w _p)	10.0 - 12.0%	10.8%	10.5%

Figure 2 illustrates a typical grain size distribution for this deposit.

Silty Sand; trace gravel, trace clay, occ. silt (ML) zones, occ. gravelly zones

The denseness of this deposit ranged from loose to very dense. However, the deposit is considered to be generally compact to very dense, as sampling procedures tended to loosen the material. This till is the main deposit at the site, underlying both the Upper Silty Clay and Sandy Silt deposits. Its vertical extent was only determined in the valley at the east end of the site, where its thickness is approximately 8 m. At the west portion of the site, the deposit is over 8 m in thickness.

Lower Silty Clay (CL); trace/some sand, trace gravel

This hard deposit was encountered only at BH #8 where it underlies the Silty Sand deposit. Its thickness at this location was 2.5 m.

Silty Sand; with Gravel

This very dense deposit was encountered at BH #8 where it underlies the Lower Silty Clay deposit.

Groundwater Conditions

The groundwater elevation is at or near the surface across the entire site. Artesian conditions with groundwater pressures equivalent to elev. 91± m (2± m above the existing ground surface), were encountered at BH #8 at elev. 72±.

Under conditions of unbalanced hydrostatic head, the cohesive material at this site is susceptible to basal heave, while the non-cohesive material is susceptible to boiling.

DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a maintenance and storage facility for GO-ALRT at this site with GO-ALRT grade at 92.5± m and structure foundations down to 89.5± m at some locations.

General Recommendations (Applicable to All Foundation Alternatives)

EARTH PRESSURE CALCULATIONS

Backfill to structures should consist of granular material in accordance with MTC Standard Special Provision #121 (83 10). Computation of earth pressures should be in accordance with Section 6.6.1.2 of the O.H.B.D.C.

For design purposes, the physical properties of the backfill are as follows:

MATERIAL	ϕ	γ
GRANULAR 'A'	35°	22.0 kN/m ³
GRANULAR 'B'	30°	21.2 kN/m ³

SETTLEMENT CONSIDERATIONS

For the recommended design loadings, differential settlements should be less than 25 mm. However, it is recommended that the building should be designed to accommodate some settlements, especially in those areas where foundations are placed on fill material.

SLOPE STABILITY

Permanent slopes should be 2:1 or flatter; temporary slopes 1.5:1 or flatter.

Detailed slope stability analyses for the area near the existing creek (Sta.27+-640) have not been completed. However, no problems are anticipated if the fill is constructed evenly across the valley.

FROST PROTECTION:

The minimum cover required for frost protection is 1.2 m.

DE-WATERING

De-watering will be required where portions of the structures are to be constructed 'in the dry' below the prevailing groundwater level, in order to prevent disturbance of the foundation soil. It should be noted that under conditions of unbalanced hydrostatic head, the cohesive material at this site is susceptible to basal heave, while the non-cohesive material is susceptible to boiling.

Also, a permanent drainage system will be required to relieve groundwater pressures beneath the structures.

During construction, it is recommended that the groundwater table be lowered a minimum of 1 m below the invert of excavations in which footings, pile/pier caps or floor slabs are to be constructed in the dry.

De-watering can be accomplished by a vacuum well point system, or alternatively, by a system of suitably designed sub-drains.

The sub-drain system could consist of a series of trenches, extending a sufficient depth below the excavation invert to lower the groundwater table as required. The trenches should be backfilled with free-draining material, such as MTC Granular B Type 1, and should contain a perforated pipe encased in a suitable geotextile material. The drain system should be designed so that the invert of the drain trenches is outside of a 2H:1V plane drawn from the edge of the footing base. Strategically located sump pumps could be used to remove water from excavations. The design of drain locations would depend on footing locations.

A series of drains, connected to a 0.6 m (minimum thickness) Granular B Type 1 pad beneath the structure floor slabs could provide the required permanent drainage for this project.

To dispose of water, the drains could be connected to a collector drain leading to a suitable drainage outlet.

RESISTANCE TO LATERAL LOADS:

A friction coefficient of 0.55 can be assumed to apply between the concrete base of spread footings and the underlying granular pad.

WATERPROOFING

A 0.3 m (minimum thickness) clay seal is recommended to provide waterproofing for the proposed tunnel, and for those areas of the building foundations where water leakage problems may arise.

At the tunnel, the clay seal should extend over those areas of the foundation exposed to groundwater. "Volclay 90" panels would provide suitable waterproofing for the tunnel sides.

Refer to Ontario Provincial Standard Specification #1205-1 (attached) for the material specification for a clay seal. The clay mixture specified in Section 1205.05.03 is preferred.

FILL:

The material requiring excavation between Sta. 27+450 and 27+470 is suitable for fill. The material requiring excavation upchainage (east) of Sta. 27+470 is less suitable, but would be acceptable under the proper moisture content conditions.

All fill should be compacted in 200 mm (maximum thickness) lifts, to 95% of the standard Proctor density of the material.

A number of foundation design alternatives are recommended. The alternatives which lead to the least expensive design should be adopted.

Design Alternatives

ALTERNATIVE 1 - CAISSONS

All proposed structures may be supported on reinforced concrete caissons. Because of the high groundwater table, these caissons should be constructed using tremie techniques.

The following design values are recommended for 750± mm (30 inch) diameter caissons installed to the base elevations indicated in Table 1. Caisson base elevations may be interpolated between the indicated stations.

(O.H.B.D.C. Method)

- Factored Capacity at U.L.S. = 1335 kN
- Capacity at S.L.S. Type II = 890 kN

Table 1

<u>Location</u>	<u>Base Elevation</u>
Sta. 27+420	86.0 m
Sta. 27+520	82.0 m
Sta. 27+580	80.0 m
Sta. 27+640	78.0 m

ALTERNATIVE 2 - STEEL H-PILES OR TUBE PILES

All proposed structures may be supported on steel H-Piles or concrete-filled tube piles. These piles are to be equipped with reinforced tips (driving shoes).

Piles should be driven in accordance with MTC Standard SS-103-10 or SS-103-11, but not below the elevations indicated in Table 2. The following ultimate capacities can be used for calculation purposes in the above-noted pile driving standards. The tip elevations provided in Table 2 can be used to estimate pile lengths. Pile tip elevations may be interpolated between the indicated stations.

<u>Pile Type</u>	<u>Ultimate Capacity</u>
H-Pile 310 HP 79	1870 kN
Tube Pile 324 mm X 6.3 mm	1870 kN

Table 2

<u>Location</u>	<u>Base Elevation</u>
Sta. 27+420	86.0 m*
Sta. 27+520	81.0 m
Sta. 27+580	79.0 m
Sta. 27+640	77.0 m

*Pre-augering for piles may be required, due to presence of very dense till material.

The following design values are recommended for piles installed in accordance with the above-noted criteria.

<u>Pile Type</u>	<u>Factored Capacity at U.L.S.</u>	<u>Capacity at S.L.S. Type II</u>
H-Pile 310 HP 79	935 kN	625 kN
Tube Pile 324 mm X 6.3 mm	935 kN	625 kN

ALTERNATIVE 3 - SPREAD FOOTINGS

The floor slab foundations, the pedestrian tunnel foundation, and the building column foundations between Sta. 27+450 and Sta. 27+470 may be supported on spread footings. A 0.6 m (minimum thickness) pad of properly compacted Granular B Type 1 is required beneath the spread footings.

Excavations for spread footings may be constructed in the dry provided that the criteria specified for de-watering are met. Alternatively, the excavations may be backfilled, with portions of the granular fill pad below water if necessary, so that the spread footings can be constructed in the dry in accordance with the de-watering criteria.

The following design values are recommended for the tunnel slab foundations and the building floor slab foundations.

- O.H.B.D.C. Method
- Factored Bearing Capacity at U.L.S. = 150 kPa
- Bearing Capacity at S.L.S. Type II = 100 kPa

The following design values are recommended for spread footings for building columns between Sta. 27+450 and Sta. 27+470.

- O.H.B.D.C. Method
- Factored Bearing Capacity at U.L.S. = 700 kPa
- Bearing Capacity at S.L.S. Type II = 300 kPa

Where spread footings on fill are proposed for future building extensions, further foundation investigations will be required to ascertain the properties of the existing foundation material.

If there are any questions, please contact this office.

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Mr. I. Wayman, Student Engineer, Messrs. T. Tam and L. Politano, Project Foundations Engineers, and Mr. D. Dundas, Foundations Engineer.

The report was written by Mr. Dundas and reviewed by Mr. M. Devata, Chief Foundations Engineer.

Various equipment used was owned and operated by Dominion Soil Investigation Ltd., Master Soil Investigation Ltd. and Eastern Soil Investigations Ltd.



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Foundations Engineer

M. Devata

M. Devata, P.Eng.
Chief Foundations Engineer (East)

APPENDIX

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

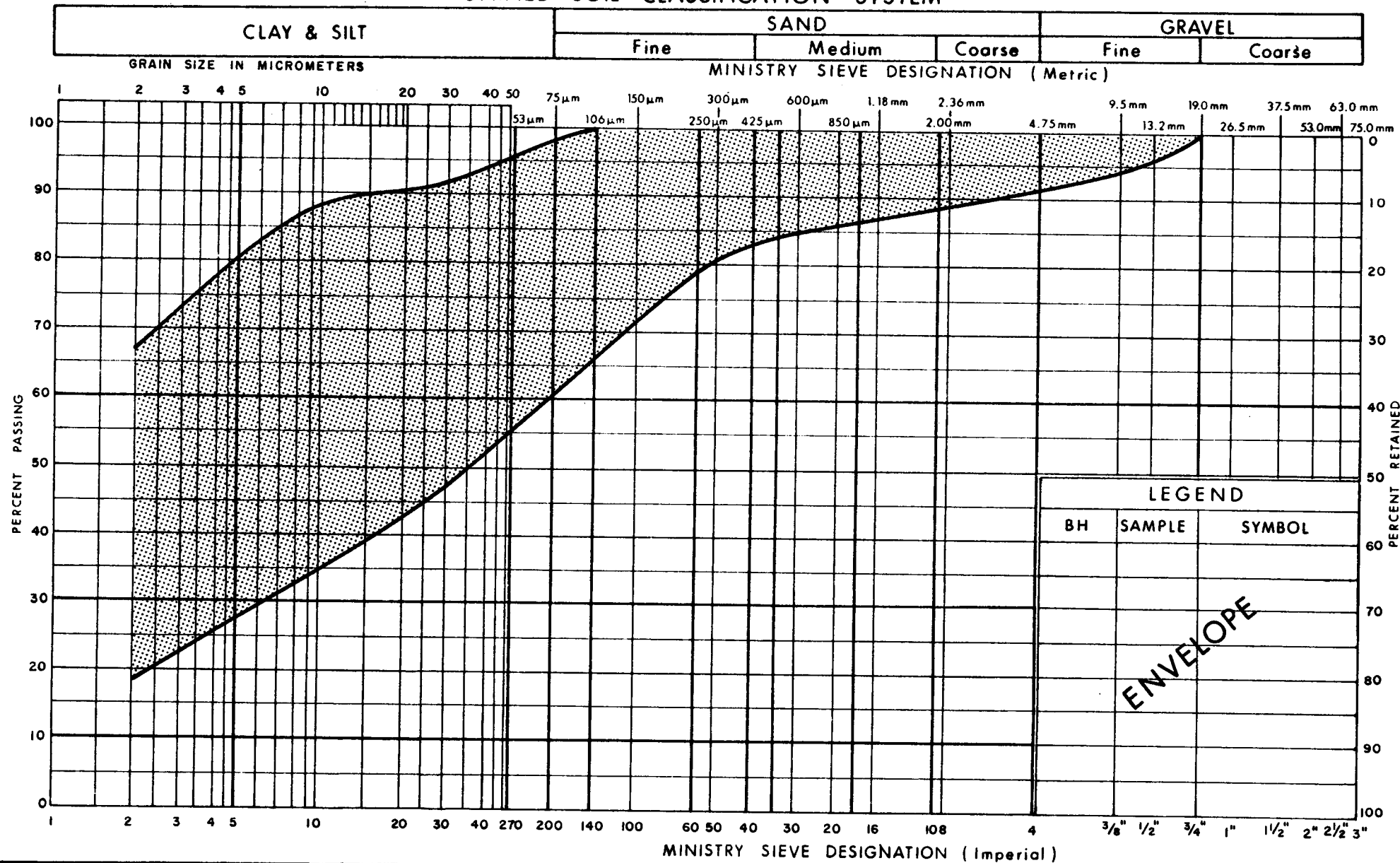
MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{v0}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_f	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kn/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kn/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m ³	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of
Transportation and
Communications

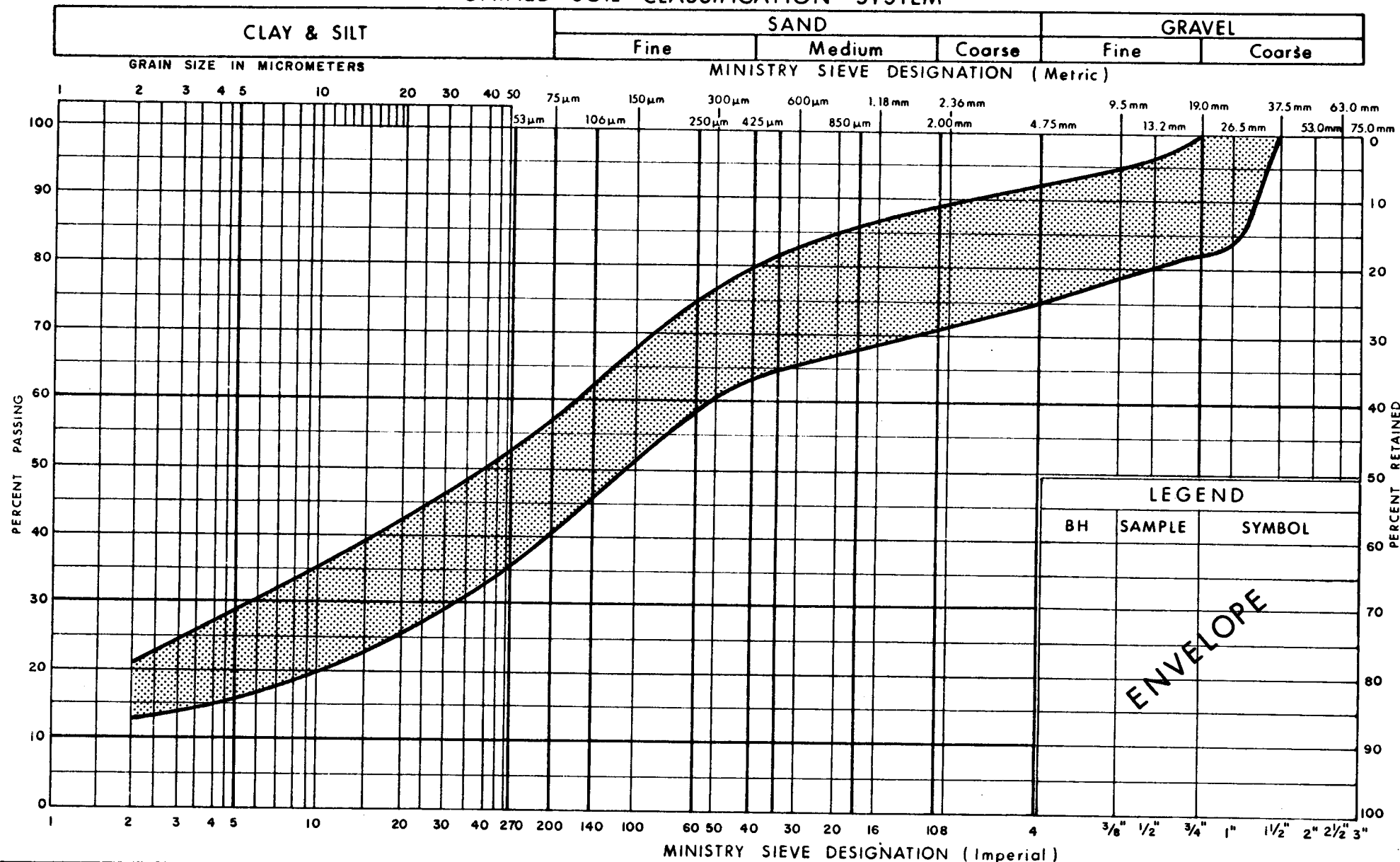
GRAIN SIZE DISTRIBUTION

SILTY CLAY, TRACE/SOME SAND TRACE OF GRAVEL
OCC CI ZONES

FIG No 1

W P F S - 331

UNIFIED SOIL CLASSIFICATION SYSTEM



**Ministry of
Transportation and
Communications**

GRAIN SIZE DISTRIBUTION
SANDY SILT, SOME CLAY TRACE / SOME GRAVEL
OCC SANDY ZONES

FIG No 2

W P FS - 331

RECORD OF BOREHOLE No 1

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 518.6; E 353 263.5
 DIST 6 HWY GO-ALRT BOREHOLE TYPE S-S Auger, & Cone Test
 DATUM Geodetic DATE 85 04 01

ORIGINATED BY IW
 COMPILED BY IW
 CHECKED BY GR

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p W W _L	WATER CONTENT (%)				
96.4	Ground Surface													
0.0	Sandy Silt some clay trace/some gravel occ. sandy zones Dense to Very Dense (slightly cohesive)		1	SS	41		96							
			2	SS	61									
			3	SS	95									
			4	SS	105	23 cm								
			5	SS	100	8 cm								
			6	SS	57									
90.6			7	SS	78									
5.8			8	SS	115									
	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Very Dense		9	SS	110									
			10	SS	100	10 cm								
			11	SS	100	13 cm								
82.6			12	SS	110	10 cm								
13.8	End of Borehole * Grounwater Elevation not determined													

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 \div 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 584.7; E 353 343.9
 DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger & Cone Test
 DATUM Geodetic DATE 85 03 28

ORIGINATED BY IW
 COMPILED BY IW
 CHECKED BY GP


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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
91.3	Ground Surface													
0.0	Silty Clay (CL) trace/some sand trace gravel Firm to Very Stiff		1	SS	7									0 6 49 45
			2	SS	22									2 6 41 51
			3	SS	17									8 33 43 16
87.3			4	SS	9									
4.0	Sandy Silt some clay		5	SS	7									
86.1			6	SS	27									
5.2	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Very Dense		7	SS	66									
			8	SS	69									
			9	SS	101									
82.0			10	SS	60	5 cm								
9.3	End of Borehole * trace/some gravel occ. sandy zones Compact to Very Dense (slightly cohesive)													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 632.2; E 353 449.5
DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test
DATUM Geodetic DATE 85 03 25

ORIGINATED BY IW
COMPILED BY IW
CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
88.8	Ground Surface												
0.0	Silty Clay (CL) trace/some sand trace gravel Very Soft to Stiff (CI) occ. sandy zones		1	SS	5		88						0 10 58 32
			2	SS	7								
			3	SS	13								
			4	SS	3								
			5	SS	1								
			6	SS	2								
			7	SS	1								
82.7			8	SS	0								8 32 44 16
6.1	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Compact to Very Dense gravelly zone		9	SS	28								
			10	SS	176								
77.8			11	SS	83								
11.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 4

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 555.4; E 353 362.6
DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test
DATUM Geodetic DATE 85 03 28

ORIGINATED BY IW
COMPILED BY IW
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
90.7	Ground Surface												
0.0	Silty Clay (CL) trace/some sand trace gravel Firm to Very Stiff		1	SS	5		90						
			2	SS	14								
			3	SS	8								
87.3			4	SS	30		88						
3.4	Sandy Silt some clay		5	SS	9								
86.1			6	SS	54		86						
4.6	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Dense to Very Dense		7	SS	36								
			8	SS	9		84						
			9	SS	76								
			10	SS	100	10 cm	82						
79.9			11	SS	120	15 cm	80						
10.8	End of Borehole * trace/some gravel occ. sandy zones compact to dense (slightly cohesive)												

RECORD OF BOREHOLE No 5

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 587.4; E 353 415.7
 DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test
 DATUM Geodetic DATE 85 03 25

ORIGINATED BY IW
 COMPILED BY IW
 CHECKED BY [Signature]

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
89.3	Ground Surface													
0.0	Silty Clay (CL) trace/some sand trace gravel Firm to Stiff		1	SS	12									
			2	SS	8									
86.6			3	SS	15									
2.7	occ. silty clay (CL) zones		4	SS	31									
			5	SS	18									
			6	SS	29									
	Silty Sand trace gravel trace clay		7	SS	16									
	occ. silt (ML) zones		8	SS	39									
	occ. gravelly zones													
	Compact to Very Dense		9	SS	184									
79.6			10	SS	92									
9.7	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 6

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 525.6; E 353 381.5 ORIGINATED BY IW
DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY IW
DATUM Geodetic DATE 85 03 27 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
90.1	Ground Surface												
0.0	Silty Clay (CL) trace/some sand trace gravel Firm to Stiff		1	SS	5								2 23 49 26
87.7			2	SS	13								
2.4	Sandy Silt some clay *		3	SS	18								21 23 35 21
86.1			4	SS	16								
4.0			5	SS	25								
	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Very Dense		6	SS	14								
			7	SS	31								
			8	SS	53								
			9	SS	121								
			10	SS	100/13 cm								
79.6			11	SS	75/10 cm								
10.5	End of Borehole * trace/some gravel occ. sandy zones compact to very dense (slightly cohesive)												



RECORD OF BOREHOLE No 7

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 554.9; E 353 435.3 ORIGINATED BY IW
DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY IW
DATUM Geodetic DATE 85 03 26 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
88.8	Ground Surface											
0.0	Silty Clay (CL) trace/some sand trace/some gravel Soft to Firm		1	SS	4		88					3 21 45 31
86.7			2	SS	7							19 27 38 16
2.1			3	SS	27							
			4	SS	31							
			5	SS	27							
			6	SS	58							
			7	SS	41							
			8	SS	69							
			9	SS	68							
			10	SS	64							
			11	SS	58							
			12	SS	150							
74.6			13	SS	149							
14.2	End of Borehole											

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 8

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 582.2; E 353 474.6 ORIGINATED BY IW
 DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY IW
 DATUM Geodetic DATE 85 03 25 CHECKED BY CP

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			20 40 60 80 100	10 20 30					
88.8	Ground Surface													
0.0	Silty Clay (CL) trace/some sand trace gravel Very Soft to Very Stiff		1	SS	4		85.0							2 21 46 31
			2	SS	15									1 3 51 45
	CI		3	SS	20									
			4	SS	4									
			5	SS	2									
			6	SS	1									
			7	SS	2									5 14 43 38
82.7			8	SS	0									4 25 41 30
6.1	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Compact to Very Dense		9	SS	16									
			10	SS	17									
			11	SS	14									
			12	SS	36									
			13	SS	114									
74.5			14	SS	60									
14.3	Silty Clay (CL) trace/some sand trace gravel Hard		15	SS	89									
72.0														
16.8	Silty Sand with gravel Very Dense													
70.2			16	SS	60									
18.6	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 9

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 456.9; E 353 344.6 ORIGINATED BY IW
DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY IW
DATUM Geodetic DATE 85 03 29 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
94.7	Ground Surface												
0.0	Sandy Silt some clay trace/some gravel occ. sandy zones Compact to Very Dense (slightly cohesive)		1	SS	18		94						25 36 26 13
			2	SS	90/25		92						12 32 41 15
			3	SS	67								
			4	SS	67								
			5	SS	119								
			6	SS	119/23		90						7 38 39 16
			7	SS	100/10		88						
			8	SS	105/15		86						
			9	SS	80/10		84						
85.6	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Very Dense		10	SS	90/15		82						
9.1			11	SS	120/15		80						
			12	SS	97/15								
			13	SS	100/13								
			14	SS	100/10								
79.2	End of Borehole												
15.5													

+³, x⁵: Numbers refer to
Sensitivity

20
15 \diamond 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 10

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 491.8; E 353 403.0
DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test
DATUM Geodetic DATE 85 03 27

ORIGINATED BY IW
COMPILED BY IW
CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
89.9	Ground Surface											
0.0	Silty Clay (CL) trace/some sand trace gravel Soft to Stiff		1	SS	8							
87.5			2	SS	7							
2.4	Sandy Silt some clay *		3	SS	7							
85.9			4	SS	6							
4.0			5	SS	27							
	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Compact to Very Dense		6	SS	15							
			7	SS	17							
			8	SS	25							
			9	SS	49							
	occ. gravelly zones		10	SS	100	15 cm						
			11	SS	100	15 cm						
78.2			12	SS	70	8 cm						
11.7	End of Borehole * trace/some gravel occ. sandy zones compact to very dense (slightly cohesive)											

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 11

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 522.5 E 353 456.7 ORIGINATED BY IW
DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY IW
DATUM Geodetic DATE 85 03 26 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
88.5	Ground Surface											
0.0	Silty Clay (CL) trace/some sand trace gravel Soft to Firm		1	SS	4							
86.4			2	SS	3							
2.1			3	SS	4							
			4	SS	12							
			5	SS	13							
			6	SS	41							
			7	SS	80							
			8	SS	123							
			9	SS	71							
			10	SS	58							
			11	SS	24							
			12	SS	12							
			13	SS	22							
			14	SS	37							
71.3	occ. gravelly zones		15	SS	200							
17.2	End of Borehole											

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 12

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 547.4; E 353 495.5 ORIGINATED BY IW
 DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY IW
 DATUM Geodetic DATE 85 03 26 CHECKED BY [Signature]

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p	W	W _L	WATER CONTENT (%)		
88.5	Ground Surface													
0.0	Silty Clay (CL) trace/some sand trace gravel Soft to Very Stiff CI		1	SS	6									
			2	SS	19									
			3	SS	25									
			4	SS	8									
			5	SS	3									
			6	SS	2									
			7	SS	2									
			8	SS	2									
82.1			9	SS	50									
6.4	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Dense to Very Dense		10	SS	118									
			11	SS	43									
			12	SS	45									
			13	SS	88									
74.3														
14.2	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 13

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 406.3; E 353 328.0 ORIGINATED BY IW
DIST 6 HWY GO-ALRT BOREHOLE TYPE S-S Auger, Cone Test COMPILED BY IW
DATUM Geodetic DATE 85 03 29 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
96.7 0.0	Ground Surface											
	Sandy Silt some clay trace/some gravel occ. sandy zones dense to very dense (slightly cohesive)		1	SS	33							
			2	SS	81							
			3	SS	130							
			4	SS	84							
			5	SS	153							
			6	SS	64							
			7	SS	11							
90.6 6.1	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Dense to Very Dense		8	SS	43							
			9	SS	35							
			10	SS	26							
			11	SS	137							
			12	SS	80							
			13	SS	78							
			14	SS	43							
81.0 15.7	End of Borehole											



RECORD OF BOREHOLE No 14

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 462.2; E 353 421.8
DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test
DATUM Geodetic DATE 85 03 27

ORIGINATED BY IW
COMPILED BY IW
CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L	WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
89.7	Ground Surface												
0.0	Silty Clay (CL) trace/some sand trace gravel Firm to Very Stiff		1	SS	14								
87.3			2	SS	16								
2.4	Sandy Silt some clay		3	SS	38								
86.0	*		4	SS	15								
3.7			5	SS	42								
			6	SS	40								
	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Dense to Very Dense		7	SS	28								
			8	SS	53								
			9	SS	145								
			10	SS	81								
78.5			11	SS	100								
11.2	End of Borehole * trace/some gravel occ. sandy zones compact to very dense (slightly cohesive)												



RECORD OF BOREHOLE No 15

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 493.1; E 353 473.5
DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test
DATUM Geodetic DATE 85 03 26

ORIGINATED BY IW
COMPILED BY IW
CHECKED BY [Signature]

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
88.4	Ground Surface													
0.0	Silty Clay (CL) trace/some sand trace gravel Soft to Firm		1	SS	8									
86.3			2	SS	7									
2.1			3	SS	3									
			4	SS	5									
			5	SS	10									
			6	SS	47									
			7	SS	16									
			8	SS	61									
			9	SS	46									
			10	SS	28									
			11	SS	128									
75.7			12	SS	95									
12.7	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 16

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 516.0; E 353 511.7

ORIGINATED BY TT

DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test

COMPILED BY IW

DATUM Geodetic DATE 85 03 29

CHECKED BY [Signature]

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
88.2	Ground Surface													
0.0	Silty Clay (CL) trace/some sand trace gravel Soft to Stiff (CI)		1	SS	4									
			2	SS	12									
			3	SS	9									
			4	SS	4									
			5	SS	2									
			6	SS	1									
82.4			7	SS	1									
5.8			8	SS	16									
	Silty Sand trace gravel trace clay occ. silt (ML) zones occ. gravelly zones Compact to Very Dense		9	SS	68									
			10	SS	109									
			11	SS	120									
75.5														
12.7	End of Borehole		12	SS	115									

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 17

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 562.2; E 353 485.0 ORIGINATED BY DD
DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY DD
DATUM Geodetic DATE 85 04 29 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 20 40 60 80 100	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
88.8	Ground Surface										
0.0	Silty Clay (CL) trace/some sand trace gravel Soft to Very Stiff (CI)										
82.7											
6.1	Silty Sand *										
81.2											
7.6	End of Borehole * trace gravel trace clay occ. silt (ML) zones occ. gravelly zones dense to very dense										

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5
0
(%) STRAIN AT FAILURE

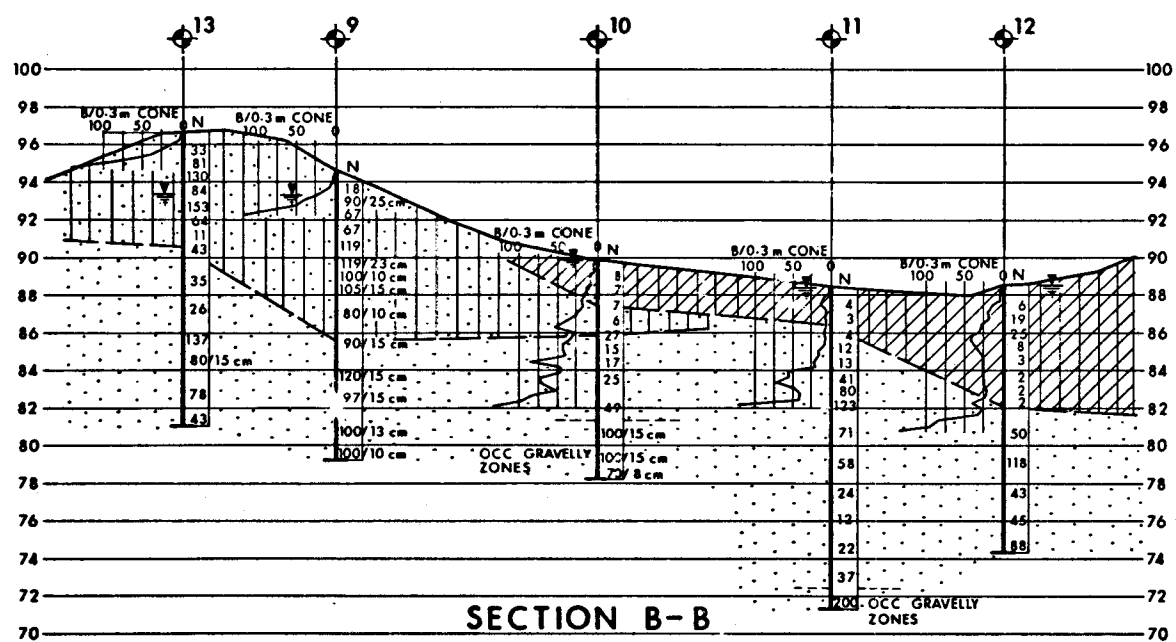
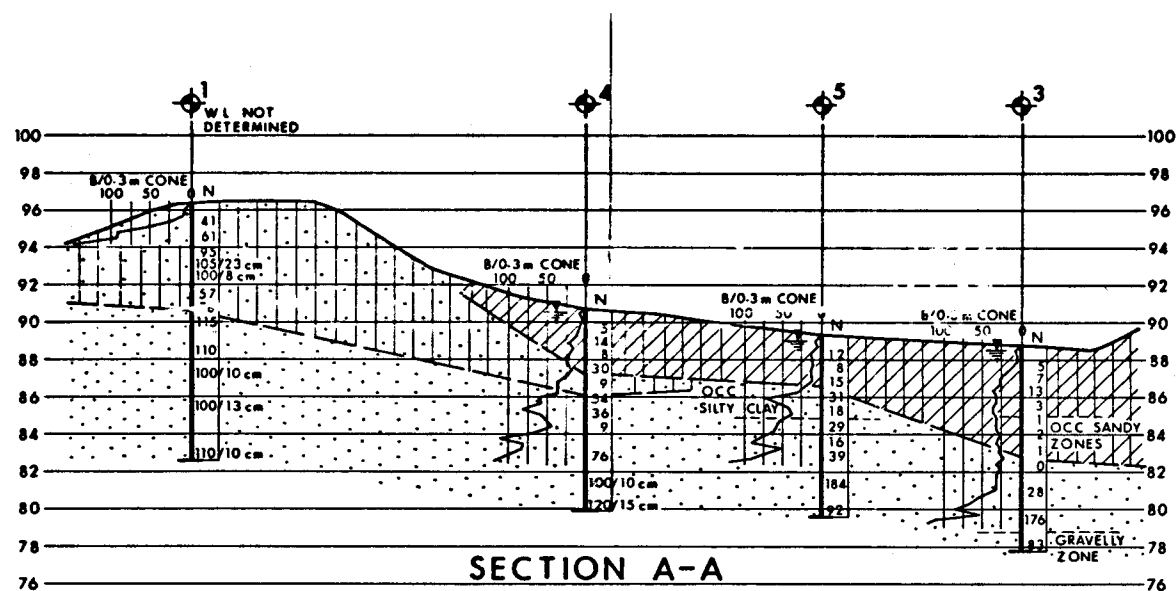
RECORD OF BOREHOLE No 18

METRIC

W P FS-331 LOCATION Co-ords. N 4 859 606.3; E 353 457.5 ORIGINATED BY DD
 DIST 6 HWY GO-ALRT BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY DD
 DATUM Geodetic DATE 85 04 29 CHECKED BY [Signature]

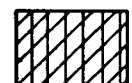
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
88.8	Ground Surface													
0.0	Silty Clay (CL) trace/some sand trace gravel Soft to Stiff (CI)													
			1	TW	PH									0 2 33 65
			2	TW	PH									0 2 37 61
83.0														
5.8	Silty Sand *													
81.5														
7.3	End of Borehole * trace gravel trace clay occ.silt (ML) zones occ. gravelly zones dense to very dense													

OFFICE REPORT ON SOIL EXPLORATION

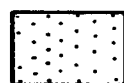


SCALE
HOR 20m 10 0 20m
VERT 4m 2 0 4m

SOIL STRATIGRAPHY LEGEND



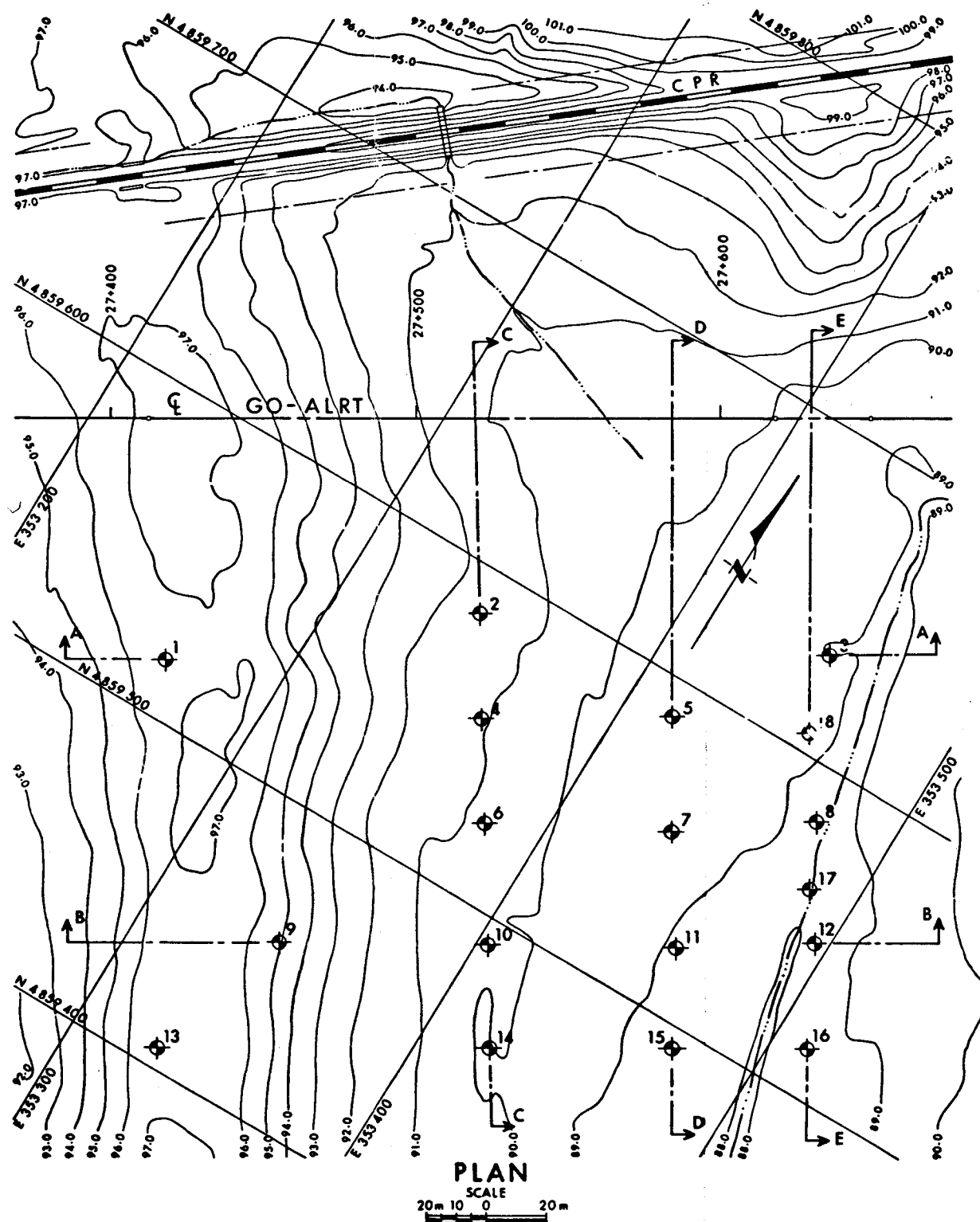
SILTY CLAY
TRACE/SOME SAND,
TRACE OF GRAVEL
Very Soft to Very Stiff



SILTY SAND
TRACE OF GRAVEL & CLAY
OCC SILT & GRAVEL ZONES
Compact to Very Dense



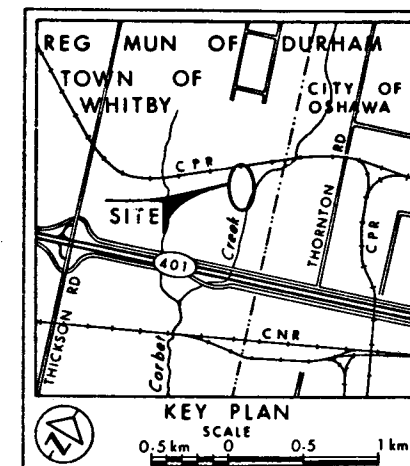
SANDY SILT
SOME CLAY, TRACE/SOME GRAVEL
OCC SANDY ZONES
Compact to Very Dense
(Slightly Cohesive)



NOTE

For Sections C-C, D-D & E-E
refer to Dwg No FS331-B

METRIC
ALL DIMENSIONS SHOWN ARE
IN METRES AND/OR MILLI-
METRES UNLESS OTHERWISE
NOTED.



LEGEND

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ◆ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- ▼ W.L. at time of investigation 85 03

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	96.4	4859518.6	353263.5
2	91.3	4859584.7	353343.9
3	88.8	4859632.2	353449.5
4	90.7	4859555.4	353362.6
5	89.3	4859587.4	353415.7
6	90.1	4859525.6	353381.4
7	88.8	4859554.9	353435.3
8	88.8	4859582.2	353474.6
9	94.7	4859456.9	353344.6
10	89.9	4859491.8	353403.0
11	88.5	4859522.5	353456.7
12	88.5	4859547.4	353495.5
13	96.7	4859406.3	353328.0
14	89.7	4859462.2	353421.8
15	88.4	4859493.1	353473.5
16	88.2	4859516.0	353511.7
17	88.8	4859562.2	353485.0
18	88.8	4859606.3	353457.5

Geocres No 30M15-77

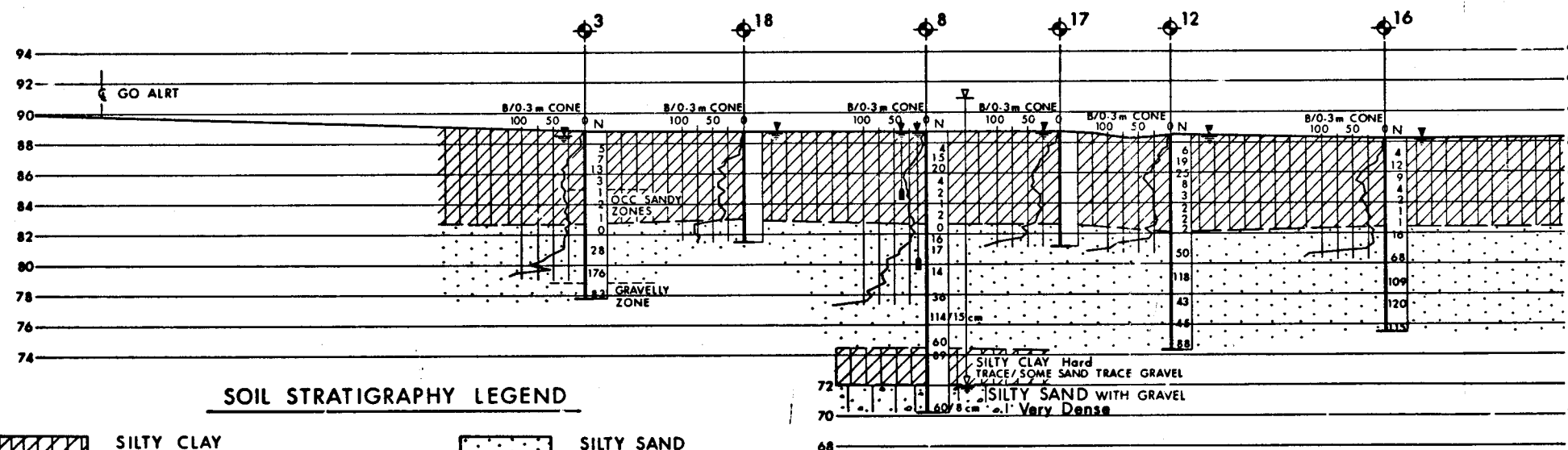
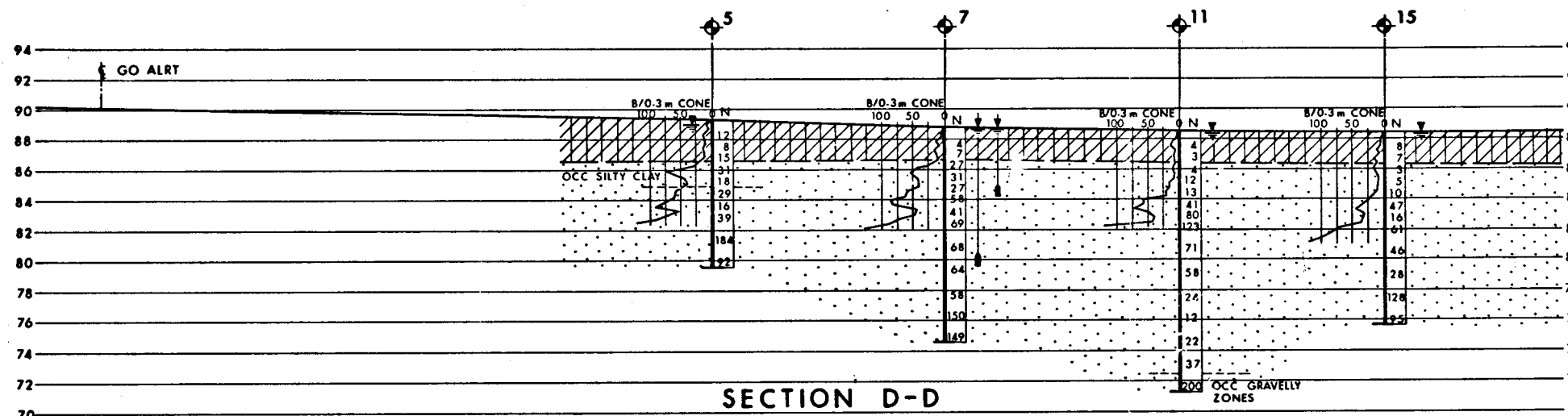
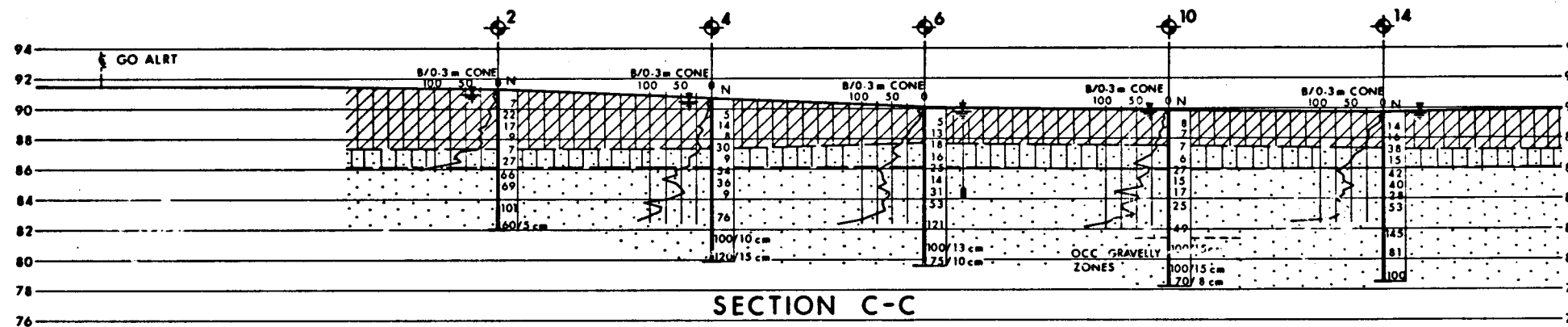
NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

GO-ALRT REF

REFERENCE DRAWINGS	REVISIONS	DRAWN BY: G P 1985 06 25 CHK'D BY: 10 SCALE: FULL SIZE ONLY	DESIGNED BY: D D APPROVED BY:	AS NOTED	 Ministry of Transportation and Communications PICKERING-OSHAWA SECTION PROJECT MANAGER	DURHAM REGION MAINTENANCE STORAGE FACILITY BORE HOLE LOCATIONS & SOIL STRATA			
						CONTRACT NO	DWG NO FS331-A	REV	SHEET



SOIL STRATIGRAPHY LEGEND

	SILTY CLAY TRACE / SOME SAND, TRACE OF GRAVEL Very Soft to Very Stiff		SILTY SAND TRACE OF GRAVEL & CLAY OCC SILT & GRAVELLY ZONES Loose to Very Dense
	SANDY SILT SOME CLAY, TRACE / SOME GRAVEL OCC SANDY ZONES Compact to Very Dense (Slightly Cohesive)		

SECTION E-E

SCALE
HORIZ 10m 5 0 10m
VERT 4m 2 0 4m

NOTE:
For Plan Refer to
Dwg No FS331-A

METRIC
ALL DIMENSIONS SHOWN ARE
IN METRES AND/OR MILLI-
METRES UNLESS OTHERWISE
NOTED.

SEE DWG No FS331-A

KEY PLAN
SCALE

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation 85 03 and 85 04
- Piezometer
- Head
- Artesian Condition
- Encountered

No	ELEVATION	CO-ORDINATES NORTH	EAST
2	91.3		
3	88.8		
4	90.7		
5	89.3		
6	90.1		
7	88.8		
8	88.8		
10	89.9		
11	88.5		
12	88.5		
14	89.7		
15	88.4		
16	88.2		
17	88.8		
18	88.8		



SEE DWG No FS331-A

Geocres No. 30M15-77

NOTE:
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 402-2 of Form 100.

60-ALRT REF

REFERENCE DRAWINGS		REVISIONS		DRAWN BY: G P 1985 06 25	DESIGNED BY: D D	 Ministry of Transportation and Communications PICKERING-OSHAWA SECTION PROJECT MANAGER	DURHAM REGION MAINTENANCE STORAGE FACILITY SECTIONS AND SOIL STRATIGRAPHY			
				CHK'D BY: 	APPROVED BY:		CONTRACT NO	DWG NO FS331-B	REV	SHEET
				SCALE: FULL SIZE ONLY						
				AS NOTED						