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## **FOUNDATION DESIGN SECTION**

**foundation  
investigation and  
design report**

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 534-91-01/02

DIST 3

HWY 6

STR SITE 35-577/1/2

Proposed Wellington St. (Hwy 24) Underpass  
Hanlon Expressway (Hwy 6)

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FOUNDATION INVESTIGATION REPORT  
FOR  
PROPOSED WELLINGTON STREET (HWY 24) UNDERPASS  
HANLON EXPRESSWAY (HWY 6)  
W.P. 534-91-01/02, SITE 35-577/1/2  
DISTRICT 3, STRATFORD

INTRODUCTION

This report summarizes the results of a Foundation Investigation conducted in conjunction with the proposed Wellington Street (Hwy 24) Underpass that will carry traffic on Hwy 24 over the Hanlon Expressway (Hwy 6). The existing Hwy 6/Hwy 24 intersection will be revamped into an interchange that will include a four span structure and associated ramps. This report pertains to the proposed structure and immediate embankment approaches.

SITE DESCRIPTION AND GEOLOGY

The site is located at the existing Hwy 24 - Hwy 6 intersection in the City of Guelph, Wellington County. The intersection is presently a level crossing with traffic lights controlling the flow of traffic in the four (4) directions. Level ramp roadways exist at three of the four quadrants to facilitate traffic flow. The Manor Motel is situated northeast of the present intersection and northwest of the intersection an open field exists with a gas station located beyond the limits of the open field. Southwest of the present intersection, an access road to the Guelph Dolime Quarry exists. The access road parallels an existing open

channel for the most part. In the southeast quadrant, an open field that at one time was occupied by a brewery and a landfill site is present. A four (4) span concrete beam Hwy 6-CNR subway is present approximately 200 metres north of the site.

A number of underground utilities are nested within the intersection area including a storm relief sewer tunnel located immediately west of the proposed west abutment.

The terrain at the site slopes gently upward in a northerly direction. There are slopes present in the southwest and southeast areas of the site with heights of approximately 3 to 4 metres and gradients of approximately 2H:IV. North of the site, excavated cut slopes up to 13 metres in depth are present south of the existing Hwy 6 - CNR subway structure. The roadways are asphaltic and the land beyond the roadways are covered primarily with grassland.

Physiographically, the site is located within the region known as the "Guelph Drumlin Field". Within this area, there are approximately 300 drumlins of all sizes. The drumlins in this area are not closely spaced and there is intervening low lying grounds between the drumlins. This is for the reason that during the most recent Wisconsin Glaciation period (approximately 12,000 years ago), the ice which moulded this field advanced from the southeast whilst the receding glacier moved perpendicular to this direction. As a result, the drainage of the ice front was directed to lower and lower outlets and hence the drumlin field is furrowed by parallel valleys running perpendicular to the trend of the drumlins. Along the sides of these valleys there are broad sand and gravel

terraces.

Therefore, the general landform pattern consists of drumlins or groups of drumlins fringed by gravel terraces. As a result, the dominant soil materials are the unstratified, unsorted drumlin tills consisting of a heterogeneous mixture of gravels, sand and silts and the deep gravel terraces of the old millwater spillways.

Overburden in the site area is underlain by dolostones of the Amabel and Guelph Formations. Overburden thickness are shallow at the site and usually less than six (6) metres.

### **INVESTIGATION PROCEDURE**

#### **General**

Soil and rock data and inherent properties were obtained by conducting both an in situ field investigation and laboratory analyses. Details of the field investigation and laboratory testing program are discussed below.

#### **Field Investigation**

The fieldwork for this project was conducted between 93 02 09 and 93 03 11 and consisted of a total of seventeen (17) boreholes. The boreholes were advanced to depths ranging from 1.5 metres to 9.4 metres. All boreholes were advanced using conventional track mounted Central Mining Equipment (CME) 55 drilling units. Hollow stem augering techniques were used to penetrate the overburden at the site.

Disturbed subsoil samples were retrieved in the overburden using a 50mm diameter split spoon sampler driven in accordance with the Standard Penetration Test (SPT-ASTM D1586). The samples were generally retrieved at 0.76 intervals. Bedrock underlying the overburden was cored up to 3.1 metres in depth using conventional rock coring techniques. A NX core barrel within NW casing was used in the coring process.

All subsoil samples were identified in the field and then properly sealed in plastic containers to preserve natural moisture contents in the soil. The samples were then transported to the laboratory where additional visual classifications were carried out and pertinent laboratory tests were conducted as described in the next section below.

Rock core samples were also identified in the field and physical index properties were determined by visual examination and also by measurement of rock quality designations (RQD's) and rock core recovery. All rock core were placed in standard rock core boxes and carefully transported to the laboratory.

Groundwater levels were determined by monitoring the water levels in the open boreholes throughout the duration of the field investigation. All boreholes were backfilled upon completion of the fieldwork.

The survey related to the location and elevation of the individual boreholes was provided by Southwestern Region Surveys and Plans.

### Laboratory Analyses

All subsoil samples were carefully visually examined in the laboratory in accordance with the procedures outlined in the Visual Method described in Chapter 2 of the MTO Soil Classification Manual. Grain size distributions of the native and fill materials at the site were determined by conducting mechanical sieve and hydrometer analysis. Natural moisture contents were also determined.

Sample preparation and testing were conducted in accordance with the MTO Laboratory Testing Manual

Detailed rock core logging was conducted in the laboratory by an in-house resident geologist. The core logging included descriptions of colour, grain size, bedding, jointing and strength.

Laboratory test results have been summarized below in the subsequent section of this report entitled "Subsurface Conditions" and are illustrated on the corresponding boreholes and figures included in the Appendix to this report.

### SUBSURFACE CONDITIONS

#### General

The subsurface conditions across the site consists of varying thickness of fill material comprised of primarily an irregular mixture of silt, sand and gravel. At the east abutment location, traces of wood, brick and glass are also present within the fill. The fill material is predominantly brown except at the east abutment location where the fill material is predominantly black and has a

distinct gas odour. This area is the site of an old brewery. the thickness of the fill material across the site varies from 0.6m to 4.6m.

A native deposit consisting of a heterogeneous mixture of gravel, sand and silt underlies the fill material where the latter material exists and elsewhere across the site occurs surficially. The thickness of the deposit varies from 0.4m to 6.9m.

The native heterogeneous mixture of gravel, sand and silt is underlain by dolostone bedrock. The bedrock surface varies from 309.9 to 303.2m sloping in a southwardly direction.

A plan of the site illustrating the locations and elevations of the boreholes and a profile of the proposed Hwy 24 grade is shown on Dwg. No. 5349101/02-A in the Appendix. Stratigraphical sections at the proposed structure foundation locations are also provided on Dwg No. 5349101/02-B. The boundaries between the various soil types, in situ and laboratory test results as well as groundwater levels established at the time of investigation are shown on the stratigraphical sections and also on the individual Record of Borehole sheets in the Appendix. Detailed soil/rock descriptions are given below.

#### SOIL/ROCK DESCRIPTIONS

##### Irregular Mixture of Silt, Sand and Gravel (Fill Material)

An irregular mixture of silt, sand and gravel has been placed as fill material at various locations across the site. This fill material was encountered at the proposed west abutment and west pier locations and also at the east abutment and



east pier locations. At the east abutment location, the fill material also contains brick, wood and glass. The fill material at the east abutment location (BH's 5B and 5 located beyond the toe of the existing slopes at that location) is black with a gas odour. The fill material elsewhere on the site is brown with an earthy odour. The thickness of the fill materials across the site varies from 0.6m to 4.6m.

The fill material is cohesionless and a grain size distribution envelope as determined by hydrometer and mechanical sieve analysis that illustrates the gradation of the fill material is shown on Figure 1 in the Appendix. The envelope depicts a broad range of particle sizes ranging primarily from silt to gravel.

Natural moisture contents of the fill material generally ranged from 7% to 20%.

The "N" values as determined by the Standard Penetration Test ranged from 5 blows/0.3m to 23 blows/0.3m indicating a denseness ranging from loose to compact. In general, it appears that the fill material is in a compact state of denseness.

#### **Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)**

Underlying the fill material and also present surficially across the site, a native heterogeneous mixture of gravel, sand and silt exists. This deposit of glacial till origin is unsorted and unstratified and also contains boulders and cobbles. The deposit is predominantly brown except for the lower metre or so which is black and contains organics. This lower metre of black, organic material may be the product of deposition of material in a body of water that may

have existed in pre-glacial time. The thickness of the deposit varies from 0.4m to 6.9m.

A grain size distribution envelope produced by mechanical sieve and hydrometer analysis is given in Figure 2 in the Appendix. The results reveal a broad range of particle sizes ranging primarily from silt to gravel. The envelope does not include particle sizes larger than gravel. The broad range of particle sizes is typical of deposits of glacial till origin.

An Atterberg Limit test conducted on one representative sample of the fine grained portion of the material (less than 425 micrometres) containing organics revealed a liquid limit ( $w_l$ ) of 36% and a plasticity index ( $I_p$ ) of 8%. These values indicate that the material behaves as an organic silt of low plasticity. The fine grained portion of the deposit without organics in general, however, is cohesionless. Natural moisture contents of the till ranged from 4% to 28%, but were generally less than 10%.

The "N" values as determined by the Standard Penetration Test range from as low as 7 blows/0.3m to as high as 60 blows/0.3m indicating a very loose to very dense state of denseness. The low "N" values reflect the organics present at the lower depths at some locations and the larger "N" values are the result of perhaps the natural denseness of the deposit and the large gravel, cobble and bolder particles sizes. In general "N" values range between 30 blows/0.3m and 80 blows/0.3m indicating a dense to very dense state of denseness.

### Bedrock

The bedrock at the site underlies the heterogeneous mixture of gravel, sand and silt and consists of a "vuggy", fossiliferous dolostone of the Guelph and the underlying Eramosa member of the Amabel Formation. The Amabel Formation was encountered at the southern limits of the proposed east pier and east abutment locations.

The bedrock surface elevation varies across the site and it appears that the bedrock surface slopes downward in a southerly direction consistent with the ground surface elevation. Table 1 below summarizes the bedrock surface elevation as confirmed by retrieving up to 3.1 metres of NX core at each of the individual boreholes advanced at the proposed structure foundation locations.

TABLE 1 - BEDROCK SURFACE ELEVATIONS	
STRUCTURE FOUNDATION	BEDROCK SURFACE ELEVATION (m)
West Abutment	307 - 308.8
West Pier	306.8 - 309
Centre Pier	305.8 - 307
East Pier	303.7 - 307.3
East Abutment	303.2 - 304.9

The elevations tabulated in Table 1 correspond to depths ranging from 1.7m to 6.9m below the existing ground surface.

The dolostone bedrock is a chemical sedimentary rock that is medium grained. The rock is unweathered to slightly weathered and is featured by a porous "vug" texture, stylolites and also stromatoporoids and corals (fossils). The rock is very pale orange to yellowish brown (Guelph Formation) to dark yellowish brown (Amabel Formation) in colour. The rock contains moderate to very close spaced fractures that are flat to dipping, undulating to planar and smooth to rough.

An assessment of the quality and strength of the rock was carried out by measuring core recoveries and Rock Quality Designations (RQD's) in the field and physical index property tests. Recoveries were in the order of 90% to 100% and RQD's ranged from 0% to 100% indicating that the rock is of very poor to excellent quality. The quality of the rock appears to be poorer at the east pier and east abutment location where RQD's were less than 50%. Elsewhere, RQD's generally exceeded 50% indicating a fair to good quality.

The strength of the rock can be described as weak for the Guelph formation to weak to medium strong for the Amabel Formation.

Rock core penetration rates were generally rapid which is indicative of the weaker nature of this sedimentary rock.

### GROUNDWATER CONDITIONS

Observation of the groundwater level was carried out by measuring the water levels in the open boreholes and monitoring these levels throughout the duration of the field investigation. The water level was generally at or slightly above the bedrock surface (see Table 1).

Groundwater levels in general, are subject to seasonal fluctuations and hence can vary from the values in this report.

### DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a four (4) span post-tensioning twin structure (square span: 20, 25, 20, 20m) that will carry traffic on Hwy 24 (Wellington Street) over Highway 6 (Hanlon Expressway). The structure will support three (3) Hwy 24 lanes in either direction (E/W); two (2) of the lanes at 3.75m width and one (1) lane at 3.5 metres. In addition, the structure will support the E-S ramp lane which is of variable width. The structure will have a 4.6% downward gradient from north to south. The Hanlon Expressway (Hwy 6) will be a four lane divided highway containing an ES ramp and WN ramp and shoulders.

The structure has been proposed along an alignment located approximately thirteen (13) metres or so south of the existing intersection. Therefore, the alignment of Hwy 24 will be revised to accommodate this relocation. The realignment will be such that the approaches will be positioned partially in low lying areas located south of the existing slopes at the site. The existing ground surface elevations within these low lying areas is approximately 306.2m at the east approach and 308.5 at the west approach. The proposed profile grades are up to approximately 318.5m at the east approach and 319.6m at the west approach. Therefore, up to 12.3 metres and 11.1 metres of approach fill will be required at the east and west approaches respectively.

Dwg 5349101/02-A in the Appendix illustrates a plan of the proposed structure location and related structure foundations and also includes the proposed profile grade.

Recommendations to facilitate the design and construction of the proposed structure foundations and related earthworks are contained in the purview of this report. Foundation and geotechnical recommendations are provided for:

- 1) Structure Foundations
- 2) Backfill to Structure
- 3) Approach Embankments
- 4) Construction Considerations

### 1) STRUCTURE FOUNDATIONS

#### General

Subsurface conditions vary across the site and therefore the structure foundation selection must consider this variability and non uniformity. At the west and east abutment locations, the ground surface elevation varies from 308.7m to approximately 313m and from 306.2 to 310.4m respectively. In view of the weaker nature of the native subsoils and the presence of fill material combined with the fact that significant thicknesses of new approach fill material will be required, it is recommended that abutments be "perched" within the approach fill and supported by deep foundation units (driven steel H-piles or augered concrete caissons) founded on the bedrock surface. The subsoil at the west pier also consists of weaker native soils and fill material unsuitable for supporting economical conventional spread footings and deep foundation units are hence also recommended at this location.

Subsoils at the centre and east pier are more competent and hence can support conventional spread footings. However, spread footings at the east pier must be designed such that the foundations are located a minimum three (3) metres edge

distance from the crest of a 2H:1V slope. Alternatively, the centre pier and east pier can be supported on deep foundation units founded on bedrock which is relatively shallow across the site.

Foundation design details are given below. As described above, various alternatives are considered viable from a foundation point of view. The foundation scheme that proves to be the most technically feasible and cost effective shall be chosen.

### Deep Foundations

#### General

All structure foundations can be supported by either driven steel H-piles or drilled concrete caissons founded on the bedrock surface. The support of the abutments on deep foundations enable an open type abutment design which should be more economical. It is prudent that the designer consider minimum embedment length criteria to ensure the necessary lateral rigidity in selecting the type of foundation such that the definition of deep foundation is satisfied. Driven steel H piles are restricted in their embedment length by the bedrock surface. Concrete caissons, on the other hand, can be socketed into the bedrock and hence can achieve longer embedment lengths.

#### Driven Steel-H Piles

Structure foundations can be founded on steel H-piles driven to the bedrock surface as summarized in Table 2 below. For purposes of the O.H.B.D.C., the steel H-piles can be designed employing the axial capacities tabulated in Table 2 below.



TABLE 2 - DRIVEN STEEL H-PILES				
Structure	Pile Type	Factored Capacity at U.L.S. (kN)	Axial Capacity at S.L.S. (kN)	Estimated Pile Elevation (m)
West Abutment	HP 310 x 110	1600	1100	307 - 308.8
	HP 310 x 79	1150	890	
West Pier	HP 310 x 110	1600	1100	306.8 - 309
	HP 310 x 79	1150	890	
Centre Pier	HP 310 x 110	1600	1100	306 - 307
	HP 310 x 79	1150	890	
East Pier	HP 310 x 110	1600	1100	303.5 - 307
	HP 310 x 79	1150	890	
East Abutment	HP 310 x 110	1600	1100	303 - 305
	HP 310 x 79	1150	890	

Axial capacities provided in Table 2 are for vertical piles only. Reductions of axial capacities for inclined loadings shall conform to factors provided in Section 6-8.3.4.3 of the O.H.B.D.C.

It is recommended that to facilitate the pile driving process, all piles be equipped with reinforced tips. Driving shoe details are given in OPSD 3301.00.

The bedrock surface varies considerably across the site and particular attention must be given to the pile installation. Accurate pile driving records must be produced to ensure the piles contact the bedrock surface.

Pile spacing shall conform with Section 6-8.3.10 of the O.H.B.D.C. For centrally loaded piles equal load sharing on the deep foundation units can be assumed. The design of eccentric loaded deep foundation units shall comply with Section 6-8.3.4.2 of the O.H.B.D.C.

The lateral resistance for both vertical and battered piles shall be computed in accordance with Section 6.8.3.8 of the O.H.B.D.C. Pertinent unfactored soil parameters to facilitate the design of vertical piles is given in Table 3 below. The corresponding soil depths can be obtained from the relevant borehole logs and having knowledge of the proposed heights of fill. In the computation of the lateral resistance of piles in the fill material, the upper 60% of the embedment length within the fill (taken from the frost penetration depth) shall be disregarded for horizontal resistance and to account for uncertainties in material selection and method of placement, it is recommended that the shear strength parameters in Table 3 be reduced by 10%. A minimum of three (3) metres horizontal cover is necessary to achieve horizontal capacities.

TABLE 3 - HORIZONTAL RESISTANCE DESIGN PARAMETERS		
Soils	Angle of Internal Internal Friction ( $\phi$ )	Bulk Unit Weight ( $\text{kN/m}^3$ ) ( $\gamma$ )
Irregular Mixture of Silt, Sand and Gravel (Fill Material)	30°	20
heterogeneous Mixture of Gravel, Sand and Silt	35°	204

Pile caps shall be protected against frost penetration by providing a minimum 1.2 earth cover or equivalent frost protection.

#### Concrete Caissons

Alternatively, all structure foundations can be founded on concrete caissons augered and placed on bedrock at or below the elevations provided in Table. 2. To facilitate the design of the concrete caissons, a vertical factored bearing capacity equivalent to 3500 kPa can be employed for the dolostone bedrock at the U.L.S. In view of the unyielding nature of the bedrock, the Serviceability Limit State (SLS) will not govern the design because the stresses required to induce detrimental settlements at the S.L.S. will exceed the factored capacity at U.L.S.

The designer can use the bearing capacity provided to select the size of the caisson and the respective ultimate capacity. For instance, a 0.9m diameter

caisson will yield a capacity equivalent to approximately 2300 kN at U.L.S.

The lateral resistance of vertical or battered concrete caissons can be computed in accordance with Section 6.8.3.8. of the O.H.B.D.C. and using the data given in Table 3. Lateral resistance can be further augmented by socketing the caissons into the bedrock. The socket shall be a minimum 0.5m and an unconfined compressive strength ( $q_u$ ) of 10 MPa can be used to compute the horizontal capacity of the caisson in the rock. Again, only the Ultimate Limit State will govern the lateral capacity design.

Pile caps shall be protected against frost penetration by providing a minimum 1.2m earth cover or equivalent frost protection.

#### SHALLOW FOUNDATIONS

The centre pier and east pier can alternatively be supported on conventional spread footings founded on the native heterogeneous mixture of gravel, sand and silt. For purposes of the O.H.B.D.C., shallow foundations can be designed as summarized in Table 4 below.

TABLE 4 - SPREAD FOOTINGS			
Structure	Factored Capacity at U.L.S. (kPa)	Bearing Capacity at S.L.S. Type II (kPa)	Founding E1 (m)
Centre Pier	900	500	310
West Pier	900	500	309

It is expected that bearing pressures equivalent to the capacities at the Serviceability Limit States will yield a settlement of up to 25mm. This settlement is anticipated to be realized almost instantaneously.

The bearing capacity tabulated in Table 4 represent values attainable ONLY with a minimum three (3) metre edge distance between the footing and the crest of a 2H:IV slope. The present proposed east pier location is such that the foundation will not satisfy the minimum edge distance criteria. It is recommended that, should a shallow foundation design be selected at the east pier, the pier be relocated to ensure that this three (3) metre distance in the native soil is obtained.

The capacities tabulated in Table 4 pertain to vertical normal loads only. Reductions of bearing capacities to account for inclined loadings shall conform to factors provided in Section 6-7.3.3.5 of the O.H.B.D.C.

The sliding resistance of the spread footing on the native heterogeneous mixture of gravel, sand and silt can be computed by employing an unfactored angle of friction of  $35^{\circ}$  between the concrete footing and the soil. Should additional horizontal resistance to sliding be required, shear keys can be incorporated. The passive resistance of the shear key can be computed using the parameters of the native soil tabulated in Table 3. The lateral resistance of shallow foundations shall be computed in accordance with Section 6.7.3.3.2 of the O.H.B.D.C.

The footing base shall be protected against weathering during construction. To preserve the integrity of the founding surface during construction, it is recommended that a 100mm thick lean mix concrete coating be placed on the footing surface within four (4) hours of exposure.

## 2. BACKFILL TO STRUCTURE

### Material

It is recommended that Granular 'A' or Granular 'B' material be placed within a wedge behind the abutments bounded by a plane rising at 60° to the horizontal as shown in Figure 6.9.6.1 of the O.H.B.D.C. The application of granular material combined with weep holes in the abutment walls or pipe subdrains to drain any accumulation of water in the backfill will prevent hydrostatic pressure build-up.

Design parameters of the soil are given in Table 5 below. Computations of lateral earth pressure shall be in accordance with Section 6-6.1.2 of the O.H.B.D.C.

TABLE 5 - BACKFILL PROPERTIES		
	Granular "A"	Granular "B"
Angle of Internal Friction ( $\phi^\circ$ ) (factored)	35°	30°
Unit Weight (Kn/m <sup>3</sup> ), $\gamma$	22.8	21.2
* Coefficient of Active Earth Pressure ( $K_a$ )		
- S.L.S.	0.27	0.33
- U.L.S.	0.33	0.41
* Coefficient of Earth Pressure at Rest ( $K_o$ )		
- S.L.S.	0.43	0.50
- U.L.S.	0.50	0.58

\*These earth pressure coefficients apply to horizontal backfill surface only. The appropriate consideration shall be given to account for sloping backfill. The coefficient of earth pressure at rest shall be applied for rigid and unyielding walls.

Backfill beyond the 60° wedge can consist of material consistent with the definition specified in OPSS 212.05 series.

#### Backfilling and Compaction

The backfill shall be placed in 300mm lifts in accordance with OPSS 902 series

and compacted to achieve the target maximum dry density as outlined in OPSS 501.070.08.

Heavy vibratory equipment should be avoided in the backfill construction adjacent to the structure. It is therefore recommended that hand compaction equipment be employed in backfilling behind the abutment within a lateral distance equal to the current height of fill above the wall footing, in order to minimize deflection or possible damage of the wall.

### **3) APPROACH EMBANKMENTS**

#### **General**

As mentioned earlier, approach embankments up to 12.3 metres and 11.1 metres in height will be required at the east and west approaches respectively.

The design of embankments such as those proposed at the site must satisfy two major criteria.

(1) Stability

(2) Settlement

These criteria are discussed below. Embankment material and construction is also discussed.



## Stability

### Internal

To preserve the internal stability of the proposed embankments and to avoid surficial slope failures, the following guidelines shall be followed for both longitudinal and transverse slopes.

1. Earth fills up to eight (8) metres in height shall be constructed at 2H:IV slopes or flatter.

✓ 2. Earth fills exceeding eight (8) metres shall be constructed at 2H:IV slopes with a nominal two (2) metre midheight berm constructed with a 2% gradient towards the toe of the embankment to promote surface runoff or alternatively 2.5H:IV slopes.

✓ 3. Slopes exist at both the west and east approaches. Embankment fills constructed on these existing slopes shall be in accordance with OPSD 207.01 which specifies the appropriate "benching" of the new embankment material into the existing slopes.

✓ 4. Normal slope vegetation cover shall be established as per conventional MTO standards as soon as possible to provide surface erosion protection.

### Global

In view of the cohesionless nature of the fill material and underlying heterogeneous mixture of gravel, sand and silt, there are no deep seated global stability problems anticipated for embankment slopes constructed at 2H:1V both

in the transverse and longitudinal directions. However, the final embankment geometry shall be designed to satisfy the internal stability of the embankment and hence the internal stability of the embankment will govern the overall design.

#### Embankment Construction

Embankment material and construction shall conform to OPSS 212 and OPSS 206 series respectively. The embankment material shall be compacted as outlined in OPSS 501 series.

✓ All loosened and/or organic material should be excavated for their full depth within the plan limits prior to fill placement.

#### Settlement

Settlements induced as a result of the applied embankment loading will be the result of the elastic compression of the native subsoil and as a result of settlements within the fill material itself including the fill material that already exists at the site. It is anticipated that approximately up to 50mm of settlement attributable to the elastic compression of the existing fill and native soil will be realized at the approaches. This settlement is expected to be elastic in nature and hence should be realized during or shortly after the construction period.

Settlements within the embankment fill material are also anticipated as the result of internal stresses induced by the self weight of the material. It is anticipated that approximately 100mm of settlement will occur within the

embankments proposed at the site.

✓ Settlements within the earth fill should occur almost instantaneously and hence should occur during or immediately following construction for a granular material. Settlements of cohesive fill embankments will be more time dependent and anticipated to be realized within a three (3) month time period following placement.

✓ It is recommended that final paving be delayed for approximately three (3) months after embankment construction regardless of the fill material selected to enable the anticipated settlements to be realized.

#### 4. CONSTRUCTION CONSIDERATIONS

##### Excavation and Dewatering

✓ No dewatering problems are anticipated in the excavation for spread footings or pile caps because the groundwater table at the site is anticipated to be below the required depth of excavation. Any localized seepage or surface runoff can be readily discharge using conventional sump pumping techniques.

##### Caisson Construction

The proposed method of caisson installation shall be in accordance with OPSS 903.07.03 and subject to review by this office. The contractor shall submit a caisson construction scheme for approval as outlined in OPSS 902.04.01.

No dewatering problems are anticipated for caissons augered to or into the bedrock. However, it is recommended that a NSSP be included in the contract

documents that states that the heterogeneous mixture of gravel, sand and silt (Glacial Till) and also the irregular mixture of silt, sand and gravel (Fill Material) submerged below the groundwater table are subjected to conditions of unbalanced head and hence can "boil" under these conditions.

#### Temporary Slopes

✓ Temporary excavation slopes within the existing fill or native material shall not be steeper than 1.5H:IV.

#### Construction Procedure

Plans to facilitate the construction of the new structures whilst maintaining traffic along Hwy 6 and Hwy 24 were not available at the time of the investigation. Temporary traffic protection, therefore, may or may not be required. Once, the proposed construction method has been determined, this office can provide pertinent recommendations regarding temporary shoring schemes and design parameters.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of T. Sangiuliano, utilizing equipment owned and operated by Malone's Soil Samples. Logging of rock core in the laboratory was carried out by D. Williams, Petrographer.

The project was carried out by T. Sangiuliano under the general supervision of P. Payer, Senior Foundation Engineer. The report was written by T. Sangiuliano, reviewed by P. Payer and approved by Mr. M.S. Devata, Chief Foundation Engineer.



A handwritten signature in black ink, appearing to read 'T. Sangiuliano'.

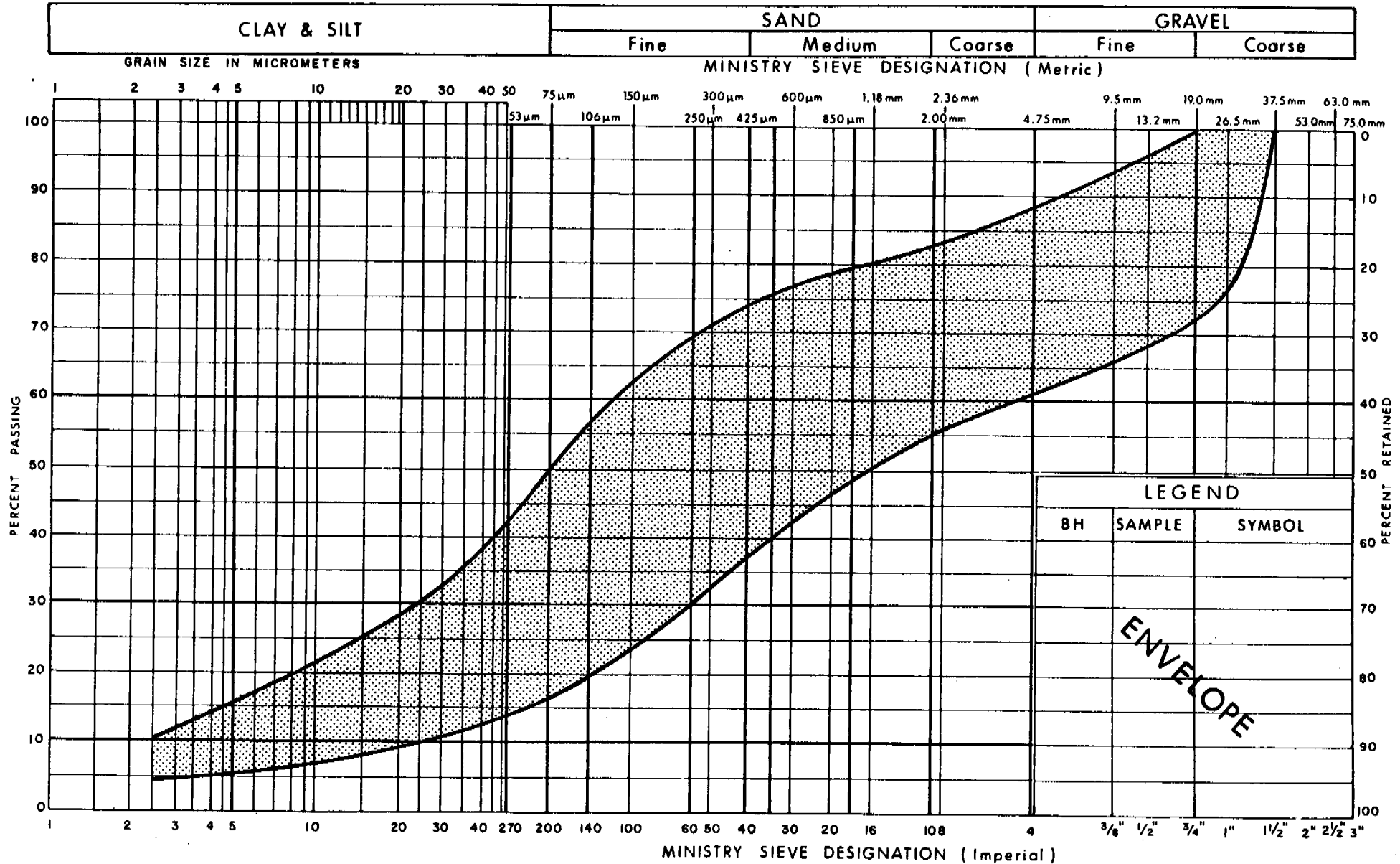
T. Sangiuliano, P.Eng.  
Foundation Engineer

A handwritten signature in black ink, appearing to read 'M.S. Devata'.

M.S. Devata, P.Eng.  
Chief Foundation Engineer

## APPENDIX

## UNIFIED SOIL CLASSIFICATION SYSTEM



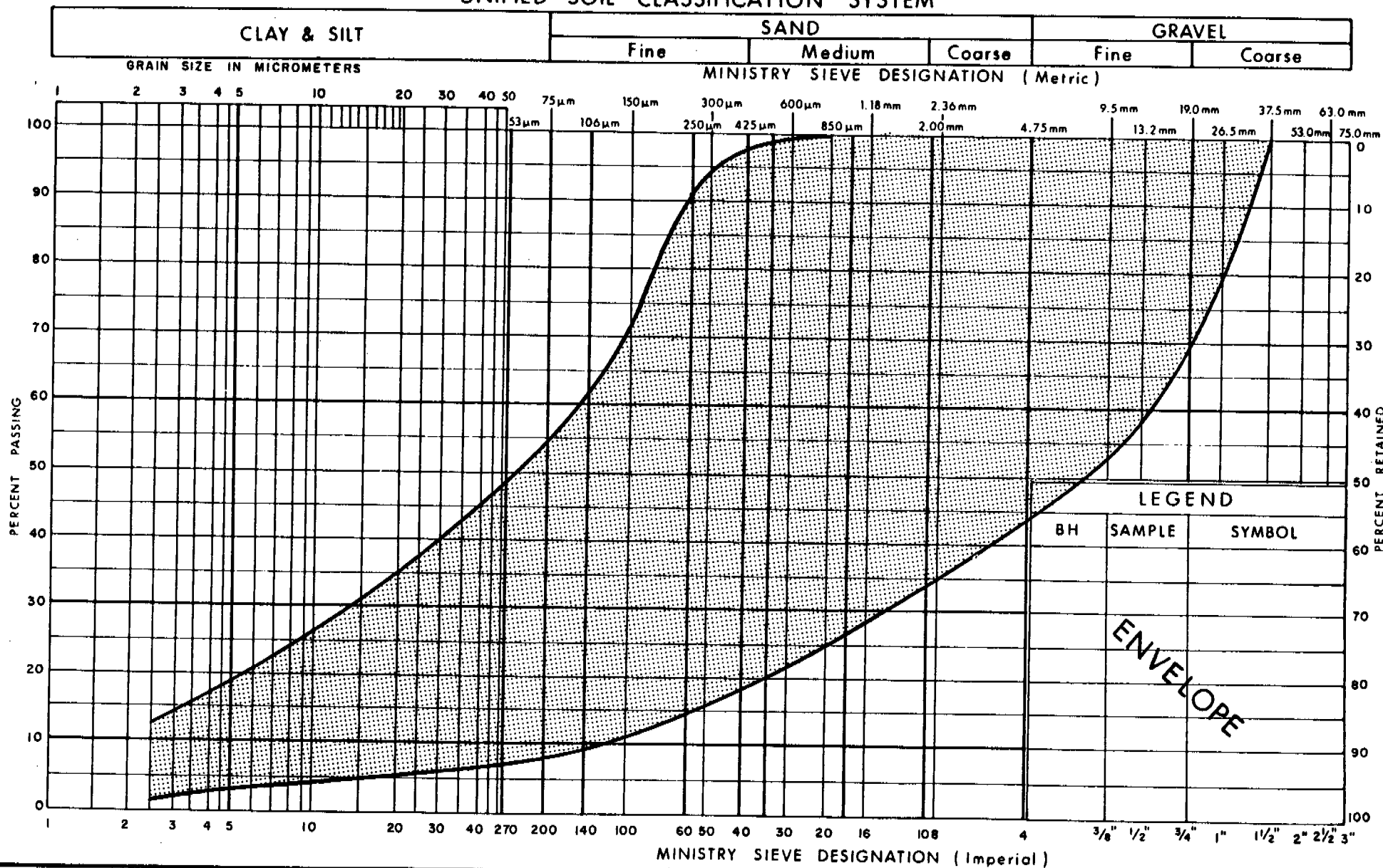
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**GRAIN SIZE DISTRIBUTION**  
 IRREGULAR MIXTURE OF  
 SILT, SAND & GRAVEL ( FILL MATERIAL)

FIG No 1

W P 534 - 91 - 01 / 02

# UNIFIED SOIL CLASSIFICATION SYSTEM

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## GRAIN SIZE DISTRIBUTION HETEROGENEOUS MIXTURE OF GRAVEL, SAND & SILT ( Glacial Till )

FIG No 2

W P 534 - 91 - 01 / 02



## 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 (R Q D), 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

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	kN/m <sup>3</sup>	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	kg/m <sup>3</sup>	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	m <sup>3</sup> /s	RATE OF DISCHARGE
$\gamma_d$	kN/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	kN/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m <sup>3</sup>	SEEPAGE FORCE
$\gamma'$	kN/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL						

# RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 846.8; E 242 927.0 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 02 10-11 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100					w <sub>p</sub> w      w <sub>L</sub>				
								SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE					WATER CONTENT (%) 10 20 30				
313.1	Ground Surface																
0.0	Irregular Mixture of Silt, Sand and Gravel (Fill Material)																
312.5																	
0.6	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)		1	SS	29		312							o	39 39 (22)		
	Brown, Compact to Dense		2	SS	33												
309.9			3	SS	60		310										
3.2	Dolostone Bedrock  Weak, Slightly Weathered to Unweathered		4	RC	REC 100%		308								RQD = 67%		
			5	RC	REC 100%										RQD = 100%		
306.6																	
6.5	End of Borehole  • 93 02 12																

# RECORD OF BOREHOLE No 1A

1 OF 1

METRIC

W.P. 534-81-01/02 LOCATION Co-ords: N 4 820 817.0; E 242 969.0 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 02 09 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
306.7	Ground Surface																
0.0	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till) trace Organics Black, Compact		1	SS	11		308										2 45 46 7
307.0			2	SS	60												
1.7	Dolostone Bedrock Weak, Slightly Weathered to Unweathered		3	RC	REC 93%		306										RQD = 31%
			4	RC	REC 100%												RQD = 71%
304.0							304										
4.7	End of Borehole • 93 02 10																

# RECORD OF BOREHOLE No 1B

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 822.6 E 242 953.4 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 02 09 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT 7 kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>		
312.6	Ground Surface																
0.0	Irregular Mixture of Silt, Sand and Gravel (Fill Material)  Brown, Compact		1	SS	23		312										
310.6																	
2.0	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)  Brown, Compact		2	SS	11		310										11 37 40 12
308.6	trace Organics		3	SS	60												
4.0	Dolostone Bedrock Weak, Slightly Weathered to Unweathered		4	RC	REC 97%		308										RQD = 62%
			5	RC	REC 100%		306										RQD = 53%
305.0																	
7.6	End of Borehole  • 93 02 10																

# RECORD OF BOREHOLE No 1C

1 OF 1 METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 827.5; E 242 936.5 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger COMPILED BY TS  
 DATUM Geodetic DATE 93 03 11 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100					w <sub>p</sub> w w <sub>L</sub>					
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE					WATER CONTENT (%)					
312.8	Asphaltic Surface																	
0.0	Irregular Mixture of Silt, Sand and Gravel (Fill Material)					DRY *	312											
311.3	Brown, Compact																	
1.5	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)  Grey, Compact to Dense  ----- trace Dolostone fragments		1	SS	34				310									
			2	SS	13													
			3	SS	17													
308.8	Dolostone Bedrock	4	SS	87														
308.2	Weak, Slightly Weathered																	
4.6	End of Borehole • 93 03 11																	

# RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 836.0; E 242 987.0 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 02 10 CHECKED BY PP




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>			NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT 7 kN/m <sup>3</sup>	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	20	40	60				
312.1	Ground Surface																		
0.0	Irregular Mixture of Silt, Sand and Gravel  (Fill Material)  Brown, Loose		1	SS	5												12 38 42 8		
310.1							310												
2.0	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)  Brown, Compact to Very Dense		2	SS	40														
			3	SS	69		308												
	Black, trace Organics		4	SS	25												22 50 26 2 56 33 (11)		
306.8																			
5.3	Dolostone Bedrock Weak, Unweathered		5	SS	81	/28cm													
			6	SS	60	/10cm	306										RQD = 67%		
			7	RC	REC 97%														
			8	RC	REC 100%		304										RQD = 66%		
302.9																			
9.2	End of Borehole																		
	• 93 02 11																		

# RECORD OF BOREHOLE No 2A

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 838.0; E 242 969.8 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 03 11 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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							
312.3	Ashpaltic Surface														
0.0	Irregular Mixture of Silt, Sand and Gravel  (Fill Material)  Brown, Loose to Compact						312								
			1	SS	8										
			2	SS	21										
			3	SS	13			310							
			4	SS	18										
	5	SS	7		308										
307.7	Block, trace Organics, trace Ash		6	SS	106										
4.6	Dolostone Bedrock  Weak, Unweathered		7	RC	REC 97%		306								
305.7															
6.6	End of Borehole  • 93 03 11														

# RECORD OF BOREHOLE No 2B

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 845.4 E 242 953.6 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 03 11 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100					w <sub>p</sub> w w <sub>L</sub>				
								SHEAR STRENGTH kPo ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100					WATER CONTENT (%) 10 20 30				
312.8	Asphaltic Surface																
0.0	Irregular Mixture of Silt, Sand and Gravel (Fill Material)																
311.3	Brown, Compact																
1.5	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)		1	SS	26												
			2	SS	23												
	Grey, Compact		3	SS	12												
309.0			4	SS	77												
3.8	Dolostone Bedrock Weak, Slightly Weathered to Unweathered		5	RC	REC 100%												
307.3																	
5.5	End of Borehole  • 93 03 11																



# RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 850.0; E 243 009.0 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 02 10 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
311.1	Ground Surface													
0.0														
	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)		1	SS	31		310							
	Brown, Dense to Very Dense		2	SS	75									41 40 16 3
			3	SS	77		308							
			4	SS	46									42 42 14 2
	Black, trace Organics		5	SS	35		306							
305.8			6	SS	100	/25cm								
5.3	Dolostone Bedrock Weak, Unweathered		7	RC	REC 100%		304							RQD = 70%
			8	RC	REC 100%									RQD = 54%
302.3														
8.8	End of Borehole													
	• 93 02 11													

# RECORD OF BOREHOLE No 3A

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 856.0; E 242 987.0 ORIGINATED BY TS  
DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
DATUM Geodetic DATE 93 02 11 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
311.9	Ground Surface																
0.0	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)																
	Compact		1	SS	24		310										
	Very Dense		2	SS	78												
			3	SS	60												37 44 16 3
			4	SS	52		308										
	Brown																
307.0	Black, trace Organics		5	SS	68	23cm											0 53 42 5
4.9	Dolostone Bedrock Weak, Unweathered		6	RC	REC 100%		306										RQD = 44%
305.4																	
6.5	End of Borehole																
	• 93 02 12																

# RECORD OF BOREHOLE No 4

1 OF 1 METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 878.4; E 242 998.0 ORIGINATED BY TS  
 DIST 3 HWY 5 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 02 09 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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					10 20 30				
311.3	Ground Surface																
0.0	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)  Brown, Compact to Very Dense						310										
			1	SS	77												
			2	SS	59												
			3	SS	16												
307.3	Black, Trace Organics		4	SS	60												
4.0	Dolostone Bedrock  Weak, Unweathered		5	RC	REC 100%		306									RQD = 40%	
			6	RC	REC 100%											RQD = 43%	
304.2																	
7.1	End of Borehole  • 93 02 12																

RECORD OF BOREHOLE No 4A

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 867.4 E 243 037.4 ORIGINATED BY TS  
DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
DATUM Geodetic DATE 93 02 11 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ KN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
310.6	Ground Surface																
0.0	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)		1	SS	13		310										
	Brown, Compact to Very Dense		2	SS	40		308										47 30 19 4
			3	SS	28												
			4	SS	66												
			5	SS	60		306										44 42 12 2
			6	SS	37												
	Black, Loose trace Organics		7	SS	7		304										27 37 32 4
303.7			8	SS	60	/10cm											
6.9	Dolostone Bedrock Weak, Slightly Weathered to Unweathered		9	RC	REC 94%												RQD = 0%
			10	RC	REC 90%		302										RQD = 23%
301.2																	
9.4	End of Borehole  * GWL not established																

# RECORD OF BOREHOLE No 4B

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 872.0; E 243 017.0 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 02 12 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
311.0	Ground Surface																
0.0	Irregular Mixture of Silt, Sand and Gravel (Fill Material)					*											
310.1	Brown, Compact																
0.9																	
	Compact		1	SS	10												
	Dense to Very Dense		2	SS	75												
	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)		3	SS	39												
	Brown		4	SS	39												
			5	SS	60	/13cm											
305.7	Boulders and Cobbles																
5.3	Dolostone Bedrock Weak, Unweathered		6	RC	REC 95%												RQD = 23%
304.5																	
6.5	End of Borehole * GWL not established																

# RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 881.0; E 243 060.0 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 02 09 CHECKED BY PP




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  7 kN/m <sup>3</sup>	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					10   20   30				
306.2	Ground Surface																
0.0	Irregular Mixture of Silt, Sand Gravel, Wood, Brick (Fill Material)  Black, Compact (Gas Odour)					5cm	306								34   39   23   4		
			1	SS	13												
			2	SS	12												
303.6		3	SS	23	304											1   56   38   5	
2.6	Heterogeneous Mixture of Gravel, Sand and Silt ( Glacial Till )   Black, Compact		4	SS	60												
303.2																	
3.0	Dolostone Bedrock  Slightly Weathered to Unweathered  Weak ----- Medium Strong		5	RC	REC 90%		302									RQD = 0%	
			6	RC	REC 100%											RQD = 0%	
			7	RC	REC 100%												RQD = 0%
300.1																	
6.1	End of Borehole  • 93 02 10																

# RECORD OF BOREHOLE No 5A

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 892.8; E 243 019.0 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 02 17 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20   40   60   80   100					w <sub>p</sub>	w	w <sub>L</sub>				
								SHEAR STRENGTH kPa ○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × LAB VANE											
							20   40   60   80   100					10   20   30							
310.4	Ground Surface																		
0.0	Irregular Mixture of Silt, Sand and Gravel  (Fill Material)  Brown, Loose to Compact						310												
			1	SS	15														
			2	SS	14			308							o				33 51 12 4
			3	SS	15														
			4	SS	8														
305.8							306												
4.6	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)		5	SS	8									o		37 55 5 3			
304.9	Grey, Loose		6	SS	60														
5.5	Dolostone Bedrock  Weak, Unweathered						304									RQD = 17%			
303.4			7	RC	REC 100%														
7.0	End of Borehole  • 93 02 18																		

# RECORD OF BOREHOLE No 5B

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 886.6 E 243 037.6 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger, NW Casing, NX Core COMPILED BY TS  
 DATUM Geodetic DATE 93 02 10 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  7 kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20   40   60   80   100					W <sub>P</sub> W   W <sub>L</sub>				
								SHEAR STRENGTH kPa ○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × LAB VANE					WATER CONTENT (%) 10   20   30				
306.5	Ground Surface																
0.0	Irregular Mixture of Silt, Sand, Gravel, Brick, Glass and Wood (Fill Material)  Black, Compact					 13cm	306									32 49 16 3	
304.8			1	SS	16												6 38 48 8
1.7	Het. Mixt. of Gravel, Sand and Silt, Trace Organics, (Glacial Till) (Black)	2	SS	60													
304.4																	
2.1	Dolostone Bedrock  Unweathered  Weak ----- Medium Strong		3	RC	REC 100%		304									RQD = 7%	
			4	RC	REC 100%		302									RQD = 32%	
301.3																	
5.2	End of Borehole  • 93 02 10																



# RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 917.4 E 243 056.8 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger COMPILED BY TS  
 DATUM Geodetic DATE 93 02 10 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
306.8	Ground Surface																
0.0	Heterogeneous Mixture of Gravel, Sand, Silt, Organics (Glacial Till)					DRY *											
305.7	Black, Loose		1	SS	46		306						o				19 61 (20)
1.1	Dolostone Bedrock																
305.2	Weak, Slightly Weathered		2	SS	60	/5cm											
1.6	End of Borehole * 93 02 10																

# RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 534-91-01/02 LOCATION Co-ords: N 4 820 799.9 E 242 947.7 ORIGINATED BY TS  
 DIST 3 HWY 6 BOREHOLE TYPE HS Auger COMPILED BY TS  
 DATUM Geodetic DATE 93 02 09 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
308.5	Ground Surface																
0.0	Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)					DRY +	308										
307.4	Brown, trace Black Organics		1	SS	56												50 31 (19)
1.1 307.0	Dolostone Bedrock Weak, Slightly Weathered																
1.5	End of Borehole  • 93 02 09																

# ROCK CORE DESCRIPTION

## WP 534-91-01/02

Page 1 of 4

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
1	4	3.45-4.98	100	67	3.45-6.50	DOLOSTONE (with abundant small vugs and some larger vugs up to at least 4 cm in diameter, commonly containing calcite crystals; stromatoporoids common), white to very pale orange to pale yellowish brown; medium grained; weak; unweathered to slightly weathered; fractures wide to very close spaced, flat to dipping, undulating to planar, smooth to rough.
	5	4.98-6.50	100	100		
1A	3	1.70-3.22	93	31	1.70-4.75	DOLOSTONE (with stylolites, abundant small vugs, and some larger vugs up to 6 cm in diameter; stromatoporoids common), white to very pale orange to moderate brown; medium grained; weak; unweathered to slightly weathered (moderately weathered, 1.70-2.03 m); fractures moderate to very close spaced, flat to near vertical, undulating to planar, smooth to rough.
	4	3.22-4.75	100	71		
1B	4	4.52-6.04	97	62	4.52-7.57	DOLOSTONE (with abundant small vugs and some larger vugs up to 4 cm in diameter, commonly containing calcite crystals), white to very pale orange to pale yellowish brown; medium grained; weak; unweathered to slightly weathered; fractures moderate to very close spaced, flat to near vertical, undulating to planar, smooth to rough.
	5	6.04-7.57	100	53		
2	7	6.20-7.72	97	67	6.20-9.24	DOLOSTONE (with abundant small vugs and some larger vugs up to 4 cm in diameter, commonly containing calcite crystals; stromatoporoids common), white to very pale orange to pale yellowish brown; medium grained; weak; unweathered to slightly weathered; fractures moderate to very close spaced, flat to dipping, undulating to planar, smooth to rough.
	8	7.72-9.24	100	66		

\*CR = CORE RECOVERY

\*RQD = ROCK QUALITY DESIGNATION

Note: Depths are approximated where core recovery is less than 100%

Logged by: DAW, Soils and Aggregates Section

**ROCK CORE DESCRIPTION**  
**WP 534-91-01/02**

Page 2 of 4

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
2A	7	5.03-6.55	97	63	5.03-6.55	<b>DOLOSTONE</b> (with abundant small vugs and some larger vugs up to 2 cm in diameter), very pale orange to pale yellowish orange to light brown; medium grained; weak; unweathered to slightly weathered (moderately weathered, 5.03- 5.18 m); fractures moderate to extremely close spaced, flat to near vertical, undulating to planar, smooth to rough.
2B	5	3.96-5.49	100	58	3.96-5.49	<b>DOLOSTONE</b> (with stylolites, abundant small vugs, and some larger vugs up to 2 cm in diameter), very pale orange to medium light grey; medium grained; weak; unweathered to slightly weathered; fractures moderate to extremely close spaced, flat to near vertical, undulating to planar, smooth to rough.

\*CR = CORE RECOVERY

\*RQD = ROCK QUALITY DESIGNATION

*Note: Depths are approximated where core recovery is less than 100%*  
 Logged by: DAW, Soils and Aggregates Section

# ROCK CORE DESCRIPTION

## WP 534-91-01/02

Page 3 of 4

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
3	7	5.74-7.26	100	70	5.74-8.79	<b>DOLOSTONE</b> (with stylolites, abundant small vugs, and some larger vugs up to 1 cm in diameter, commonly containing calcite crystals), white to very pale orange to pale yellowish brown; medium grained; weak; unweathered to slightly weathered; fractures moderate to very close spaced, flat to near vertical, undulating to planar, smooth to rough.
	8	7.26-8.79	100	54		
3A	6	4.95-6.48	100	44	4.95-6.48	<b>DOLOSTONE</b> (with abundant small vugs and some larger vugs up to at least 4 cm in diameter, commonly containing calcite crystals), very pale orange to yellowish grey to greyish yellow; medium grained; weak; unweathered to slightly weathered; fractures close to very close spaced, flat to near vertical, undulating to planar, smooth to rough.
4	5	4.04-5.56	100	40	4.04-7.09	<b>DOLOSTONE</b> (with stylolites, abundant small vugs, and some larger vugs up to 2 cm in diameter, commonly containing calcite crystals; stromatoporoids and corals common), white to very pale orange to pale yellowish brown; medium grained; weak; unweathered to slightly weathered; fractures moderate to extremely close spaced, flat to near vertical, undulating to planar, smooth to rough.
	6	5.56-7.09	100	43		
4A	9	6.96-7.87	94	0	6.96-9.40	<b>DOLOSTONE</b> (with stylolites, abundant small vugs, and larger vugs up to 5 cm in diameter, commonly containing calcite crystals), very pale orange to pale yellowish brown (6.96-7.57 m) and medium dark grey to dark yellowish brown to pale yellowish brown (7.57-9.40 m); medium grained; weak (6.96-7.57 m) to medium strong (7.57-9.40 m); unweathered to slightly weathered (moderately weathered, 6.96-7.24 m); fractures close to extremely close spaced, flat to near vertical, undulating to planar, smooth to rough.
	10	7.87-9.40	90	23		

\*CR = CORE RECOVERY

\*RQD = ROCK QUALITY DESIGNATION

*Note: Depths are approximated where core recovery is less than 100%*

Logged by: DAW, Soils and Aggregates Section

# ROCK CORE DESCRIPTION

## WP 534-91-01/02

Page 4 of 4

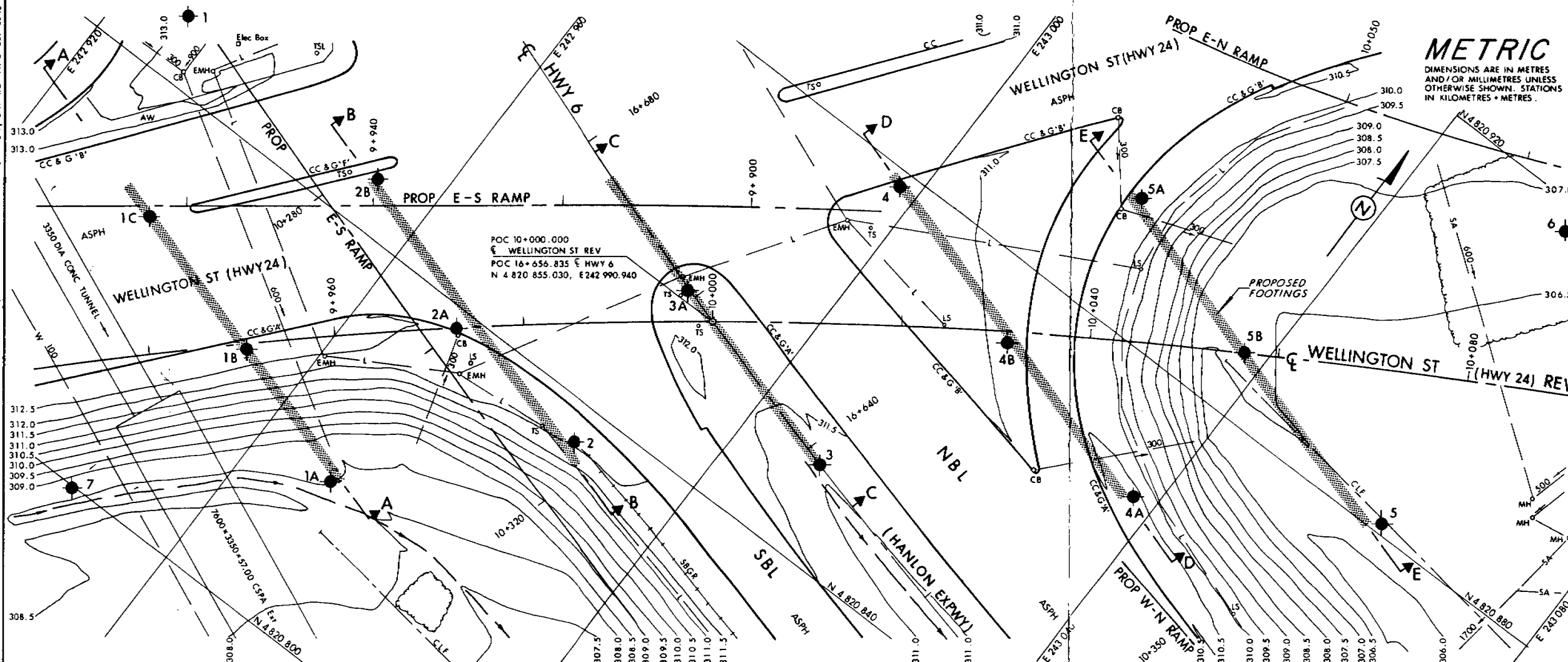
CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
4B	6	5.31-6.83	95	23	5.31-5.66	<b>OVERBURDEN</b> (calcareous sand and gravel). <b>DOLOSTONE</b> (with stylolites and abundant small vugs; stromatoporoids and corals common), very pale orange to pale yellowish brown; medium grained; weak; unweathered to slightly weathered (moderately weathered, 5.66-5.79 m); fractures moderate to extremely close spaced, flat to near vertical, undulating to planar, smooth to rough.
					5.66-6.83	
5	5	3.10-4.62	90	0	3.10-6.15	<b>DOLOSTONE</b> (with stylolites, abundant small vugs, and larger vugs up to 4 cm in diameter, commonly containing calcite crystals; corals common), very pale orange to pale yellowish brown (3.10-5.08 m) and dark yellowish brown to pale yellowish brown (5.08-6.15 m); medium grained; weak (3.10-5.08 m) to medium strong (5.08-6.15 m); unweathered to slightly weathered; fractures close to extremely close spaced, flat to near vertical, undulating to planar, smooth to rough.
	6	4.62-5.23	100	0		
	7	5.23-6.15	100	0		
5A	7	5.51-7.03	100	17	5.51-7.03	<b>DOLOSTONE</b> (with stylolites and abundant small vugs), very pale orange to pale yellowish brown; medium grained; weak; unweathered to slightly weathered; fractures close to extremely close spaced, flat to near vertical, undulating to planar, smooth to rough.
5B	3	2.13-3.66	100	7	2.13-5.18	<b>DOLOSTONE</b> (with abundant small vugs and larger vugs up to 4 cm in diameter, commonly containing calcite crystals), very pale orange to pale yellowish brown (2.13-2.90 m) and dark yellowish brown to pale yellowish brown (2.90-5.18 m); medium grained; weak (2.13-2.90 m) to medium strong (2.90-5.18 m); unweathered to slightly weathered; fractures close to extremely close spaced, flat to near vertical, undulating to planar, smooth to rough.
	4	3.66-5.18	100	32		

\*CR = CORE RECOVERY

\*RQD = ROCK QUALITY DESIGNATION

Note: Depths are approximated where core recovery is less than 100%

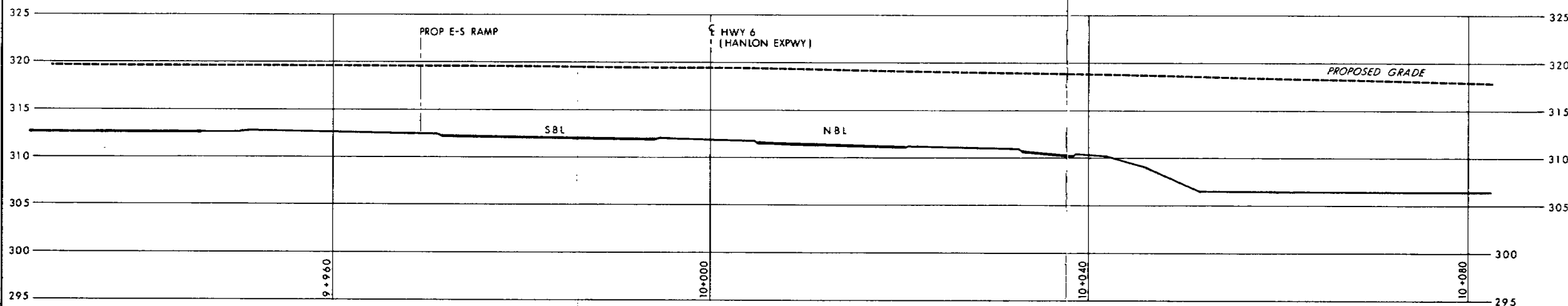
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PLAN  
SCALE  
5m 0 5m

NOTES:

- For Subsoil Stratigraphical Sections refer to DWG 5349101/02 - B
- For Subsoil information of BH's 6 & 7 refer to Record of Borehole Sheets.



PROFILE WELLINGTON ST (HWY 24) REV

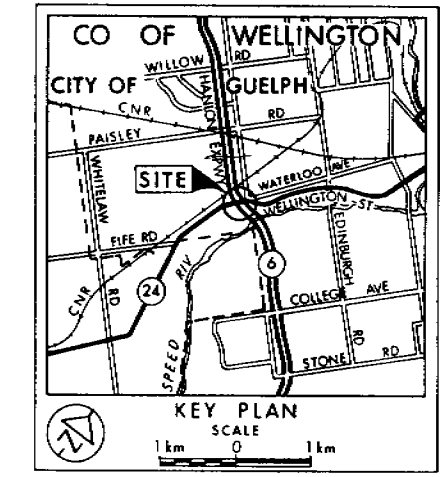
SCALE  
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CONT No  
WP No 534-91-01/02

WELLINGTON ST (HWY 24)  
UNDERPASS  
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



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  
1993 02 and 03

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	313.1	4 820 846.6	242 927.0
1A	308.7	4 820 817.0	242 969.0
1B	312.6	4 820 822.6	242 953.4
1C	312.8	4 820 827.5	242 936.5
2	312.1	4 820 836.0	242 987.0
2A	312.3	4 820 838.0	242 969.8
2B	312.8	4 820 845.4	242 953.6
3	311.1	4 820 850.0	243 009.0
3A	311.9	4 820 856.0	242 987.0
4	311.3	4 820 878.4	242 998.0
4A	310.6	4 820 867.4	243 037.4
4B	311.0	4 820 872.0	243 017.0
5	306.2	4 820 881.0	243 060.0
5A	310.4	4 820 892.8	243 019.0
5B	306.5	4 820 886.6	243 037.6
6	306.8	4 820 917.4	243 056.8
7	308.5	4 820 799.9	242 947.7

NOTE

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

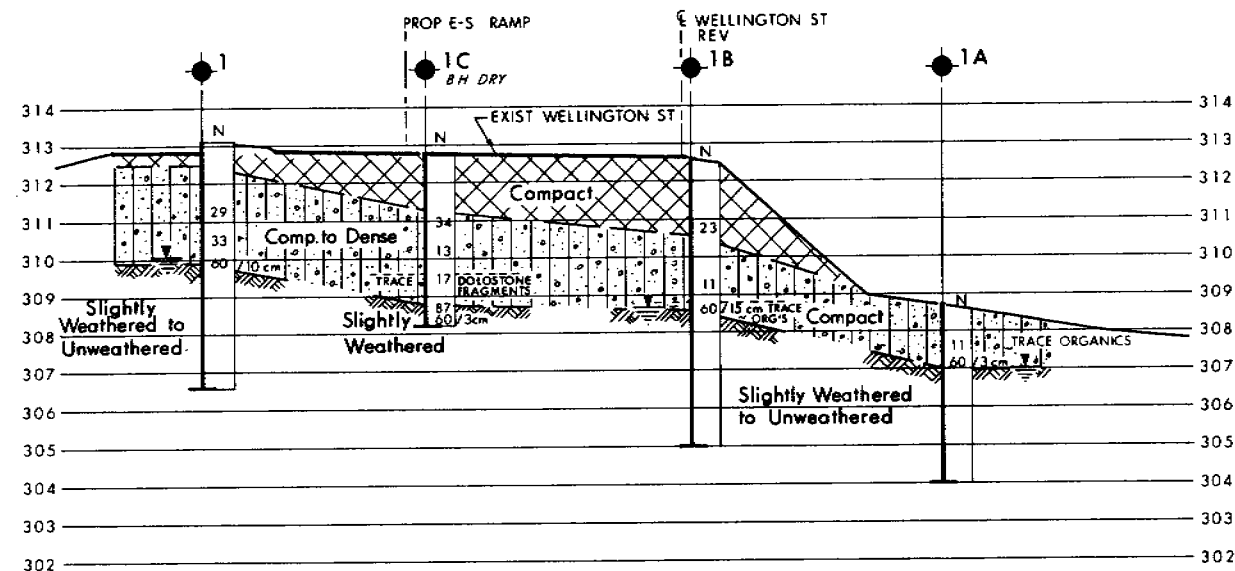
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

REV	DATE	BY	DESCRIPTION
1			

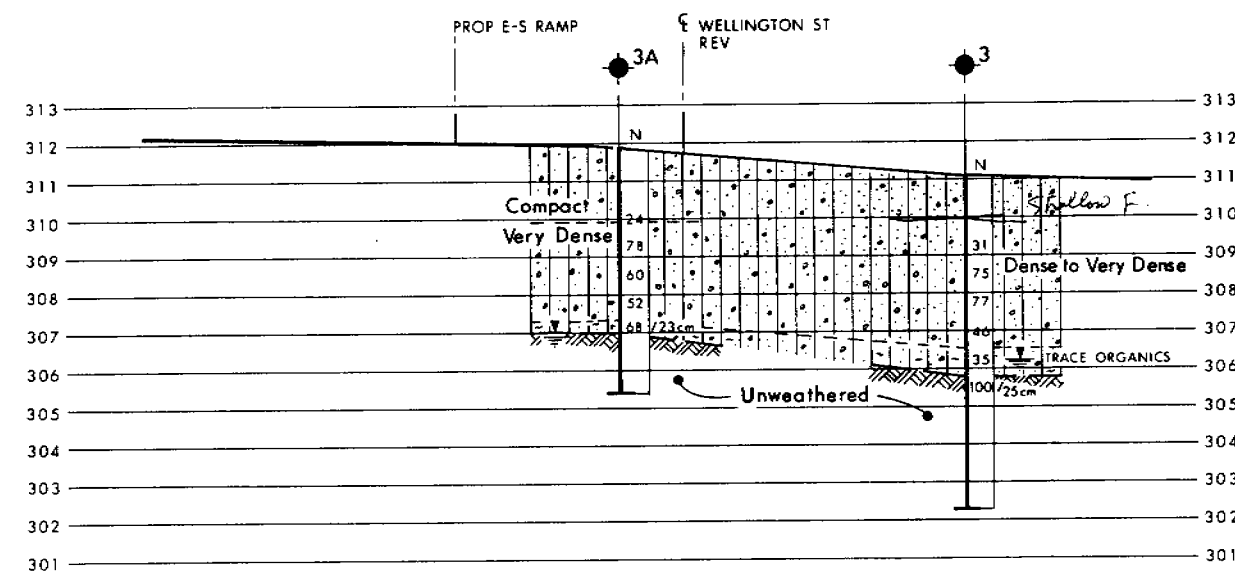
Geocres No 40P9-30

HWY No 6 (HANLON EXPWY)	DIST 3
SUBM'D T.S.	CHECKED Y.S.
DRAWN R.S.	CHECKED C.S.

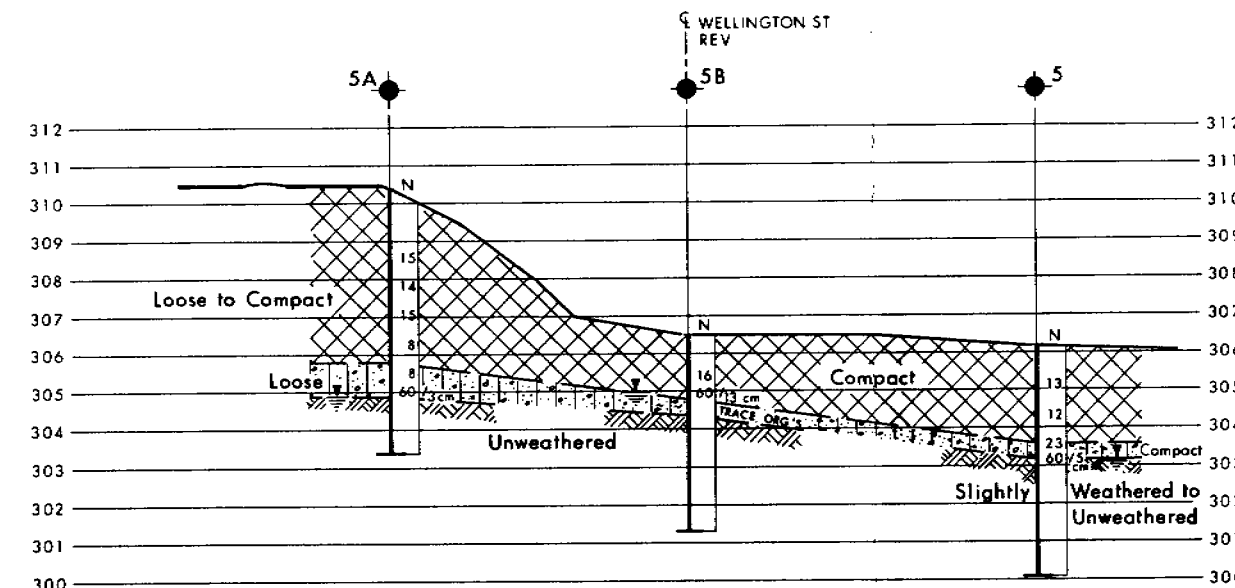
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DWG 5349101/02-A



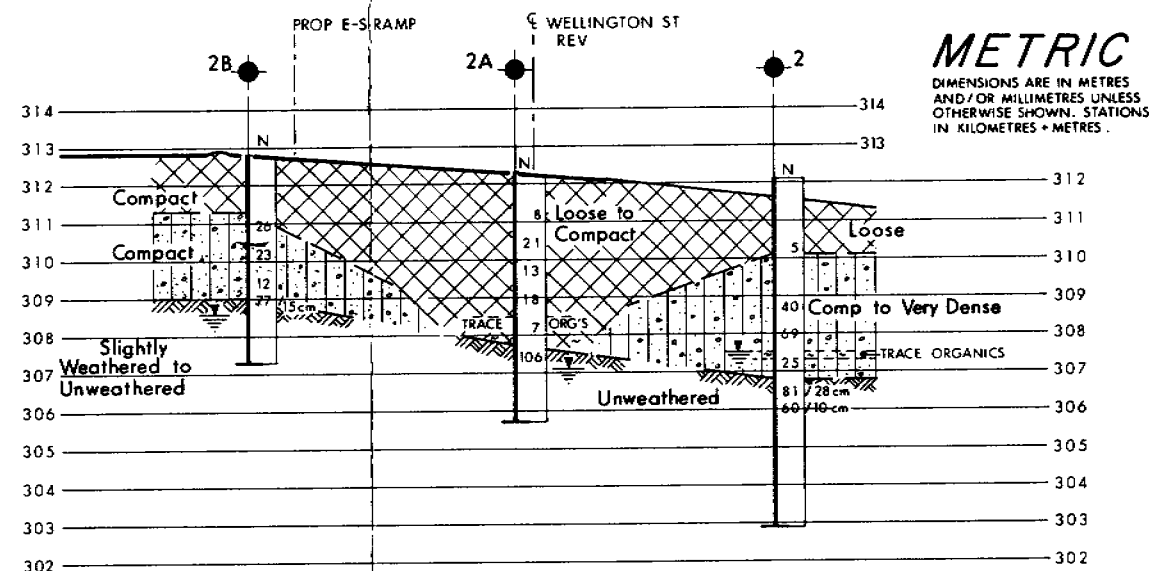
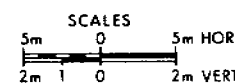
SECTION A-A



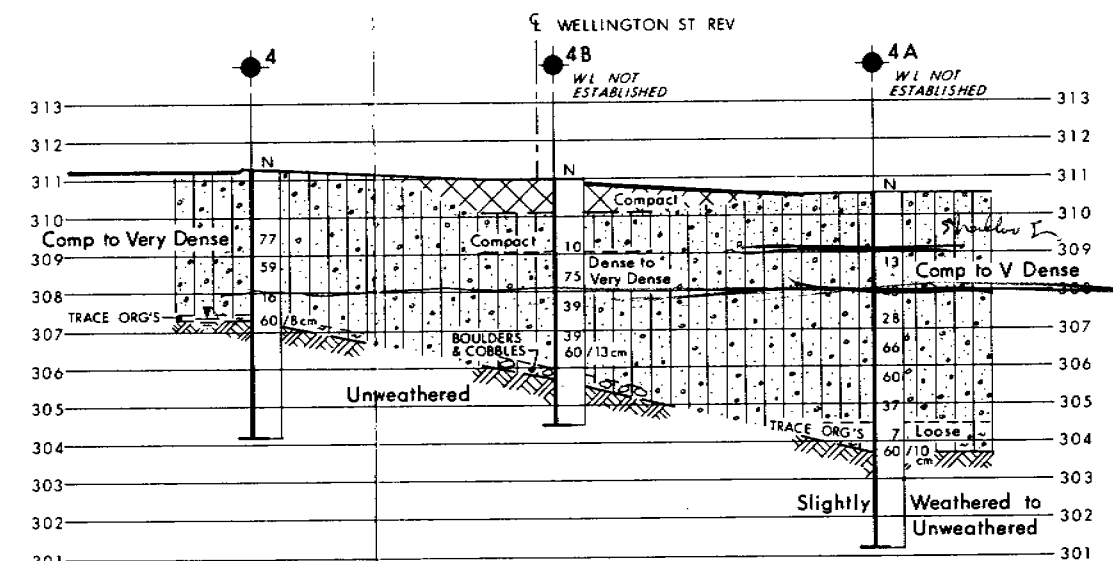
SECTION C-C



SECTION E-E



SECTION B-B



SECTION D-D

### SOIL STRATIGRAPHY LEGEND

- IRREGULAR MIXTURE OF SILT, SAND & GRAVEL (FILL MATERIAL)
- HETEROGENEOUS MIXTURE OF GRAVEL, SAND & SILT (GLACIAL TILL)
- DOLOSTONE BEDROCK

### NOTE

For Plan and Profile refer to DWG 5349101/02-A

CONT No  
WP No 534-91-01/02

WELLINGTON ST (HWY24)  
UNDERPASS  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

SEE DWG 5349101/02-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)
- W.L. at time of investigation 1993 02 and 03

No	ELEVATION
1	313.1
1A	308.7
1B	312.6
1C	312.8
2	312.1
2A	312.3
2B	312.8
3	311.1
3A	311.9
4	311.3
4A	310.6
4B	311.0
5	306.2
5A	310.4
5B	306.5

### =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 GC 2.01 of OPS GenCond.

DATE	BY	DESCRIPTION
HWY No 6 (HANLON EXPWY)	DIST 3	
SUBMD TS	CHECKED TS	DATE 1993 05 10 SITE 35-577/1/2
DRAWN RS	CHECKED RS	APPROVED DWG 5349101/02-B

Geocres No 40P9-30