

GEOCRES No. 31D-312DIST. 7 REGION W.P. No. 74-70-06(B)CONT. No. 89-57W. O. No. STR. SITE No. 21-39-445HWY. No. 115LOCATION Peterborough Co. Rd # 10
UnderpassNo of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 74-70-06 [B] DIST #7
HWY #115 STR SITE 21-39-445

CONT 89-57
PETERBOROUGH COUNTY ROAD #10 UNDERPASS

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FOUNDATION INVESTIGATION REPORT
FOR
W.P. 74-70-06 - B
Peterborough Co. Rd. 10 Structure
Hwy. 115, District 7, Port Hope

INTRODUCTION

This report summarizes the results of a foundation investigation required for the proposed structure at the above-noted site. The area investigated extends along Co. Rd. 10 from Sta. 9+790 to Sta. 10+370.

The fieldwork was carried out during the period from 85-05-14 to 85-05-29, 85-07-03 to 85-07-08, and from 85-07-22 to 85-07-24. Continuous flight auger machines equipped with 82 mm I.D. hollow-stem augers and B casing were used.

The investigation consisted of 21 sampled boreholes (BH 1-11, 100-107, 122,123) ranging in depth from 4.3 m to 20.2 m below the existing ground surface.

SITE DESCRIPTION

The proposed interchange location is situated at Peterborough County Rd. 10, approximately 2.5 km south-west of Hwy. 7A. The site lies within the Township of Cavan, County of Peterborough. The existing intersection is a level crossing.

Physiographically, the site lies within the Peterborough Drumlin Field (Chapman and Putnam, 1984). This physiographic region is characterized by the numerous drumlins, eskers, and drumlinoid hills. These features result in the region to be described as "rolling".

Specifically, the local topography is rolling with numerous hills in the surrounding area. The low point appears to be at the intersection. In the vicinity of the site land use is primarily agricultural.

SUBSURFACE CONDITIONS

General

The Record of Borehole Sheets in the Appendix illustrate the conditions at the borehole locations. The boreholes are referenced as BH 1-11, 100-107, and 122, 123. The locations and elevations of the boreholes are shown on Dwg 747006A-A.

It should be noted that BH 100, 101, 105, 106 and 107 and not shown on the above-noted drawing since they are located outside the limits of the drawing. The log sheets for these boreholes are however included in this report. The following describes the location of these boreholes:

<u>BH</u>	<u>Sta. + O/S(from exist. Co. Rd. 10 C.L.)</u>	
100	9+786	3.5 m Rt.
101	9+851	3.5 m Rt.
105	10+151	2.5 m Rt.
106	10+203	3.0 m Rt.
107	10+375	10.5 m Rt.

The following paragraphs describe the subsurface conditions encountered at this site. For the sake of clarity, the descriptions have been subdivided into "South Approach" and "North Approach".

It is to be noted that all non-cohesive materials across this site will experience "boiling" if subjected to an unbalanced hydrostatic pressure. Furthermore, an artesian condition was encountered in the vicinity of the Hwy. 115/Co. Rd. 10 intersection. This condition is described under the "Groundwater" heading.

South Approach

Fill

Fill material was encountered in BH 1, 4, 6. In BH 1, the fill was encountered to a depth of 2.2 m below the pavement surface and generally consisted of a non-cohesive mixture of sand and gravel. 'N' values of 13 and 15 blows/0.3 m were obtained in this fill. No laboratory testing was carried out on this material. In BH 4, sandy gravel fill was found to a depth of 0.5 m below the ground surface.

In BH 6, sand with silt fill was encountered to a depth of 2 m below the ground surface. One grain size distribution test was carried out on a sample of this non-cohesive material. The following was the result: 8% gravel, 53% sand, 29% silt, 10% clay.

Organic Silt

Surficial organic silt was encountered in BH 104 down to a depth of 2.1 m. Based on an 'N' value of 9 blows/0.3 m, this non-cohesive material can be considered to be in a loose state. Sand and fibres were evident within this material.

Occasional thin seams of organic material were also encountered in BH 5 and 123 at various depths. In addition, the topsoil across the site can also be considered to be organic in nature.

Silty Clay

Silty clay was found in BH 1-6, 103-107, 122 and 123 as the uppermost native material. In some locations, this cohesive material was encountered below sand and gravel fill. In BH 107, this silty clay was overlain by a non-cohesive 3.5 m deposit of a compact to dense sandy silt. The thickness of this silty clay stratum ranges from 1.8 m (BH 6) to 6.3 m (BH 106).

The results of 14 Atterberg Limits test are shown on Figure 2 in the Appendix. Based on the results of these tested samples, it can be concluded that this material can be described generally as silty clay of low (CL group) to intermediate (CI) plasticity.

Based on the interpretation of field vane tests, unconfined compression tests and standard penetration test 'N' values, this cohesive material is assessed to generally have a consistency ranging from stiff to very stiff. In-situ vane shear tests yielded strengths ranging from 40 kPa to greater than 100 kPa. Laboratory unconfined compression tests yielded shear strengths ranging from 32 kPa to 128 kPa. Sensitivity of this material generally ranges from 2 to 4.

Results of grain size distribution tests are indicated on the log sheets. It is to be noted that this material includes varying amounts of sand and gravel as well as occasional non-cohesive thin seams.

The unit weight of this silty clay, as measured in 4 undisturbed samples ranges from 18.7 to 20.9 kN/m³.

Silt some sand/gravel, trace clay

Silt with various proportions of other particle sizes was encountered in BH 1-6, 103, 105-107, and 122. The following is a description of the silt deposit encountered in each of these boreholes.

BH 1: The deposit was encountered at a depth of 5.0 m (Elev. 210.2) below the ground surface. A grain size distribution test carried out on a sample of this material from the upper zone resulted in 28% gravel, 7% sand, 58% silt, and 7% clay. Based on this, the material can be considered to be a silt with gravel, trace sand, clay. With depth however, this material changes to a sand and gravel, some silt. A gradation test was conducted on a sample of this material from Elev. 206, with the following results: 30% gravel, 49% sand, 19% silt and 2% clay. The entire non-cohesive deposit at this borehole location is considered to be compact, based on 'N' values ranging from 20 to 30 blows/0.3 m.

BH 2: The deposit was encountered at a depth of 4.6 m (Elev. 211.6) below the ground surface. A grain size distribution test carried out on a sample of this material from the upper zone resulted in 0% gravel, 29% sand, 56% silt and 15%

clay. Based on this, the material can be considered to be a silt with sand, some clay, trace gravel. As with BH 1 this deposit changes with depth to a sand and gravel. A gradation test was conducted on a sample of this material from Elev. 206, with the following results: 50% gravel, 40% sand, 8% silt, and 2% clay. At this borehole location, this non-cohesive material is considered to be very dense, based on 'N' values ranging from 65 to 137 blows/0.3 m.

BH 3, 4, 5: In these boreholes, the silt was found at a depth of approximately 4.5 m below the ground surface. This deposit was found to have a thickness of 0.7 m, 1.3 m, and 2.4 m in BH 3, 4, and 5 respectively. Based on the interpretation of the 'N' values, this non-cohesive deposit is in a compact (BH 3, 4) to dense (BH 5) state. Two grain size distribution tests were carried out on samples of this material. The following results were obtained:

Gravel	0% , 0%
Sand	6% , 3%
Silt	78% , 88%
Clay	16% , 9%

BH 6: The deposit was encountered at a depth of 3.8 m (Elev. 211.3) below the ground surface. At this location, the full extent of this deposit was not investigated. Based on visual observation, this deposit changes with depth from a silt to a sand and gravel. Two grain size distribution tests carried out on samples from approximately Elev. 209 gave the following results:

Gravel	25% , 18%
Sand	40% , 37%
Silt	31% , 32%
Clay	4% , 13%

Based on the Standard Penetration Test 'N' values ranging from 14 to 28 blows/0.3 m the deposit at this location is considered to be in a compact state.

BH 103: The deposit at this location was encountered at a depth of 4.1 m (at Elev. 211.5). The full extent was not investigated. Based on visual observation, the sand and gravel content increases with depth, eventually changing the deposit to a sand and gravel. Based on the interpretation of the Standard Penetration Test 'N' values, this material is in a compact state down to Elev. 209. Below this elevation, the deposit becomes very dense. No laboratory testing was conducted on samples from this borehole.

BH 105, 106: In these boreholes, the silt deposit was encountered at Elev. 217.9 and 220.1 respectively. At these two locations the deposit remained primarily as a silt without the gradual change to sand and gravel which was evident at other locations. No laboratory testing was carried out on samples of the silt from these two boreholes. Based on the interpretation of the 'N' values, this non-cohesive material at these two locations is in a dense state. The silt extends down to Elev. 214 in BH 105, and Elev. 216.6 in BH 106. At both locations, the silt is underlain by very dense sand.

BH 107: At this location, sandy silt was found to extend from the ground surface down to Elev. 235.4, a depth of 3.5 m. No laboratory testing was carried out on samples of this material from this location. Based on the interpretation of 'N' values ranging from 29 to 35 blows/0.3 m, this non-cohesive material is in a compact to dense state.

BH 122: Silt was encountered from Elev. 212.3 down to Elev. 209.3 at this location. With depth, the silt gradually changes to a sand and gravel. A grain size distribution test was conducted on a sample of this non-cohesive material from Elev. 210.5. The following were the results: Gravel 0%, Sand 1%, Silt 94%, Clay 5%. Based on the interpretation of the Standard Penetration Test 'N' values ranging from 17 to 39 blows/0.3 m this material is considered to be in a compact to dense state.

Sand

Sand was encountered in BH 105 and 106 at Elev. 214.0 and 216.6 respectively. The full extent of this non-cohesive deposit was not investigated. No laboratory testing was carried out on this material, however, based on visual observation, the sand contains traces of silt and clay. Based on 'N' values ranging from 30 to over 180 blow/0.3 m, this deposit is in a very dense state.

Sand and Gravel

A sand and gravel deposit was encountered in BH 3, 4, 5 and 122. The upper surface of this non-cohesive deposit was found to vary between Elev. 209.3 and 211.8. In this deposit, the sand and gravel proportions vary and are not consistent. The following is a summary of 8 grain size distribution tests carried out on samples of this material:

	<u>Range %</u>	<u>Average %</u>
Gravel	14-71	35
Sand	26-56	40
Silt	2-44	22
Clay	1-5	3

Based on the interpretation of the Standard Penetration Test 'N' values obtained through this deposit, this material is very dense.

It is to be noted that within this deposit, seams of silt may be encountered.

Till

Till was encountered in BH 2 and BH 4. In BH 2, this non-cohesive material was encountered at a depth of 12.2 m below the ground surface (at Elev. 204.0). The full extent of this deposit was not investigated. A grain size distribution test was carried out on one sample of this material. The results indicate that this sample contains 0% gravel, 33% sand, 62% silt, and 5% clay. Based on this distribution, the till can be described as primarily a silt and sand. A Standard Penetration Test 'N' value of 140 blows/0.3 m indicates that this deposit is a very dense state.

In BH 4, the till was encountered at a depth of 7.5 m below the ground surface (at Elev. 208.3). The full extent of this deposit was not investigated. No laboratory testing was carried out on samples of this material. However, based on visual observation, the till encountered at this location can be described as a sand and gravel. Based on a Standard Penetration Test 'N' value of 120 blows/0.3 m, this material can be considered to be in a very dense state.

North Approach

Fill

Sand and gravel fill was encountered in BH 9, 10, 11 and 100. This non-cohesive material extends from the ground surface down to a depth of generally 2 m. In BH 100, this material extends to a depth of 2.9 m. No laboratory tests were conducted on samples of this material.

Silty Clay

Silty clay was encountered in BH 7-9 and 100-102 as the uppermost native material. In BH 9, 100 and 101, the silty clay was encountered under 1.4 to 2.9 m of sand and gravel fill. The thickness of this cohesive deposit ranges from 1.2 m (BH 9) to 6.6 m (BH 100). The upper surface of this material was encountered from Elev. 208.9 to 213.7 and extended as far down as Elev. 202.3 (BH 100).

The results of 3 Atterberg Limits tests are shown on Figure 3. Based on the results of these tested samples, it appears that this material can be described as a silty clay of low plasticity (CL group).

Based on the interpretation of in-situ vane tests, unconfined compression tests and Standard Penetration Test 'N' values, this cohesive material is assessed to generally have a consistency ranging from firm to very stiff. In BH 100, where the silty clay deposit was found to be the thickest, a 3 m soft zone was encountered between Elev. 202 and 205. In this area, the shear strength of the silty clay ranged from 15 to 25 kPa, as determined by in-situ vane tests.

The results of grain size distribution tests are indicated on the borehole logs. Generally, this material includes various amounts of sand and gravel.

The unit weight of this silty clay, as measured in one undisturbed sample (BH 7, #2) is 21.2 kN/m³.

Silt

Underlying the silty clay in BH 7-9 and 100-102 is a non-cohesive deposit of silt. This material is encountered at an elevation ranging from Elev. 202.3 (BH 100) to Elev. 211.2+ (BH 7, 8). The thickness of this stratum is a minimum of 0.6 m (BH 9) to at least 3.8 m (BH 102).

The results of grain size distribution tests conducted on 5 samples of this material are shown in envelope form on Figure 4. The results can be summarized as follows:

	<u>Range</u>
Gravel	0-24%
Sand	1-43%
Silt	29-94%
Clay	4-13%

It should be noted that with depth, the sand and gravel content may often increase, and the deposit gradually changes to silty sand. This is indicated by the wide envelope in the Figure.

Based on the interpretation of Standard Penetration Test 'N' values, this non-cohesive material is generally in a compact to very dense state.

The unit weight of this material, based on one tested sample (BH 9, #4), was measured to be 20.7 kN/m³.

Silty Sand-Sand

Silty sand or sand was encountered in 4 boreholes (BH 9, 10, 11, 102) at an elevation ranging from Elev. 205.5 to 211.4. The thickness of this deposit ranges from at least 1.5 m to over 4.5 m.

The results of grain size distribution tests conducted on 4 samples of this non-cohesive material are shown in envelope form on Figure 5. The results can be summarized as follows:

	<u>Range</u>
Gravel	7-42%
Sand	35-45%
Silt	11-53%
Clay	2-14%

It should be noted that the gravel content increases with depth in this deposit.

Based on the interpretation of Standard Penetration Test 'N' values, this material is generally in a dense to very dense state. There are however, zones where this stratum is in a loose or compact state.

Silt and Sand Till

In BH 101 and 102 a very dense silt and sand till deposit was encountered at Elev. 203.2 and 201.7 respectively. The extent of this non-cohesive deposit was not explored. Based on visual observation, this stratum includes between 25 and 40% gravel. Standard Penetration Tests conducted in this material yielded values ranging from 154 blows/0.3 m to 130 blows/15 cm. indicating this till is in a dense state. No laboratory testing was carried out on samples of this material.

Groundwater Conditions

During the drilling at the vicinity of the intersection of Hwy. 115 and Co. Rd. 10, it became evident that an artesian condition existed. Eight piezometers were installed.

Artesian pressures are usually developed by sloping aquifers where the point at which the water enters the confined pervious stratum is higher than the point at which the pressure is measured. When a hole is drilled into an artesian aquifer, the water rises to the elevation of zero pressure. This elevation is known as the piezometric level (or surface).

As determined by the subsurface investigation at this site, a surficial cohesive deposit overlies a non-cohesive, pervious aquifer. This pervious aquifer is under artesian pressures as a result of the rolling nature of the local topography.

Figure 1 summarizes the data obtained from the piezometers installed at this location. The natural groundwater table was encountered approximately at Elev. 213.9 at (Co. Rd. 10) Sta. 10+015 and approximately at Elev. 213.3 at (Co. Rd. 10) Sta. 9+965. Figure 1 illustrates an approximate piezometric surface across this location. The following table summarizes the results:

PIEZOMETER NUMBER	LOCATION STATION	O/S	DEPTH OF PIEZO.	GROUND ELEV.	PIEZOMETER TIP ELEV.	PIEZOMETRIC SURFACE ELEVATION
1a	10+038	6m RT.	7.5	215.3	207.8	216.4
1b	10+038	6m RT.	9.1	215.3	206.2	217.2
2a	10+060	3m RT.	7.5	216.4	208.9	219.2
2b	10+060	3m RT.	9.1	216.4	207.3	219.6
3	10+013	5m RT.	7.6	215.1	207.5	217.9
4	9+940	3m RT.	6.1	213.5	207.4	214.2
5	10+040	10m RT.	5.5	215.2	209.7	216.0
6	10+045	10m RT.	3.9	215.3	211.4	214.9

Discussion and Recommendations

In conjunction with the proposed widening of Hwy. 115, it is proposed to construct an interchange at Peterborough Co. Rd. 10. As part of the interchange, a structure crossing Hwy. 115 is required. Fills of up to 8 m in height are necessary for the structure approaches.

The following are our recommendations for the design and construction of the structure.

Approaches

Recommendations regarding the structure approaches are presented in the Report titled:

"Foundations Investigation Report
for
W.P 74-70-06-A
Peterborough Co. Rd. 10 Interchange
Hwy 115, District 7, Port Hope."

Details of pre-loading requirements are presented in the above-mentioned report.

Structure Foundations

The foundation investigation (as reported herein) revealed that below a 3.5 m[±] surficial silty clay deposit, a non-cohesive deposit of silt exists. This lower deposit is under an artesian pressure. The magnitude of this pressure varies up to a 3 m pressure head above the ground surface.

In view of the artesian condition present across the site it became difficult to predict capacities and long term performance of piles that could be used for this structure. A full-scale pile load test was undertaken in order to confidently provide loadings for various pile types and lengths.

The load test program involved axially testing five piles to "failure" or to a maximum load of 2670 kN (300 Tons). Each pile was subsequently tested laterally. The five piles tested were as follows:

<u>Pile #</u>	<u>Type</u>
1	HP 310 x 110 (Steel -H)
2	40 cm dia. (Butt) Timber
3A	34 cm dia. (Butt) Timber
4 & 5	324 mm O.D. x 9.5 mm thick (steel-tube)

The following table summarizes the tip elevation, length and soil at tip for each pile.

<u>Pile #</u> - <u>Type</u>	<u>Tip Elev.</u> (m)	<u>Length in Ground*</u> (m)±	<u>Material at Tip</u>
1 - Steel H	199.7	16.2	Sand & Gravel/Silt
2 - Timber	212.6	3.3	Silty Clay
3A - Timber	210.9	5.0	Silt
4 - Steel Tube	203.9	11.9	Sand and Gravel
5 - Steel Tube	199.7	16.1	Sand & Gravel/Silt

*Approximate ground elevation at test site: Elev. 215.9

Based on the interpretation of the test results as per the O.H.B.D.C., and by considering the potential effects of the artesian conditions across the site, the following design loads can be used for the associated pile:

	<u>Pile</u>				
	1	2	3A	4	5
	(Steel-H)	(Timber)	(Timber)	(Tube)	(Tube)
(KN)					
U.L.S.	1300	225	225	400	800
S.L.S.II	900	150	150	250	600

Tip elevations and driving methods and control are discussed in the following paragraphs.

. TIMBER PILES

We do not recommend that timber piles be used on this project.

. TUBE-PILES

Based on the results of the load test, secondary consideration can be given to the use of 324 mm O.D. x 9.5 mm thick steel tube piles. These tube piles should be driven to an approximate tip elevation of 199.5. If these piles are used, however, the following applies since the measured head of the artesian zone was found to be up to 3 m above the ground surface.

a) piles are to be driven open-ended.

b) when the pile is driven, one of two things can happen within the pile (depending on the specific local soil and artesian conditions).

i) the inside of the tube pile will develop a dense soil plug and therefore water will not come up through the pile, or

ii) the soil inside the tube will be in a loose state and water will come up to its equilibrium level.

If item ii) occurs, then provisions should be made to ensure that enough pile is sticking up above the ground surface so that the hydraulic head can be balanced. The head must be balanced so that the material at the pile tip is not disturbed and end-bearing can be developed.

c) If i) above occurs, then the inside of the pile should be cleaned out with an auger and a 1 m soil plug should be left at the tip. The pile should then be filled with concrete.

If ii) above occurs, then the inside of the pile should be cleaned out by using wash methods (the head should be maintained at all times). The pile should then be filled with concrete using tremie methods.

d) If tube piles are selected for the design, this office should be contacted so that details of the driving control can be provided.

. STEEL -H PILES

Based on various factors including the artesian zone location, the pile driving and the loaded performance of each test pile, we recommend that the Co. Rd. 10 U'Pass by designed using HP 310 x 110 steel-H piles. The design loads given in the previous table under Pile #1 should be used. The abutments should be perched in the approach fill which will be pre-constructed.

With consideration to the subsurface conditions, the driving of the Steel-H piles should be controlled by the following:

1. During the test program, it became evident that a considerable amount of resistance was encountered by the steel-H pile at approximately Elev. 206 while it was being driven. It is important that this zone is penetrated. The Steel-H piles should be driven to a minimum elevation of 199±.
2. Below Elev. 200 the steel-H pile should be driven for an additional 1.2 m (minimum) while resisting a minimum 5 blows/25 mm with a driving energy of approximately 53.5 kilojoule/blow. A D-22 hammer is capable of delivering this energy.
3. The Hiley formula should be applied to each pile to ensure that an ultimate resistance, R, of 3450 kN is obtained once the previous 2 requirements are met.
4. Piles should be retapped a minimum of 2 weeks after the initial driving. The piles should be retapped to an extent that an additional 75 mm penetration is obtained. The same energy used for the original driving should be used for the retapping.

The Construction Office field staff should maintain detailed pile driving records for each pile if possible. It is particularly important to record the number of blows per 25 mm within the final 200-250 mm. Similarly, it is essential that a record of the retapping be maintained. This record should also document the number of blows for each 25 mm for the retap penetration. If the resistance during the retapping is reduced, the Foundation Design should be notified. It should also be noted that the pile load test was conducted at one specific location. If, during construction, the subsurface conditions are found to be different than now anticipated, this Section should be contacted.

DRAINAGE BLANKET

As already mentioned, an artesian zone is present across this site. It is anticipated that when piles penetrate this zone, water will seep up along the shaft of the pile to the surface. In view of this, a drainage medium should be provided in the area where the piles are situated. The details shown on Figure A (next page) should be incorporated in the design of the footings.

The pier footings should be constructed as high up as possible so as to avoid excavating into the underlying non-cohesive material. It may be necessary to provide the equivalent of 1.6 m frost protection in the form of insulation.

It is possible that a void will form around the pile perimeter while the pile is being driven. In the event that a void develops, the void should be kept filled with granular, free draining material. This is only applicable to the pier footings.

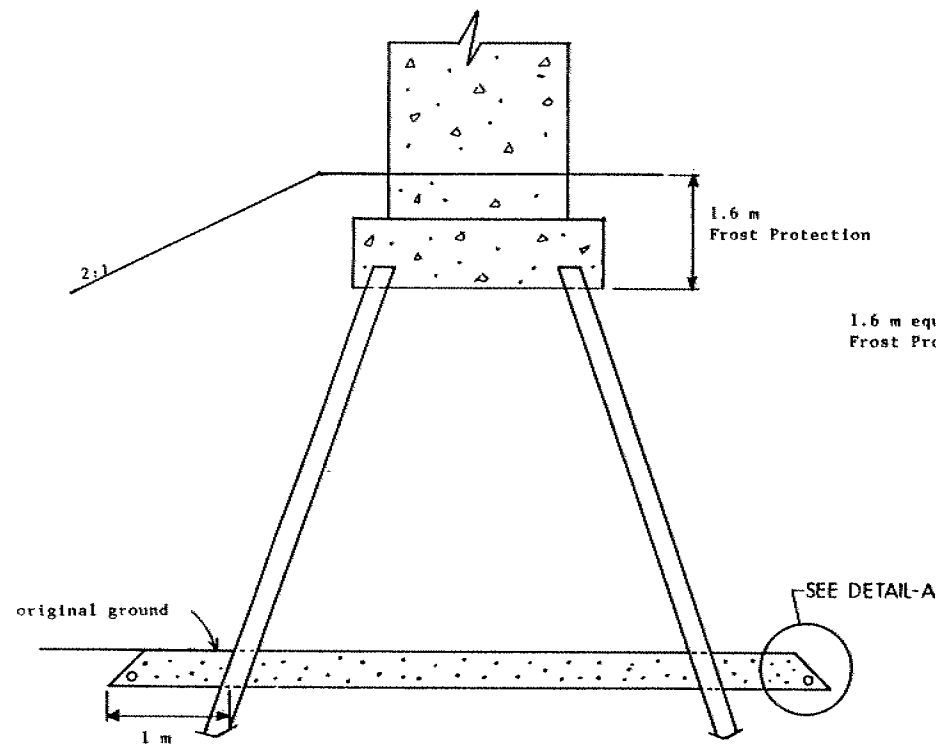
After the pile driving is completed at each pier footing location, the drainage blanket as defined in Figure A should be restored.

GENERAL

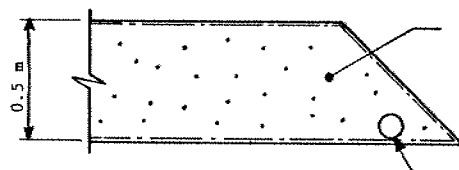
- . Backfill to structures should consist of granular material in accordance with MTC Standard Special Provision #121 (83-10). Computation of earth pressures should be in accordance with Section 6.6.1.2. of the O.H.B.D.C. For design purposes, the physical properties of the backfill are as follows:

<u>Material</u>	<u>ϕ</u>	<u>γ</u>
Gran 'A'	35°	22.0 kN/m ³
Gran 'B'	30°	21.2 kN/m ³

- . Active conditions (k_a) apply.
- . All fill material placed in the area where the piles will penetrate should be restricted to a maximum particle size of 75 mm.
- . No dewatering problems are anticipated provided that excavations do not extend into the underlying non-cohesive materials.
- . The results of the pile load test program are available in the Foundations Design Section for consultation.



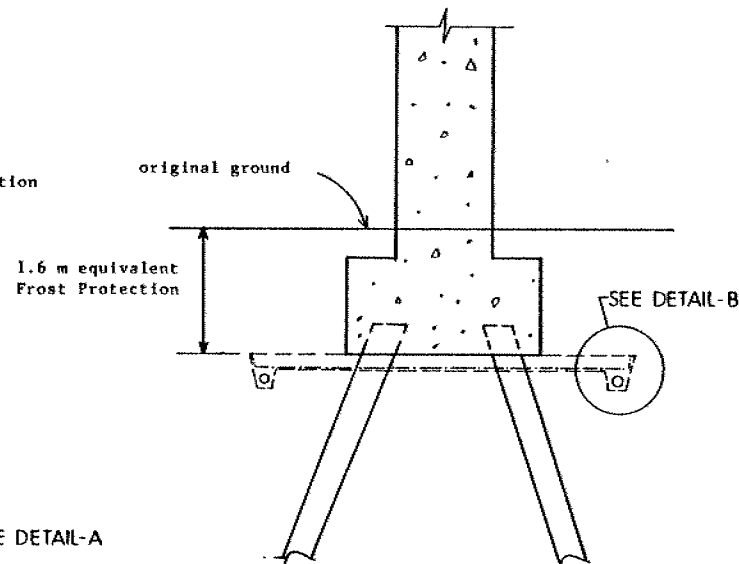
ABUTMENT SECTION (TYP)



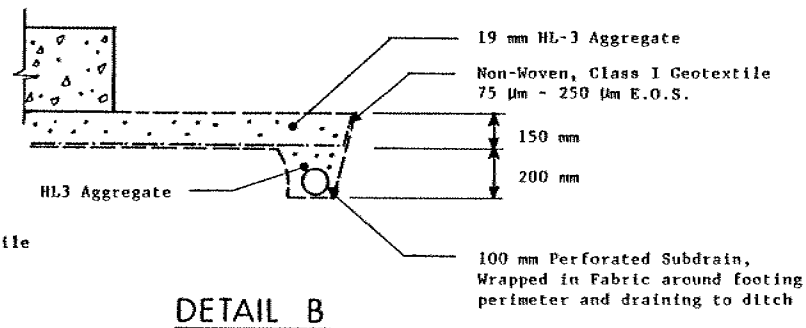
DETAIL A

19 mm HL-3 Aggregate
Completely wrapped in
non-woven, Class I Geotextile
75 μ m - 250 μ m E.O.S.

100 mm Perforated
Subdrain, wrapped in
Fabric around perimeter
of blanket and draining
to ditch



PIER SECTION (TYP)



DETAIL B

NOTES:

1. The drainage blankets should be in place prior to pile driving
2. The geotextile should be cut with a 300 mm x 300 mm "x" at locations where piles will penetrate. This is applicable only to the pier locations
3. If blanket at pier locations is disturbed during pile driving, the blanket should be restored to the details shown on this drawing after the completion of the pile driving

FIGURE 'A' - DRAINAGE BLANKET DETAILS
FOR ABUTMENTS & PIERS

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of F. Saccon, Project Foundations Engineer, and I. Richardson, Student Engineer.

The drilling equipment used was owned and operated by Dominion Soil Investigation Inc. of Toronto.

The report was prepared by L. Politano, Project Foundations Engineer, and reviewed by M. Devata, Chief Foundations Engineer.



A handwritten signature in black ink, appearing to read "L. Politano".

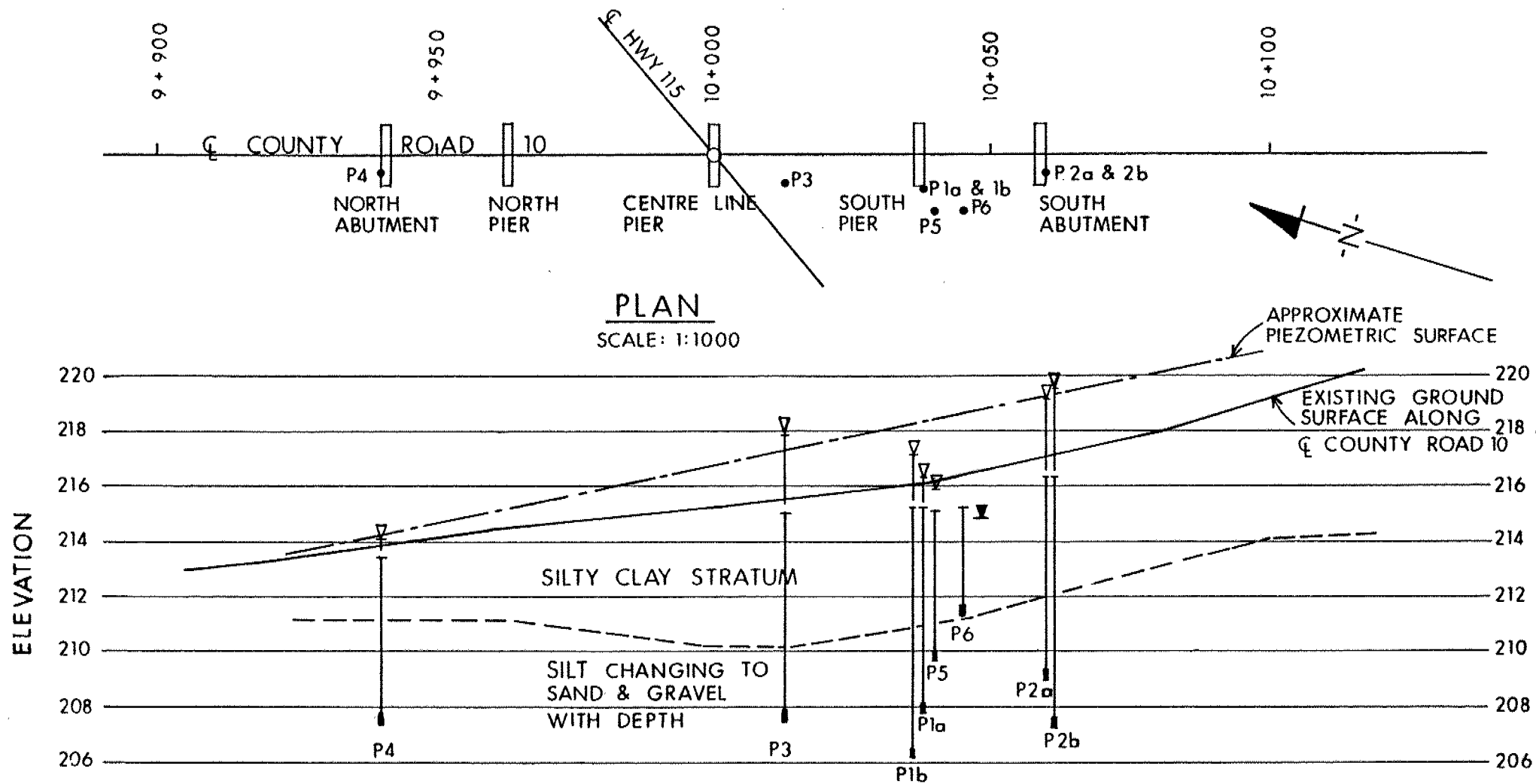
L. Politano, P.Eng.
Project Foundations Engineer

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

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

February, 1986.

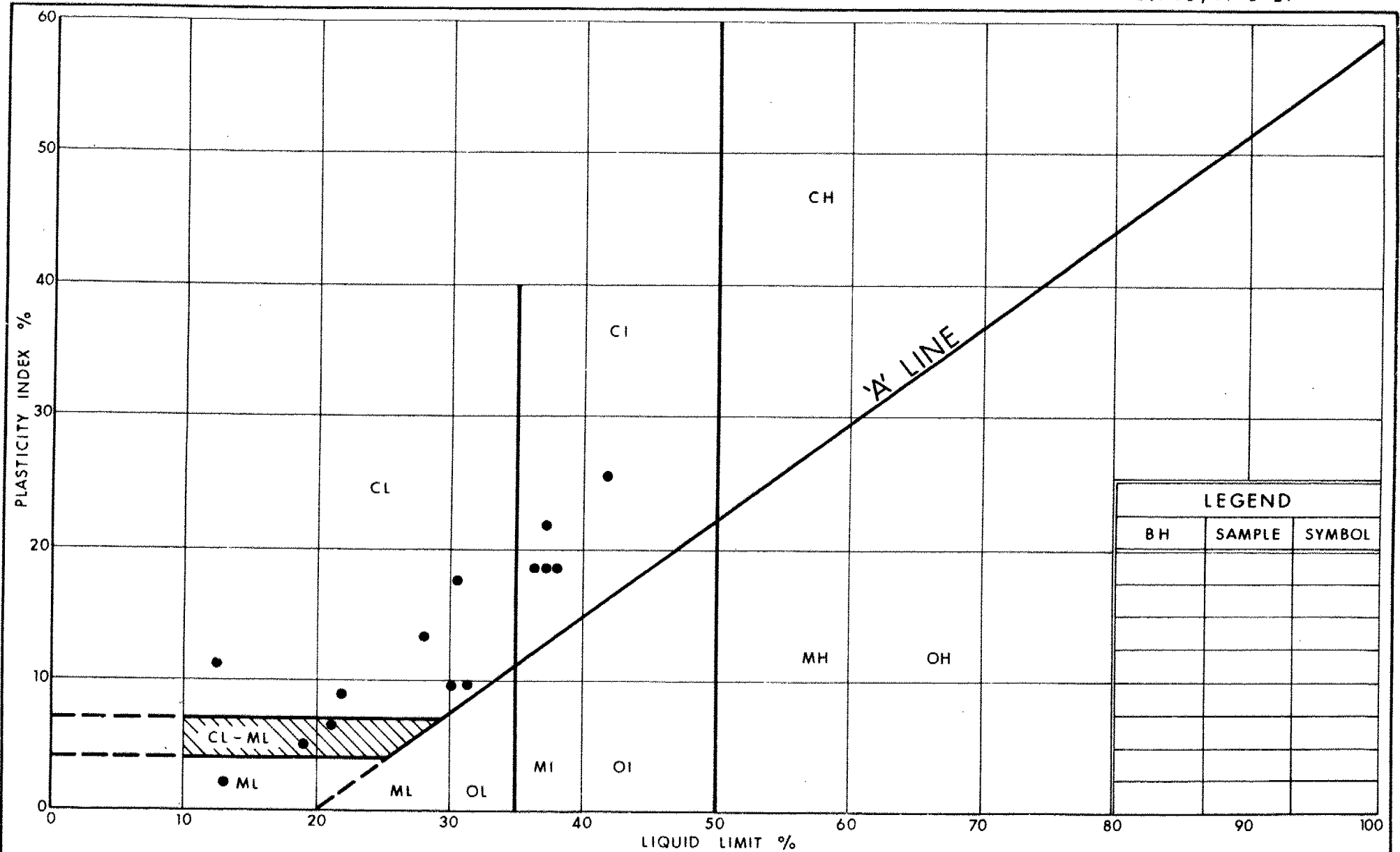
APPENDIX



GROUNDWATER CONDITIONS AT CO RD 10 & HWY 115

SCALE
1:1000 Hor 1:200 Vert

- GROUND ELEVATION
- PIEZOMETER
- PIEZOMETRIC HEAD
- GROUNDWATER LEVEL IN SILTY CLAY STRATUM

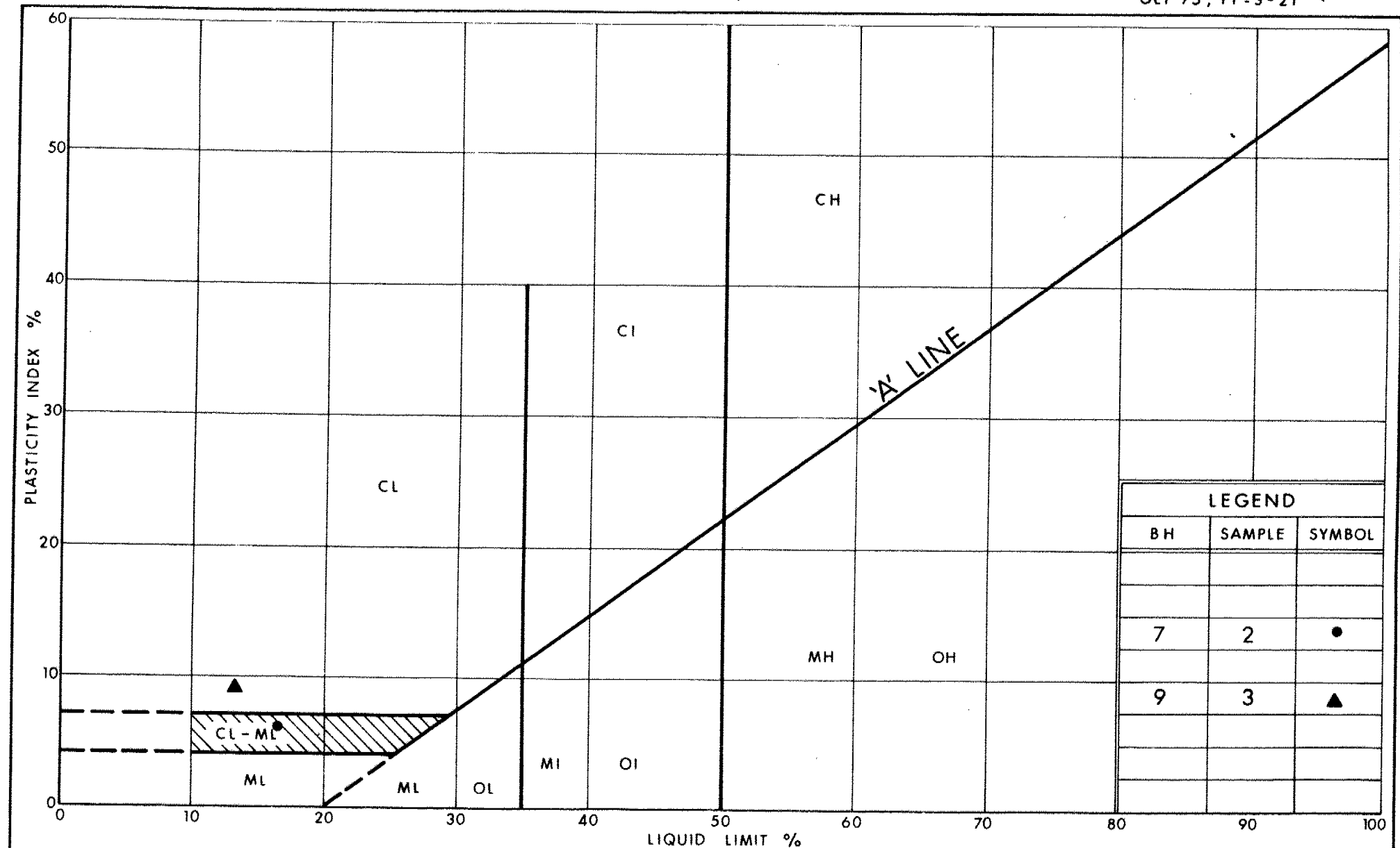
Ministry of
Transportation and
Communications

PLASTICITY CHART SILTY CLAY

FIG No 2

W P 74 -70-06- B

SOUTH APPROACH



LEGEND		
BH	SAMPLE	SYMBOL
7	2	•
9	3	▲



Ministry of
Transportation and
Communications
Ontario

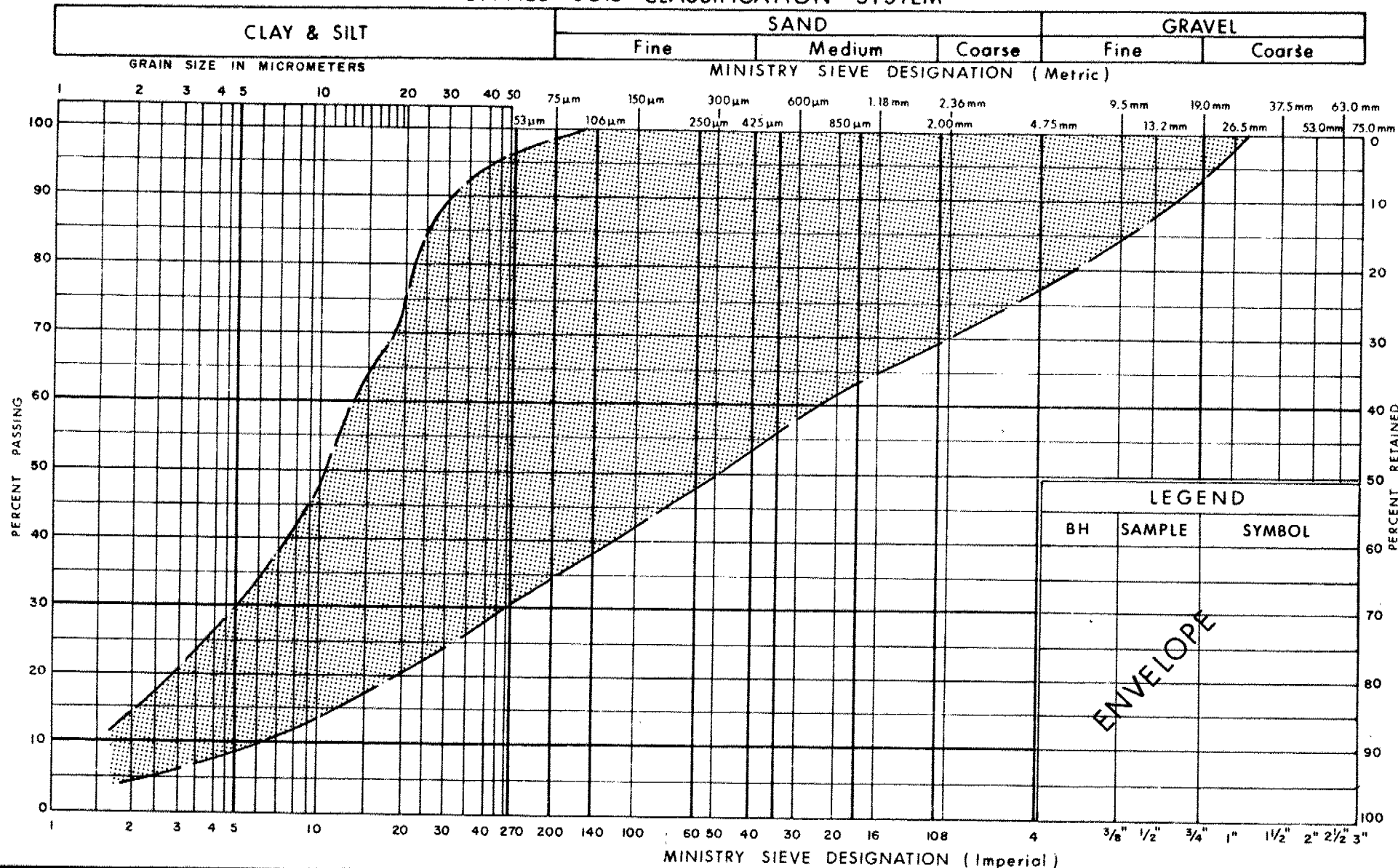
PLASTICITY CHART SILTY CLAY

FIG No 3

W P 74-70-06-B

NORTH APPROACH

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION

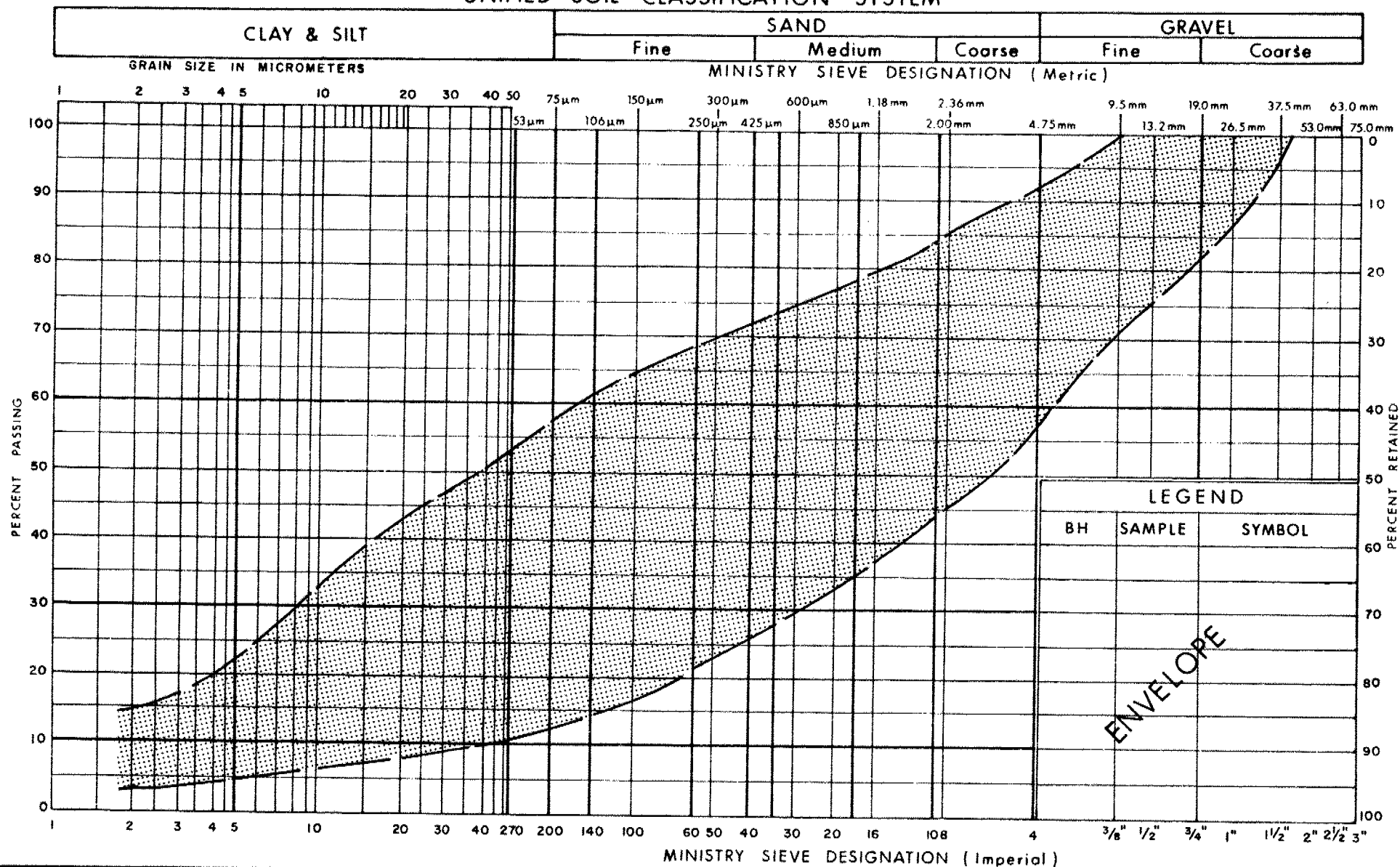
SILT TO SANDY SILT

FIG No 4

W P 74-70-06-B

NORTH APPROACH

UNIFIED SOIL CLASSIFICATION SYSTEM

Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SILTY SAND TO SAND

FIG No 5

W P 74-70-06-B

NORTH APPROACH

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

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

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_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

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

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 ²	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						



RECORD OF BOREHOLE No 1

METRIC

W P 74-70-06 LOCATION CO-ORDS: N 4 894 280.0; E 387 699.4 ORIGINATED BY IR
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY IR
DATUM Geodetic DATE 85 05 14 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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
215.2	Ground Surface															
0.0	Fill Sand and Gravel					*	215									
	Silty clay, trace sand		1	SS	15		214									
213.5																
1.7	Organics Sand, some silt		2	SS	13		213									
213.0	Compact															
2.2	Silty clay trace/some sand with increasing silt content with depth		3	SS	15		212									0 2 23 75
			4	SS	10		211									0 3 57 40
			5	SS	10		210									0 6 68 26
210.2	Stiff Grey															
5.0	Silt with Gravel, trace sand, clay gradually changing with depth to Sand and Gravel, some silt		6	SS	20		209									28 7 58 7
			7	SS	25		208									
			8	SS	20		207									
			9	SS	30		206									30 49 19 2
204.1	Compact		10	SS	27		205									
11.1	End of Borehole															
	* For groundwater conditions See Figure 1															



RECORD OF BOREHOLE No 2

METRIC

W P 74-70-06 LOCATION CO-ORDS: N 4894 226.3; E 387 715.3 ORIGINATED BY IR
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY IR
DATUM Geodetic DATE 85 05 16 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
216.2	Ground Surface																
0.0	Silty Clay trace/some Sand trace Gravel increasing silt content with depth trace to some organics		To El. 219.2				216	To El. 219.6									
	Firm		1	SS	7		215									2.9	0 17 66 17
	Silty Sand Occ. Boulders		2	SS	102	23 cm	214										
			3	SS	25		213									0.5	0 10 67 23
			4	SS	39		212										
			5	SS	27		211										
211.6	Very Stiff to Hard						210										
4.6	Silt with Sand some Clay trace Gravel gradually changing with depth to Sand and Gravel		6	SS	70		209									0.4	0 29 56 15
			7	SS	69		208										
			8	SS	65		207										
			9	SS	129		206									0.3	50 40 8 2
	Very Dense		10	SS	137		205										
204.0							204										
12.2	Silt with Sand trace to some Gravel, Clay (Till)		11	SS	140		203										
	Very Dense						202										
201.3																	
14.9	End of Borehole																

* 102/23 cm Likely due to Boulder

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

METRIC

W P 74-70-06 LOCATION CO-ORDS: N 4 894 237.0; E 387 712.0 ORIGINATED BY PS
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers COMPILED BY IR
DATUM Geodetic DATE 85 05 17 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT Wp W WL	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	15 30 45		
215.8	Ground Surface														
0.0	Silty Clay with sand trace gravel					*	215								
			1	TW	PH		214							19.1	2 12 50 36
							213								
			2	TW	PH		212								
							211								
			3	SS	9		210								
211.2	Stiff														
4.6	Silt trace Sand trace Gravel		4	TW	PH										
210.5	Compact		5	SS	27										
5.3	Silty Sand some Gravel		6	SS	62										
209.2	Dense to Very Dense		7	SS	39										
6.6	End of Borehole														
	* For groundwater conditions See Figure 1														

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 74 - 70 - 06 LOCATION CO-ORDS: N 4 894 252.6; E 387 722.0 ORIGINATED BY FS
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers COMPILED BY IR
DATUM Geodetic DATE 85 05 17 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
215.8	Ground Surface																
0.0	Sandy Gravel																
215.3	(Fill)																
0.5	Silty Clay trace Sand trace Gravel trace organics		1	SS	13		215										47 34 13 6
	increasing silt content with depth						214										
			2	TW	PH		213										
			3	SS	16		212										
	Stiff to Very Stiff		4	TW	PH		211										
211.3			5	SS	18		210										
4.5	Silt, some Silty Clay Seams		6	TW	PH		209										
210.0	Compact		7	SS	76		208										
5.8	Silty Sand with Gravel		8	SS	50												
208.3	Very Dense		9	SS	120												
7.5	Sand and Gravel																
207.7	Very Dense (Till)																
8.1	End of Borehole																
	* Approx. natural groundwater level in Silty Clay stratum																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 5

METRIC

W P 74-70-06 LOCATION CO-ORDS: N 4 894 190.7; E 387 731.5 ORIGINATED BY IR
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers COMPILED BY IR
DATUM Geodetic DATE 85 05 21 CHECKED BY OP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
								SHEAR STRENGTH kPa						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
								20 40 60 80 100						
WATER CONTENT (%)					PLASTIC LIMIT Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl							
218.9	Ground Surface													
0.0	Silty Sand					*								
217.8	Compact		1	SS	13		218							
1.1	Silty Clay trace sand -- trace gravel organics		2	SS	9		217							
	increasing silt content with depth		3	TW	PH		216	9			18.7	0 3 82 15		
			4	SS	25		215					0 11 42 47		
			5	SS	13		214							
214.2	Firm to Stiff						213					0 3 88 9		
4.7	Silt with occasional silty clay seams		6	TW	PH		212							
	trace Gravel		7	SS	32		211					14 39 44 3		
			8	SS	40									
211.8	Dense													
7.1	Silty Sand with Gravel													
210.8	Dense		9	SS	48									
8.1	End of Borehole													
	* For groundwater conditions See Figure 1													

+3, x5: Numbers refer to
Sensitivity

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



RECORD OF BOREHOLE No 6

METRIC

W P 74-70-06 LOCATION CO-ORDS: N 4 894 292.4; E 387 709.0 ORIGINATED BY IR
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers COMPILED BY IR
DATUM Geodetic DATE 85 05 21 CHECKED BY JP

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					
215.1	Ground Surface																
0.0	Sand with Silt (Fill)		1	SS	29	*	215										
							214										
213.1			2	SS	11												8 53 29 10
2.0	Silty Clay trace Sand trace Gravel increasing silt content with depth		3	TW	PH		213										
			4	TW	PH												
			5	SS	9		212										
211.3	Stiff to Very Stiff		6	TW	PH												
3.8	Silt		7	SS	25		211										1 18 36 45
	changing to silty Sand and clay		8	SS	14												
	gravel, some silt with depth		9	TW	PH		210										25 40 31 4
	Compact		10	SS	14												
208.8			11	SS	28		209										18 37 32 13
6.3	End of Borehole																
	* For groundwater conditions See Figure 1																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 7

METRIC

W P 74-70-06 LOCATION CO-ORDS: N 4 894 320.7; E 387 683.6 ORIGINATED BY IR
 DIST 7 HWY 115 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY IR
 DATUM GEODETIC DATE 85 05 21 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					
212.9	Ground Surface																
0.0	Silty Clay Trace Organics		1	SS	6	*	212										0 18 42 40
211.1	Firm to Very Stiff		2	TW	PH		211						128 kPa			21.2	2 12 70 16
1.8	Silt		3	SS	24		210										0 2 94 4
	Changing to Silty Sand with Gravel with depth		4	SS	34		209										24 43 29 4
			5	SS	31		208										
207.9	Compact to Dense		6	SS	41		208										
5.0	END OF BOREHOLE																
	* For groundwater conditions see Fig. 1																

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 8

METRIC

W P 74-70-06 LOCATION CO-ORDS: N 4 894 329.9; E 387 681.0 ORIGINATED BY FS
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers COMPILED BY TR
DATUM Geodetic DATE 85 05 21 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
212.7	Ground Surface																
0.0	Silty Clay					*	212										
	Trace sand, gravel		1	TW	PH												
211.2	Very Stiff						211										
1.5	Silt, trace clay with occasional silty clay seams		2	SS	20												
			3	TW	PH												
	changing to silty sand with gravel with depth		4	SS	43		210										
			5	TW	PH		209										
			6	SS	105												
207.7	Compact to Very Dense		7	SS	97		208										
5.0	End of Borehole																
	* For groundwater conditions See Figure 1																

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 9

METRIC

W P 74-70-06 LOCATION CO-ORDS: N 4 894 337.8; E 387 695.4 ORIGINATED BY FS
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers COMPILED BY IR
DATUM Geodetic DATE 85 05 21 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
213.9	Ground Surface					20	40	60	80	100							
0.0	Sand and Gravel (Fill)					*											
212.5			1	SS	44		213										
1.4	Silty Clay increasing silt content with depth						212										
			2	SS	14												
			3	SS	7		211									0 43 43 14	
210.2	Firm to Very Stiff																
3.7	silt some sand trace clay		4	TW	PH		210									0 18 74 8	
209.6																	
4.3	Silty Sand with Gravel						209										
	Gravel content increasing with depth		5	SS	10												
208.1			6	SS	15											42 45 11 2	
5.8	End of Borehole																
	* For groundwater conditions See Figure 1																

+3, x5 : Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 10

METRIC

W P 74-70-06 LOCATION CO-ORDS: N 4 894 345.7; E 387 691.3 ORIGINATED BY IR
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers COMPILED BY IR
DATUM Geodetic DATE 85 05 29 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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
213.4	Ground Surface																
0.0	Sand and Gravel (Fill)					*	213										
211.4	Silty Clay some Organics		1	SS	18		212										
2.0	Silty Sand		2	SS	9		211										
	Loose						210										
	Silt		3	SS	26		209										
	With Gravel		4	SS	37		208										
	Dense		5	SS	64		207										
	Very Dense		6	SS	100												
206.8			7	SS	128	23cm	207										12 40 34 14
6.6	End of Borehole																
	* For groundwater conditions See Figure 1																



RECORD OF BOREHOLE No 11

METRIC

W P 74-70-06 LOCATION Co-ords N 4 894 375.2; E 387 671.3 ORIGINATED BY IR
 DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers COMPILED BY IR
 DATUM Geodetic DATE 85 05 30 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
213.0	Ground Surface																
0.0	Sand and Gravel (Fill)		1	SS	37	*	212										
211.0	Silty Clay Some Organic		2	SS	8		211										
2.0	Silty Sand increasing Gravel content with depth		3	SS	31		210						o				39 45 13 3
	Dense		4	SS	35		209										
208.3	Very Dense		5	SS	159	28cm							o				7 35 53 5
4.7	End of Borehole																
	* For groundwater conditions see Fig. 1																

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 100

METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 894 489.0; E 387 634.0
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Auger & Cone Test
DATUM Geodetic DATE 85 07 03
ORIGINATED BY ZN
COMPILED BY IR
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							
211.8	Ground Surface							20 40 60 80 100							
0.0	Fill Sand and Gravel Mixture														
			1	SS	10										
			2	SS	6										
208.9															
2.9			Silty Clay to Clay with silt seams increasing silt content with depth. brown trace grey organics		3	SS	5								
	4	SS			5										
	5	SS			7										
	6	SS			1										
202.3	Soft to Firm														
9.5	Silt, some Sand trace Clay		7	SS	100	15cm									
200.9	Very Dense		8	SS	100	15cm									
10.9	End of Borehole														

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 101

METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 894 428.0; E 387 653.6 ORIGINATED BY ZN
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY IR
DATUM Geodetic DATE 85 07 03 CHECKED BY


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
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		
212.2	Ground Surface													GR SA SI CL
0.0	Organic Silt trace Fibres		1	SS	10		212							
210.6	Loose						211							
1.6	Silty Clay trace Sand trace Gravel		2	SS	10		210							
			3	SS	13		209							
			4	SS	13		208							
			5	SS	11		207							
206.7	Stiff						206							
5.5	Silt trace gravel, clay with sand content increasing with depth.		6	SS	10		205							
	Compact		7	SS	55		204							
			8	SS	70		203							
203.2	Very Dense		9	SS	154									
9.0	Silt and Sand, with gravel (Till)		10	SS	100/15cm									
202.1	Very Dense													
10.1	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 102

METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 894 341.0; E 387 681.5 ORIGINATED BY ZN
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem & Cone Test COMPILED BY IR
DATUM Geodetic DATE 85 07 04 & 85 07 17 CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
213.7	Ground Surface													
0.0	Silty Clay, trace sand with seams of silt.													
	Firm													
	with gravel													
209.3			1	SS	11									
			2	SS	6									
			3	SS	97									
4.4	Silt trace clay some gravel		4	SS	141									
			5	SS	151									
			6	SS	75									
			7	SS	60									
			8	SS	69									
205.5	Very Dense		9	SS	57									
8.2	Sand, trace clay, silt.		10	SS	74									
	Increasing gravel content with depth.		11	SS	100									
			12	SS	125									
			13	SS	113									
201.7	Very Dense		14	SS	110									
12.0	Silt and Sand with gravel (Till)		15	SS	130									
200.4	Very Dense													
13.3	End of Borehole													

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 103

METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 894 249.6; E 387 711.0 ORIGINATED BY ZN
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY IR
DATUM Geodetic DATE 85 07 04 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					
215.7	Ground Surface																
0.0	Silty clay with silt and sand seams.		To El. 216.4				To El. 217.2										
	trace organics																
	brown		1	SS	13												
	grey		2	SS	28												
			3	SS	14												
211.5	Stiff to very stiff																
4.1	Silt, trace clay. Increasing sand and gravel content with depth.		4	SS	30												
	Compact		5	SS	25												
	Very Dense		6	SS	110												
			7	SS	76												
			8	SS	63												
	Sand, with silt, trace clay		9	SS	135												
206.1	End of Borehole																
9.6	*For groundwater conditions see Figure 1.																



RECORD OF BOREHOLE No 104

METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 894 232.0; E 387 728.0 ORIGINATED BY ZN
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY IR
DATUM Geodetic DATE 85 07 04 CHECKED BY CP

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	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
216.7	Ground Surface												
0.0	Organic Silt trace sand, fibres					*	216						
214.6	Loose		1	SS	9		215						
2.1	Silty Clay		2	SS	14		214						
	trace sand, gravel		3	SS	33		213						
	Brown		4	SS	22		212						
	Grey						211						
210.9	Very Stiff		5	SS	23								
5.8	End of Borehole												
	*Groundwater level not encountered.												



RECORD OF BOREHOLE No 105

METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 894 142.5; E 387 746.8 ORIGINATED BY ZN
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY IR
DATUM Geodetic DATE 85 07 05 CHECKED BY SP

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			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
222.2	Ground Surface							20 40 60 80 100	20 40 60 80 100						
0.0	Silty clay, trace sand						222								
			1	SS	28		221								
	with organics		2	SS	8		220								
		3	SS	21	219					+2					
217.9	Stiff to very stiff						218			+ +					
4.3	Silt, trace clay		4	SS	28		217								
			5	SS	38		216								
			6	SS	42		215								
			7	SS	58		214								
			8	SS	44		213								
214.0	Dense						212								
8.2	Sand, trace silt, clay		9	SS	56										
			10	SS	30										
			11	SS	180										
211.1	Very Dense		12	SS	135	15cm			150						
11.1	End of Borehole														

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 106

METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 894 094.6; E 387 762.0 ORIGINATED BY ZN
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY IR
DATUM Geodetic DATE 85 07 08 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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
226.4	Ground Surface													
0.0	Silty clay													
			1	SS	7									
	Trace organics													
	Firm		2	SS	4									
	Brown													
	Grey		3	SS	17									
			4	SS	18									
220.1	Very Stiff													
6.3	Silt, trace clay													
			5	SS	45									
			6	SS	59									
			7	SS	46									
			8	SS	45									
216.6	Dense													
9.8	Sand, trace clay silt		9	SS	59									
			10	SS	76									
			11	SS	180									
			12	SS	185									
213.8	Very Dense													
12.6	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 107

METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 893 925.8; E 387 807.7 ORIGINATED BY FS
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY IR
DATUM Geodetic DATE 85 07 08 CHECKED BY CD

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
238.9	Ground Surface												
0.0	Sandy Silt trace clay					*	238						
			1	SS	35		237						
	Brown		2	SS	34		236						
235.4	Compact to Dense		3	SS	29		235						
3.5	Silty Clay trace Sand		4	SS	46		234						
			5	SS	68		233						
			6	SS	80		232						
	Grey		7	SS	26		231						
			8	SS	47								
			9	SS	46								
			10	SS	96								
230.0	Hard												
8.9	End of Borehole												
	*Groundwater level not established.												



RECORD OF BOREHOLE No 122 (Sheet 1 of 2)

METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 894 245.7; E 387 705.0 ORIGINATED BY FS
DIST 7 HWY 115 BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY ZN
DATUM Geodetic DATE 85 07 22 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	0 20 40 60 80 100	0 20 40 60 80 100					
215.2	Ground Surface														GR SA SI CL
0.0	Silty Clay trace Sand trace Gravel		To El. 216.0				215								
	trace organics		1	SS	9		214								
	Increasing silt content with depth.		2	SS	20		213								0 11 60 29
212.3	Stiff to Very Stiff		3	SS	17		212								
2.9	Silt, trace Silty Clay Seams, some gravel		4	SS	17		211								0 1 87 12
	gradually increasing in sand and gravel content.		5	SS	35		210								
	Compact to Dense		6	SS	25		209								0 1 94 5
209.3			7	SS	39		208								
5.9	Sand and Gravel		8	SS	93		207								28 34 33 5
	Some silt, trace clay with occasional sand and silt seams.		9	SS	60	10cm	206								
			10	SS	101		205								18 47 30 5
			11	SS	110		204								
			12	SS	108		203								32 56 7 5
			13	SS	100	15cm	202								
			14	SS	95		201								51 38 7 4
			15	SS	76		200								
	Silt, some sand		16	SS	38		199								0 24 72 4
			17	SS	154	28cm	198								
			18	SS	101		197								10 21 64 5
200.1							196								
15.1							195								

Continued

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

Continued

RECORD OF BOREHOLE No 122 (Sheet 2 of 2)

METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 894 245.7; E 387 705.0 ORIGINATED BY FS
 DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY ZN
 DATUM Geodetic DATE 85 07 22 CHECKED BY SP

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					
200.1	Continued																
15.1	Silt, some sand		19	SS	60	8cm	200										
			20	SS	100	11cm	199										
			21	SS	88		198										36 42 20 2
	Sand and Gravel Some Silt, trace clay		22	SS	100	12cm	197										
							196										
195.0	Very Dense		23	SS	100												71 26 2 1
20.2	End of Borehole *For groundwater conditions see Figure 1.																



RECORD OF BOREHOLE No 123

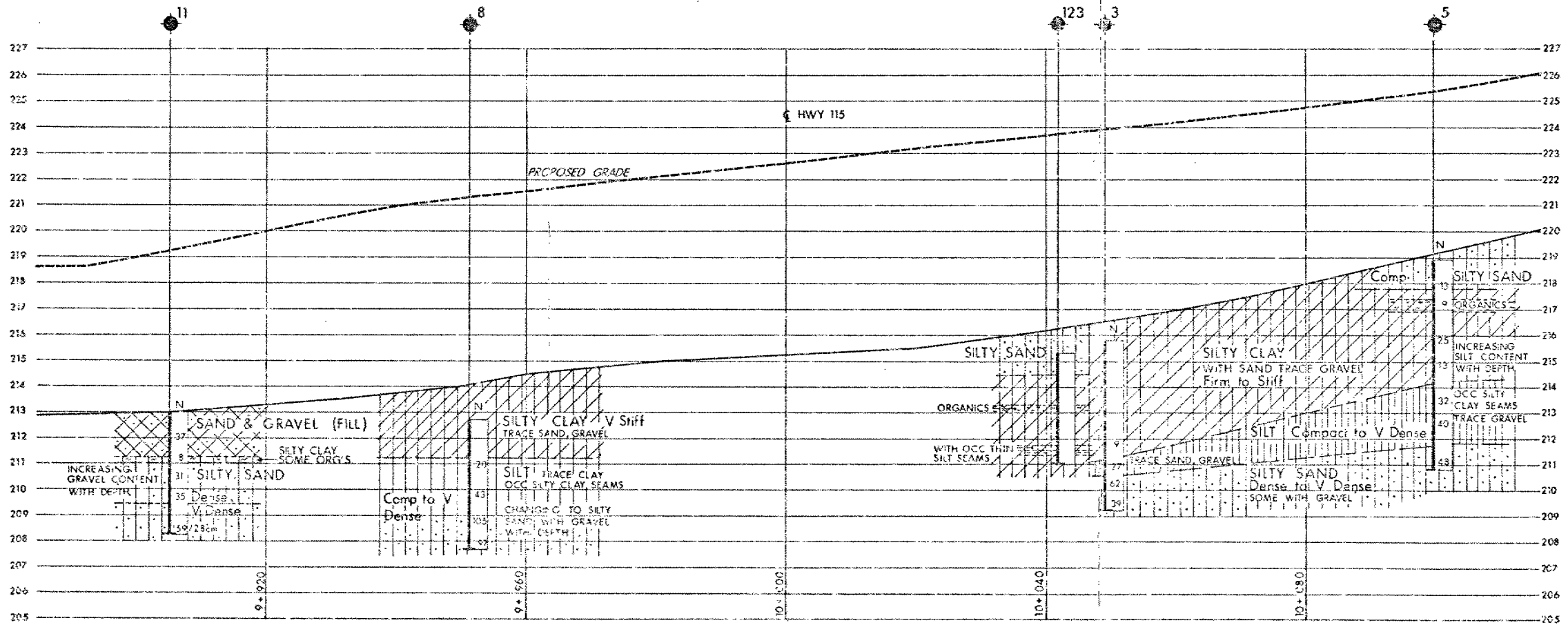
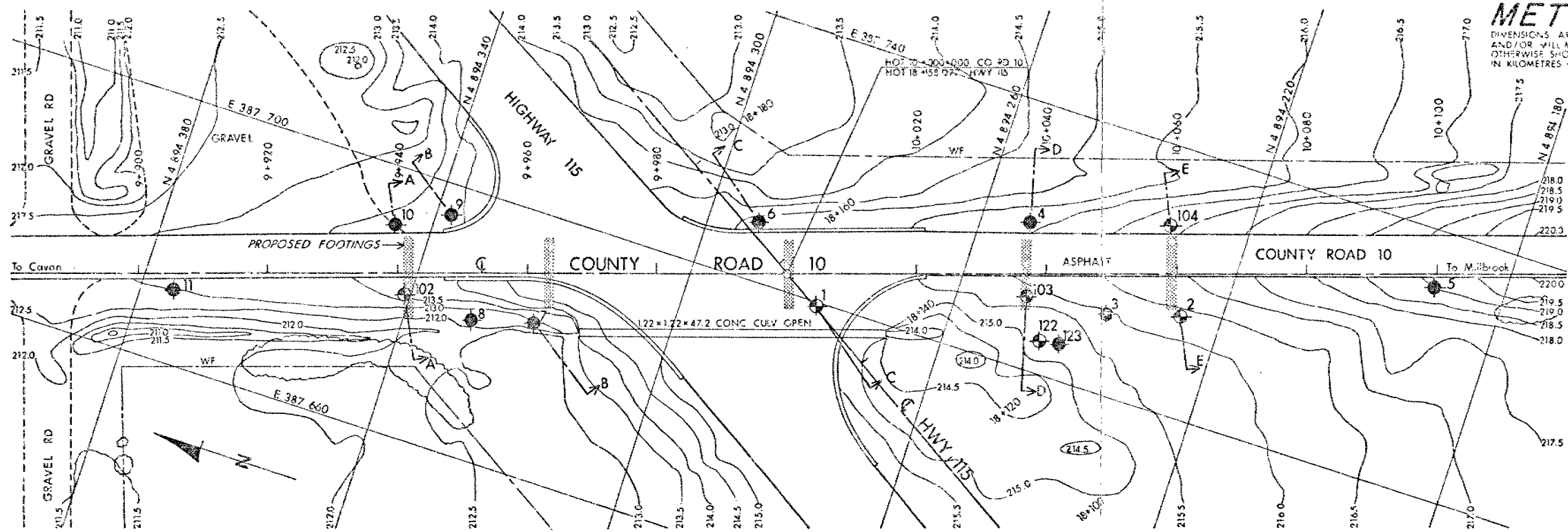
METRIC

W P 74-70-06 LOCATION CO-ORDS N 4 894 242.7; E 387 705.6
DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers
DATUM Geodetic DATE 85 07 23
ORIGINATED BY ZN
COMPILED BY FS
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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
215.3	Ground Surface																
0.0	Silty Sand						215									18.2	
214.4																	
0.9	Silty Clay		1	TW	PH		214		9							20.2	1 9 35 55
			2	TW	PH												
	Organics		3	TW	PH		213									20.2	
			4	TW	PH		212									20.7	0 3 75 22
211.0	with occ. thin silt seams		5	TW	PH											21.2	
4.3	End of Borehole																
	*For groundwater conditions see Figure 1.																

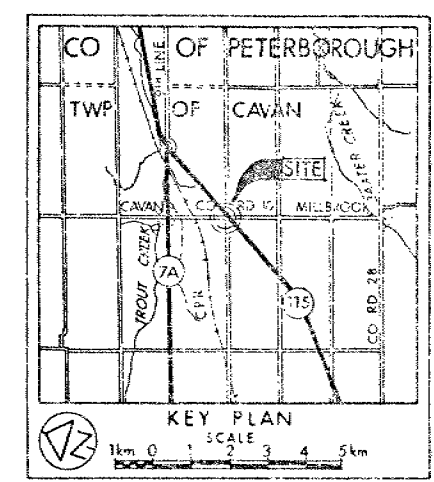
+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



CONT No
WP No 74-70-06

COUNTY ROAD 10
BORE HOLE LOCATIONS & SOIL STRATA



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

For Groundwater Conditions see
Record of Borehole Sheets.

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	215.2	4 894 280.0	387 699.4
2	216.2	4 894 226.3	387 715.3
3	215.8	4 894 237.0	387 712.0
4	215.8	4 894 252.6	387 722.0
5	218.9	4 894 190.7	387 731.5
6	215.1	4 894 292.4	387 709.0
7	212.9	4 894 320.7	387 683.6
8	212.7	4 894 329.9	387 681.0
9	213.9	4 894 337.8	387 695.4
10	213.4	4 894 345.7	387 691.3
11	213.0	4 894 375.2	387 671.3
102	213.7	4 894 341.0	387 681.5
103	215.7	4 894 249.6	387 711.0
104	216.7	4 894 232.0	387 728.0
122	215.2	4 894 245.7	387 705.0
123	215.3	4 894 242.7	387 705.6

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

NOTES: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office. Information contained in this report and related documents is specifically included in accordance with the conditions of Section 102.2 of Form 100.

DATE	BY	DESCRIPTION

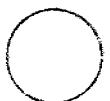
Geocres No 31D - 312

HWY No 115
ISSUED LP CHECKED DATE SITE 21-10-85
FOR AN DT CHECKED 21-10-85 BY BWS 74706-A

REF No F-6048-1 85 02

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

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

CONT No WP No 74-70-06	
COUNTY ROAD 10 BORE HOLE LOCATIONS & SOIL STRATA	

SHEET

SEE DWG 747006-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

For Groundwater Conditions see
Record of Borehole Sheets

No	ELEVATION		
1	215.2		
2	216.2		
3	215.8		
4	215.8		
5	218.9		
6	215.1		
7	212.9	SEE DWG 747006-A	
8	212.7		
9	213.9		
10	213.4		
11	213.0		
102	213.7		
103	215.7		
104	216.7		
122	215.2		
123	215.3		

NOTE

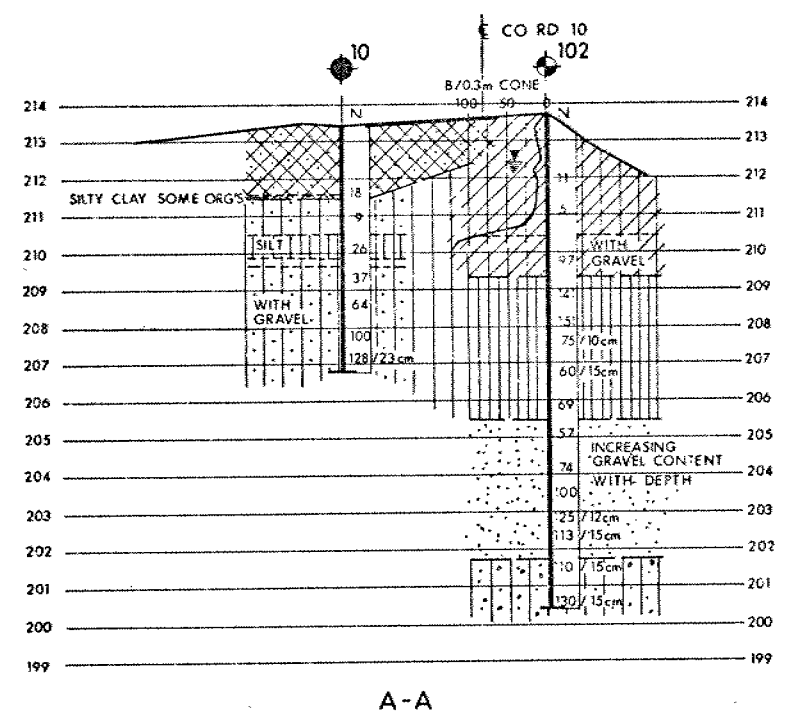
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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.

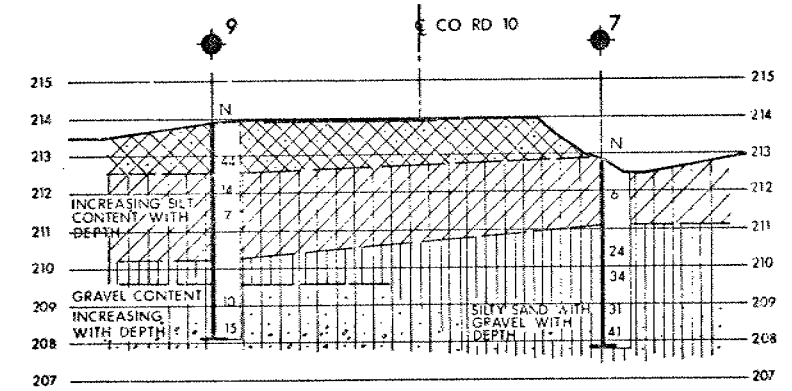
DATE	BY	DESCRIPTION

Geocres No 31D - 312

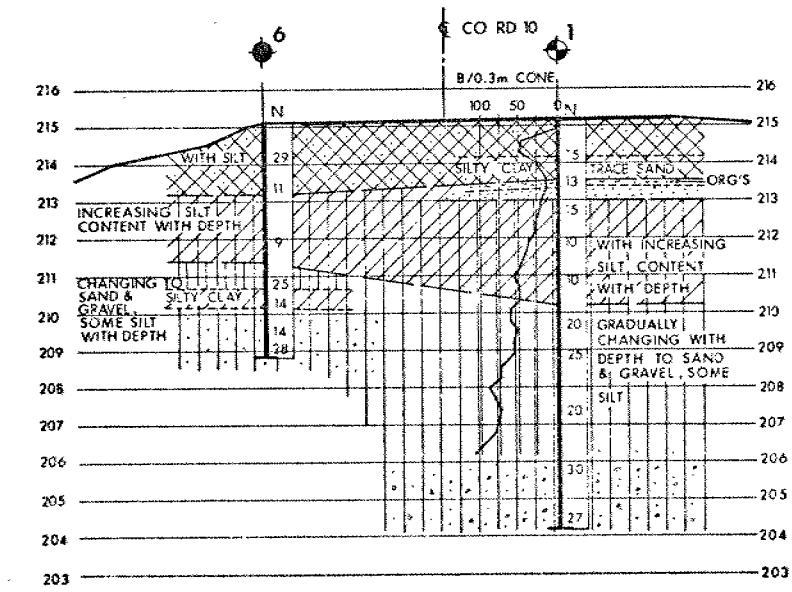
HWY No 115	SUBMITTAL	CHECKED	DATE	SITE	DIST
				21-39-445	7
DRAWN BY	CHECKED	APPROVED	86 02 14	DWG	747006-B



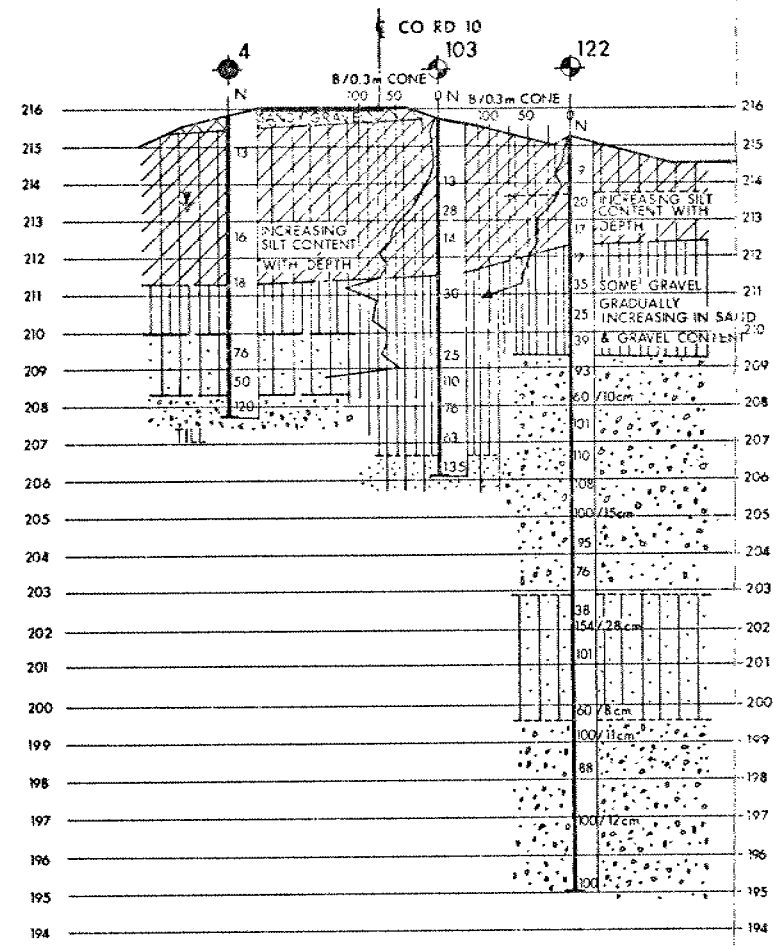
A-A



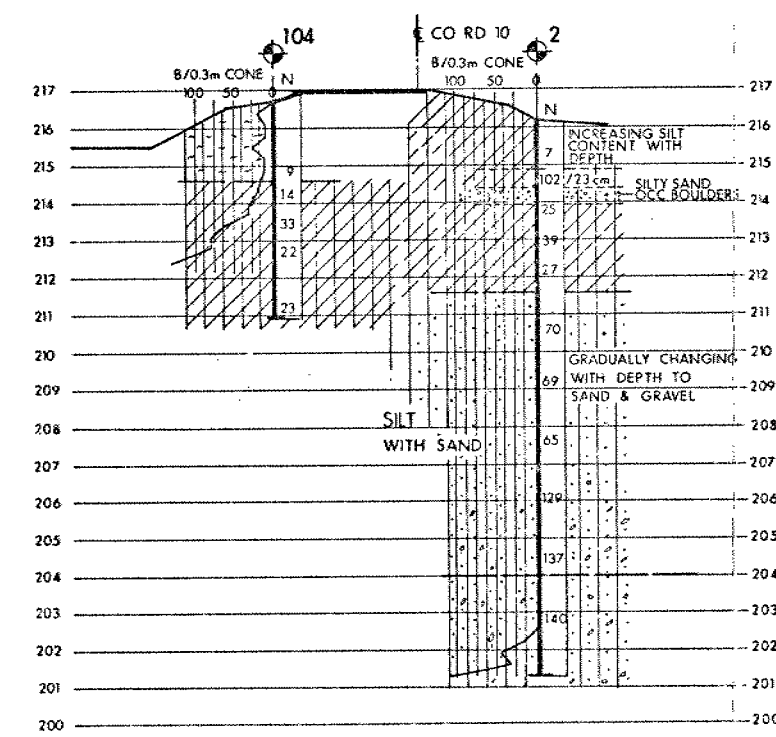
B-B



C-C

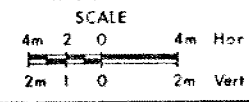


D-D



E-E

SECTIONS



- LEGEND
- SAND & GRAVEL (FILL)
 - SAND Comp to V Dense
TRACE CLAY, SOME SILT
 - ORGANIC SILT Loose
TRACE SAND, FIBRES
 - SILTY CLAY Firm to Hard
TRACE/SOME SAND & GRAVEL
TRACE ORGANICS
 - SILTY SAND Loose to V Dense
WITH GRAVEL
 - SILT Comp to V Dense
SOME SAND/GRAVEL, TRACE CLAY
 - SAND & GRAVEL V Dense
SOME SILT, TRACE CLAY WITH OCC
SAND & SILT SEAMS
 - SILT & SAND (TILL) V Dense
TRACE/SOME GRAVEL, CLAY

memorandum



To: S. Gwartz
Area Construction Engineer
Central Region

Date: 1989 10 27

Atten: Bev Stanley

From: Foundation Design Section
Room 315, Central Building

RE: Contract 89-57
Peterborough County Road #10 Underpass
W.P. 74-70-06, Site 21-445
Hwy. 115, District 7, Port Hope

Further to Peter Verok's request of Oct. 20/89 and our subsequent discussions with Brian Gould, Lawrence Cotgrave and Bev Stanley, we have assessed the stability of the 2+ m deep excavation for the piers located immediately north and south of Hwy. 115.

Based on our review of the subsurface conditions and our site inspection of Oct. 24/89, we recommend that;

- a soldier pile/lagging shoring system should not be installed due to our concerns with the potential loss of material if the artesian condition is penetrated.
- the excavations should be stabilized by constructing a 1:1 slope, or alternatively a gabion wall, adjacent to the highway.

In our opinion, a slope failure will not occur although some minor settlement and distress is anticipated. The conditions should continue to be monitored and if the situation deteriorates, consideration should be given to realigning the traffic lanes away from the affected area.

If there are any questions or if you have further concerns, please contact this office.

D.H. Dundas
D.H. Dundas, P. Eng.
Sr. Foundation Engineer

DHD/jb

memorandum



To: J. Smrcka
Manager, Construction Office
Central Region

Date: 1989 10 27

Attn: S.E. Gwartz

From: Foundation Design Section
Room 315, Central Bldg.

Subject: Use of Hydrohammer S-70
County Road #10 Underpass at Hwy. 115
W.P. 74-70-06, Site 21-445
District 7, Port Hope

Further to the meeting of October 5, 1989, we undertook an evaluation of the Hydrohammer S-70 at the above site.

PROCEDURE

The evaluation procedure consisted of driving half of the vertical piles using a B 400 diesel hammer and the remaining half of the vertical piles using the S-70 hammer. In the latter case, the energy transmitted by the hydrohammer was adjusted to yield elastic compression values which are comparable to those obtained with the diesel hammer.

At the time of writing this memo, we have reviewed the driving records of a total of 5 piles, listed below.

<u>File No.</u>	<u>Location</u>	<u>Hammer Used</u>
10	S. Pier	B 400 & S-70
11	S. Pier	B 400 & S-70
16	C. Pier	B 400
7	S. Pier	S-70
14	S. Pier	S-70

It is proposed to drive half of the remainder of the vertical piles at County Road 10/Hwy. 115 using the B 400 hammer and the remaining half using the S-70 hydrohammer. When this data is received, we would review them and provide additional comments as required.

.... /2

COMMENTS

Based on an evaluation of the above data, it is considered that the S-70 hammer set at 20 kJ delivers an energy equivalent to that delivered by the B 400 diesel hammer (operating at 40 blows/minute). Comparing the driving of the above five piles using the B 400 and S-70 hammers, it is concluded that the ultimate capacity of a pile driven using a hydrohammer shall be calculated using the Hiley formula, with the parameters as follows;

Wgh = Energy read out in the control panel of S-70 hammer

$$n = \frac{(W + Pe^2)}{(W + P)} \times 3$$

where e = 0.55 (steel to steel)

CLOSING REMARKS

Piles driven using;

- the S-70 hammer
- set at 20 kJ energy
- driving resistance of 5 blows/25^{mm} for the last 75mm and
- elastic compression of about 10mm

will yield an ultimate resistance of 3450 kN.



Dr. B. Iyer, P. Eng.
Sr. Foundation Engineer

BI/jb

Memo

89 10 20

To: File # Contract 89-57

WP 74-70-06

Hwy 115 / Co. Rd 10

On 89 10 20, Peter Versk called and advised of distress of Hwy 115 near the excavation for the pier in the median and affecting the south side of the WBL.

Apparently, a similar problem may potential arise at the ~~abutment~~^{pier} excavation near the N side of Hwy 115 WBL.

I discussed with M. Deane who this site is in Daley's area. M. Deane stated that I should respond.

Bruce Gould, the assistant in Quality Assurance dropped off the attached sketch and plan and came over for a brief meeting to review the situation.

I reviewed the file and told Bruce that we had considered this situation in a meeting of 88 09 with Giffels and the Structural Office. I reiterated our recommendations from that meeting.

1) We are concerned with any proposal that would involve driving piles that may penetrate the artesian condition of this site where the piles are not driven through a granular blanket to control loss of fines if water runs up piles. (Bruce reported that the granular blanket for the pier was working well to control water).

2) We suggest moving the detour, perhaps by reducing the shoulder should be considered as a first alternative.

This might involve moving the barrier from the existing edge of shoulder to the existing edge of pavement.

3) It had been determined that although a large pile of gravel in A had been placed on the slope it probably wasn't compact.

Alternatively a gabion structure could be used to provide gravity support for the road. I pointed out that although the existing Green A pile did not seem to the job, the gabions would do better by acting as a unit.

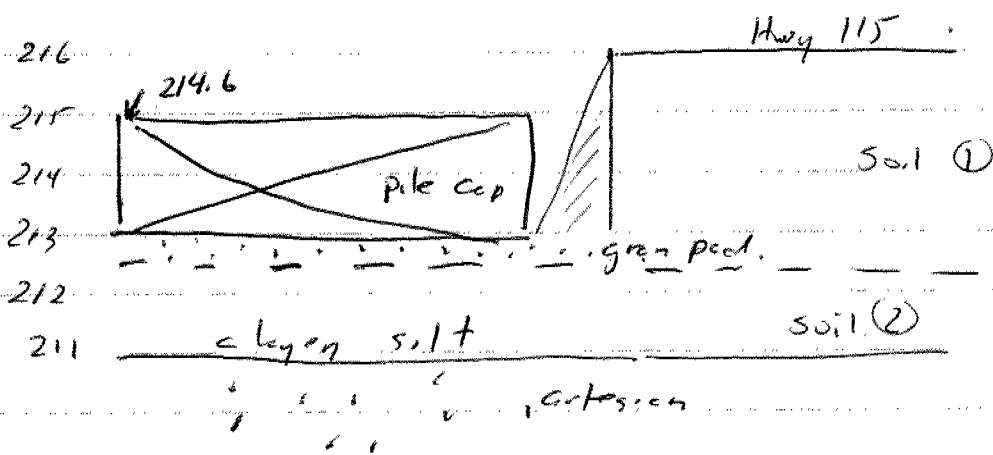
4) A ~~4~~ ft. deep timber lagging wall could be considered as an alternative if the other measures could not practically be implemented. Due to concerns with erosion water to the very high remedial costs that could result, we suggested that even if the other options may be appear to be initially economically preferable they should be given careful consideration.

I agreed to discuss with the Structural Office and send formal recs.

5) I told Brian they should monitor dishes but I didn't foresee a catastrophic failure, only minor subsidence that could be patched up.

6) Bruce reported that the base of the granular fill just was elev. 212.5

Following is a sketch of the site



~~Summary~~ The following parameters were suggested if the design of pile lagging wall was essential

Soil (1) $c=0$ $\phi=30^\circ$ $\gamma=20 \text{ kN/m}^3$

Soil (2) $c=40 \text{ kPa}$ $\phi=0$ $\gamma=20 \text{ kN/m}^3$

Obviously we do not want to penetrate piles below 211.4 ft. gran peed. extension to control loss of material by seepage.

D. Dardas
Sr. Fdn. Engr.

memorandum

Walked to Athens



Tel: 3731

To: J. Smrcka
Manager
Construction Office
Central Region

Date: 1989 10 05

Atten: S. Gwartz, Area Construction Engineer

From: Foundation Design Section
Room 315, Central Building

RE: Contract 89-57
Use of S-7- Hydrohammers vs
B-400 Diesel Hammers

It is understood that the piling subcontractor, Bermingham Construction Limited have proposed to use an S-70 Hydro-hammer for the above-mentioned project, even though M.T.O. Specification required the piles to be driven using a diesel or a drop hammer.

This memo deals with the actions taken by the Foundation Design Section in this regard and contains recommendations for a field comparison of the two hammers.

As per the request from Mr. Peter Verok of your office on September 28, 1989, Balu Iyer and Paul Payer of our office met with Mr. Fine and P. Bermingham of Bermingham Construction on October 2nd (a.m.). The data supplied by Bermingham at the above meeting was not sufficient to permit us to conclude that the S-70 Hydro-hammer is equivalent to or better than the B-400 diesel hammer.

The contractor was given an option to provide us with more pertinent data on the S-70 hammer or do a comparison of the two hammers (S-70 and B-400) at the site. At the October 2nd meeting, Bermingham were confident that they could supply adequate data from their files to satisfy our queries. Therefore, the details and scope of the field comparison were not discussed at the above-mentioned meeting.

No further data was provided by Bermingham on October 2nd or October 3rd. On October 3rd, Bermingham decided to mobilize the B-400 diesel hammer to the site.

On October 4th, a discussion meeting was held between Shael Gwartz of your office and M. Devata, D. Dundas and B. Iyer of our office. The following is a summary of items discussed and agreed upon at this meeting.

1. Bermingham would be advised by the Construction Office to drive half of the vertical piles in the north abutment, north central and south pier footings at the County Road 10 using the B-400 Diesel hammer and the remaining half using the S-70 hydro hammer.

2. The following observations are to be taken for the piles driven using the diesel hammer.
 - (i) number of blows per minute of the hammer at refusal
 - (ii) final set (penetration in millimetres per blow)
 - (iii) measured rebound (c_p) of the pile in millimetres per hammer blow at refusal.
3. Based on above, calculate the efficiency of the diesel hammer, as per MTO Standard where
energy transmitted to the pile = $E = nWgh$.
4. The following observations are to be made for the piles driven using the hydraulic hammer
 - (i) the driving energy for the hammer (see the data control panel of the S-70 hammer).
 - (ii) number of blows per minute of the hammer at refusal
 - (iii) measured rebound of the pile (c_2) in millimetres per hammer blow at refusal
 - (iv) if the above rebound value (c_2) is different from that (c_1) for the pile driven using a diesel hammer adjust the driving energy of the S-70 which would yield a rebound of C_1 millimetres.
5. Take ALL of the above-mentioned observations (together with other normally taken with pile driving such as pile length, pile location ground elevation etc.). All of the above readings are required to make a proper comparison of the two hammers.
6. Transmit the data to this office at the end of each day or sooner.

A review of the data by this office would permit us to conclude on the suitability of the S-70 hammer for this project.

Please contact this office, should you require clarification or elaboration on any aspect of this memo.

BI/mmj

Dr. B. Iyer, P. Eng.
Sr. Foundation Engineer

MINISTRY OF TRANSPORTATION

M E M O R A N D U M

TO: File

DATE: 1988-12-23

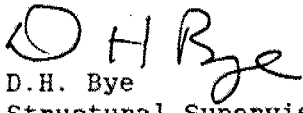
FROM: Structural Section
Central Region

RE: Peterborough County Road 10 Underpass
Site 21-445, W.P. 74-70-06
Hwy 115, District 7

This will confirm several discussion held between this office, Planning and Design, Construction and the Foundation Design Section.

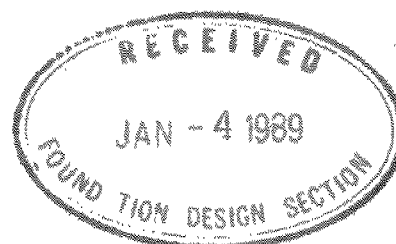
As a result of a very serious artesian condition at this structure, special measures are required in order to excavate and construct the foundation in the dry. The major requirement is the drainage blanket under the pier foundations. The other stipulation at this site that further complicates matters, is that roadway protection cannot be used, again, due to the artesian condition. The excavation required for the area of the drainage blanket extends into the existing roadway. In order to reduce the area of conflict the Foundation Design Section was asked if a portion of the drainage blanket could be eliminated. They indicated that due to the sensitive nature of the subsoil at the site, no reduction in the area of the drainage blanket could be considered.

As a result, a special short term staging arrangement will be required to maintain traffic during the excavation and installation of the drainage blanket. When the drainage blanket has been constructed the roadway material can be replaced to a point where the bottom of the fill intersects the top of the granular blanket. The structure foundations can then be constructed in the normal manner. The Foundation Design Section also indicated that the requirement for retapping the piles 2 weeks after the initial driving should be adhered to.


D.H. Bye
Structural Supervisor
for:
G.C.E. Burkhardt
Head, Structural Section

DHB/dd

cc: P. Verok
M. Devata
G. Jewell



80-12-21

WP 74-70-06

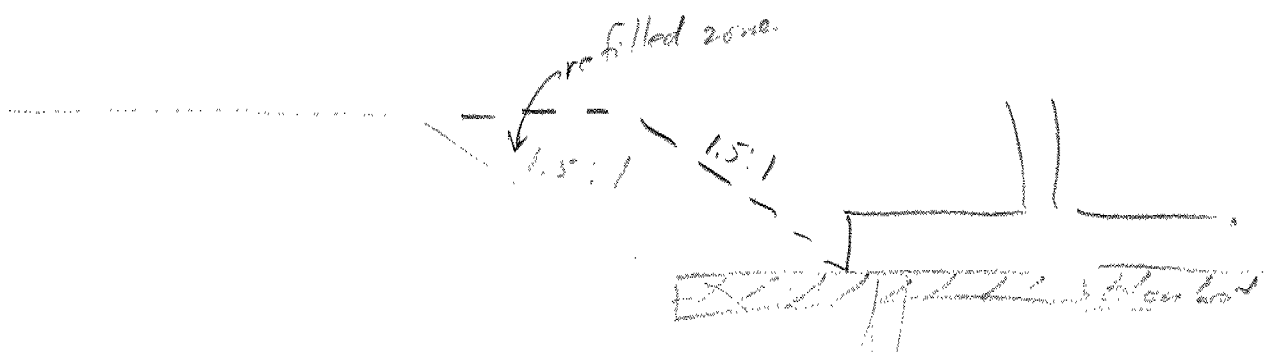
Hwy 115/Co Rd. 10

Meeting with Duncan Bye of Structural Section
& M. Korte and D. Dunder.

Duncan indicated problem with space
between piers in view of requirements
for 3 lanes of traffic.

Duncan inquired if extent of granular
release pad for exterior conditions could
be relaxed.

FOS recommended that the work should
be staged to maintain desired requirements
and re-fill to achieve required lane width.
The temporary slopes should be 1.5:1



memorandum



235-3731

To: G. Al-Bazi
Design Engineer
Structural Office

Date: 88 12 06

From: Foundation Design Section
Room #315, Central Building

RE: Peterborough County Road #10 Underpass
WP 74-70-06, Site 21-445
Hwy. 115, District 7, Toronto

We have reviewed the final drawings and documents for this project.

Our comments are as follows:

1. The Foundation Report recommends the following requirements of pile driving control.
 - piles should be driven to below elevation 199m
 - the piles should resist a minimum of 5 blows per 25mm with a driving energy of 53.5 kilo joules per blow (D-22 hammer or equivalent) over the final 1.2m of driving
 - following the above 2 criteria, the Hiley Formula should indicate an ultimate resistance R of 3450 kN
 - after a minimum of 2 weeks, piles should be retapped 75mm using the same criteria
2. As indicated on page 16a of the Foundation Report, the drainage blankets for the abutments should consist of 0.5m thick HL-3 wrapped in geotextile.
3. It is noted that excavations for piers are 0.5± m lower than recommended in the Foundation Report. The reason for this restriction was a concern for possible blow-out of the foundation caused by artesian pressure. However, in this case it appears that excavations are required to this depth in order to accommodate the footing thickness at the piers. The construction staff should be alerted to watch for signs of heave and blowout and report any such occurrences to this office immediately.
4. Regarding roadway protection, we believe that further to our meetings in September 1988, that it will no longer be required and has been replaced by a detour.

.....2/

To: G. Al-Bazi

88 12 06

5. Recommendations regarding the structure approaches are provided on pages 20-21 of the Foundation Report for WP 74-70-06 [A] dated February 19, 1986.

If there are any questions, please advise.

DHD:st

D. H. Dundas
D. H. Dundas, P.Eng.
Senior Foundation Engineer

for

M. Devata, P.Eng.
Chief Foundation Engineer

88 09 07

WP 74-70-06

Hwy 115 / Co. Rd. 10

Meeting with E. Brumitt, Ken Wong, Lydie Hsu
(Giffels) (Giffels) (Stud. Office)

Mary Kate (Giffels), D. Dieder
FDS FDS

Re: Shoring for north pier

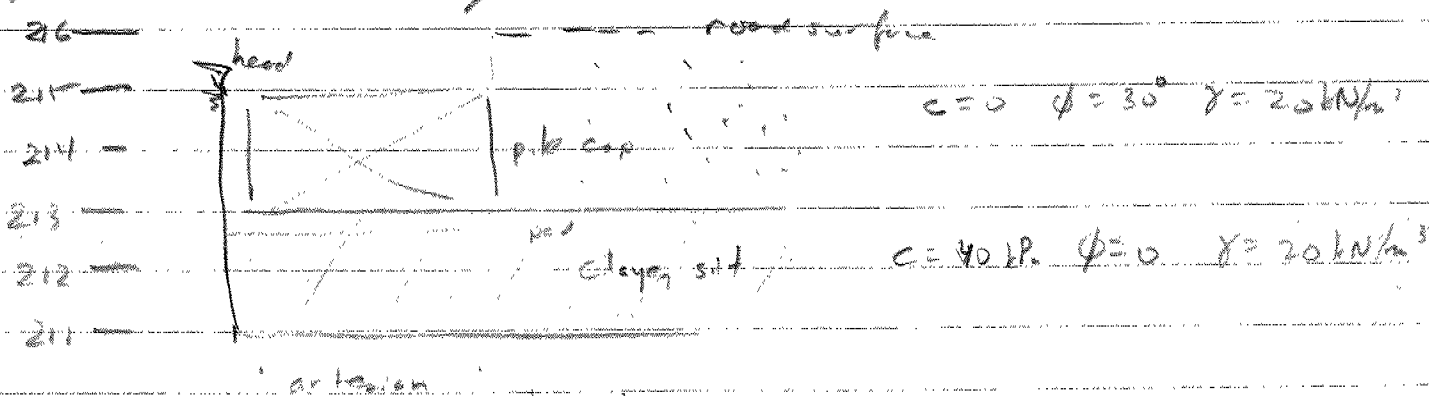
① FDS strongly recommends that 1.5:1 temporary slopes, with usual erosion control measures, should be adopted instead of shoring, due to our concerns for water permeability at this site.

② If traffic can not be detoured, and shoring is required, we agree that the most economical shoring should be used and that this would probably be soldier pile/lagging wall rather than indicated sheet pile wall.

(The sheet pile wall was only conceptual design according to Giffels).

FDS stressed inherent dangers in penetrating exterior zone with p. b. & suggested that this should be avoided.

③ The following parameters were provided for calculation of earth pressure.



④ FDS recommended, due to concerns about blowout, the footing should be kept as high an elevation as possible. It was stated by Giffels that the controlling depth was thickness of footing rather than requirements for frost protection. It was noted that styrofoam insulation could be used to reduce frost depth.

⑤ Giffels & Tybur indicated that footings are 300 mm below frost elevation recommended by Ice Phasing. I told them we were not concerned with 1' difference & it was would be O.K. M.D. said we would re-evaluate blow-out cases when design review was submitted.

⑥ General discussions.

Agreed that SP for pile driving should be in contrast to short contractor of downtown, Run of material, pile driving concerns.

D. Dunder
Sr. Edm. Eng.

memorandum



Tel: 235-3731

To: G. Al-Bazi
Design Engineer
Structural Office

Date: 1988 04 11

From: Foundation Design Section
Room 315, Central Building

RE: Peterborough Co. Road No. 10 U'Pass
W.P. 74-70-06, Site 21-445
District 7

Further to your Memorandum on 88 02 29, this letter summarizes our review on the submitted General Arrangement Drawing 21-445-P1 for the above-noted project.

As you are aware, Foundation Design Section submitted detailed Foundation Investigation Reports for the proposed interchange, W.P. 74-70-06-A, 86 02 19 and for the proposed 4 span structure, W.P. 74-70-06-B, 86 02 19; which included our recommendations for the above structure. However, in view of the presence of the silt to silty sand deposit which is under artesian pressure in the area of the proposed structure, pier and abutment footings should be constructed no deeper than 1.6 m below the ground surface, if possible.

Because of our concern with potential basal heave, it was recommended in our previous letter (our letter dated March 17, 1987, W.P. 74-70-06) that excavations should not extend below the following elevations at each footing location described:

North Abutment	Elev. 212.1
North Pier	Elev. 212.3
Centre Pier	Elev. 212.8
South Pier	Elev. 213.1
South Abutment	Elev. 213.7

.....2

Based on our review, it is concluded that the General Arrangement Drawing 21-445-P1 has generally complied with our recommendations. However, it should be noted that all fill material placed in the area where the piles will penetrate at both abutments, should be restricted to a maximum particle size of 75 mm as discussed in our report.

We have no further comments at this time.

If you have any questions, please contact us.



Tae C. Kim, P. Eng.
Foundation Engineer

for

Murty Devata, P. Eng.
Chief Foundation Engineer
(East)

TCK/mj

c.c. - K. Bassi
G.C.E. Burkhardt
A. Wittenberg

memorandum



To: V. Mitranic
Senior Project Manager
Planning & Design Section
Central Region
5000 Yonge Street
Willowdale

From: Foundation Design Section
Rm 315, Central Building
Downsview, Ontario

RE: County Rd. 10 & Hwy. 7A
W.P. 128-86-00
Hwy. 115, Dist. 7, Port Hope

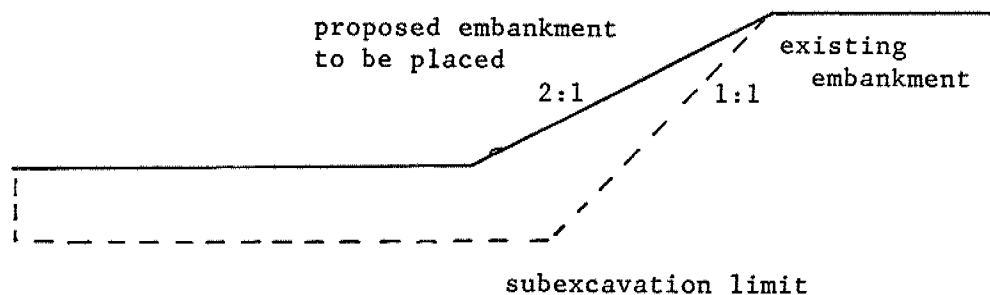
Tel: (416) 235-3731
Date: 1987 08 07

Further to your memo of 1987 07 29, we have considered the proposal to designate SSM as embankment fill for the above noted projects.

In our opinion, this material is acceptable for fills above the prevailing groundwater level. However, for those portions of embankments below the groundwater level, there are potential construction problems if the clay/cohesive silt component exceeds approximately 10% and it would be advantageous to incorporate this restriction, if possible.

I have enclosed a copy of a previous memo which will clarify that we have always proposed that the most economical fill should be used, and that recommendations restricting the fill to Granular B originated with the Central Region Geotechnical Section.

Further to our meeting of 1987 08 06, this will confirm that we agree to the following subexcavation geometry provided that the subexcavation/backfilling operations are carried out in a continuous operation and no more than 5 m of subexcavation is exposed at any time.



If there are any questions, please contact this office.

DHD/pb

c.c.: D. Woods
G. Green

Enclosed

D.H. Dundas
D.H. Dundas, P. Eng.
Sr. Foundations Engineer

memorandum



To: V. Mitranic
Senior Project Manager
Planning & Design Section
Central Region
5000 Yonge Street
Willowdale

Tel: (416) 235-3731
Date: 1987 07 24

From: Foundation Design Section
Rm 315, Central Building
Downsview, Ontario

RE: County Rd. 10 & Hwy. 7A
W.P. 128-86-00
Hwy. 115, Dist. 7, Port Hope

We have reviewed the minutes to the mini-tech review meeting of 87 07 14 and wish to draw your attention to a possible misconception regarding the requirement for Granular B for embankment fills at these sites.

In point 1.1, the minutes imply that the Central Region Geotechnical Section recommends Granular B in order to meet the requirements of the Foundation Design Section.

I refer you to our memo to Totten Sims Hubick dated 87 03 16 in which we have indicated that our requirements are for a non-cohesive fill, preferably similar to, but not necessarily Granular B. Less than optimum material may be salvageable if drainage measures are incorporated in the design, and we recommend that the most economical alternative should be adopted. Our only other requirement is that the unit weight of in place compacted fill at Hwy. 7A does not exceed 20.4 kN/m^3 as recommended in the Foundation Report for the Hwy. 7A Underpass.

It is our understanding that the recommendations for Granular B originate from the Central Region Geotechnical Section, as indicated at the above-noted meeting and on page 2 of the minutes for Progress Meeting No. 85-08 (85 10 09).

If there are any questions, please contact this office.

DHD/pb

D.H. Dundas

D.H. Dundas, P. Eng.
Sr. Foundations Engineer

memorandum



To: V. Mitranic
Senior Project Manager
Planning & Design Section
Central Region
5000 Yonge Street
Willowdale

From: Foundation Design Section
Rm 315, Central Building
Downsview, Ontario

RE: County Rd. 10 & Hwy. 7A
W.P. 128-86-00
Hwy. 115, Dist. 7, Port Hope

Tel: (416) 235-3731
Date: 1987 07 24

We have reviewed the minutes to the mini-tech review meeting of 87 07 14 and wish to draw your attention to a possible misconception regarding the requirement for Granular B for embankment fills at these sites.

In point 1.1, the minutes imply that the Central Region Geotechnical Section recommends Granular B in order to meet the requirements of the Foundation Design Section.

I refer you to our memo to Totten Sims Hubick dated 87 03 16 in which we have indicated that our requirements are for a non-cohesive fill, preferably similar to, but not necessarily Granular B. Less than optimum material may be salvageable if drainage measures are incorporated in the design, and we recommend that the most economical alternative should be adopted. Our only other requirement is that the unit weight of in place compacted fill at Hwy. 7A does not exceed 20.4 kN/m^3 as recommended in the Foundation Report for the Hwy. 7A Underpass.

It is our understanding that the recommendations for Granular B originate from the Central Region Geotechnical Section, as indicated at the above-noted meeting and on page 2 of the minutes for Progress Meeting No. 85-08 (85 10 09).

If there are any questions, please contact this office.

DHD/pb

A handwritten signature in black ink that reads "D.H. Dundas".

D.H. Dundas, P. Eng.
Sr. Foundations Engineer

memorandum



To: V Mitranic
Senior Project Manager
Planning & Design Section
Central Region
5000 Yonge Street
Willowdale

From: Foundation Design Section
Rm 315, Central Building
Downsview, Ontario

RE: W.P. 128-86-00
Hwy. 115/Co. Rd. 10 & Hwy. 115/Hwy. 7A
Contract Package Review

Tel: (416) 235-3731
Date: 1987 07 17

We have reviewed the contract drawings and related documents for the above-noted projects. Our comments are as follows:

Co. Rd. 10

- 1) The SP for settlement plates should include the details and sketch (attached) provided in M.L. Pauly's memo dated April 28, 1987.
- 2) The SP for the granular blanket over the pile locations can be changed to require HL4 instead of HL3.

Hwy. 7A

- 1) Based on the available drawings, it is difficult to review the berm design. It is our understanding that additional X-sections will be available for the contract. When these become available, please provide us with representative X-sections for review. Preferably, the representative X-sections should consist of the highest and lowest grades, where berms are required, for each ramp/approach.
- 2) Concerning the subexcavation detail in the typical sections, we are concerned
 - a) that the vertical subexcavation indicated will not be attainable due to the soft organic soil.and
 - b) that a vertical cut adjacent to the existing toe of the slope may adversely affect the stability of the existing embankment.

Consequently we recommend

- a) that the subexcavation geometry should be modified as illustrated in the attached sketch. If any distress to the existing embankment results, the subexcavation should be backfilled to 2H:1V and this office should be immediately advised.

.....2

If there are any questions, please contact this office.

D.H. Dundas

D.H. Dundas
Sr. Foundations Engineer

DHD/pb

Attachment

RECOMMENDED SUBEXCAVATION DETAIL

existing embankment fill

OG

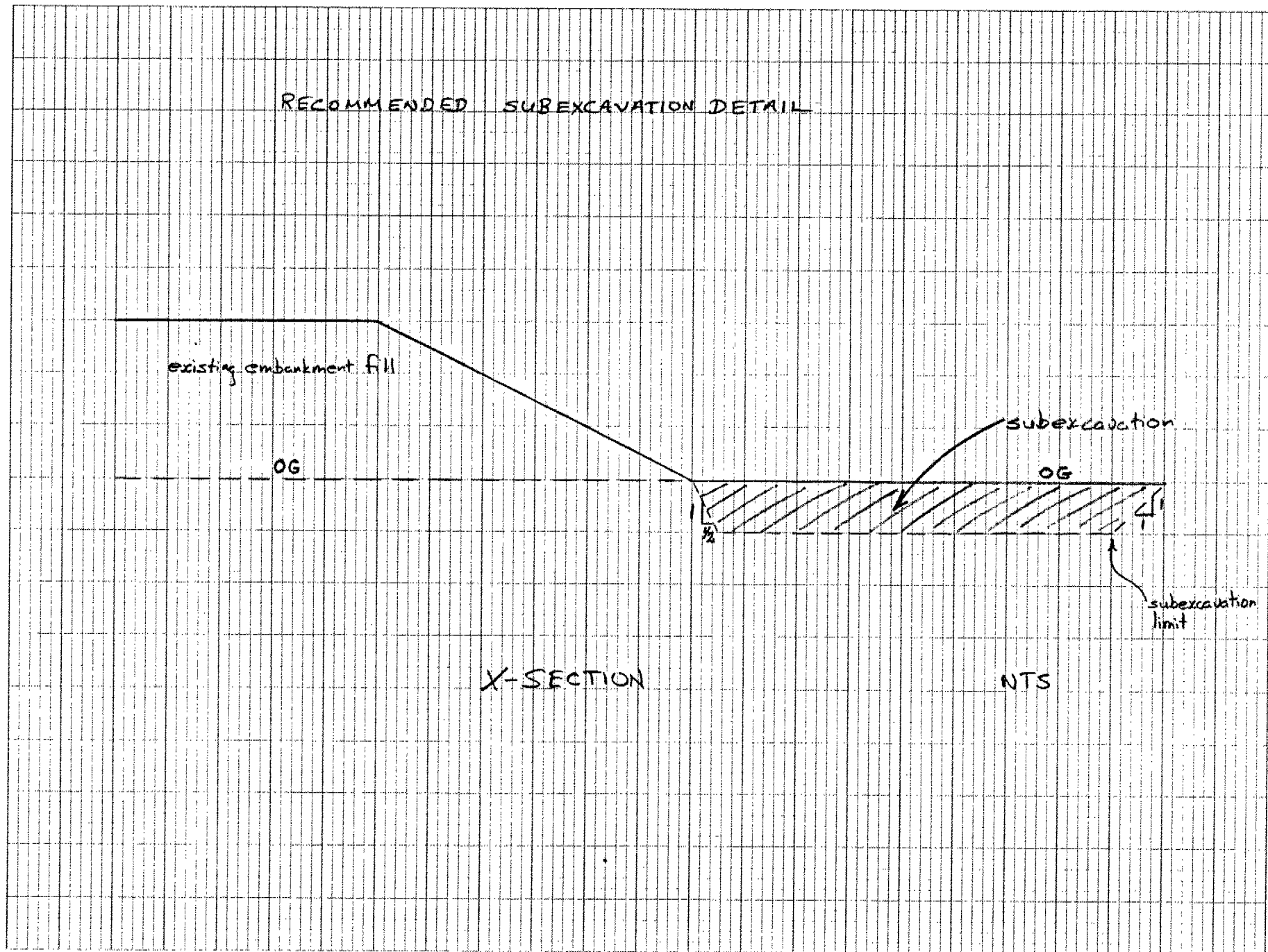
subexcavation

OG

subexcavation
limit

X-SECTION

NTS



SPECIAL PROVISION W.P. 128-86-00 Preload

INSTALLATION AND PROTECTION OF SETTLEMENT MEASURING DEVICES

The Ministry will be installing measuring devices at Station 10 + 085 Hwy 7A as indicated on sheet no. XXXXXX of the Contract Drawings.

The Contractor will be required to supply the manpower to install the settlement plates and should be informed of the scope of the work at a pre-construction meeting with the Ministry. The Contractor shall advise the Ministry at least three weeks prior to placing any fill in the embankment so that the required supervision from this office can be scheduled.

Payment for all materials, labour and equipment shall be on a Force Account Basis except as noted (OR Payment for work will be made in accordance with Form 100, Section 103-3, Extra Work). The Ministry will not pay stand-by time for labour and equipment for the unit price items operations held up as a result of the instrumentation.

The Contractor shall exercise all necessary precautions to prevent any damage to the settlement plates and shall provide adequate access to the installations at all times for Ministry Personnel and vehicles. The Contractor shall be responsible for the protection of settlement plate installations during the time of construction, and should any damage occur to the installation due to his equipment or personnel, he shall restore these installations at his own expense, to the satisfaction of the Engineer.

*Shown to V. Mutranic Apr. 28
Will distribute and send feedback to me.*

Procedure for Installation of Settlement Plates

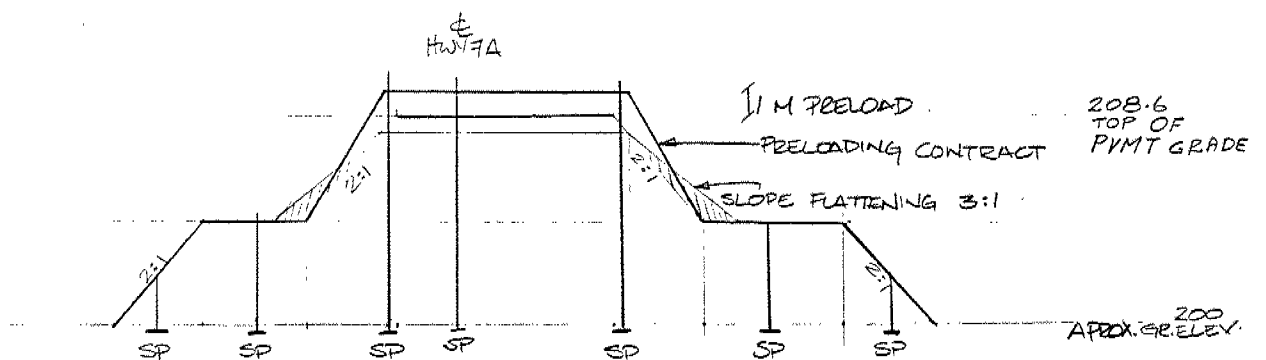
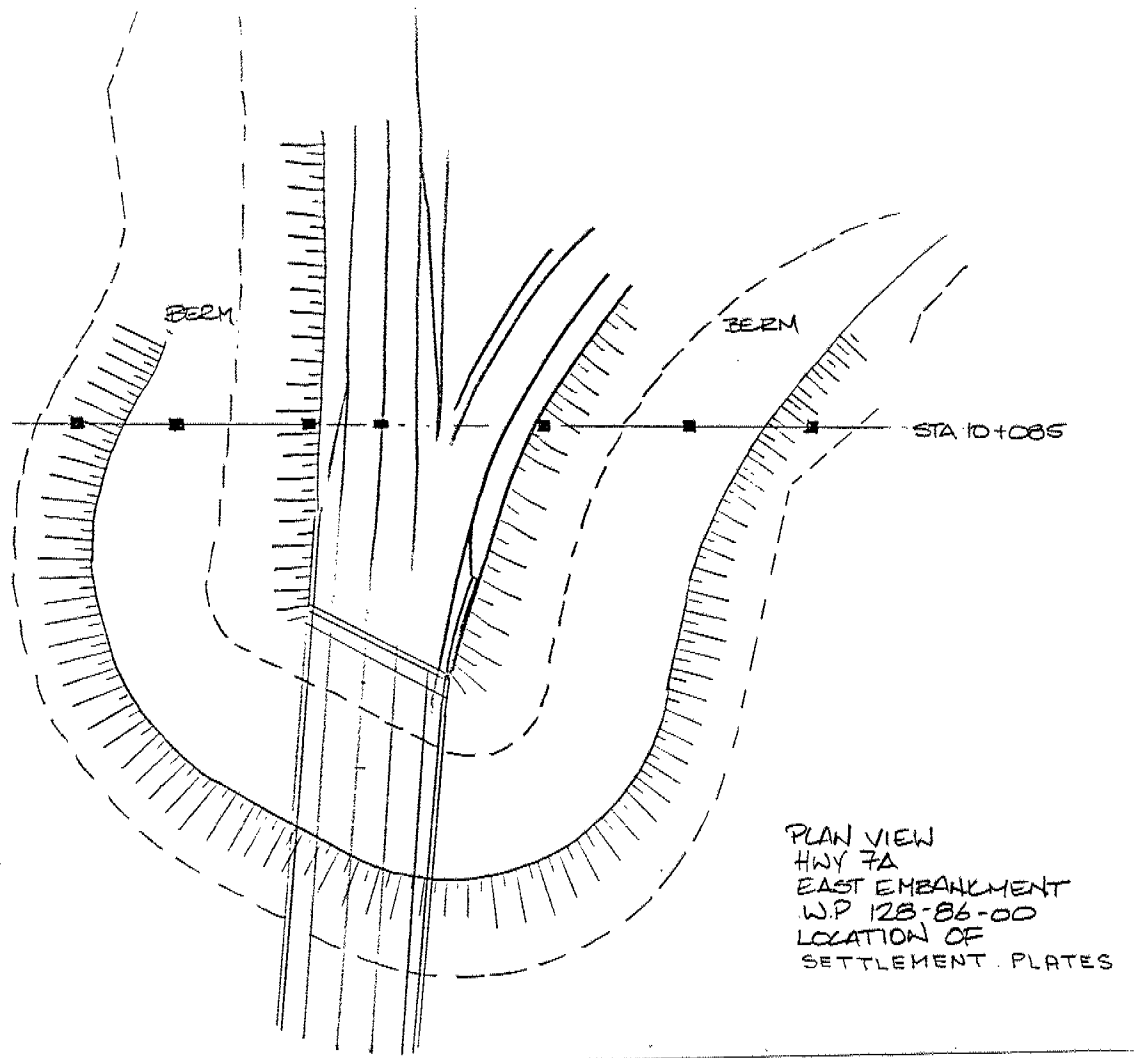
- 1) The settlement must be levelled on a compacted granular bed (minimum 300 mm depth), and pegged into the existing ground, prior to any grading work. When installing the plates, care must be taken to ensure that they are level and evenly bedded.
- 2) Elevations should be recorded immediately after installation.
- 3) Backfilling should be carried out so as not to disturb the installation.
- 4) When the final lift is placed, boreholes should be driven to the plates, PVC pipe installed as an access tube, and a rod used to obtain the elevation.
- 5) Monitoring of plate levels should be carried out regularly throughout the construction period.

Responsibilities:

Contractor- shall supply labour to install settlement plates, and assure access to MTC personnel and vehicles during construction

MTC Construction Staff- shall provide survey crew to accurately place and locate plates
- shall provide survey crew to measure plate locations and elevations throughout the construction period

Foundation Section- shall provide supervisory staff to oversee installation and surveying of locations and elevations of plates
- shall supply plates (1m x 1m x 3.175mm) with pins, protective pipes, rods and couplings, which will be delivered to the site (or picked up by the Contractor at Downsview).
- shall obtain drilling company to provide boreholes to plates after final construction



X-SECTION HWY 7A STA. 10+085
LOCATION OF SETTLEMENT PLATES

V= 1:200
H= 1:500

re: W.P. 74-70-01, Hwy. 115
County Rd. 10 Interchange
Preliminary Foundation Recommendations
for Ramps and Approaches

The 1 m berms and associated drains will depress a potential high water table while at the same time allow for the collection of surface run-off along the face of the slope. It is necessary to control the groundwater along the mentioned limits because of the non-cohesive nature of the sub-soils. If the groundwater and surface run off is not controlled, sloughing of the face of the slope may occur.

- 2.0 The face of the cut should be covered in topsoil and provided with vegetation.
- 3.0 No special treatment is required beyond the previously mentioned limits.

The foundation report for this project will follow in the future. In the meantime, if you have any questions, please do not hesitate to contact me.



L. Politano, P. Eng.,
Project Foundations Engineer

LP:ma

cc: D. Woods,
P. Roy

memorandum



To:

G.C.E. Burkhardt
Head, Structural Section
Central Region
5000 Yonge Street.

Date:

1985 06 25

From: Foundation Design Section
Room 315, Central Building
Downsview

ATT: P.K. Roy

Re: Foundation Investigation
Preliminary Recommendations
W.P. 74-70-06, Site 21-39-445
Peterborough County Rd. 10 Underpass
Hwy. 115, District 7, Port Hope

The fieldwork for the structure portion of the above-noted project has been completed.

This memo outlines the preliminary recommendations pertaining to the design and construction of the proposed structure and its immediate approaches. Recommendations with regards to the associated interchange ramps are not made in this memo.

Our complete foundation investigation and design report will be issued in the not-to-distant future. If there any questions, please contact this office.

SUBSURFACE CONDITIONS

The subsurface investigation for this project was carried out between 85-05-14 and 85-05-30. The investigation consisted of 11 sampled boreholes advanced to various depths.

Three boreholes were advanced in the vicinity of the proposed south abutment where the existing ground elevation is approximately at 216. In general, silty clay was encountered down to elev. 211.5. The silt content of this material increased gradually with depth until Elev. 211.5 where the soil changes to a silt with sand, gravel. With depth, the non-cohesive silt deposit changed to a silty sand and gravel mixture. This material was proven to approximately Elev. 201. An artesian condition was encountered approximately at Elev. 211 with a measured hydraulic head of approximately 2 m above the ground surface.

At the location of the proposed pier 2 holes were advanced. The existing ground elevation at this location is approximately at 215. Fill was encountered in both holes down to Elev. 213. At the west side of the pier 1 m of gravelly sand fill was encountered above approximately 1 m of silty clay fill. At the east side of the pier 2 m of gravelly sand fill was encountered above the natural ground surface.

.../2

Silty clay, trace sand, gravel was encountered at Elev. 213 down to Elev. 210 - 211. The silt content of this material increased with depth until approximately Elev. 210 - 211 where silt was found. This silt deposit changed to sand and gravel which was proven to Elev. 204.

Artesian conditions were encountered at approximately Elev. 208 and the estimated artesian head is 2 m above the ground surface.

At the site of the proposed north abutment 4 boreholes were advanced. The existing ground elevation at this location is approximately at 213.5. Between 1.5 and 2.0 m of gravelly sand fill was encountered in the area of the east shoulder.

Silty clay was encountered in all 4 boreholes at an approximate elevation of 211 - 212. There is a gradual transition from the silty clay to a silt at approximately Elev. 210 - 211. With depth the silt changes to a silty sand with gravel. Silty sand with gravel was encountered to at least Elev. 207.

Although not proven at the location of the north abutment, it is expected that an artesian condition similar to the one previously described exists.

DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a two-span structure (43 m - 43 m) to carry Peterborough County Rd 10 over Hwy 115. This proposal requires that the existing Co. Rd 10 grade be raised by approximately 8 m in the vicinity of the structure.

The following are the preliminary recommendations for design and construction of this structure

1. STRUCTURE FOUNDATIONS

Considering the artesian conditions present across the site, end bearing piles extending down to a competent stratum are not feasible. As a result tapered (350 mm down to 200 mm dia) timber piles extending down to the following elevation, should be incorporated:

<u>Location</u>	<u>Tip Elev.</u>	<u>S.L.S. Type II</u>	<u>U.L.S.</u>
South Abut.	211	90-130 KN	130-175 KN
Pier	211	90-130 KN	130-175 KN
North Abut.	210	90-130 KN	130-175 KN

The actual design loads will be given in the final foundation report.

The tip of the piles should not extend into the non-cohesive deposits where upward seepage of water under artesian pressures along the shaft of the piles would occur.

The above loadings are derived using soil mechanics theory. It is recommended, however, that full scale pile load tests be carried out at this site prior to finalizing the design. If such

tests were to be carried out, the design capacity of the timber piles may be considerably increased and consequently minimize the number of piles and cost. The Foundation Design Section is in a position to administer and supervise the load tests.

Due to the anticipated settlement of the silty clay stratum, a 15% reduction in any pile capacity recommended should be applied to compensate for the effects of negative skin friction (downdrag) on the piles.

It is also recommended that both the north and south abutments be perched in the approach fill.

Active conditons (K_a) apply

2. STABILITY AND SETTLEMENTS

Based on preliminary stability analyses of 8 m of non-cohesive fill with an assumed unit weight of 22 Kn/m^3 it appears that stability will not be of concern at the approaches.

It is expected that some settlement of the silty clay will occur under the 8 m of fill. Consolidation tests to determine magnitude and rates of settlements have not yet been carried out. However, if the calculated settlements prove to be unacceptable, the following alternatives can be taken (depending on the consolidation test results).

- (i) approach fills can be constructed and left in place for a 3-6 month period prior to driving abutment piles (pre-load).
- (ii) Approach fill can be surcharged and left in place for a 3-6 month period prior to driving abutment piles.
- (iii) light-weight fill (90 pcf) could be used and remain in place for a given period of time as necessary. If light-weight fill were to be used there would be no need for the granular backfill to the structure abutment. The light-weight fill would have to extend to at least 15 m behind the abutment wall and be provided with a 10:1 transition taper.

Appropriate details of each of there alternatives will be provided in the final foundation report.

3. GENERAL CONSIDERATIONS

If light-weight material is not used, backfill to structure should consist of granular material in accordance with MTC Standard Special Provision #121 (83 - 12). Computation of earth pressures should be in accordance with Sect. 6.6.1.2 of the O.H.B.D.C.

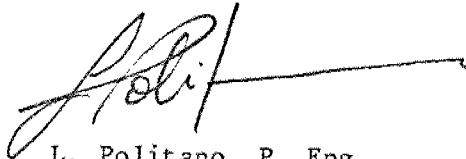
For design purposes the physical properties of the backfill are as follows:

Gran. 'A'	35°	22.0 Kn/m ³
Gran. 'B'	30°	21.2 Kn/m ³

For frost protection earth cover of 1.6 m, or equivalent is required

All final slopes should be constructed at 2:1.

Dewatering will not pose a major problem provided that the artesian stratum is not penetrated.



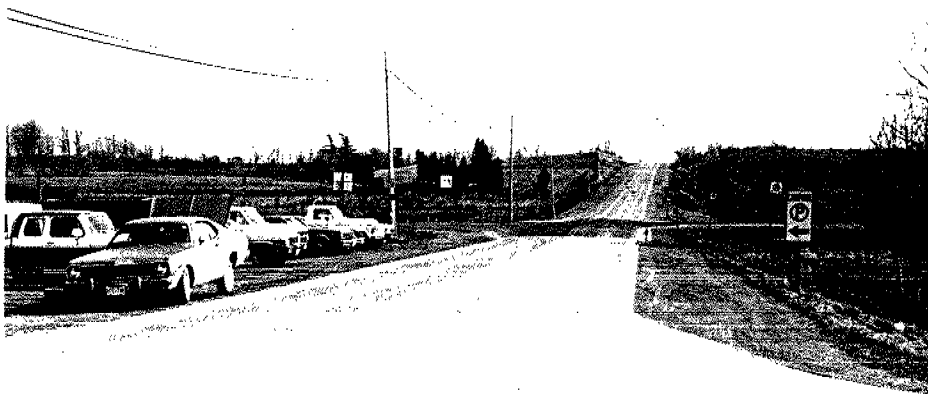
L. Politano, P. Eng.
Project Foundations Eng.
for
M. Devata, P. Eng.
Chief Foundations Eng.
(East)

LP/pet

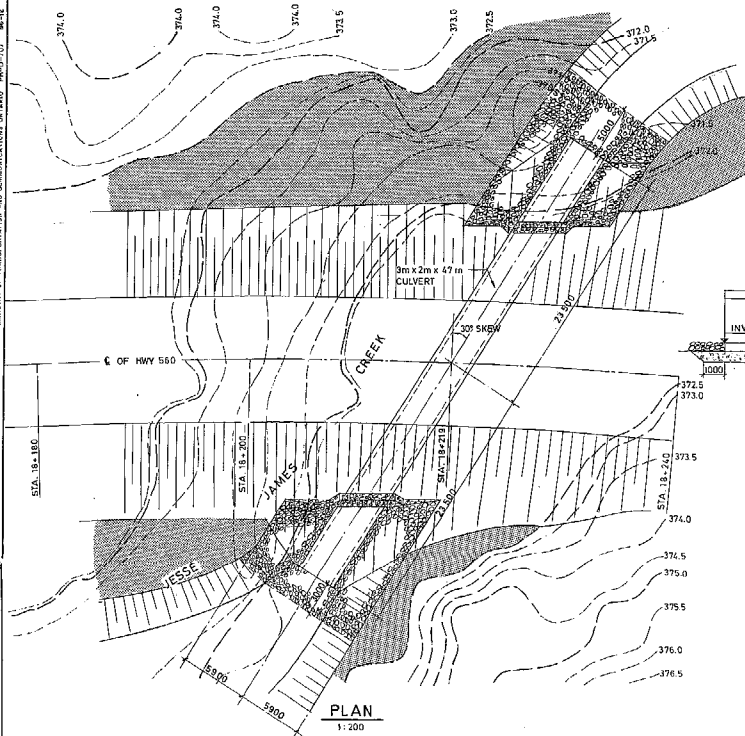
PETERBOROUGH CO. RD. #10 U'PASS AT HWY. 115
SITE 21-39-445, W.P. 74-70-06
DISTRICT 7, PORT HOPE



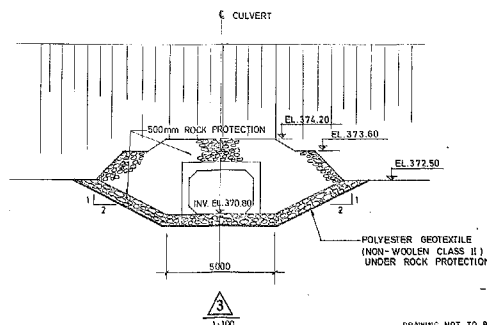
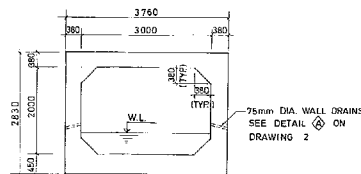
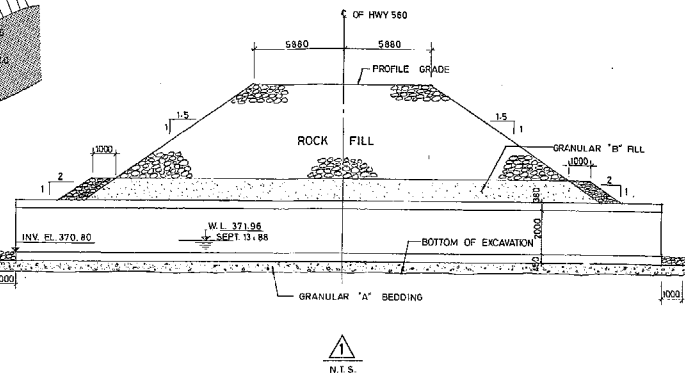
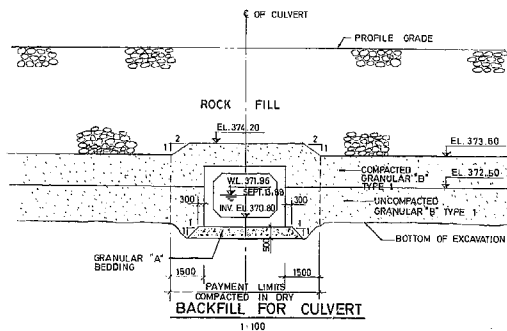
VIEW OF PETERBOROUGH CO. RD.#10 (LOOKING NORTH)



VIEW OF PETERBOROUGH CO. RD. #10 (LOOKING SOUTH)



LEGEND:
 FILL TO EL. 372.50 (MIN.)



METRIC
 DIMENSIONS ARE IN METRES
 AND/OR MILLIMETRES
 UNLESS OTHERWISE SHOWN

PLATE No	CONT No 90 - 450	
WP No 194-88-02	WP No 194-88-02	
JESSE JAMES CREEK BOX CULVERT GENERAL ARRANGEMENT	SHEET S1	
 Marshall Macklin Monaghan Limited Consulting Engineers • Surveyors • Planners		

NOTES:

Location

1. OHPC Code 83 Class 'A' Highway.

Materials

1. Class of Concrete
All concrete 30 MPa
2. Reinforcing Steel
Reinforcing Steel - Grade 486 MPa
3. Class Cover to Reinforcing Steel
Cast Against Ground 100 ± 15
Bottom of Top Slab 40 ± 10
Breadth 75 ± 10
Unless Noted on Drawings

Construction

1. Contractor must submit the dewatering system to the engineer for approval.
2. No concrete shall be placed until the depth of the excavation and character of the foundation approved by the engineer.
3. Wall drain openings shall be formed of non-metallic material. The vertical location of wall drain shall be verified in the field by the engineer.
4. Backfill shall be placed at both sides of the culvert simultaneously with a maximum height difference of 500 mm.

DRAWING NOT TO BE SCALED
 100 mm ON ORIGINAL DRAWING

DATE	BY	DESCRIPTION	DATE	BY
1997	K.K. CHEN	DESIGN	1997	K.K. CHEN
1997	R.S. CHEN	CHECK	1997	R.S. CHEN
1997	K.K. CHEN	APPROVE	1997	K.K. CHEN