

31D-385

FINAL  
FOUNDATION INVESTIGATION AND DESIGN REPORT FOR  
HIGHWAY 35  
GWP 81-99-00

FROM 8.1 KILOMETRES NORTH OF VICTORIA/HALIBURTON  
COUNTY BOUNDARY  
NORTHERLY 10.4 KILOMETRES  
DISTRICT 52, HUNTSVILLE

Submitted To:

**Triton Engineering Services Limited**  
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25 October 2001  
TT20868.1

GEOCRES No. 31D-385

Triton Engineering Services Limited  
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 County Boundary, Northerly 10.4 km  
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## 1.0 INTRODUCTION

AMEC Earth & Environmental Limited, Consulting Geotechnical Engineers, was retained by Triton Engineering Services Limited on behalf of the Ministry of Transportation Northern Region, to conduct a foundation investigation at the site of 20 areas of embankment widening along Highway 35 and at the location of two proposed concrete culverts. The project limits of the proposed highway widening/rehabilitation are from Station 18+070 (about 300 m north of Miner's Bay) and extends northerly to Station 28+420, just south of the intersection of Highway 35 and Regional Road 121.

The purpose of the investigation has been to obtain information about the sub-surface conditions at the site by means of exploratory boreholes, in-situ tests and laboratory tests on selected samples. Twenty areas were identified in the terms of reference of the project issued by the Ministry of Transportation of Ontario in which foundation investigation was to be conducted and an additional area was noted during the fieldwork. In order to simplify reference to these individual investigation areas, each area is denoted with a letter corresponding to the investigation area, as indicated in Table I, Appendix 'A'. Further, when presenting a cross-section of an embankment in a drawing and for discussion purposes, the cross-section will be cut and viewed facing north such that the left and right sides of the embankments are facing west and east, respectively.

Cross-sections of the existing highway embankment and the preliminary profile of the highway were provided by MTO, which were surveyed in 1997 by Delcan Corporation. Some additional survey information was supplied by Triton Engineering Services Limited.

The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Sub-surface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations. The elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.



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## **2.0 SITE DESCRIPTION AND PHYSIOGRAPHY**

### **2.1 Site Description**

Each investigation area is briefly described below:

#### **Site 'A' (Stations 18+600 to 18+700)**

In this area the highway embankment is about 1.5 m to 8 m in height, with side slope inclinations of 1.5H:1V to 1.9H:1V. Rockfill is exposed along the entire length of the side slopes. A rock cut is located immediately south of the area, which form a high rock knob. The ground along the left side of the embankment slopes down from the rock knob to the south and is heavily treed to about Station 18+650 where an open clearing is present. Beyond the right toe of the embankment a bedrock knob is exposed between approximately Stations 18+650 to 18+680. Exposed bedrock can also be seen near Station 18+700. The entire area is sparsely treed.

#### **Site 'B' (Stations 18+740 to 18+780)**

This area comprises the intersection of Davis Lake Road/Pine Ridge Road with Highway 35. The highway embankment is about 5 m to 10 m in height. Davis Lake Road (to the east of Highway 35) is fairly level with an embankment height of about 5 m to 10 m. The grade of Pine Ridge Road drops from the Highway 35 level down to the valley floor (about 10 m below the highway grade). Rockfill is exposed along the side slopes of the embankments. Bedrock is exposed in the southeast quadrant of the intersection, while the northeast and northwest quadrants are heavily treed. The southwest quadrant is in an open clearing.

#### **Site 'C' (Stations 19+030 Lt to 19+100 Lt)**

The highway embankment in this area is about 1.5 m to 3 m in height with side slope inclinations of 2.2H:1V to 3.2H:1V. A 1.0 m diameter CSP culvert crosses underneath the highway at about Station 19+040. This small creek flows easterly. A rock cut is located at about Station 19+000, with a ridge running from the rock cut, covered by overburden, to about Station 19+040. The ground is fairly level beyond this ridge.

#### **Site 'D' (Stations 19+060 Rt to 19+200 Rt)**

The highway embankment is about 2 m to 3 m high with side slope inclinations of about 2.1H:1V to 2.7H:1V. Rock cuts are present to the north and south of this area. The ground beyond the right toe is fairly level, gently sloping to the east towards a lake. The area is swampy and sparsely treed.

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Site 'E' (Stations 19+430 to 19+600)

The highway embankment is about 1 m to 7 m high with side slope inclinations of about 1.4H:1V to 2.9H:1V. Rock cuts are present immediately south of this area and bedrock outcrops immediately north of this area. The highway embankment crosses a swamp at this location, with the majority of the swamp east of the embankment. The ground beyond the toe of the embankment is fairly level, while rising sharply to the bedrock knob to the south and rising slightly towards the north at the bedrock outcrop. Open water parallels the eastern edge of the embankment and flows into an open water pond in the northeastern part of the investigation area.

Site 'F' (Stations 19+680 Rt to 19+900 Rt)

The highway embankment is about 1 m to 6 m high with side slope inclinations of about 1.9H:1V to 2.8H:1V. The ground beyond the right toe of the embankment rises gently at the north and south ends of the investigation area where exposed bedrock can be seen. The investigation area is swampy and sparsely treed.

Site 'G' (Stations 19+750 Lt to 19+840Lt)

The highway embankment is about 2.5 m to 6 m high with side slope inclinations of about 2.1H:1V to 3.1H:1V. Exposed bedrock is present immediately south of this area. An open water swamp is present beyond the left toe of the embankment. The ground surface rises in the area of Station 19+820 where the ground is littered with boulders and heavily treed.

Site 'H' (Stations 20+200 Lt to 20+500 Lt)

This investigation area is at the bottom of a valley. The highway embankment is about 2m to 7m high with side slope inclinations of about 1.5H:1V to 3.7H:1V. A large swamp is located beyond the left toe of the embankment and the ground rises sharply at the north end of the investigation area and steadily at the south end. Exposed bedrock can be seen near the north end. Rock cuts are present along the majority of the east side of the embankment.

Site 'J' (Stations 21+140 Rt to 21+190 Rt)

The highway embankment is about 1 m high with side slope inclinations of about 2.5H:1V to 3.2H:1V. Shallow bedrock cuts are found to the north and south of this investigation area, as well as on the left side of the highway. The investigation area is flat and swampy with bulrushes.

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#### Site 'K' (Stations 21+250 Lt to 21+350 Lt)

The highway embankment is about 0.5 m to 5.5 m high with side slope inclinations of about 1.3H:1V to 3.3H:1V. The ground beyond the left toe falls sharply from the north and south to Station 21+300. Rock cuts/outcrops are present to the north and south of the area. The area outside of the highway right-of-way is heavily treed.

#### Site 'L' (Stations 21+600 to 21+700)

The highway embankment is about 1 m to 5 m in height in this area. Exposed rockfill can be seen in localized areas along the slopes of this embankment. The slopes are at an inclination of about 2.0H:1V to 4.8H:1V. The old Highway 35 embankment runs along the right toe of the existing Highway 35 embankment, and is about 2 m in height. Beyond the right toe of the embankment and old highway embankment is a large swamp area bounded by sloping ground to the north and east and west. The ground beyond the left toe of the embankment slopes steeply from the east and west to the culvert crossing underneath Highway 35 which feeds a small creek into the swamp on the right side of the embankment. Bedrock cuts are found 50 m south and north of the investigation area. Gull Lake Road Number 28 is located at Station 21+600.

#### Site 'M' (Stations 22+630 Rt to 22+890 Rt)

This area is located at the bottom of two hills (to the north and south), adjacent to a swamp. The highway embankment is about 2 m to 3 m high with side slopes at an inclination of about 1.9H:1V to 3.4H:1V. Beyond the right toe of the embankment is a large swamp with some open water areas and is feed by a creek by three CSP culverts underneath Highway 35 (see Site 'N'). The creek parallels the toe of the embankment from about Stations 22+720 to 22+800 where it turns into the swamp. Beaver dams have been built along this creek. Beyond the left toe of the embankment the ground rises slightly to a treed area and two houses. An entrance to a campground is also located along this investigation area.

#### Site 'N' (Station 22+695 ±)

Three 1.2 m diameter CSP culverts cross underneath the Highway 35 embankment at this location. The embankment is about 2 m high. The creek which flows through the culverts flows to the east into the swamp, as noted above.

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#### Site 'O' (Stations 23+020 Rt to 23+300 Rt)

This area comprises the upslope of Highway 35 from the valley located in Site 'M'. The embankment is about 2.5 m to 10 m in height with slope inclinations of about 1.7H:1V to 3.8H:1V. Rockfill is exposed along the entire length of the slope. Old Highway 35 parallels the existing highway to about Station 23+150 where it turns eastward. The old highway is still used as a local road and the embankment is about 2 m in height. Bedrock is exposed along the old highway near Stations 23+125 to 23+150 and beyond the left toe of the existing highway embankment. The area between the old highway and the existing highway is sparsely treed. The ground beyond the right toe of the existing embankment rises sharply to the north.

#### Site 'P' (Stations 23+550 Rt to 23+650 Rt)

The highway embankment in this area is about 2 m to 7 m in height with a side slope inclination of about 1.8H:1V to 3.5H:1V. Bedrock cuts are exposed immediately to the north and south of this area. The ground beyond the right toe slopes sharply from the north and south towards Station 23+600. This area at the toe of the slope is heavily treed and slopes away from the highway.

#### Site 'Q' (Stations 24+010 Rt to 24+300 Rt)

The grade of the highway gently slopes to the northeast in this area. The highway embankment is about 2 m to 5 m high, with a side slope inclination of about 1.8H:1V to 3.2H:1V. An open water swamp exists to the right of the embankment, with bedrock cuts located on the left. The old highway alignment follows along the toe of the existing embankment.

#### Site 'R' (Stations 24+850 Rt to 25+200 Rt)

The highway grade rises steadily to the north in this area, with highway embankment heights of about 1 m to 3 m for the first 150 m and then rising to a maximum embankment height of about 6 m at the north end. The inclination of the side slopes of the embankment range from about 1.9H:1V to 3.6H:1V. A lake extends from the embankment at Station 24+940 to Station 25+200. A bedrock cut extends along the west side of the embankment from Station 25+000 to beyond Station 25+200.

#### Site 'T' (Stations 25+550 Rt to 25+950 Rt)

The highway embankment is about 1.5 m to 6 m high with side slope inclinations of about 1.5H:1V to 4.1H:1V. The grade of the highway drops towards the north, where the embankment heights are low. The existing ground beyond the right toe is relatively flat and consists of a swamp with open water areas. The old highway alignment follows the toe of the embankment along the southern end of this area. Rock cuts are present beyond the left toe of the embankment along the middle section

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of this investigation area.

Site 'U' (Stations 27+400 to 27+600)

In this area the highway embankment is about 1 to 3m in height. The existing embankment is composed of earth/granular fill with rockfill inferred to the north (Station 27+620). Two existing 2 m diameter CSP culverts cross Highway 35 at Station 27+519  $\pm$ . During the time of investigation, the culverts are underwater on the west side of the highway. The existing ground surface slopes from the north and south towards the swamp located adjacent to the culverts. West of the embankment, the treeline opens up into a large open water swampy area.

Site 'V' (Stations 28+150 Rt to 28+200 Rt)

The highway embankment is about 3.5 m in height, with a side slope inclination of about 2.0H:1V. Beyond the toe of the embankment a small swamp is located with open water further to the east. The ground surface slopes upwards to the north and south.

Site 'W' (Stations 18+250 Rt to 18+330 Rt)

In this area the highway embankment is about 9 to 10 m in height along the east side of the highway, and about 2 to 4 m on the west side of the highway. The existing embankment is composed of granular fill over rockfill, with side slope inclinations of about 1.4H:1V. The rockfill embankment rests along an existing slope which extends down another 4 to 9 m, with a side slope inclination of about 2.5H:1V. The natural slope is heavily treed and strewn with boulders and/or bedrock outcrops. At the toe of the natural slope is a small marshy area which is fed by a lake to the east. The topography rises sharply to the north and south to form a gully within this investigation area.

## 2.2 Physiography

The project area is in the physiographic region termed the Algonquin Highlands (Chapman and Putnam, 1984). The region is characterized by frequent bedrock outcrops covered by a thin discontinuous sheet of sandy glacial till. The bedrock forms a rough relief of knobs and ridges rising 15 m to 60 m above valley floors which are generally floored with outwash sands and gravels. Bogs and swamps are frequently found in poorly drained, bedrock controlled low areas and generally underlain by glaciolaustrine silts and clays. Deeper deposits of glaciolaustrine sands and gravels are present in the northern limits of the project.

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### 3.0 INVESTIGATION PROCEDURES

The fieldwork for this project was performed from 20 November 2000 to 15 February 2001, July 30, August 1, 9 and 10, 2001, and consisted of drilling and sampling 160 boreholes. The plan locations of the boreholes, along with stratigraphic sections are shown on Drawings Numbers. A to H, J to R and T to W, in Appendix 'B'.

The majority of the boreholes were advanced using solid and hollow stem continuous flight augers with a track-mounted and/or truck-mounted (CME 55 and 75) power auger drilling rig owned and operated by Geo-Environmental Drilling Inc., Groundwork Drilling Inc. and Master Soil Investigation Inc.

Where the boreholes could not be accessed with a drill rig, boreholes were advanced with portable hand drilling equipment. Depending on the accessibility of the borehole location, various drilling techniques and equipment were used, such as wash boring, Pionjar sampling and continuous sampling with manual operated standard soil sampling equipment. Master Soil Investigation Inc., Sonic Soil Sampling Limited and AMEC engineering staff were employed to perform these types of fieldwork. All drilling was conducted under the full-time supervision of experienced geotechnical technicians or professional engineers from AMEC Earth & Environmental Limited.

Sampling in the boreholes was effected at frequent intervals of depth (0.76 m to 1.5 m intervals or continuously) by the Standard Penetration Test Method, as specified in American Society for Testing and Materials Method Number: D1586. This consists of freely dropping a 63.5 kgs hammer a vertical distance of 0.76 m to drive a nominal 51 mm diameter o.d. split barrel (split-spoon) sampler into the ground. The number of blows of the hammer to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m is recorded as the Standard Penetration

Where the consistency of the clayey soil deposits permitted, undisturbed Shelby tube (TW) samples were obtained. In soft clayey deposits, in-situ vane tests were carried out using a Ministry of Transportation of Ontario's 'N' vane.

Where sampling with a tripod or conventional drill rig was not accessible, boreholes were sampled continuously and consisted of freely dropping a 31.75 kgs hammer a vertical distance of 0.76 m to drive a 51 mm diameter o.d. split barrel (split-spoon) sampler into the ground. The number of blows of the hammer to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m was recorded. These values were then correlated with the Standard Penetration Test, as specified in American Society for Testing and Materials Method Number: D1586. The correlated values are reported as Standard Penetration Resistances or the 'N'-values of the soil and this gives an indication of the consistency or the relative density of the soil deposit.

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Due to auger refusal within the rockfill embankments in Boreholes E9, E10, H8 and L7, the boreholes were advanced with an air track drill rig supplied by Bay Blasting Limited. The presence of rockfill, soil or bedrock was inferred by monitoring the penetration of the air track drill.

In order to prove bedrock in Boreholes N3 and N5, rotary core drilling was carried out utilizing NQ size casings and core barrel. Bedrock at shallow depth was confirmed using a track-mounted backhoe where accessible.

The borehole locations were established in the field by our engineering staff, in relation to the centreline of Highway 35. The borehole geodetic elevations and co-ordinates were later taken by C.T. Strongman Surveying Limited.

The soil samples were shipped in sealed containers to our Advanced Soil Laboratory in Toronto (Scarborough) for further examination and classification. A laboratory testing programme, consisting of natural moisture content determinations, Atterberg Limits tests, consolidation testing, unit weights and grain-size analyses, was performed on selected representative soil samples. The results of the laboratory tests are presented on the appropriate Record of Borehole sheets and also in Appendix 'D'.

Standpipe piezometers were installed in selected boreholes to monitor the groundwater level over a prolonged period of time without interference from surface water.

The boreholes were backfilled and compacted with auger cuttings, except Borehole N3 which was backfilled with bentonite. The borings through the rockfill embankments were backfilled with concrete.

#### **4.0 SUB-SURFACE CONDITIONS**

The sub-surface conditions were explored at 160 borehole locations and are shown on Drawing Numbers: A to H, J to R and T to W in Appendix 'B', as well as indicated on the individual Record of Borehole Sheets in Appendix 'C'. Cross sections of inferred sub-surface stratigraphy are also given in the corresponding drawings.

##### **4.1 General Sub-Surface Conditions**

Descriptions of the sub-surface conditions encountered in the boreholes are presented on the Record of Borehole sheets in Appendix 'C'. The following paragraphs describe the various strata. Table II in Appendix 'A' presents a tabulated form of all the boreholes, the soil stratigraphy .../...

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encountered and the thickness of each soil unit.

#### 4.1.1 Fill

The majority of the fill encountered across the site consists of the existing Highway 35 embankment. The fill ranges from rockfill with sand to granular fill. The presence of rockfill was generally inferred by auger refusal and proven in Boreholes E9, E10, H8 and L7 by an air track drill. The voids in the rockfill were generally infilled with sand.

Granular fill embankments were penetrated in Boreholes F6, G4, J4, N1, N2, N5, Q8, Q9, R9, R10, T10, U5, U6 and M7 through M12, inclusive. This fill consisted of sand with gravel to gravelly sand and traces of silt size particles. Localized clayey silt fill was encountered in Site 'M'. Measured 'N'-values within the fill ranged from 1 to greater than 50 blows per 0.3 m indicating a very loose to very dense relative density, but generally compact. The presence of cobbles and/or boulders within the granular embankments was inferred during drilling.

The granular base and sub-base granular fills were encountered in all boreholes drilled through the highway embankment. Reference as to the depth and composition of these materials can be made using the Final Pavement Design Report by AMEC Earth & Environmental Limited, dated October 2001, Reference Number: TT20868.

Fill was also encountered in the area of the old Highway 35 alignments in Boreholes L5, L6, O1, O2, O3, T1, T2 and T4. This fill generally consisted of sand with traces of gravel, silt and organics. Localized shallow areas of clayey silt were encountered in Site 'O'. Measured 'N'-values within the granular fill of old Highway 35 ranged from 4 to 25 blows per 0.3 m indicating a very loose to compact relative density, but generally loose to compact.

Laboratory test results from soil samples in the fill are as follows

#### Granular Embankment Fill

Natural Moisture Content (%):	5 - 20
Grain Size (four samples):	
Gravel (%):	9 - 28
Sand (%):	64 - 88
Silt (%):	3 - 8

The grain size curves for this material are provided on Figure 1, in Appendix 'D'.

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#### 4.1.2 Organic Deposits

Topsoil or peat deposits were encountered at the surface of the majority of the boreholes advanced beyond the toe of the existing highway embankment and underneath some of the granular fill embankments. Generally the peat thickness ranges from 0.1 m to 3 m, however, at Sites 'E' and 'U' the thickness of peat was found to be up to 9.1 m thick. Sands layers/seams and inclusions of gravel or cobbles were found in numerous locations. Measured 'N'-values range from 0 to 7 blows per 0.3 m, indicating a very soft to firm consistency. Measured natural moisture contents range from 17% to over 1,000%.

Underlying the peat or at the ground surface, silty sand to sand to clayey silt deposits with peat layers or organics, and in Site 'E' organic silt, were encountered in the majority of the investigation areas. The thickness of these deposits range from 0.1 m to 2.9 m. Measured 'N'-values within the cohesionless silty sand to sand with organic deposits range from 0 to 41 blows per 0.3 m indicating a very loose to dense relative density, but generally very loose to compact. Measured 'N'-values within the clayey silt with organics and organic silt range from 1 to 5 blows per 0.3 m indicating a very soft to firm consistency, but generally very soft.

Laboratory test results from soil samples in the soil deposits with organics are as follows

##### Silty Sand to Sand with Organics

Natural Moisture Content (%):	8 - 310
Grain Size (two samples):	
Gravel (%):	10 - 24
Sand (%):	72 - 85
Silt (%):	4 - 5

The grain size curves for this material are provided on Figure 2, in Appendix 'D'.

##### Clayey Silt with Organics to Organic Silt

Natural Moisture Content (%):	22 - 55
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#### 4.1.3 Silty Sand to Sand to Silt

Underlying the peat, organic soils and/or fill deposits, most investigation areas encountered a silty sand to sand to silt deposit. These deposits can be considered as the upper cohesionless deposits. The thickness of these deposits ranges widely across the site from about 0.4 m to greater than 12 m. Measured 'N'-values range from 1 to greater than 50 blows per 0.3 m indicating a very loose to .../...

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very dense relative density, but generally loose to compact.

Underlying the silty clay to clayey silt deposits in Sites 'A', 'D', 'E', 'F', 'H', 'L', 'M', 'N', 'O', 'Q', 'R' and 'U', a lower cohesionless deposit was encountered overlying the inferred bedrock surface. This lower deposit consists of silty sand to sand to silt to sand and gravel. Measured 'N'-values range from 1 to greater than 50 blows per 0.3 m indicating a very loose to very dense relative density.

Laboratory test results from soil samples in the silt and sand deposits are as follows

### **Silty Sand**

Natural Moisture Content (%):	8 - 34
Grain Size (four samples):	
Gravel (%):	1 - 3
Sand (%):	56 - 64
Silt (%):	35 - 42
Clay (%):	0 - 1

The grain size curves for this material are provided on Figure 3, in Appendix 'D'.

### **Sand**

Natural Moisture Content (%):	8 - 30
Grain Size (24 samples):	
Gravel (%):	0 - 28
Sand (%):	62 - 94
Silt (%):	5 - 25
Clay (%):	0 - 1

The grain size curves for this material are provided on Figures 6, 7, 8 and 9, in Appendix 'D'.

### **Silt to Sandy Silt**

Natural Moisture Content (%):	5 - 32
Atterberg Limits:	
• Liquid Limit (%):	17 - 21
• Plastic Limit (%):	15 - 18
• Plasticity Index (%):	2 - 4
Grain Size (five samples):	
Gravel (%):	0 - 25
Sand (%):	3 - 34

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Silt (%): 42 - 95  
 Clay (%): 0 - 8

The grain size curves for this material are provided on Figures 4 and 5, in Appendix 'D'. Atterberg Limits test results are present in Figure 13, in Appendix 'D'.

## Sand and Gravel

Natural Moisture Content (%): 8

### 4.1.4 Clayey Silt to Silty Clay

A clayey silt to silty clay deposit was encountered in the majority of the boreholes below the organic deposits and interlayered within the cohesionless sand deposits. Exceptionally thick deposits of the silty clay to clayey silt was encountered at Sites 'M' and 'N'. These cohesive deposits have a homogeneous to varved structure. The thickness of this clayey soil ranges from 0.1 m to 13.5 m. Measured 'N'-values range from 0 to greater than 50 blows per 0.3 m, indicating a very soft to hard consistency, but generally very soft to very stiff.

In Borehole L5, overlying the silty clay, a clayey silt glacial till deposit was encountered. This till is composed of a heterogeneous mixture of silt and clay with traces of sand and occasional gravel size particles. Measured 'N'-values range from 26 to 41 blows per 0.3 m indicating a very stiff to hard consistency.

Laboratory test results from soil samples in the cohesive soil deposits are as follows

### Silty Clay to Clayey Silt

Natural Moisture Content (%):	8 - 53
Atterberg Limits:	
• Liquid Limit (%):	20 - 52
• Plastic Limit (%):	12 - 27
• Plasticity Index (%):	7 - 30
Unit Weight (kN/m <sup>3</sup> ):	17.8 - 23.0
Grain Size (39 samples):	
Gravel (%):	0 - 20
Sand (%):	0 - 29
Silt (%):	45 - 91
Clay (%):	5 - 47

The grain size curves for this material are provided on Figures 11a, 11b, 12a and 12b in Appendix .../...

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'D'. The results of the Atterberg Limits tests are presented in Figures 14, 15, 16 and 17 in Appendix 'D'.

The results of the consolidation tests conducted on eight undisturbed samples are found in Appendix 'D'.

A summary of the consolidation tests conducted on the clayey silt to silty clay deposits, along with a summary of the grain size and Atterberg Limits tests conducted on the undisturbed samples are tabulated in Table III in Appendix 'A'.

#### **Clayey Silt (Glacial Till)**

Natural Moisture Content (%):	17 - 25
Atterberg Limits:	
• Liquid Limit (%):	30
• Plastic Limit (%):	18
• Plasticity Index (%):	12
Grain Size (one sample)	
Gravel (%):	0
Sand (%):	8
Silt (%):	67
Clay (%):	25

The grain size curve for this material is provided on Figure 10 and the results of the Atterberg Limits test are present on Figure 18, in Appendix 'D'.

#### **4.1.5 Bedrock**

Bedrock was inferred from auger refusal in numerous boreholes at various depths (ranging from at ground surface to 17.8 m). In some locations the presence of shallow bedrock was confirmed by excavation with a track-mounted backhoe. In Boreholes E9, E10, H8, L7 and R9 bedrock was inferred by the penetration rate of an air track drill. Bedrock in Boreholes N3 and N5 was proven by rotary core drilling utilizing an NQ casing and core barrel. A description of the bedrock cores is given in Section 4.2.4. Generally, based on geologic publications and from examination of the rock cuts in the area, the bedrock is generally a metamorphic rock, typically skarn and/or calc-silicate rocks or migmatite to gneiss.

#### **4.1.6 Groundwater Conditions**

Groundwater in the open boreholes were observed during drilling and upon completion of each .../...

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borehole. For groundwater levels in the boreholes the individual Record of Borehole sheets in Appendix 'C' should be referenced. To permit long term monitoring of groundwater levels at the site, standpipe piezometers were installed in Boreholes C2, D1, H3, L5, M2, M10, N4, O1, and O4. Observed groundwater levels are indicated on the individual Record of Borehole sheets.

Generally, the low lying areas near swamps have a high groundwater level near the ground surface.

Artesian water conditions were encountered at Borehole N3 immediately above the bedrock surface. Groundwater was overflowing the drill casing 0.6 m above ground. After coring, the borehole was sealed with bentonite. Water level measurements in Borehole N4 also indicate the presence of artesian water conditions.

It should, however, be pointed out that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

## **4.2 Summarized Sub-Surface Conditions for Areas of Proposed Grade Raise**

Due to the anticipated grade raise of the highway and/or major re-alignment of the highway, the sub-surface conditions for the following investigation areas are described in more detail.

### **4.2.1 Site 'E'**

#### **Fill**

Boreholes E9 and E10 were advanced through the existing highway embankment. The boreholes encountered 100 mm of hot mix over 1.1 m to 1.2 m of sand to gravelly sand fill, with gravel and cobbles. Underlying the granular base and sub-base materials, rockfill was inferred from the penetration of the air track drill. The voids in between the rockfill were infilled with sand. The rockfill was encountered to depths of 18.3 m to 17.4 m (or Elevations 279.2 and 280.1 m), respectively.

#### **Peat**

All boreholes advanced beyond the toe (except Borehole E1) of the highway embankment encountered a peat deposit at the ground surface to depths of 1.1 m to 8.7 m below existing grade (or to Elevations 290.2 to 282.9 m). Measured 'N'-values range from 0 to 5 blows per 0.3 m, indicating a very soft to firm consistency, but generally very soft to soft. The peat ranges from a fibrous to amorphous texture and in some boreholes the presence of sand seams or wood fragments were encountered. Measured natural moisture contents range from 50% to 807%.

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Underlying the peat in some boreholes, an organic sandy silt layer was encountered. This layer contained shells and ranges in thickness from 0.3 m to 0.4 m. Measured 'N'-values of 3 and 5 were obtained within the organic layer indicating a soft to firm consistency.

A 0.2 m to 0.3 m thick topsoil layer was encountered at the surface of Boreholes E1 and E4. Underlying this topsoil and the peat in Boreholes E1 and E3 a silty sand with occasional peat layers was encountered to a depth of 2.1 m. Measured 'N'-values range from 1 to 14 blows per 0.3 m, indicating a very loose to compact relative density.

#### **Silty Sand to Sand**

Underlying the topsoil/peat and/or organic sandy silt in Boreholes E1, E1A, E3, E4, E5, and E8 a silty sand deposit was encountered to the remaining depths of the boreholes (0.9 m to 4.7 m). The silty sand contains a heterogeneous mixture of gravel and cobbles. The silty sand in Borehole E1A contains some clay. Measured 'N'-values range from 3 to greater than 50 blows per 0.3 m, indicating a very loose to very dense relative density, but generally compact to very dense.

Laboratory test results from soil samples in the silty sand to sand soil deposits are as follows

Natural Moisture Content (%):	14 - 18
Grain Size (one sample):	
Gravel (%):	0
Sand (%):	64
Silt (%):	35
Clay (%):	1

The grain size curve for this material is provided on Figure 3, in Appendix 'D'

#### **Silty Clay to Clayey Silt**

Underlying the peat in Boreholes E2, E2A, E3A, E6 and E7, a silty clay to clayey silt deposit was encountered to the remaining depths of the boreholes (3.8m to 9.6 m). A 0.1 m thick silty sand layer was encountered below the cohesive soil in Borehole E6, overlying the bedrock. Measured 'N'-values within the silty clay to clayey silt range from 0 to 18 blows per 0.3 m, indicating a very soft to very stiff consistency.

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Laboratory test results from soil samples in the cohesive soil deposits are as follows:

Natural Moisture Content (%):	24 - 45
Atterberg Limits:	
• Liquid Limit (%):	15 - 37
• Plastic Limit (%):	16 - 21
• Plasticity Index (%):	10 - 19
Unit Weight (kN/m <sup>3</sup> ):	19.1
Grain Size (two samples):	
Gravel (%):	0
Sand (%):	0
Silt (%):	68 - 84
Clay (%):	16 - 32

The grain size curves for this material are provided on Figures 12a and 12b and the results of the Atterberg Limits tests are presented in Figures 14 and 17 in Appendix 'D'. The results of the consolidation test conducted on an undisturbed sample are also presented in Appendix 'D'. A summary of the consolidation test conducted on the clayey silt to silty clay deposit, along with a summary of the grain size and Atterberg Limits tests conducted on the undisturbed sample are tabulated in Table III in Appendix 'A'.

### Bedrock

Refusal to augering or wash boring or cone penetration was encountered in Boreholes E1, E2, E3, E4, E5, E6, E7 and E8 at depths of 0.9 m to 12.5 m below existing grade, or Elevations 294.7 to 279.1 m. Bedrock is inferred at this depth. In Boreholes E9 and E10, bedrock was inferred by the penetration rate of the air track drill. Bedrock is inferred at these two locations at depths of 18.3 m and 17.4 m, or Elevations 279.2 and 280.1 m, respectively. The surface of the bedrock appears to drop sharply from the north and south to a low area at Station 19+500.

### Groundwater Conditions

Groundwater in the open boreholes were observed during drilling and upon completion of each borehole. For groundwater levels in the boreholes the individual Record of Borehole sheets in Appendix 'C' should be referenced. Groundwater levels were generally observed at the ground surface to depths of 1.5 m below ground surface. Boreholes E9 and E10 advanced through the embankment remained dry on completion.

It should, however, be pointed out that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

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#### 4.2.2 Site 'H'

##### Fill

Borehole H8 was advanced through the existing highway rockfill embankment. The borehole encountered 110 mm of hot mix over 1.2 m of sand to gravelly sand fill, with gravel and cobbles. Underlying the granular base and sub-base materials, rockfill was inferred from the penetration of the air track drill. The voids in between the rockfill were infilled with sand. The rockfill was encountered to a depth of 3.2 m (or Elevation 282.4 m), respectively.

##### Peat

All boreholes advanced beyond the toe (except Borehole H7) of the highway embankment encountered a peat deposit at the ground surface to depths of 0.4 m to 1.8 m below existing grade. Measured 'N'-values range from 0 to 4 blows per 0.3 m, indicating a very soft to firm consistency, but generally very soft to soft. The peat generally has a fibrous texture and in the majority of the boreholes the presence of sand layers and gravel were encountered. Measured natural moisture contents range from 17% to 215%.

##### Upper Sand to Sandy Silt

Underlying the peat in Boreholes H5 and H6 a sand with traces of silt and organics to a sandy silt with gravel deposit was encountered to depths of 1.1 m and 2.2 m, respectively. Measured 'N'-values range from 7 to 20 blows per 0.3 m, indicating a loose to compact relative density. Measured moisture contents range from 16% to 32%.

##### Silty Clay to Clayey Silt

Underlying the peat and/or sand to sandy silt, Boreholes H1 through H5, inclusive, encountered a silty clay to clayey silt deposit to depths of 1.1 m to 9.6 m (or Elevations 281.0 to 269.6 m). Measured 'N'-values within the silty clay to clayey silt range from 4 to greater than 50 blows per 0.3 m, indicating a firm to hard consistency, but generally firm to very stiff.

Laboratory and field test results from soil samples in the cohesive soil deposits are as follows

Natural Moisture Content (%):	18 - 39
Atterberg Limits:	
• Liquid Limit (%):	21 - 38
• Plastic Limit (%):	19 - 21
• Plasticity Index (%):	6 - 17
In-situ Shear Vane Tests (kPa):	33 - 44
Unit Weight (kN/m <sup>3</sup> ):	18.6

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**Grain Size (two samples):**

Gravel (%):	0
Sand (%):	0
Silt (%):	55 - 59
Clay (%):	41 - 45

The grain size curves for this material are provided on Figure 12a and the results of the Atterberg Limits tests are presented in Figures 14 and 17 in Appendix 'D'. The results of the consolidation test conducted on an undisturbed sample are also presented in Appendix 'D'. A summary of the consolidation test conducted on the clayey silt to silty clay deposit, along with a summary of the grain size and Atterberg Limits tests conducted on the undisturbed sample are tabulated in Table III in Appendix 'A'.

**Lower Sand to Sandy Silt**

Underlying the silty clay to clayey silt deposit in Boreholes H2, H3, H4 and H5, a lower deposit of sandy silt to sand was encountered. The thickness of this layer ranges from 0.2 m to 1.6 m. A measured 'N'-value of 49 blows per 0.3 m was obtained within the sandy silt layer indicating a dense relative density. Measured moisture contents range from 18% to 26%.

**Bedrock**

Auger refusal on possible bedrock was encountered in Boreholes H2, H3, H4 and H6 at depths of 3.2 m to 9.8 m (or Elevations 276.6 to 269.4 m). Bedrock was also inferred from the penetration rate of the air track drill in Borehole H8 at a depth of 3.2 m, or Elevation 282.4 m. Bedrock outcropping was found at Borehole H7.

**Groundwater Conditions**

Groundwater in the open boreholes were observed during drilling and upon completion of each borehole. For groundwater levels in the boreholes the individual Record of Borehole sheets in Appendix 'C' should be referenced. A standpipe piezometer was installed in Borehole H3 in order to monitor the groundwater level over a prolonged period of time without interference from surface water. Based on the measured groundwater levels in the boreholes and from tactile and visual observations of the recovered soil samples, the groundwater table beyond the embankment is at a depth of about 1 m to 2 m below existing ground. Borehole H8 which was advanced through the embankment remained dry on completion.

It should, however, be pointed out that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

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#### **4.2.3 Site 'L'**

##### **Fill**

Borehole L7 was advanced through the existing highway rockfill embankment. The borehole encountered 100 mm of hot mix over 0.8 m of sand with gravel fill. Underlying the granular base and sub-base materials, rockfill was inferred from the penetration of the air track drill. The voids in between the rockfill were infilled with sand. The rockfill was encountered to a depth of 10m (or Elevation 289.4 m).

Boreholes L5 and L6 were advanced through the old Highway 35 embankment, at the base of the existing Highway 35 embankment. Immediately below a thin topsoil layer (0.1 m to 0.15 m thick), a sand fill was encountered to depths of 1.6m to 2.1 m, or Elevations 293.8 to 292.7 m. The fill contained traces of gravel, silt, organics, decaying wood, rootlets and occasional cobbles. Measured 'N'-values within this fill range from 4 to 15 blows per 0.3 m, indicating a very loose to compact relative density, but generally compact. Measured moisture contents range from 8% to 14%.

##### **Peat**

At the surface of Borehole L2, and below the old Highway 35 embankment fill, a peat deposit was encountered. This peat deposit is 0.4m to 0.6 m thick. Measured 'N'-values of 1 and 4 blows per 0.3 m was obtained indicating a very soft to soft consistency. Measured moisture contents of 24% to 42% were obtained. Boreholes L3, L4, L5 and L6 encountered 0.1 m to 0.15 m of topsoil at the ground surface.

Underlying the peat and/or at the ground surface, Boreholes L1 and L2 encountered a clayey silt with peat layers to a depth of 0.8 m to 1.1 m. A measured 'N'-value of 1 blow per 0.3 m was obtained in Borehole L2, indicating a very soft consistency.

##### **Upper Sand**

Underlying the topsoil in Boreholes L3 and L4 a sand deposit with gravel or silt was encountered to a depth of 1.1 m to 1.7 m. The sand contains traces of organics and occasional cobbles. Measured 'N'-values ranges from 16 to greater than 50 blows per 0.3 m, indicating a compact to very dense relative density. Lower 'N'-values (5 to 7) was obtained at the ground surface. Measured moisture contents range from 8% to 13%.

##### **Clayey Silt (Glacial Till)**

Underlying the old highway embankment encountered in Borehole L5, a clayey silt glacial till deposit was encountered. This glacial till deposit was encountered to a depth of 3.7 m (or Elevation 291.1 m). The till is a heterogeneous mixture of clayey silt and trace of sand and occasional gravel size particles.

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Measured 'N'-values of 26 and 41 blows per 0.3 m indicates a very stiff to hard consistency.

Laboratory test results from soil samples in the cohesive till deposit are as follows

Natural Moisture Content (%):	17 - 25
Atterberg Limits:	
• Liquid Limit (%):	30
• Plastic Limit (%):	18
• Plasticity Index (%):	12
Grain Size (one sample):	
Gravel (%):	0
Sand (%):	8
Silt (%):	67
Clay (%):	25

The grain size curve for this material is provided on Figure 10 and the results of the Atterberg Limits test are present on Figure 18, in Appendix 'D'.

### **Silty Clay to Clayey Silt**

Underlying the peat and/or glacial till, Boreholes L2, L5 and L6 encountered a silty clay to clayey silt deposit to depths of 3.6 m to 5.6 m (or Elevations 290.1 to 287.9 m). Measured 'N'-values within the silty clay to clayey silt range from 4 to 25 blows per 0.3 m, indicating a firm to very stiff consistency.

Laboratory and field test results from soil samples in the cohesive soil deposits are as follows

Natural Moisture Content (%):	27 - 33
Atterberg Limits:	
• Liquid Limit (%):	24 - 37
• Plastic Limit (%):	16 - 21
• Plasticity Index (%):	7 - 16
In-situ Shear Vane Tests (kPa):	34 - 170
Unit Weight (kN/m <sup>3</sup> ):	19.9
Grain Size (six samples):	
Gravel (%):	0 - 20
Sand (%):	1 - 20
Silt (%):	45 - 86
Clay (%):	7 - 15

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The grain size curves for this material is provided on Figure 11a and the results of the Atterberg Limits tests are presented on Figure 14, in Appendix 'D'.

#### **Lower Sand**

Below the clayey silt to silty clay deposit in Boreholes L2, L5 and L6, a sand deposit was encountered to the remaining depths of the boreholes (3.9 m to 6 m). The sand layer is about 0.1 m to 0.4 m thick and overlies the inferred bedrock. It contains varying amounts of gravel and in Borehole L6 a trace of silt. A measured 'N'-value of greater than 50 blows per 0.3 m was obtained within this layer indicating a very dense relative density.

#### **Bedrock**

Auger refusal or refusal to pionjar sampling on possible bedrock was encountered in all boreholes at depths of 0.8 m to 6 m (or Elevation 294.8 to 287.4 m). Bedrock was also inferred from the penetration rate of the air track drill in Borehole L7 at a depth of 10.0 m, or Elevation 289.4 m.

#### **Groundwater Conditions**

Groundwater in the open boreholes were observed during drilling and upon completion of each borehole. For groundwater levels in the boreholes the individual Record of Borehole sheets in Appendix 'C' should be referenced. A standpipe piezometer was installed in Borehole L5 in order to monitor the groundwater level over a prolonged period of time without interference from surface water. Based on the measured groundwater levels in the boreholes and from tactile and visual observations of the recovered soil samples, the groundwater table beyond the right toe of the embankment is at a depth of about 1 m to 2 m below existing ground. Borehole L7 which was advanced through the embankment remained dry on completion.

It should, however, be pointed out that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

#### **4.2.4 Sites 'M' and 'N'**

##### **Fill**

Boreholes N1, N2, N5 and M7 through M12, inclusive, were advanced through the existing granular highway embankment. These boreholes encountered a sand fill embankment with gravel and traces of silt, asphalt tar and occasional cobbles. Measured 'N'-values range from 2 to 49 blows per 0.3 m indicating a very loose to dense relative density, but generally compact. Measured moisture contents range from 5% to 20%.

Underlying the granular fill, a clayey silt fill was encountered in Boreholes M11 and M12. This fill  
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ranges in thickness from 0.1 m to 0.8 m and was encountered to a depth of 1.8 m to 2.6 m (or Elevation 271.0 m). The fill contains traces of rootlets. Measured moisture contents range from 27% to 33%.

#### **Peat**

At the ground surface, below the existing highway embankment and ponded water, a peat deposit was encountered ranging in thickness from 0.3 m to 2.9 m. The peat was encountered to depths of 0.7 m to 2.9 m, or Elevation 270.0 to 267.5 m. Measured 'N'-values range from 0 to 2 blows per 0.3 m indicating a very soft to soft consistency. Measured moisture contents range from 32% to 308%.

#### **Silty Sand to Clayey Silt with Organics**

Boreholes N1, N2, M3, M4 and M8 encountered a silty sand to clayey silt with organics or peat layers underlying the peat, fill or ponded water to depths of 1.5 m to 3.7 m. This layer ranges in thickness from 0.5 m to 1.6 m. Measured 'N'-values range from 0 to 8 blows per 0.3 m indicating a very loose to loose relative density or very soft consistency. Measured moisture contents range from 10% to 308%.

#### **Upper Sand to Silt**

Boreholes N3 and M2 encountered a sand to silt deposit underlying the peat deposits to depths of 1.6 m to 3.1 m. This layer ranges in thickness from 0.5 m to 0.6 m. Measured 'N'-values range from 0 to 1 blows per 0.3 m indicating a very loose relative density.

#### **Clayey Silt to Silty Clay**

Underlying the peat, organics deposits, upper sand to silt and/or fill, all boreholes encountered a silty clay to clayey silt deposit to depths of 3.3 m to 16.2 m (or Elevations 268.8 to 255.4 m). This cohesive soil ranges in thickness from 0.1 m to 12.9 m. Measured 'N'-values within the silty clay to clayey silt range from 0 to 21 blows per 0.3 m, indicating a very soft to very stiff consistency.

Laboratory and field test results from soil samples in the cohesive soil deposits are as follows:

Natural Moisture Content (%):	12 - 51
Atterberg Limits:	
• Liquid Limit (%):	24 - 51
• Plastic Limit (%):	18 - 22
• Plasticity Index (%):	8- 23
In-situ Shear Vane Tests (kPa):	18 - 110
Unit Weight (kN/m <sup>3</sup> ):	17.8 - 19.2
Grain Size (10 samples):	
Gravel (%):	0
Sand (%):	0 - 4

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Silt (%): 69 - 91  
 Clay (%): 5 - 30

The grain size curves for this material is provided on Figures 11a and 11b, and the results of the Atterberg Limits tests are presented on Figure 15, in Appendix 'D'. A summary of the consolidation tests conducted on the clayey silt to silty clay deposit, along with a summary of the grain size and Atterberg Limits tests conducted on the undisturbed samples are also found in Appendix 'D'.

### Lower Sand to Sandy Silt

All of the boreholes in Sites 'M' and 'N' (except Boreholes M4 and M5) encountered a lower sandy gravel to sand to silty sand to sandy silt deposit to the remaining depth of the boreholes (i.e. to depths of 7.7 m to 17.8 m). These cohesionless samples range in thickness from 0.1 m to 6.3 m. Measured 'N'-values ranges from 2 to greater than 50 blows per 0.3 m indicating a very loose to very dense relative density. Where auger refusal was encountered within these deposits, a dynamic cone penetration test was conducted at the base of the borehole in order to determine the possible depth of bedrock.

Laboratory test results from soil samples in the sands and silts are as follows:

Natural Moisture Content (%): 13 - 23

### Sand

Grain Size (four samples):

Gravel (%): 4 - 26  
 Sand (%): 62 - 88  
 Silt (%): 8 - 20

### Sandy Silt

Atterberg Limits (in silts):

Liquid Limit (%): 20  
 Plastic Limit (%): 17  
 Plasticity Index (%): 3

Grain Size (one sample):

Gravel (%): 21  
 Sand (%): 27  
 Silt (%): 51  
 Clay (%): 1

The grain size curves for these materials are provided on Figures 4 and 7, in Appendix 'D'. Atterberg Limits test results for the silt are presented in Figure 13, in Appendix 'D'.

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### **Bedrock**

Auger refusal or refusal to dynamic cone penetration tests on possible bedrock were obtained in all boreholes (except Boreholes M3, M4 and M5) at depths ranging from 7.7 m to 17.8 m (or Elevations 264.0 to 253.8 m). Bedrock was proven by rotary coring in Boreholes N3 and N5 at depths of 15.3 m and 9.6 m, respectively, or Elevations 254.9 and 262.5 m. The bedrock was cored for a depth of 2.6 m to 3.0 m. The recovered core samples show that the Precambrian bedrock consists of a massive closely to moderately closely jointed migmatite. Calc-silicate rock is also present in zones within the core and the presence of vugs were found in the core in Borehole N5. The percentage of Total Core Recovery ranges from 75% to 100%. The Rock Quality Designation increases with depth from 21% to 94%. Based on these values and visual examination of the cores, the rock is considered to be of very poor to excellent quality.

### **Groundwater Conditions**

Groundwater in the open boreholes were observed during drilling and upon completion of each borehole. For groundwater levels in the boreholes the individual Record of Borehole sheets in Appendix 'C' should be referenced. Standpipe piezometers were installed in Boreholes M2, M10 and N4 in order to monitor the groundwater level over a prolonged period of time without interference from surface water. Based on the measured groundwater levels in the boreholes and from tactile and visual observations of the recovered soil samples, the groundwater table is about at the ditch line of the embankment (i.e. at the ground surface beyond the embankment), with artesian conditions in the vicinity of the existing triple culverts.

Artesian water conditions were encountered at Borehole N3 immediately above the bedrock surface. Groundwater was overflowing the drill casing 0.6 m above ground. After coring, the borehole was sealed with bentonite. Water level measurements in Borehole N4 also indicate the presence of artesian water conditions.

It should, however, be pointed out that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

#### **4.2.5 Site 'Q'**

##### **Fill**

Boreholes Q8 and Q9 were advanced through the existing highway embankment, while Borehole Q2 was advanced through the old highway alignment at the toe of the existing embankment. These boreholes encountered a sand with gravel to gravelly sand fill material with occasional cobbles and trace silt. The fill encountered extended to depths of 1.2 m to 2.7 m (or Elevation 293.7 to 293.5 m). A thin layer of hot mix asphalt was encountered overlying the fill in Borehole Q2. Measured 'N'-values within the fill ranges from 11 to greater than 50 blows per 0.3 m, indicating a compact to

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very dense relative density.

Laboratory test results from soil samples in the fill are as follows:

Natural Moisture Content (%):	5 - 15
Grain Size (one sample):	
Gravel (%):	28
Sand (%):	64
Silt (%):	8

The grain size curve for this material is provided on Figure 1, in Appendix 'D'.

### Peat

At the ground surface or below the embankment fill in Boreholes Q4, Q5, Q5A, Q6, Q7 and Q9, a peat deposit was encountered to depths of 0.3 m to 5.0 m (or Elevation 293.8 to 288.5 m). The peat ranges in thickness from 0.3 m to 2.9 m and is overlain in Boreholes Q3, Q4, Q5A and Q6 by 0.1 to 2.9 m of water/ice at the time of the investigation. Measured 'N'-values within the peat range from 0 to 5 blows per 0.3 m indicating a very soft to firm consistency, but generally very soft. Measured moisture contents range from 25% to 317%.

Underlying the peat and/or water in Boreholes Q3, Q4 and Q5 a sand to silty sand with frequent to occasional peat layers was encountered to a depth of 2.7 m to 5.5 m below existing grade. This deposit ranges in thickness from about 1.1 m to 1.8 m. Measured 'N'-values range from 1 to 9 blows per 0.3 m indicating a very loose to loose relative density. Measured moisture contents range from 17% to 53%.

### Clayey Silt

Underlying the peat, organics deposits, and upper sand to silty sand, Boreholes Q4, Q5, Q5A, Q6 and Q7 encountered a clayey silt deposit to depths of 3.3 m to 8.0 m (or Elevations 290.8 to 285.5 m). The clayey silt ranges in thickness from 0.6 m to 3.0 m. Measured 'N'-values within the clayey silt range from 2 to 14 blows per 0.3 m, indicating a soft to stiff consistency.

Laboratory and field test results from soil samples in the cohesive soil deposits are as follows:

Natural Moisture Content (%):	13 - 42
Atterberg Limits:	
• Liquid Limit (%):	22 - 28
• Plastic Limit (%):	12 - 18
• Plasticity Index (%):	8 - 12
In-situ Shear Vane Tests (kPa):	24

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Unit Weight (kN/m <sup>3</sup> ):	21.5 - 22.3
Grain Size (two samples):	
Gravel (%):	0
Sand (%):	1 - 12
Silt (%):	73 - 85
Clay (%):	14 - 15

The grain size curves for this material are provided on Figure 12a and the results of the Atterberg Limits tests are presented on Figure 17, in Appendix 'D'.

#### **Silty Sand to Sand to Silt**

Underlying the peat, sand with peat layers, fill and above and below the clayey silt, all boreholes (except Q5, Q6, Q7) encountered a sand to silty sand to silt deposit and the boreholes were terminated within these deposits at depths of 0.5 m to 6.3 m. These cohesionless deposits range in thickness from 0.2 m to 2.5 m. Measured 'N'-values ranges from 14 to greater than 50 blows per 0.3 m indicating a compact to very dense relative density. Measured moisture contents range from 8% to 28%.

#### **Bedrock**

Auger refusal on possible bedrock was encountered in all boreholes (except Boreholes Q5, Q5A and Q9) at depths of 0.5 m to 6.3 m (or Elevation 295.9 to 287.6 m). The bedrock also appears to be sloping toward the lake.

#### **Groundwater Conditions**

Groundwater in the open boreholes were observed during drilling and upon completion of each borehole. For groundwater levels in the boreholes the individual Record of Borehole sheets in Appendix 'C' should be referenced. Based on the measured groundwater levels in the boreholes and from tactile and visual observations of the recovered soil samples, the groundwater table is about level with the lake, at about Elevation 294 ± m.

It should, however, be pointed out that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

#### **4.2.6 Site 'R'**

##### **Fill**

Boreholes R9 and R10 were advanced through the existing highway embankment and encountered 0.9 m to 5.0 m of sand with gravel fill. Measured 'N'-values ranges from 7 to greater than 50 blows per 0.3 m indicating a loose to very dense relative density. Measured moisture contents range from

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5% to 21%.

### Peat

All boreholes (except Boreholes R2, R4, R5 and R6A) encountered a peat deposit underlying the embankment fill, at the ground surface or below the lake. The peat ranges in thickness from 0.3 m to 1.5 m and is overlain in Boreholes R2 through R7B by 0.3 m to 3.7 m of water/ice at the time of the investigation. Measured 'N'-values within the peat range from 1 to 7 blows per 0.3 m indicating a very soft to firm consistency. Measured moisture contents range from 29% to 70%.

Underlying the peat and/or lake, Boreholes R2, R4, R5, R6, R6A, R7 and R7B encountered a silty sand to sand, with occasional peat layers or organics, to a depth of 1.2 m to 2.9 m below existing grade. This layer ranges in thickness from 0.4 m to 2.9 m. Measured 'N'-values range from 1 to 31 blow per 0.3 m indicating a very loose to dense relative density, but generally very loose to compact

Laboratory test results from soil samples in the sand with organics are as follows:

Natural Moisture Content (%):	10 - 72
Grain Size (one sample):	
Gravel (%):	10
Sand (%):	85
Silt (%):	5

The grain size curve for this material is provided on Figure 2, in Appendix 'D'.

### Clayey Silt

Underlying the peat, organic deposits, and upper sand to silty sand, Boreholes R2, R3, R6, R7 and R7A encountered a clayey silt deposit to depths of 2.4 to 3.5 m (or Elevations 293.8 to 292.5 m). This clayey silt ranges in thickness from about 0.1 to 1.6 m. Measured 'N'-values within the clayey silt range from 2 to 30 blows per 0.3 m, indicating a soft to hard consistency.

Laboratory and field test results from soil samples in the cohesive soil deposits are as follows:

Natural Moisture Content (%):	8 - 44
Atterberg Limits:	
Liquid Limit (%):	27 - 32
Plastic Limit (%):	17 - 18
Plasticity Index (%):	10 - 14

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Grain Size (two samples):

Gravel (%):	0
Sand (%):	1 - 2
Silt (%):	73 - 88
Clay (%):	10 - 26

The grain size curves for this material are provided on Figure 12a and the results of the Atterberg Limits tests are presented in Figure 17, in Appendix 'D'.

**Sand to Silty Sand**

A silty sand to sand deposit was encountered in all the boreholes in Site 'R' (except in Boreholes R1, R3, R7 and R7A) immediately below the peat, organics soils, fill and underlying the clayey silt. The sand was encountered to depths of 1.4 m to 6.7 m and ranges in thickness from about 0.1 m to more than 4.3 m. This cohesionless deposit ranges in composition from sand to silty sand with varying amounts of gravel. Measured 'N'-values range from 1 to 30 blows per 0.3 m, indicating a very loose to dense relative density.

Laboratory test results from soil samples in the sand are as follows:

Natural Moisture Content (%):	8 - 32
Grain Size (two samples):	
Gravel (%):	10 - 23
Sand (%):	69 - 83
Silt (%):	7 - 9

The grain size curves for this material are provided on Figure 6, in Appendix 'D'.

**Bedrock**

Auger refusal on possible bedrock was encountered in all boreholes (except Boreholes R1, R2, R5 and R6) at depths of 1.2 m to 6.7 m (or Elevation 295.2 to 292.6 m). Bedrock was also inferred from the penetration rate of the air track drill in Borehole R9 at a depth of 6.7 m, or Elevation 293.9 m. The bedrock appears to slope toward the lake and towards Boreholes R5 and R6.

**Groundwater Conditions**

Groundwater in the open boreholes were observed during drilling and upon completion of each borehole. For groundwater levels in the boreholes the individual Record of Borehole sheets in Appendix 'C' should be referenced. Based on the measured groundwater levels in the boreholes and from tactile and visual observations of the recovered soil samples, the groundwater table is about level with the lake at about Elevation 296 ± m.

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It should, however, be pointed out that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

#### 4.2.7 Site 'U'

##### Fill

Boreholes U5, U6, U7, U8, U9 and U10 were advanced through the existing highway shoulder and encountered about 0.7 to 1.9 m of sand and gravel to gravelly sand fill. The brown fill contains trace silt and trace asphalt fragments in Borehole U10. Borehole U10 was terminated within the fill at a depth of about 1.5m due to auger refusal on possible rockfill or boulders. Measured 'N'-values range from 10 to 38 blows per 0.3m indicating a compact to dense relative density, but generally compact. The fill is generally in a damp condition.

Underlying the embankment fill in Boreholes U5, U6 and U9, a brown to grey sand fill deposit was encountered which contains trace to with silt and gravel, occasional cobbles and traces of peat. This fill represents backfill material placed during the original highway construction to replace the organic peat deposits. Borehole U9 encountered auger refusal at a depth of 3.7 m on possible boulders. Measured 'N'-values range from 5 to 97 blows per 0.3m indicating a loose to very dense relative density. These high 'N'-values are likely due to contact with cobbles. This fill is generally wet.

Laboratory test results from soil samples in the fill are as follows:

Natural Moisture Content (%):	5 - 34
Grain Size (three samples):	
Gravel (%):	5 to 16
Sand (%):	73 to 88
Silt (%):	3 to 22

The grain size curves for this material are provided on Figure 1, in Appendix 'D'.

##### Organic Deposits

At the ground surface, Boreholes U11 to U18 (except Borehole U15) encountered about 0.2 to 0.3m of topsoil.

Underlying the topsoil, fill and/or peat in Boreholes U6, U15, U16, U17 and U18 a brown to black sand deposit was encountered to depths of 0.7 to 5.3m below existing grade. This sand contains peat, wood fragments and rootlets. Measured 'N'-values range from 1 to 17 blows per 0.3 m was

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obtained.

Underlying the organic rich sand, Boreholes U15 to U18 (inclusive) encountered a peat deposit about 0.4 to 2.3 m in thickness. A second lower peat layer was encountered in Borehole U16 at a depth of about 6.0 m, about 0.3m in thickness.

At the ground surface or below the embankment fill, Boreholes U1, U2, U3, U4, U5 and U15 encountered a peat deposit was encountered to depths of about 0.5 m to 8.7 m . The peat ranges in thickness from 0.5 m to 8.7 m and is overlain in Boreholes U1, U2, U3 and U4 by 0.1 m to 0.6 m of water/ice at the time of the investigation. Measured 'N'-values within the peat range from 0 to 3 blows per 0.3 m indicating a very soft to soft consistency, but generally very soft. Measured moisture contents range from 24% to 1,014%.

#### **Silty Clay to Clayey Silt**

Underlying the peat or interlayered within the sand, a silty clay to clayey silt deposit was encountered in Boreholes U3, U4 and U6. This cohesive layer ranges in thickness from 0.3 m to 2.2 m and was encountered at a depth of 7.5 m to 8.7 m, or Elevation 286.8 to 283.9 m. Measured 'N'-values of 1 blow per 0.3 m were obtained within the silty clay/clayey silt.

Underlying the sand and peat deposits in Boreholes U16, U17 and U18, a silty clay to clayey silt deposit was encountered. Boreholes U16 and U18 were terminated within this deposit at depths of about 7.3 and 4.2 m, respectively. The silty clay deposit in Borehole U17 was about 0.8 m in thickness and was encountered to a depth of 2.9 m. Measured 'N'-values range from 8 to greater than 50 blows per 0.3m indicating a stiff to hard consistency.

Underlying the embankment fill in Borehole U7, a brown clayey silt deposit was encountered to a depth of 1.9m. A measured 'N'-value of 62 blows per 0.3 m was obtained within this deposit indicating a hard consistency.

Laboratory and field test results from soil samples in the cohesive soil deposits are as follows:

Natural Moisture Content (%):	11 - 50
Atterberg Limits:	
• Liquid Limit (%):	23 - 52
• Plastic Limit (%):	15 - 22
• Plasticity Index (%):	7 - 30
In-situ Shear Vane Tests (kPa):	18

The Atterberg Limits test results for this material are provided on Figure 16, in Appendix 'D'.

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## **Sand**

Underlying the peat and/or silty clay/clayey silt in Boreholes U1 through U5 and U7 through U18, and above and below the silty clay/clayey silt in Borehole U6, a brown to grey sand deposit was contacted to the remaining depths of the boreholes (i.e. the boreholes were terminated within this deposit at depths of 4.1 m to 18.8 m), except in Boreholes U16 and U18 where the sand was encountered to a depth of 6.0m and 3.7 m, respectively. This sand deposit contains varying amounts of silt and gravel and occasional cobbles overlying the silty clay in Borehole U6. Measured 'N'-values range from 1 to greater than 50 blows per 0.3 m indicating a very loose to very dense relative density, but generally loose to compact. Generally the sand is very loose to compact to the south in the area of Station 27+400 (Boreholes U7, U11 U12 and U16) and near the culvert locations. A dynamic cone penetration test was performed at the bottom of Boreholes U5, U6, U11, U12, U13, U15, and U16 and extended to depths of 7.0 m to 22.7 m. Dynamic cone penetration test results range from 8 to greater than 100 blows per 0.3 m. The sand is generally in a wet condition.

Laboratory test results from soil samples in the sand are as follows:

Natural Moisture Content (%):	7 - 35
Grain Size (19 samples):	
Gravel (%):	0 - 23
Sand (%):	74 - 94
Silt (%):	2 - 25

The grain size curves for this material are provided on Figure 9, in Appendix 'D'.

## **Groundwater Conditions**

Groundwater in the open boreholes were observed during drilling and upon completion of each borehole. For groundwater levels in the boreholes the individual Record of Borehole sheets in Appendix 'C' should be referenced. Based on the measured groundwater levels in the boreholes and from tactile and visual observations of the recovered soil samples, the groundwater table is generally at the ditch line of the embankment (i.e. at the ground surface beyond the embankment).

It should, however, be pointed out that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

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## **5.0 DISCUSSIONS AND RECOMMENDATIONS**

### **5.1 GENERAL**

This report contains the findings of our geotechnical investigation, together with our recommendations and comments. These recommendations and comments are based on factual information and are intended only for use of the design engineers. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The anticipated construction conditions are also discussed, but only to the extent that they may influence design decisions. Construction methods discussed, however, express our opinion only and are not intended to direct the contractors on how to carry out the construction. Contractors should also be aware that the data and their interpretation presented in this report may not be sufficient to assess all the factors that may have an effect upon the construction.

The preliminary plans and profile for the proposed embankment widening were provided to us by Triton Engineering Services Limited.

The borehole locations, soil stratigraphic plots and cross sections of the proposed embankment widening are presented in Drawings A to H, J to R and T to W attached in Appendix B of the report.

### **5.2 EMBANKMENTS**

The discussions and recommendations of this section (Section 5.2) of the report cover the general and common geotechnical design and construction aspects of the highway embankments associated with proposed road widening and grade raise for twenty (20) investigation areas (Sites A to H, J to R and T to W), for Highway 35 and the proposed culvert at Site "N". Discussions and recommendations for each Site are presented in the sub-sections below (Section 5.2.1 to Section 5.2.21).

Embankments of granular/earth fill with a side slope inclination of 2 horizontal to 1 vertical (2H:1V), or rockfill embankments with a side slope inclination of 1.25 horizontal to 1 vertical (1.25H:1V), would be stable against surficial stability, provided that the subgrade is properly prepared by removing all surficial topsoil, loose existing fill, organic and otherwise unsuitable materials as per MTO Standards before placing the new fill. Appropriate benching (as per OPSD 208.010) at the sloping subgrade level should be considered to allow the new fill to key into the existing slope.

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Berms of 2 m in width should be provided as per current MTO practice, and where indicated in Sub-Sections 5.2.1 to 5.2.20. The berm gradient should be sloped (about 20H:1V) to drain away surface water from the embankment.

For earth fill embankment, assuming properly compacted and acceptable inorganic earth fill material, 2 horizontal to 1 vertical (2H:1V) side slopes can be used throughout. Proper erosion control measures should be implemented both during the construction and permanently. This can be achieved by immediate seeding or sodding (OPSS 572).

The fill materials used for construction of the earth fill embankment, or for the purposes of backfilling, should consist of approved, clean earth fill (e.g. Select Subgrade Materials - OPSS 1010). The majority of the fill will have to be imported for this purpose. The fills should be placed in accordance with OPSS501 and with lifts not exceeding 300 mm before compaction and each lift should be uniformly compacted to at least 95% of the Standard Proctor Maximum Dry Density of the materials. The degree of compaction within the top 0.6 m of the fill (i.e. the subgrade immediately beneath the granular sub-base) should be increased to 98%. The selection, placement and compaction of the fill should be carried out under a geotechnical control programme.

For rockfill embankment, rockfill should be placed in accordance with OPSS206 and its Amendments, and with lift thickness not exceeding two thirds the nominal size of the rock fill materials, and compacted by overlapping track prints of the construction equipment. The maximum rock fill size should be 1.0 m. Depending on the size and type of equipment used, six to eight passes along each path may be required. The surface voids of each layer of rock fill material should be filled with fragments of rock before the next layer is deposited. The final surface of rock fill material should be compacted by at least two additional passes with a bulldozer and should be chinked with compacted fine fill material prior to installation of the road subbase layer. Rock fill material should be clean, free of contaminants and consist of pieces of hard and durable rock with no sign of decomposition. Concrete, masonry, brick and similar should not be used. A geotextile separator, or granular filter layer (i.e. Granular 'B' Type II), will be required between rockfill and earth fill, and between rockfill and native soils, in order to prevent infiltration of fine soils into the rockfill and subsequent settlement. A geotextile separator should comprise a Class II non-woven geotextile with a Filtration Opening Size (F.O.S.) of 105 to 210  $\mu\text{m}$ .

The permanent side slopes of the rockfill embankment should be maintained no steeper than 1.25H:1V. It is noted that Northern Region practice may require berms of 2 m wide to ensure no

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uninterrupted slope is greater than 6 m in height.

In general, we recommend that, in as much as practicable, for the construction of the widened sections the same materials as the existing embankment be used. That is, if the existing material is rockfill then the use of rockfill should be considered to match the existing materials. Similarly, if the existing embankment was constructed of earth fill, the widening should preferably be implemented using earth fill

If the widening parts of the embankments are constructed using earth fill, the existing embankment slopes should be stripped and, although stripping depths will vary, the design depth used should be 150 mm. The existing embankment slopes should also be benched in accordance with OPSD 208.010 to ensure that the new embankment is keyed into the existing embankment and to minimize differential settlements. The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. This fill will be installed to the bottom of the road sub-base. The use of granular backfill is recommended for fill to be placed below the water table.

Alternatively, the widening parts of the embankments could be constructed using rockfill, except when the embankment widening is less than 1.2 m in height. If rockfill is to be used, all the topsoil and organic rich soils should be removed from the subgrade and the rockfill should be penetrated into the upper weaker zones of the underlying inorganic soil. This will help strengthen the soil.

For whichever type of embankment fill is selected (rockfill or granular fill), the granular base and sub-base thickness should match those within the existing roadway. The transition treatment for cut and fill between two different materials (earth fill, granular fill and rockfill materials) should be carried out in accordance to OPSD 205.010 to OPSD 205.050.

As per the Northern Region embankment design guidelines, the proposed platform cross-section should be widened by at least 1 m on each side of the road, in swamp environments.

Details of site specific design recommendations for each Section are discussed below.

#### **5.2.1 Site "A" (Stations 18+600 to 18+700)**

The highway embankment is about 1.5 m to 8.0 m in height, with side slope inclinations of 1.5H:1V to 1.9H:1V. Rockfill is exposed along the entire length of the side slopes. It is proposed to widen the left and right shoulders of the existing embankment and improve the intersection by additional lanes. The proposed road widening will result in the toe of the embankment extending outwards to

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a maximum of about 5 m (for 1.25H:1V slope) to 15 m (for 3H:1V slope) and 7 m (for 1.25H:1V slope) to the left and right, respectively.

From the borehole information, the soils along the left side of the embankment generally comprise about 2 m of peat and organic soils over silty clay, silty sand, and sand and gravel deposits of varying thickness, which is underlain by probable bedrock at about 3 m to 10 m below existing grade. Exposed bedrock was noted along the right side of the embankment.

From available borehole information, the probable existing embankment material consists of road granular fill over rockfill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. (This O.P.S.D. can be modified such that height of fill,  $h$ , can be greater than 3.0 m). This excavation will extend to minimum depths of about 2 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance with OPSS501 and with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (visual observations during drilling suggest that the existing side slopes are constructed of rockfill). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

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Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 25 mm on the left side and practically no settlement on the right side. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.2 Site "B" (Stations 18+740 to 18+780)**

This area comprises the intersection of Davis Lake Road/Pine Ridge Road with Highway 35. The highway embankment is about 5.0 m to 10.0 m in height. Rockfill is exposed along the side slopes of the embankments. It is proposed to widen the left and right shoulders of the existing embankment and improve the intersection by additional lanes. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 7 m (for 1.25H:1V slope) to 15 m (for 3H:1V slope) and 2 m (for 1.25H:1V slope) to 10 m (for 3H:1V slope) to the left and right, respectively.

From the borehole information, the soils along the left side of the embankment generally comprise about 2 m of peat and organic soils over silty clay, and silt to silty sand deposits of varying thickness, which is underlain by probable bedrock at about 4 m to 12 m below existing grade. Bedrock at shallow depth was noted along the right side of the embankment.

From available borehole information, the probable existing embankment material consists of road granular fill over rockfill.

The embankment widening over this Section should include the excavation of all the peat, organic soils and soft silty clay deposits at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. (This O.P.S.D. can be modified such that height of fill, h, can be greater than 3.0 m). This excavation will extend to minimum depths of about 2 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible.

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The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (visual observations during drilling suggest that the existing side slopes are constructed of rockfill). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 30 mm and 10 mm on the left and right side, respectively. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

### **5.2.3 Site "C" (Stations 19+030 Lt to 19+100 Lt)**

The highway embankment in this area is about 1.5 m to 3.0 m in height with side slope inclinations of 2.2H:1V to 3.2H:1V. A 1.0 m diameter CSP culvert crosses underneath the highway at about Station 19+040. It is proposed to widen the left shoulder of the existing embankment. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 3 m (for 1.25H:1V slope) to the left.

From the borehole information, the soils generally comprise about 1.5 m of peat and organic soils over silty clay, silty sand, sand and gravel deposits of varying thickness, which is underlain by probable bedrock at about 2 m to 5 m below existing grade.

From available borehole information, the probable existing embankment material consists of road  
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granular fill over rockfill.

The embankment widening over this Section should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. This excavation will extend to minimum depths of about 1.5 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Below the creek water level flatter slopes will be required. Depending on the material used, a suitable rip-rap protection may be required below and close to water level. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (visual observations during drilling suggest that the existing side slopes are constructed of rockfill). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 15 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

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#### **5.2.4 Site "D" (Stations 19+060 Rt to 19+200 Rt)**

The highway embankment is about 2.0 m to 3.0 m high with side slope inclinations of about 2.1H:1V to 2.7H:1V. It is proposed to widen the right shoulder of the existing embankment with an additional passing lane. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 1 m (for 1.25H:1V slope) to 6 m (for 3H:1V slope) to the right.

From the borehole information, the soils along the right side of the embankment generally comprise about 2 m to 3 m of peat and organic soils over stiff to hard silty clay, which is underlain by probable bedrock at about 5 m (or deeper) below existing grade.

From available borehole information, the probable existing embankment material consists of road granular fill over rockfill.

The embankment widening over this Section should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. This excavation will extend to minimum depths of about 3 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible. The embankment should be monitored at regular and frequent intervals. The excavation and backfill procedure should be modified as required to prevent any horizontal movement or settlement of the highway carrying public traffic.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (visual observations during drilling suggest that the existing side slopes are constructed of rockfill). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its

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Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 15 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.5 Site "E" (Stations 19+430 to 19+600)**

The highway embankment is about 1.0 m to 7.0 m high with side slope inclinations of about 1.4 H:1V to 2.9H:1V. It is proposed to widen the right shoulders of the existing embankment with an additional passing lane on the right side. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 13 m (for 1.25H:1V slope) to the right.

From the borehole information, the soils generally comprise 2 m to 9 m of peat and organic soils over very soft to very stiff silty clay, which is underlain by probable bedrock at about 2 m to 13 m below existing grade. Free standing water was noted during the time of investigation.

From available borehole information, the probable existing embankment material consists of road granular fill over rockfill.

Due to the deep organic deposits at this site, excavation of the peat and very soft clays will require elaborate excavation techniques, such as using a dragline excavator. The following two fill placement methods can be considered, or a combination of the two methods,

- Full Excavation – Complete excavation of the peat and compressible soils can be carried out in open cut using a dragline which will result in a substantial excavation size, as well as costs incurred by disposing or transporting the excavated waste material. Rockfill would be required to be pushed into the excavation as backfill. Construction of a platform to sit the dragline will also be required due to difficult access at this location. This method will eliminate any post construction foundation soil settlements as the compressible material will be removed, provided quality control measures are carried out to ensure that no trapped compressible materials remain.

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- Displacement – The weak, compressible peat and clay deposits can be displaced by pushing rockfill along the edge of the embankment to induce yielding/failure of the weak soils and create a mudwave away from the embankment. This can be accomplished by pushing rockfill into the peat areas starting from the south end at Station 27+480 + and progressing towards the north at an angle away from the embankment. Any upheaved march material that accumulates at the leading edge of the fill should be removed to avoid entrapping pockets of the displaced soil within the embankment. Prior to displacement, the surficial organic mat (about top 2 m) should be removed perpendicular to the highway in an attempt to control the mudwave direction. The main disadvantage with this method is that it is difficult to confirm that the organic deposits and compressible clays have been removed. This will result in some differential settlements in the future and subsequent regrading or resurfacing of the embankment..

For full excavation, the embankment widening over this Site should include the excavation of all the peat and organic soils, and very soft clays at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. (This O.P.S.D. can be modified such that height of fill, h, can be greater than 3.0 m). This excavation will extend to minimum depths of about 10 m and will most likely have to be done using dredging techniques because of the free-standing water. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations. In addition, because of the potential deep seated slope failure surfaces and lateral spreading of materials, the excavation of all the peat and organic soils should be extended by at least 3 m beyond the proposed embankment toe at the interface of the 'firm' bottom soils and backfilled with granular materials or rockfill.

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. not more than 5m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible. The embankment should be monitored at regular and frequent intervals. The excavation and backfill procedure should be modified as required to prevent any horizontal movement or settlement of the highway carrying public traffic.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Fill below the water level should consist of granular material since it will have to be dumped and pressed from surface in as much as possible (i.e. it will not be possible to properly compact it unless the site was properly dewatered). Embankment fill above the water level should be placed in accordance to OPSS501 and in lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

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Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (air-track drilling and visual observations during drilling suggest that the existing side slopes are constructed of rockfill) and also because the placement of rockfill below water will be simpler (unless the site was first dewatered). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

In areas where the overburden consists of weak and compressible soils and is not excavated or displaced, the long-term settlements may reach a maximum of 250 mm. About 75% of the consolidation should occur within one year following construction. In other areas where the overburden may be shallow (e.g. near Borehole E6), the estimated consolidation settlement will be about 120 mm. For locations near Boreholes E5 and E8, the fill materials due to embankment widening may be founded on the compact to very dense silty sand to sand (with occasional cobbles) deposit and the estimated settlement will be practically zero. If the peat and weak compressible soils are removed to 'firm' bottom soils (i.e. full excavation), then the settlement of the founding soils will be in the order of about 120 mm. If these weak and compressible soils are displaced by rockfill, as discussed above, then the settlement of the founding soils may be in the order of about 150 mm. This may lead to a differential settlement condition along this section of the embankment. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed or displaced before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.6 Site "F" (Stations 19+680 Rt to 19+900 Rt)**

The highway embankment is about 1.0 m to 6.0 m high with side slope inclinations of about 1.9H:1V to 2.8H:1V. It is proposed to widen the right shoulder of the existing embankment with an additional passing lane on the right side. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 5 m (for 1.25H:1V slope) to the right.

From the borehole information, the soils generally comprise about 2 m to 3 m of peat and organic soils over firm to very stiff silty clay, which is underlain by probable bedrock at about 2 m to 5 m

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below existing grade.

From available borehole information, the probable existing embankment material consists of road granular fill over earth fill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. (This O.P.S.D. can be modified such that height of fill,  $h$ , can be greater than 3.0 m). This excavation will extend to minimum depths of about 2 m to 3 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible. The embankment should be monitored at regular and frequent intervals. The excavation and backfill procedure should be modified as required to prevent any horizontal movement or settlement of the highway carrying public traffic.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

The embankment slopes should be stripped and benched in accordance with OPSD 208.010 to ensure that the new embankment is keyed into the existing embankment and to minimize differential settlement. The embankment fill can comprise of acceptable earth borrow such as SSM, or alternatively, the embankment widening could be constructed using rockfill. Details of earth fill and rockfill construction were given in Section 5.2 and will not be repeated here.

Several slope stability analyses were completed to investigate potential failures through the new embankment materials. The resulting factors of safety against relatively deep seated, circular  
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failure through the underlying native soils were greater than the minimum requirement of 1.3.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 30 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.7 Site "G" (Stations 19+750 Lt to 19+840Lt)**

The highway embankment is about 2.5 m to 6.0 m high with side slope inclinations of about 2.1H:1V to 3.1H:1V. It is proposed to widen the left shoulder of the existing embankment. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 6 m (for 1.25H:1V slope) to the left.. The widening associated with the right side of the highway is discussed under Site "F".

From the borehole information, the soils generally comprise about 2 m to 3 m of peat and organic soils over firm to very stiff silty clay, which is underlain by probable bedrock at about 2 m to 5 m below existing grade. Free standing water was noted during the time of investigation.

From available borehole information, the probable existing embankment material consists of road granular fill over earth fill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. (This O.P.S.D. can be modified such that height of fill, h, can be greater than 3.0 m). This excavation will extend to minimum depths of about 3 m and will most likely have to be done using dredging techniques because of the free-standing water. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible. The embankment should be monitored at regular and frequent intervals. The excavation and backfill procedure should be modified as required to prevent any horizontal movement or settlement of the highway carrying public traffic.

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The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Fill below the water level should consist of granular material since it will have to be dumped and pressed from surface in as much as possible (i.e. it will not be possible to properly compact it unless the site was properly dewatered). Embankment fill above the water level should be placed in accordance to OPSS501 and in lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred as the placement of rockfill below water will be simpler (unless the site was first dewatered). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

The embankment slopes should be stripped and benched in accordance with OPSD 208.010 to ensure that the new embankment is keyed into the existing embankment and to minimize differential settlement. The embankment fill can comprise of acceptable earth borrow such as SSM, or alternatively, the embankment widening could be constructed using rockfill. Details of earth fill and rockfill construction were given in Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 30 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.8 Site "H" (Stations 20+200 Lt to 20+500 Lt)**

This investigation area is at the bottom of a valley. The highway embankment is about 2.0 m to 7.0m high with side slope inclinations of about 1.5H:1V to 3.7H:1V. It is proposed to widen the left shoulder of the existing embankment with 3.5 m grade raise. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 4 m (for 1.25H:1V slope) to the left.

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From the borehole information, the soils generally comprise about 1 m to 2 m of peat and organic soils over firm to hard silty clay, which is underlain by probable bedrock at about 2 m to 10 m below existing grade.

From available borehole information, the probable existing embankment material consists of road granular fill over rockfill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. (This O.P.S.D. can be modified such that height of fill, h, can be greater than 3.0 m). This excavation will extend to minimum depths of about 1 m to 2 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Below the creek water level flatter slopes will be required. Depending on the material used, a suitable rip-rap protection may be required below and close to the creek water level. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (visual observations during drilling suggest that the existing side slopes are constructed of rockfill). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

Borehole H8 indicated that the existing rockfill embankment is founded on bedrock, providing good foundation for the proposed embankment with 3.5 m grade raise.

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Several slope stability analyses were completed to investigate potential failures through the new embankment materials. The resulting factors of safety against relatively deep seated, circular failure through the underlying native soils were greater than the minimum requirement of 1.3.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the left side of the embankment should not exceed 35 mm. These values do not include settlement of embankment fill due to improper compaction. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.9 Site "J" (Stations 21+140 Rt to 21+190 Rt)**

The highway embankment is about 1.0 m high with side slope inclinations of about 2.5H:1V to 3.2H:1V. It is proposed to widen the right shoulder of the existing embankment with additional passing lane on the right side. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 5 m (for 1.25H:1V slope) to the right.

From the borehole information, the soils generally comprise about 1 m to 2 m of peat and organic soils which is underlain by probable bedrock at about 2 m below existing grade.

From available borehole information, the probable existing embankment material consists of road granular fill over earth fill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. This excavation will extend to minimum depths of about 1 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible.

The embankment fill can comprise acceptable earth borrow such as select subgrade material  
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(SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

The embankment slopes should be stripped and benched in accordance with OPSD 208.010 to ensure that the new embankment is keyed into the existing embankment and to minimize differential settlement. The embankment fill can comprise of acceptable earth borrow such as SSM, or alternatively, the embankment widening could be constructed using rockfill. Details of earth fill and rockfill construction were given in Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 10 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.10 Site "K" (Stations 21+250 Lt to 21+350 Lt)**

The highway embankment is about 0.5 m to 5.5 m high with side slope inclinations of about 1.3H:1V to 3.3H:1V. It is proposed to widen the left shoulder of the existing embankment with an additional passing lane on the left side. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 6 m (for 1.25H:1V slope) to the left.

From the borehole information, the soils generally comprise about 1 m of peat and organic soils followed by a layer of silty materials, which is underlain by probable bedrock at about 2 m below existing grade.

From available borehole information, the probable existing embankment material consists of road granular fill over rockfill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. (This O.P.S.D. can be modified such that height of fill, h, can be greater than 3.0 m). This excavation will extend

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to minimum depths of about 1 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (visual observations during drilling suggest that the existing side slopes are constructed of rockfill). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 10 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.11 Site "L" (Stations 21+600 to 21+700)**

The highway embankment is about 1.0 m to 5.0 m in height in this area. Exposed rockfill can be seen in localized areas along the slopes of this embankment. The slopes are at an inclination of about 1V:2.0H to 1V:4.8H. It is proposed to widen the left and right shoulders of the existing embankment with additional passing lanes on both sides and 0.5 m grade raise. The proposed

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road widening will result in the toe of the embankment extending outwards to a maximum of about 4 m (for 1.25H:1V slope) to 8 m (for 3H:1V slope) to the right.

From the borehole information, the soils generally comprise about 2 m of peat and organic soils followed by a layer of firm to stiff silty clay, which is underlain by probable bedrock at about 7 m below existing grade.

From available borehole information, the probable existing embankment material consists of road granular fill over rockfill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. (This O.P.S.D. can be modified such that height of fill,  $h$ , can be greater than 3.0 m). This excavation will extend to minimum depths of about 1 to 2 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H:1V or flatter. Below the water level flatter slopes will be required. Depending on the material used, a suitable rip-rap protection may be required below and close to water level. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (visual observations during drilling suggest that the existing side slopes are constructed of rockfill). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

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Borehole L7 indicated that the existing rockfill embankment is founded on bedrock (at about 10 m depth), providing good foundation for the proposed embankment with 0.5 m grade raise.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 50 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.12 Site "M" (Stations 22+630 Rt to 22+890 Rt)**

This area is located at the bottom of two hills (to the north and south), adjacent to a swamp. The highway embankment is about 2.0 m to 3.0 m high with side slopes at an inclination of about 1.9H:1V to 3.4H:1V. It is proposed to widen the right and left shoulders of the existing embankment with 1.5 m grade raise. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 7 m (for 1.25H:1V slope) to 8 m (for 3H:1V slope) and 6 m (for 3H:1V slope) to the left and right, respectively.

From the borehole information, the soils generally comprise about 2 m of peat and organic soils followed by a layer of very soft to stiff silty clay (about 12 m), which is underlain by probable bedrock at about 13 m (and deeper) below existing grade. Free standing water was noted during the time of investigation.

From available borehole information, the probable existing embankment material consists of road granular fill over earth fill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. This excavation will extend to minimum depths of about 2 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations). In addition, because of the potential deep seated slope failure surfaces, the excavation of all the peat and organic soils should be extended by at least 3 m beyond the proposed embankment toe at the interface of the 'firm' bottom soils and backfilled with granular materials or rockfill.

To prevent undermining of the existing embankment, the excavations should be carried out in short  
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sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible. The embankment should be monitored at regular and frequent intervals. The excavation and backfill procedure should be modified as required to prevent any horizontal movement or settlement of the highway carrying public traffic.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill. The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

The embankment slopes should be stripped and benched in accordance with OPSD 208.010 to ensure that the new embankment is keyed into the existing embankment and to minimize differential settlement. The embankment fill can comprise of acceptable earth borrow such as SSM, or alternatively, the embankment widening could be constructed using rockfill. Details of earth fill and rockfill construction were given in Section 5.2 and will not be repeated here.

Several slope stability analyses were completed to investigate potential failures through the new embankment materials. The resulting factors of safety against relatively deep seated, circular failure through the underlying native soils were greater than the minimum requirement of 1.3.

In areas where the overburden consists of weak and compressible soils, the long-term settlements may reach a maximum of about 60 mm, 150 mm and 40 mm for the left side, centre and right side of the embankment, respectively. About 70% of the consolidation should occur within one year following construction. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

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#### **5.2.13 Section "N" (Station 22+695 +)**

Three 1.2 m diameter CSP culverts cross underneath the Highway 35 embankment at this location. The embankment is about 2.0 m high. The creek which flows through the culverts flows to the east into the swamp. It is proposed to replace the existing triple CSP culverts with a new concrete box culvert with about 1 m grade raise. The proposed road widening and associated grade raise will result in the toe of the embankment extending outwards to a maximum of about 7 m (for 1.25H:1V slope) to 8 m (for 3H:1V slope) and 6 m (for 3H:1V slope) to the left and right, respectively.

From the borehole information, the soils generally comprise about 3 m of peat and organic soils followed by a layer of very soft to stiff silty clay (about 12 m), which is underlain by probable bedrock at about 13 m (and deeper) below existing grade. Free standing water was noted during the time of investigation.

From available borehole information, the probable existing embankment material consists of road granular fill over earth fill.

The recommendations for the design and construction of Site "N" is the same as for Site "M" discussed above and will not be repeated here. The discussions and recommendations for the design and construction of the culvert replacement and estimation of settlement will be discussed in Section 5.3 of this report.

#### **5.2.14 Site "O" (Stations 23+020 Rt to 23+300 Rt)**

This area comprises the upslope of Highway 35 from the valley located in Site 'M'. The embankment is about 2.5 m to 10.0 m in height with slope inclinations of about 1.7H:1V to 3.8H:1V. Rockfill is exposed along the entire length of the slope. It is proposed to widen the right shoulder of the existing embankment. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 2 m (for 3H:1V slope) to the right.

From the borehole information, the soils generally comprise about 1 m of fill followed by about 4 m of stiff to very stiff clayey silt and sand deposits, which is underlain by probable bedrock at about 6 m below existing grade.

From available borehole information, the probable existing embankment material consists of road granular fill over rockfill.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm

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thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (visual observations during drilling suggest that the existing side slopes are constructed of rockfill). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 15 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.15 Site "P" (Stations 23+550 Rt to 23+650 Rt)**

The highway embankment in this area is about 2.0 m to 7.0 m in height with a side slope inclination of about 1.8H:1V to 3.5H:1V. It is proposed to widen the right shoulder of the existing embankment. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 5 m (for 3H:1V slope) to the right.

From the borehole information, the soils generally comprise about 1 m of peat, organic soils and silty clay followed by probable bedrock.

From available borehole information, the probable existing embankment material consists of road granular fill over rockfill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. This excavation will extend to minimum depths of about 1 m. It should be noted that the excavation

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depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (visual observations during drilling suggest that the existing side slopes are constructed of rockfill). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 10 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.16 Site "Q" (Stations 24+010 Rt to 24+300 Rt)**

The grade of the highway gently slopes to the northeast in this area. The highway embankment is about 2.0 m to 5.0 m high, with a side slope inclination of about 1.8H:1V to 3.2H:1V. It is proposed to widen the right shoulder of the existing embankment. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 5 m (for 3H:1V slope) to the right.

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From the borehole information, the soils generally comprise about 3 m of peat and organic soils overlying by firm to stiff silty clay and sandy deposits of varying thickness, which is underlain by probable bedrock at about 8 m below existing grade. Free standing water was noted during the time of investigation.

From available borehole information, the probable existing embankment material consists of road granular fill over earth fill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. (This O.P.S.D. can be modified such that height of fill,  $h$ , can be greater than 3.0 m). This excavation will extend to minimum depths of about 3 m and will most likely have to be done using dredging techniques because of the free-standing water. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible. Temporary cofferdam using steel sheetpile may be required for better control of excavation.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Fill below the water level should consist of granular material since it will have to be dumped and pressed from surface in as much as possible (i.e. it will not be possible to properly compact it unless the site was properly dewatered). Embankment fill above the water level should be placed in accordance to OPSS501 and in lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Below the water level flatter slopes will be required. Depending on the material used, a suitable rip-rap protection may be required below and close to water level. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred as the placement of rockfill below water will be simpler (unless the site was first dewatered). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

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The embankment slopes should be stripped and benched in accordance with OPSD 208.010 to ensure that the new embankment is keyed into the existing embankment and to minimize differential settlement. The embankment fill can comprise of acceptable earth borrow such as SSM, or alternatively, the embankment widening could be constructed using rockfill. Details of earth fill and rockfill construction were given in Section 5.2 and will not be repeated here.

Several slope stability analyses were completed to investigate potential failures through the new embankment materials. The resulting factors of safety against relatively deep seated, circular failure through the underlying native soils were greater than the minimum requirement of 1.3.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 20 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.17 Site "R" (Stations 24+850 Rt to 25+200 Rt)**

The highway grade rises steadily to the north in this area, with highway embankment heights of about 1.0 m to 3.0 m for the first 150 m and then rising to a maximum embankment height of about 6.0 m at the north end. The inclination of the side slopes of the embankment range from about 1.9H:1V to 3.6H:1V. It is proposed to widen the right shoulder of the existing embankment with 1 m grade raise. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 2 m (for 3H:1V slope) to both the left and right of the embankment.

From the borehole information, the soils generally comprise about 1 m of peat and organic soils overlying layers of sand to silty sand with organics, and sand with gravel of varying thickness, which is underlain by probable bedrock at about 6 m below existing grade. Free standing water (a lake) was noted during the time of investigation.

From available borehole information, the probable existing embankment material consists of road granular fill over earth fill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, .../...



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over the full width of the proposed embankment widening as per O.P.S.D. 203.030. This excavation will extend to minimum depths of about 1 m and will most likely have to be done using dredging techniques because of the free-standing water. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible. Temporary cofferdam using steel sheetpile may be required for better control of excavation.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Fill below the water level should consist of granular material since it will have to be dumped and pressed from surface in as much as possible (i.e. it will not be possible to properly compact it unless the site was properly dewatered). Embankment fill above the water level should be placed in accordance to OPSS501 and in lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Below the water level flatter slopes will be required. Depending on the material used, a suitable rip-rap protection may be required below and close to water level. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred as the placement of rockfill below water will be simpler (unless the site was first dewatered). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

The embankment slopes should be stripped and benched in accordance with OPSD 208.010 to ensure that the new embankment is keyed into the existing embankment and to minimize differential settlement. The embankment fill can comprise of acceptable earth borrow such as SSM, or alternatively, the embankment widening could be constructed using rockfill. Details of earth fill and rockfill construction were given in Section 5.2 and will not be repeated here.

Several slope stability analyses were completed to investigate potential failures through the new embankment materials. The resulting factors of safety against relatively deep seated, circular failure through the underlying native soils were greater than the minimum requirement of 1.3.

Provided the embankment widening is constructed as detailed above and as per the applicable  
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MTO standards, the settlement of the right side of the embankment should not exceed 25 mm. As shallow bedrock was encountered along the left side of the embankment, the anticipated settlement will be very small. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.18 Site "T" (Stations 25+550 Rt to 25+950 Rt)**

The highway embankment is about 1.5 m to 6.0 m high with side slope inclinations of about 1.5H:1V to 4.1H:1V. The grade of the highway drops towards the north, where the embankment heights are low. It is proposed to widen the right shoulder of the existing embankment. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 3 m (for 1.25H:1V slope) and 5 m (for 1.25H:1V slope) to the left and right, respectively.

From the borehole information, the soils generally comprise about 2 m of peat and organic soils overlying layers of sand, sandy silt, silty clay to clay silt of varying thickness, which is underlain by probable bedrock at about 3 m to greater than 12 m below existing grade. Free standing water was noted in the same area during the time of investigation.

From available borehole information, the probable existing embankment material consists of road granular fill over earth fill to the north and rockfill to the south.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. This excavation will extend to minimum depths of about 2 m and will most likely have to be done using dredging techniques because of the free-standing water. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Fill .../...

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below the water level should consist of granular material since it will have to be dumped and pressed from surface in as much as possible (i.e. it will not be possible to properly compact it unless the site was properly dewatered). Embankment fill above the water level should be placed in accordance to OPSS501 and in lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Below the water level flatter slopes will be required. Depending on the material used, a suitable rip-rap protection may be required below and close to water level. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred as the placement of rockfill below water will be simpler (unless the site was first dewatered). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

The embankment slopes should be stripped and benched in accordance with OPSS 208.010 to ensure that the new embankment is keyed into the existing embankment and to minimize differential settlement. The embankment fill can comprise of acceptable earth borrow such as SSM, or alternatively, the embankment widening could be constructed using rockfill. Details of earth fill and rockfill construction were given in Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 20 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.19 Site "U" (Station 27+400 to 27+600)**

In this area the highway embankment is about 1 to 3m in height. The existing embankment is composed of earth/granular fill with rockfill inferred to the north (Station 27+620). Two existing 2 m diameter CSP culverts cross Highway 35 at Station 27+519 ±. During the time of investigation, the culverts are underwater on the west side of the highway. It is proposed replace the existing culverts with a new concrete culvert and to raise the grade by up to 2.5 m in this area, with the highest grade raise over the existing culverts. The proposed grade raise will result in the toe of the embankment extending outwards to a maximum of about 3 m (for 1.25H:1V to 1.5H:1V slope) and

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2 m (for 1.25H:1V to 1.5H:1V slope) to the left and right, respectively.

From the borehole information, the soils along the left side of the embankment in the area of the existing culverts (west end of the culvert) generally comprise about 9 m of peat and organic soils followed by very soft clay and compact sand deposits. Outside of the culvert area, along the left side of the highway, the subsurface conditions generally consist of about 1 to 3 m of interbedded peat and sands, underlain by loose to compact sands. The soils along the right side of the embankment comprise of about 1 to 2m of peat and organic soils followed by loose to compact sand deposits. Free standing water was noted during the time of investigation in the area of the culverts.

From available borehole information, the probable existing embankment material consists of road granular fill over earth fill. The majority of the existing peat underlying the road had been removed and replaced with earth fill during the initial highway construction.

The embankment grade raise and subsequent widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. (This O.P.S.D. can be modified such that height of fill, h, can be greater than 3.0 m). This excavation will extend to minimum depths of about 2 m on the right side of the highway. It should be that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations). In addition, because of the potential deep seated slope failure surfaces and lateral spreading, the excavation of all the peat and organic soils should be extended by at least 3 m beyond the proposed embankment toe at the interface of the 'firm' bottom soils and backfilled with granular materials or rockfill.

Based on the results of the boreholes the excavation depths are summarized in the table below,

Borehole	Approximate Station	Approximate Minimum Excavation Depth (m)
U4	27+510 + Lt	10.0
U3	27+520 + Lt	10.6
U16	27+550 + Lt	6.3
U18	27+610 + Lt	1.8
U2	27+510 + Rt	1.5
U1	27+520 + Rt	1.1
U15	27+540 + Rt	1.8
U17	27+580 + Rt	1.8

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Based on the above table, the excavations along the right side of the highway can be carried out using standard construction techniques, such as excavation with a hydraulic excavator. The deep peat deposits found on the left side of the highway will require more elaborate excavation techniques between Stations 27+480 to 27+600  $\pm$ , such as dragline excavator. Full excavation and displacement methods, or a combination of the two should be considered. These were discussed in Section 5.2.5 and will not be further discussed here.

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. not more than 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible. The embankment should be monitored at regular and frequent intervals. The excavation and backfill procedure should be modified as required to prevent any horizontal movement or settlement of the highway carrying public traffic.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill above the water level should be placed in accordance to OPSS501 and in lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H : 1V or flatter. Depending on the material used, a suitable rip-rap protection may be required below and close to water level. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred as the placement of rockfill below water will be simpler. The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

The embankment slopes should be stripped and benched in accordance with OPSD 208.010 to ensure that the new embankment is keyed into the existing embankment and to minimize differential settlement. The embankment fill can comprise of acceptable earth borrow such as SSM, or alternatively, the embankment widening could be constructed using rockfill. Details of earth fill and rockfill construction were given in Section 5.2 and will not be repeated here.

The settlement of the embankment founding soil should not exceed 50 mm, 50 mm and 20 mm for the left, centre and right side of the embankment, respectively, if the peat and organic soils are completely removed beyond the toe of the embankment. If the peat and organic soils are removed by displacement beyond the left toe of the embankment, settlement of the founding soil may be in the order of about 80 mm on the left side of the embankment. Where the embankment fill is founded on the compact sand deposits (i.e. in the area of Borehole U13), settlement may be practically zero. This may lead to a differential settlement condition along this section of the

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embankment. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed or displaced before placing the embankment widening fill, no instability problems are anticipated for this section.

Design and construction issues (geotechnical aspects) for the replacement box culvert will be discussed in Section 5.3 of this report.

#### **5.2.20 Site "V" (Stations 28+150 Rt to 28+200 Rt)**

The highway embankment is about 3.5 m in height, with a side slope inclination of about :2.0H:1V. It is proposed to widen the right shoulder of the existing embankment. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 5 m (for 3H:1V slope) and 6 m (for 3H:1V slope) to the left and right, respectively.

From the borehole information, the soils generally comprise about 2 m of peat and organic soils followed by layers of sandy and silty deposits of varying thickness.

From available borehole information, the probable existing embankment material consists of road granular fill over rockfill.

The embankment widening over this Site should include the excavation of all the peat and organic soils at the toe of the existing embankment to expose the native, competent ('firm' bottom) soils, over the full width of the proposed embankment widening as per O.P.S.D. 203.030. This excavation will extend to minimum depths of about 2 m. It should be noted that the excavation depth may have to be altered to ensure competent, native soils are exposed (e.g. the organic deposits may be thicker in between the borehole locations).

To prevent undermining of the existing embankment, the excavations should be carried out in short sections (i.e. about 5 m wide) along the toe of embankments and should be backfilled and compacted with approved fill as soon as possible.

The embankment fill can comprise acceptable earth borrow such as select subgrade material (SSM) as per OPSS1010. The new fill will be installed to the bottom of the road sub-base. Embankment fill should be placed in accordance to OPSS501 with lifts not exceeding 300 mm thickness and be compacted to at least 95% of the material's Standard Proctor Maximum Dry Density, using suitable compaction equipment. The slopes of the final embankment should be 2H :

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1V or flatter. Below the water level flatter slopes will be required. Depending on the material used, a suitable rip-rap protection may be required below and close to water level. Vegetation cover should be established on all earth fill slopes to protect the embankment fill against surficial erosion.

Alternatively, the embankments could be constructed using rockfill. The use of rockfill is preferred if the existing embankment consists of rockfill (visual observations during drilling suggest that the existing side slopes are constructed of rockfill). The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should not exceed 15 mm. The expected settlements are anticipated to occur along the new slopes and shoulders and the grading can be corrected, if necessary, by the placement of additional granular materials.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

#### **5.2.21 Site "W" (Stations 18+250 Rt to 18+330 Rt)**

It is proposed to widen the right shoulder of the existing embankment. The proposed road widening will result in the toe of the embankment extending outwards to a maximum of about 11 m (assuming 1.25H:1V side slope and mid-height berms for slopes higher than 6 m) to the right.

From the borehole information, the soils generally comprise about 1 to 2 m of sand underlain by bedrock.

The embankment widening over this Section should include the excavation of all the topsoil within 1.8 m of the proposed highway grade over the proposed widening.

The proposed embankment widening should be constructed using rockfill. The use of rockfill is preferred since the existing embankment consists of rockfill. The slopes of the final embankment should be 1.25H:1V or flatter. The rockfill should be placed in accordance with OPSS206 and its Amendments, and compacted by overlapping track prints of the construction equipment.

Details of earth fill and rockfill construction, stripping and benching requirements were given in .../...

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Section 5.2 and will not be repeated here.

Provided the embankment widening is constructed as detailed above and as per the applicable MTO standards, the settlement of the embankment should be negligible.

Based on the borehole results, provided that all organics, weak and otherwise unsuitable materials are removed before placing the embankment widening fill, no instability problems are anticipated for this section.

### **5.3 BOX CULVERTS**

The discussions and recommendations of this section (Section 5.3) of the report cover the general and common geotechnical design and constructions aspects (foundations, backfilling and erosion protection) of culvert replacement for Site "N" and Site "U". Discussions of specific aspects of foundation designs are included in Section 5.3.1.1 and Section 5.3.1.2 for Site "N" and Site "U", respectively.

#### **5.3.1 Foundations**

##### **5.3.1.1 Site "N" (Station 22+695+)**

The proposed invert of the concrete box culvert is expected to be at about Elevation 269.2 m at the east end, and at about Elevation 269.1 m at the west end. It is understood that the existing twin culvert will be replaced by a 3.05 m by 1.8 m concrete box culvert. The soils (Boreholes N1, N2 and N5) underneath the embankment generally consist of a layer of peat and organic silt (about 0.1 m to 0.9 m thick) overlying very soft to stiff clayey silt to silty clay and followed by very loose to compact silty sand deposit. The soils near the right toe of the embankment (Boreholes N3 and N4) generally consist of about 3 m of peat and organic soils overlying very soft to stiff clayey silt to silty clay, compact silty sand and very loose to compact sandy gravel of varying thickness. Probable bedrock was found at about 9 m to 15 m below existing grade. Free standing water was noted during the time of investigation.

In order to avoid excessive settlement, to provide a more uniform founding subgrade condition and to improve the load carrying capacity of the upper zones of the founding soils, we recommend that the peat, organics and the underlying weak or unsuitable zones be removed to a depth of 2 m below the founding depth and replaced with compacted Granular 'A' materials, or preferably crushed stone that can be placed in wet conditions. If clear stone is used, it should be wrapped in a suitable geotextile (non-woven, Class II, FOS 75 to 150  $\mu$ m). The sub-excavation and

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replacement with granular fill should be carried out over the full length of the culvert.

We understand that the proposed culvert will be constructed in stages involving construction of detours to facilitate public traffic. This will likely involve the driving of sheetpiles for temporary roadway protection. The design of the roadway protection is to be carried out by the contractor.

Assuming an open cut excavation, the plan limits of the excavation base should be at least 2 m beyond the perimeter of the culvert base. The excavations will extend below the groundwater table and therefore groundwater control will be required. Provided adequate groundwater control measures are implemented, temporary excavation side slopes should be stable at an inclination of 2H:1V. Alternatively, a proper temporary shoring system could be provided to support sides of the excavation and to minimize ground surface settlement, existing services deformation and differential settlement of existing structures, if encountered. Care must be exercised during excavation to avoid disturbing the founding subgrade.

When the excavation reaches the required depth, the subgrade should be inspected and approved by a geotechnical engineer contracted by the Contract Administrator (Quality Verification Engineer).

If necessary, the excavation may need to be deepened to a depth below any peat or organic layers. After its approval, the exposed subgrade at the base of the excavation may need to be compacted, if requested by the representative of the Contract Administrator, to achieve a density of not less than about 95% of the material's Standard Proctor Maximum Dry Density (SPMDD). The fill used to raise the grade inside the excavation should be Granular 'A' material placed when its moisture content is within  $\pm 2\%$  of its optimum moisture content, or Granular 'B' Type II or clear stone. The granular material should be placed in loose lifts not exceeding 200 mm in thickness and should be uniformly compacted to not less than 100% of its SPMDD. Special Provision 902S01-Excavation and Backfilling- Structures should also be included in the Contract Documents.

A factored geotechnical resistance at U.L.S. of 500 kPa and a geotechnical resistance at S.L.S. equal to 200 kPa can be assigned to the founding Granular 'A'/Granular 'B' Type II/clearstone subgrade prepared in this manner.

The culvert should be designed to resist frost forces, weight of embankment fill, hydraulic and earth pressures, and traffic loadings. It is noted that compression of the native subgrade induced by the embankment fill will be in the order of 60 mm at the west end (left side) of the culvert, 40 mm at the centerline of the highway and 80 mm at the east end (right side) of the culvert. These settlement values should be considered in designing the culvert.

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It is also recommended that construction joints be introduced at regular intervals along the culvert alignment in order to mitigate the adverse effects of differential settlement.

The unfactored horizontal resistance against sliding between concrete and Granular 'A'/Granular 'B' Type II/clear stone type material can be calculated using a friction angle of 35 degrees.

In view of the above design constraints, as well as to enhance structural rigidity, we recommend that preference be given to the rigid box culvert design using reinforced concrete.

Along the culvert alignment, some form of groundwater control will be required during construction as the proposed bottom of excavation is below the water table. Dewatering will need to be capable of drawing the water level to no less than 1 m below the bottom of the excavation. If the water table is not properly lowered, the soil at the bottom of the excavation can lose its load carrying capacity (in addition to the instability of the side slopes). If this happens and the engineered fill is placed on disturbed and loosened subgrade, excessive settlements can occur after construction of the culvert extension. We therefore recommend that the contractor investigate the position of the water table before starting the excavation to assess required dewatering.

It is recommended that a dewatering NSSP be included in the contract document which requires that the Contractor be fully responsible for the proposed dewatering scheme.

We recommend that any water flow in the existing water course be diverted away from the culvert excavation to enable the culvert construction and fill placement to be carried out in dry conditions. This can be achieved by using temporary CSP pipes. The temporary CSP pipes should be removed after completion of the concrete box culvert or adequately filled with concrete.

Discussions and recommendations in Section 5.2.13 of this report should also be referred.

#### **5.3.1.2 Site "U" (Station 27+513 ±)**

The proposed invert of the concrete box culvert is expected to be at about Elevation 291.2 m at the west end of the culvert and at about Elevation 291.5m at the east end of the culvert. It is understood that the existing twin culvert will be replaced by a 2.44m by 1.8 m concrete box culvert. The soils (Boreholes U5 and U6) underneath the embankment generally consist of a layer of peat and organic soils (about 0.9 m thick) overlying very loose to compact sand deposits. The soils near the right toe of the embankment (Boreholes U1 and U2) generally consist of about 1 m of peat and

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organic soils overlying loose to compact sand deposit. The soils near the left toe of the embankment (Boreholes U3 and U4) generally consist of about 9 m of peat and organic soils overlying very soft silty clay (about 2 m thick) and compact sand deposits. Free standing water was noted during the time of investigation.

We understand that the proposed culvert will be constructed in stages involving construction of detours to facilitate public traffic. This will likely involve the driving of sheetpiles for temporary roadway protection. The design of the roadway protection is to be carried out by the contractor.

We also understand that the existing peat deposits beyond on the left toe of the highway will be displaced by rockfill and the west end of the culvert constructed over the rock backfill.

As discussed earlier, in order to avoid excessive settlement, to provide a more uniform founding subgrade condition and to improve the load carrying capacity of the upper zones of the founding soils, we recommend that the peat, organics and the underlying weak or unsuitable zones be removed to a depth of 2 m below the founding depth and replaced with compacted Granular 'A' materials, Granular 'B' Type II or clear stone. Clear stone would require to be enwrapped in a suitable geotextile (non-woven, Class II, FOS 105 to 210  $\mu\text{m}$ ). The sub-excavation and replacement with granular fill should be carried out over the full length of the culvert. The west end of the culvert will be constructed over rockfill subgrade and the granular/crushed stone/clear stone will need to be enwrapped in a geotextile.

Assuming an open cut excavation, the plan limits of the excavation base should be at least 2 m beyond the perimeter of the culvert base. The excavations will extend below the groundwater table and therefore groundwater control will be required. Provided adequate groundwater control measures are implemented, temporary excavation side slopes should be stable at an inclination of 2H:1V. Alternatively, a proper temporary shoring system could be provided to support sides of the excavation and to minimize ground surface settlement, existing services deformation and differential settlement of existing structures, if encountered. Care must be exercised during excavation to avoid disturbing the founding subgrade.

When the excavation reaches the required depth, the subgrade should be inspected and approved by a geotechnical engineer contracted by the Contract Administrator (Quality Verification Engineer).

If necessary, the excavation may need to be deepened to a depth below any peat or organic layers. After its approval, the exposed subgrade at the base of the excavation may need to be compacted, if requested by the representative of the Contract Administrator, to achieve a density of not less than about 95% of the material's Standard Proctor Maximum Dry Density (SPMDD). The fill used to raise the grade inside the excavation should be Granular 'A' material placed when its

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moisture content is within  $\pm 2\%$  of its optimum moisture content or Granular 'B' Type II or clear stone. It should be placed in loose lifts not exceeding 200 mm in thickness and should be uniformly compacted to not less than 100% of its SPMDD. Special Provision 902S01- Excavation and Backfilling- Structures should also be included in the Contract Documents.

A factored geotechnical resistance at U.L.S. of 500 kPa and a geotechnical resistance at S.L.S. equal to 200 kPa can be assigned to the founding Granular 'A'/Granular 'B' Type II/clearstone subgrade prepared in this manner. The culvert should be designed to resist frost forces, weight of embankment fill, hydraulic and earth pressures, and traffic loadings. It is noted that compression of the native subgrade induced by the embankment fill will be in the order of 55 mm at the west end (left side) of the culvert, 15 mm at the centerline of the highway, and 25 mm at the east end (right side) of the culvert. These settlement values should be considered in designing the culvert.

It is also recommended that construction joints be introduced at regular intervals along the culvert alignment in order to mitigate the adverse effects of differential settlement.

The unfactored horizontal resistance against sliding between concrete and Granular 'A'/Granular 'B' Type II/clearstone type material can be calculated using a friction angle of 35 degrees.

In view of the above design constraints, as well as to enhance structural rigidity, we recommend that preference be given to the rigid box culvert design using reinforced concrete.

Along the culvert alignment, some form of groundwater control will be required during construction as the proposed bottom of excavation is below the water table. Dewatering will need to be capable of drawing the water level to no less than 1 m below the bottom of the excavation. If the water table is not properly lowered, the soil at the bottom of the excavation can lose its load carrying capacity (in addition to the instability of the side slopes). If this happens and the engineered fill is placed on disturbed and loosened subgrade, excessive settlements can occur after construction of the culvert extension. We therefore recommend that the contractor investigate the position of the water table before starting the excavation to assess required dewatering.

It is recommended that a dewatering NSSP be included in the contract document which requires that the Contractor be fully responsible for the proposed dewatering scheme.

We recommend that any water flow in the existing water course be diverted away from the culvert excavation to enable the culvert construction and fill placement to be carried out in dry conditions. This can be achieved by using temporary CSP pipes. The temporary CSP pipes should be removed after completion of the concrete box culvert, or adequately concreted.

Discussions and recommendations in Section 5.2.19 of this report should also be referred.

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### 5.3.2 Backfilling

Backfill arrangements around the culvert should be carried out as per OPSD 803.010 and OPSD 803.02. Backfill to the culvert should consist of free-draining, non-frost susceptible granular materials in accordance with OPSS 1010. The excavated material may not be suitable for backfilling purposes due to its high frost susceptibility and high (wetter than optimum) natural moisture contents. All granular fill should be placed in loose lifts not exceeding 200 mm thick and be compacted to at least 95% of its SPMDD.

Heavy compaction equipment should not be used adjacent to the walls and roof of the culvert. The height of the backfill to the culvert walls should be maintained equal on both sides of the structure during all stages of backfill placement.

Computation of earth pressures acting against rigid culvert walls should be in accordance with the Ontario Highway Bridge Design Code, 3<sup>rd</sup> Edition (1991). For design purposes, the following properties can be assumed for backfill:

#### Compacted Granular 'A'

Angle of Internal Friction  $\phi = 35^\circ$  (unfactored)  
Unit Weight = 22kN/m<sup>3</sup>

Coefficient of Lateral Earth Pressures:

Level Backfill

$$K_a = 0.27$$

$$K_b = 0.35$$

$$K_o = 0.43$$

$$K^* = 0.45$$

#### Compacted Granular 'B'

Angle of Internal Friction  $\phi = 30^\circ$  (unfactored)  
Unit Weight = 21 kN/m<sup>3</sup>

Coefficient of Lateral Earth Pressures:

Level Backfill

$$K_a = 0.33$$

$$K_b = 0.41$$

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$$K_o = 0.50$$
$$K^* = 0.57$$

### Rockfill

Angle of Internal Friction  $\phi = 45^\circ$  (unfactored)  
Unit Weight =  $21 \text{ kN/m}^3$

Coefficient of Lateral Earth Pressures:

Level Backfill

$$K_a = 0.17$$
$$K_b = 0.23$$
$$K_o = 0.29$$
$$K^* = 0.33$$

NOTE:  $K_a$  is the coefficient of active earth pressure

$K_b$  is the backfill earth pressure coefficient for an unrestrained structure including compaction effects

$K_o$  is the coefficient of earth pressure at rest

$K^*$  is the earth pressure coefficient for a soil loading a fully restrained structure and includes compaction effects

The earth pressure coefficient adopted will depend on whether the structure is restrained or movements can be allowed such that the active state of earth pressure can develop. If the culvert walls are restrained (such as a rigid box structure) and does not allow lateral yielding, then at rest pressures should be used as per Clause C6-7.1 of the O.H.B.D.C., 3<sup>rd</sup> Edition.

The effect of compaction should also be taken into account in the selection of the appropriate earth pressure coefficients in accordance with Clause 6-7.4.3 of the O.H.B.D.C., 3<sup>rd</sup> Edition. Alternatively a compaction surcharge of 16 kPa can be included in the lateral earth pressure for the structural design of the culvert.

Vibratory equipment for use behind culvert walls and retaining walls should be restricted in size as per current MTO practice.

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In order to avoid unbalanced loading on the culvert, the height of the backfill around the culvert should be maintained equal on both sides throughout construction as much as practically possible.

Allowance should also be made to place an approximately 150 mm thick layer of lean concrete on the subgrade surface, i.e. excavation base, within four hours of preparation and acceptance of the bearing soil. It should be pointed out that if the foundation soil is disturbed, excessive settlements can occur after structural loads are applied.

### **5.3.3 Erosion Protection**

Erosion protection should be provided at the culvert inlet (including the slopes and sides) and outlet, especially if head and wing walls are not incorporated. We recommend the use of cutoff walls or seepage seals (minimum 0.6 m thick) around the proposed culvert to prevent erosion of the enclosing soil.

Rip-rap should also be provided for an adequate distance from the culvert, both upstream and downstream, taking into account the anticipated flow rates, culvert gradient and scouring caused by the stream (see MTO Drainage Management Manual for details and OPSD810.01 for rip-rap treatment). The stones should be adequately sized (maximum 0.5 m in diameter, blocky and angular in shape) to prevent erosion of the stream bed. The rip-rap layer should cover all areas of the channel up to high water level and the rip-rap layer should be at least 0.3 m thick.

A granular filter layer or geotextile is required beneath the rip-rap. Should a granular filter be used, the material should be graded such that it will prevent loss of soil particles and the collapse of the lining material (i.e. Granular 'B' Type I). The granular filter layer should be at least 150 mm thick. Should a geotextile be used, it should consist of non-woven Class II, F.O.S. 105 - 210  $\mu\text{m}$  (F.O.S. 75 - 150  $\mu\text{m}$  at Site "N"). A toe for the filter and rip-rap protection should be provided at the edge of the lining and protective cover to key the lining into the natural ground to provide protection to erosion and scour.

Any footings constructed in the area of the stream should be located below the anticipated scour depth and/or protected by rip-rap blanket.

A qualified hydraulics engineer should be consulted to design the specifics of the channel, and culvert outlet and inlet (i.e. thickness and extent of protection).

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#### **5.4 CONSTRUCTION**

All excavations should be performed in accordance with the most recent guidelines of the Occupational Health & Safety Act (O.Reg.213/91) and good construction practices. For the most part, excavations will be relatively shallow, with excessive surface and groundwater due to the nature of swampy sections. In areas that are continually fed with water, it is likely that coffer or diversion dams will be required to control water in the vicinity of excavations. Proper action should also be taken to control the release of suspended solids (fine soils) into any flowing watercourse.

It may be possible to minimize excavation seepage and the sloughing of the side slopes of the excavations by pumping from properly filtered sumps, otherwise more sophisticated methods of groundwater control may be required. As mentioned before, pumping of soil fines during dewatering should be avoided, as this may lead to loss of ground.

In the cohesionless soil types (i.e. sands, silts and to a certain extent in peats) temporary side slopes for excavations to be constructed below the water table will depend largely on the effectiveness of the dewatering, while in the cohesive soils the consistency of the material will play a significant role (e.g. in very soft firm to firm clayey soils the sides may collapse due to low shear strengths). These soils (i.e. wet sands and silts and very soft to firm clays) can be classified as Type 4 soil. We recommend therefore that allowance be made for oversized excavations. Allowance should also be made for excavating in short sections (i.e. narrow strips) and for immediate backfilling. This latter aspect is also important in maintaining the stability of the existing embankments. Alternatively, a proper temporary shoring system could be provided to support sides of the excavation and to minimize ground surface settlement, existing services deformation and differential settlement of existing structures, if encountered. Care should be taken to direct surface water away from open excavations.

Stockpiles of excavated materials should be kept at least 3 m from the edge of the excavation to avoid slope instability. Care should also be taken to avoid instability of the existing embankment slopes, and to avoid overloading of any underground services/structures, hydro poles by the stockpiles.

If backfilling operations are carried out in freezing temperature conditions, frozen soils, snow and ice should not be incorporated into the backfill zone. The amount of excavated native material suitable for use as backfill in freezing conditions will also be reduced as drying out of these materials become quite difficult in these temperature conditions; the soil will usually freeze before it dries out. Close quality control of the backfill material will, therefore, be required during cold weather construction. To ensure quality backfill and satisfactory long term performance of the backfill zone (i.e. minimization of surface settlements, etc.), considerations should be given to the use of only approved, imported granular fill for backfill material during any cold weather

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construction, especially for settlement sensitive areas.

Water can be removed by pumping and the effluent from dewatering operations should be filtered or passed through sediment traps to prevent turbidity.

During the construction, temporary runoff controls such as sediment trap, interceptor drain, dike and/or silt fence should be provided and installed to prevent uncontrolled water flow and sediment down towards the swamps, water ponds and creeks.

We recommend that any surface water be diverted away from the culvert excavation, in addition to the chosen dewatering scheme, to enable the culvert construction and fill placement to be carried out in the dry. Major problems due to groundwater seepage are not anticipated, provided dewatering is carried out properly.

## **5.5 FROST PROTECTION**

Design frost penetration for the general area is 1.8 m. Therefore, a permanent soil cover of 1.8 m or its thermal equivalent is required for frost protection of foundations.

## **5.6 CONSTRUCTION INSPECTION**

It is recommended that a quality control programme of inspection and testing be carried out during the construction phase of the project to confirm that the conditions encountered are consistent with design assumptions; and to confirm that the various project specifications and material requirements and handling are being satisfied.

## **5.7 INSTRUMENTATION AND MONITORING**

Prior and during construction, instrumentation by surveying station should be required in the following sites,

Site "D"  
Site "E"  
Site "F"  
Site "G"  
Site "M" and "N"  
Site "U"

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The settlement and horizontal movement of the embankment should be monitored regularly and reported to the Project Administrator. Any significant movement of the embankment should be reported to the Project Administrator immediately.

## 6.0 CLOSURE

We recommend that once the details of the structures are finalized, our recommendations should be reviewed for their specific applicability.

### AMEC Earth and Environmental Limited

Prepared By:



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Reviewed By:



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APPENDIX A  
LIST OF TABLES

**TABLE I: FOUNDATION INVESTIGATION AREAS**

Section	Stations	Existing Conditions	Proposed Works
A	18+600 to 18+700	Embankment fill from 1.5 m to 8 m in height	Shoulder widening on both sides of the embankment and intersection improvements (additional lanes).
B	18+740 to 18+780	Embankment fill from 5 m to 10m in height	Shoulder widening and intersection improvements (additional lanes); subsurface information required at each quadrant of this intersection
C	19+030 to 19+100	Swamp crossing 1.5 m to 3m embankment	left shoulder widening
D	19+060 to 19+200	Embankment fill from 2m to 3m in height	Right shoulder widening and addition of passing lane
E	19+430 to 19+600	Embankment fill from 1m to 7m in height	Shoulder widening on both sides of the embankment and passing lane on right side
F	19+680 to 19+900	Embankment fill from 1m to 6m in height; swamp crossing	Shoulder widening on right side and addition of passing lane
G	19+750 to 19+840	Embankment fill from 2.5m to 6m in height; swamp crossing	Shoulder widening on the left side
H	20+200 to 20+500	Embankment fill from 2m to 7m in height	Shoulder widening on the left side and vertical curve improvement with 3.5m grade raise
J	21+140 to 21+190	Swamp crossing 1m embankment	Shoulder widening and passing lane on right side
K	21+250 to 21+350	Embankment fill from 0.5m to 5.5m in height	Shoulder widening and passing lane on left side
L	21+600 to 21+700	Embankment fill from 1m to 5m in height; swamp crossing	Shoulder widening and passing lanes on both sides and 0.5m grade raise
M	22+630 to 22+890	Swamp crossing 2m to 3m embankment in height	Shoulder widening on the right side and 1.5m grade raise
N	22+718±	Triple culverts 2m embankment	Replace culverts with a new concrete box culvert
O	23+020 to 23+300	Embankment fill from 2.5m to 10m in height	Shoulder widening on the right side

**TABLE I: FOUNDATION INVESTIGATION AREAS**

Section	Stations	Existing Conditions	Proposed Works
P	23+550 to 23+650	Embankment fill from 2m to 7m in height	Shoulder widening on the right side
Q	24+010 to 24+300	Embankment fill from 2m to 5m in height; swamp crossing	Shoulder widening on the right side
R	24+850 to 25+200	Embankment fill from 1m to 6 m in height crossing a lake	Shoulder widening on the right side and 1m grade raise
T	25+550 to 25+950	Embankment fill from 1.5m to 6m in height; swamp crossing	Shoulder widening on the right side
U	27+400 to 27+600	Twin culverts 1 to 3m embankment height	Replace culverts with a new concrete box culvert. 2.5 m grade raise
V	28+150 to 28+200	Swamp crossing 3.5 m embankment	Shoulder widening on the right side
W	18+250 to 18+330	Embankment fill about 9 to 10 m in height resting on existing slope 4 to 9 m in height	Shoulder widening on the right side

**TABLE II: SUMMARIZED SUBSURFACE CONDITIONS**

Borehole No.	Ground Elevation (m)	Water Level Elevation (m)	Thickness (m)							Depth to Inferred Bedrock (m)
			Ponded Water	Fill	Peat / Topsoil	Clay/ Sand with Organics	Upper Silty Sand to Sand to Silt	Silty Clay to Clayey Silt	Lower Sand to Silty Sand to Silt	
A1	283.9	-	-	-	0.2	-	0.7	-	-	0.9
A2	285.2	-	-	-	-	-	-	-	-	Exposed Rock
A3	287.5	-	-	-	0.2	-	1.3	-	-	1.5
A4	281.9	279.3	-	0.1	1.3	-	-	1.8	-	3.2
A5	282.0	278.5	-	-	0.6	-	-	3.9	1.0 / 0.7 Clay	6.2
A6	280.9	279.4	-	-	1.5	-	0.8 Clay / 1.5	4.7	1.1	-
A7	289.8	-	-	1.0	-	-	-	-	-	-
B1	286.0	-	-	0.3 TPS / 0.8	-	-	-	-	-	1.1
B2	282.4	-	-	0.3 TPS / 0.2	-	-	-	1.0	-	1.5
B3	279.1	279.1	-	-	0.3	-	-	4.0	-	-
B4	280.4	277.0	-	-	1.4	-	1.5	8.3	-	11.2
B5	289.8	-	-	1.0	-	-	-	-	-	-

Borehole No.	Ground Elevation (m)	Water Level Elevation (m)	Thickness (m)							Depth to Inferred Bedrock (m)
			Ponded Water	Fill	Peat / Topsoil	Clay/ Sand with Organics	Upper Silty Sand to Sand to Silt	Silty Clay to Clayey Silt	Lower Sand to Silty Sand to Silt	
C1	292.2	-	-	-	0.2	-	0.9	-	-	1.1
C2	292.1	290.9	-	-	1.0	-	-	4.0	0.1	5.1
C3	294.2	293.3	-	-	0.6	0.9	0.2	-	-	1.7
C4	292.8	-	-	1.0	-	-	-	-	-	-
D1	292.4	289.2	-	-	2.1	-	-	1.7	0.3	-
D2	292.4	291.2	-	-	2.7	-	-	2.7	-	-
D3	292.7	292.1	-	-	2.9	-	-	1.0	-	-
D4	295.6	-	-	1.3	-	-	-	-	-	-
E1	292.2	290.8	-	-	0.3	1.8	1.4	-	-	3.5
E1A	292.2	292.2	-	-	4.3	0.3	0.1	-	-	-
E2	291.5	291.5	-	-	6.2	-	-	3.4	-	9.6
E2A	291.5	291.5	-	-	5.2	0.4	-	2.4	-	-
E3	291.7	290.2	-	-	1.5	0.6	0.5	-	-	2.6
E3A	291.7	291.7	-	-	3.1	-	-	0.7	-	-
E4	295.6	294.7	-	-	0.2	-	0.7	-	-	0.9

Borehole No.	Ground Elevation (m)	Water Level Elevation (m)	Thickness (m)							Depth to Inferred Bedrock (m)
			Ponded Water	Fill	Peat / Topsoil	Clay/ Sand with Organics	Upper Silty Sand to Sand to Silt	Silty Clay to Clayey Silt	Lower Sand to Silty Sand to Silt	
E5	291.6	291.6	-	-	1.1	-	0.4	-	-	1.5
E6	291.6	291.6	-	-	5.4	-	-	2.5	0.1	8.0
E7	291.6	291.6	-	-	8.7	-	-	3.8	-	12.5
E8	291.6	291.6	-	-	3.1	-	0.2	-	-	3.3
E9	297.5	-	-	18.3	-	-	-	-	-	18.3
E10	297.5	-	-	17.4	-	-	-	-	-	17.4
F1	294.5	293.9	-	-	-	0.5	1.2	-	-	1.7
F2	293.2	292.9	-	-	2.3	-	-	2.1	-	-
F3	293.1	292.8	-	-	2.3	-	-	2.2	-	-
F4	293.1	293.1	-	-	1.5	-	-	1.6	0.5	-
F5	295.6	-	-	-	-	0.5	0.9	-	-	1.4
F6	298.9	292.7	-	6.7	0.7	-	-	0.6	-	8.0
G1	294.4	294.1	-	-	-	2.3	0.7	0.6	-	3.6
G2	293.3	293.0	-	-	-	2.6	-	2.2	-	-
G3	293.9	-	-	-	-	0.5	-	-	-	-
G4	298.9	292.5	-	6.7	-	-	0.8	2.4	-	9.9



Borehole No.	Ground Elevation (m)	Water Level Elevation (m)	Thickness (m)							Depth to Inferred Bedrock (m)
			Ponded Water	Fill	Peat / Topsoil	Clay/ Sand with Organics	Upper Silty Sand to Sand to Silt	Silty Clay to Clayey Silt	Lower Sand to Silty Sand to Silt	
H1	282.1	281.1	-	-	0.8	-	-	0.3	-	-
H2	279.8	278.3	-	-	1.8	-	-	0.9	0.5	3.2
H3	279.2	277.4	-	-	0.9	-	-	8.7	0.2	9.8
H4	279.8	275.2	-	-	0.5	-	-	4.8	0.5	5.8
H5	279.4	278.6	-	-	0.4	0.7	-	1.9	1.6	4.6
H6	281.2	279.7	-	-	0.9	-	1.3	-	-	2.2
H7	289.5	-	-	-	-	-	-	-	-	Exposed Rock
H8	285.6	-	-	3.2	-	-	-	-	-	3.2
J1	301.9	301.9	-	-	0.4	0.1	-	-	-	0.5
J2	301.8	301.8	-	-	0.7	0.4	-	-	-	1.1
J3	301.9	301.9	-	-	0.2	-	0.7	-	-	0.9
J4	303.0	301.5	-	0.8	-	0.6	0.4	-	-	1.8
K1	300.9	-	-	-	-	-	1.1	-	-	1.1
K2	298.8	298.8	-	-	-	1.1	1.1	-	-	2.2
K3	299.9	299.6	-	-	-	0.6	0.5	-	-	1.1
K4	304.0	-	-	0.5	-	-	-	-	-	-

Borehole No.	Ground Elevation (m)	Water Level Elevation (m)	Thickness (m)							Depth to Inferred Bedrock (m)
			Ponded Water	Fill	Peat / Topsoil	Clay/ Sand with Organics	Upper Silty Sand to Sand to Silt	Silty Clay to Clayey Silt	Lower Sand to Silty Sand to Silt	
L1	295.7	-	-	-	-	0.8	-	-	-	0.8
L2	293.5	293.5	-	-	0.6	0.5	-	4.5	0.4	6
L3	297.7	-	-	-	0.1	-	1.0	-	-	1.1
L4	296.5	-	-	-	0.1	-	1.6	-	-	1.7
L5	294.8	293.5	-	0.2 TPS / 1.9	-	-	-	2.6	0.1	4.8
L6	295.4	-	-	0.1 TPS / 1.5	0.5	-	-	1.5	0.3	3.9
L7	299.4	-	-	10.0	-	-	-	-	-	10.0
M1	270.4	267.9	-	-	1.4	-	-	7.9	2.9	12.2
M2	270.2	269.1	-	-	1.0	-	0.6	12.9	0.8	15.3
M3	270.2	270.2	0.3	-	-	1.2	-	4.6	0.1	-
M4	270.5	270.5	0.5	-	-	1.5	-	7.2	-	-
M5	270.6	270.6	0.6	-	0.3	-	-	4.5	-	-
M6	270.7	268.5	-	-	0.7	-	-	6.6	0.4	7.7
M7	271.5	267.5	-	2.7	1	-	-	9.8	3.4	17.1
M8	271.6	269.5	-	2.1	-	1.6	-	12.5	1.6	17.8

Borehole No.	Ground Elevation (m)	Water Level Elevation (m)	Thickness (m)							Depth to Inferred Bedrock (m)
			Ponded Water	Fill	Peat / Topsoil	Clay/ Sand with Organics	Upper Silty Sand to Sand to Silt	Silty Clay to Clayey Silt	Lower Sand to Silty Sand to Silt	
M9	272.2	267.0	-	1.4	-	-	-	5.5	3.8	10.7
M10	272.7	-	-	1.4	-	-	-	3.6	3.0	8.0
M11	272.9	268.3	-	1.9	0.5	-	-	6.4	1.1	9.9
M12	273.6	269.6	-	2.6	0.1	-	-	4.6	2.3	9.6
N1	272.0	269.5	-	2.6	-	0.9	-	5.3	1.4	10.2
N2	272.0	265.6	-	2.7	0.1	0.5	-	6.1	3.9	13.3
N3	270.2	270.8	0.1	-	2.5	-	0.5	8.5	3.7	15.3
N4	270.4	270.6	-	-	2.9	-	-	7.3	2.4	12.6
N5	272.1	270.5	-	3.2	-	-	-	0.1	6.3	9.6
O1	276.8	272.2	-	0.1TPS / 0.6	-	-	-	4.2	2.1	7.0
O2	275.9	272.5	-	0.7	-	-	-	4.9	0.5	6.1
O3	275.8	274.3	-	0.2 TPS / 0.6	-	-	-	1.3	1.9	4.0
O4	276.1	274.7	-	0.2	-	-	-	1.9	0.7	2.8
O5	278.8	278.8	0.2	-	-	-	-	1.5	-	1.7

Borehole No.	Ground Elevation (m)	Water Level Elevation (m)	Thickness (m)							Depth to Inferred Bedrock (m)
			Ponded Water	Fill	Peat / Topsoil	Clay/ Sand with Organics	Upper Silty Sand to Sand to Silt	Silty Clay to Clayey Silt	Lower Sand to Silty Sand to Silt	
O6	279.5	-	-	0.2 TPS / 0.3	-	-	-	-	-	0.5
O7	291.5	-	-	-	0.3	0.8	-	0.3	1.0	2.5
O8	289.3	-	-	0.5	-	-	-	-	-	-
P1	301.2	-	-	0.2 TPS / 0.7	-	-	-	-	-	0.9
P2	294.6	-	-	-	0.4	-	0.3	-	-	0.7
P3	301.1	-	-		0.3	-	0.8	-	-	1.1
P4	304.8	-	-	0.6	-	-	-	-	-	-
Q1	296.4	-	-	-	-	-	0.5	-	-	0.5
Q2	294.7	-	-	1.2	-	-	1.1	-	-	2.3
Q3	294.1	294.1	1.6	-	-	1.1	1.2	-	-	3.9
Q4	294.1	294.1	2.5	-	1.1	-	1.9	0.6	0.2	6.3
Q5	293.5	293.0	-	-	1.8	1.8	-	0.9	-	-
Q5A	293.5	293.5	2.9	-	2.1	-	-	3.0	1.2	-
Q6	293.7	293.7	0.8	-	2.9	-	-	2.3	-	6.0

Borehole No.	Ground Elevation (m)	Water Level Elevation (m)	Thickness (m)							Depth to Inferred Bedrock (m)
			Ponded Water	Fill	Peat / Topsoil	Clay/ Sand with Organics	Upper Silty Sand to Sand to Silt	Silty Clay to Clayey Silt	Lower Sand to Silty Sand to Silt	
Q7	294.1	294.1	-	-	0.3	-	-	3.0	-	3.3
Q8	296.4	293.4	-	2.7	-	0.9	2.0	-	-	5.6
Q9	296.4	293.7	-	1.7	0.6	-	2.5	-	-	-
R1	296.5	296.5	-	-	0.5	-	0.9	-	-	-
R2	296.0	296.0	0.8	-	-	0.4	0.7	1.6	0.1	-
R3	296.0	296.0	0.6	-	1.5	-	-	1.4	-	3.5
R4	296.0	296.0	1.2	-	-	0.4	0.8	-	-	2.4
R5	296.0	296.0	0.6	-	-	1.1	4.3	-	-	-
R6	296.0	296.0	0.6	-	0.6	1.5	3.1	0.2	-	-
R6A	296.0	296.0	3.7	-	-	2.9	3.1	-	-	6.6
R7	296.2	296.2	0.3	-	0.3	1.7	-	0.1	-	2.4
R7A	296.2	296.2	0.9	-	1.4	-	-	0.4	-	2.7
R7B	296.2	296.2	0.9	-	0.6	1.4	1.4	-	-	4.3
R8	296.4	296.4	-	-	0.8	-	0.4	-	-	1.2
R9	301.0	295.0	-	5.0	0.7	-	1.0	-	-	6.7
R10	297.8	296.0	-	0.9	0.5	-	1.7	-	-	3.1



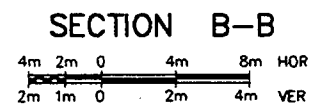
Borehole No.	Ground Elevation (m)	Water Level Elevation (m)	Thickness (m)							Depth to Inferred Bedrock (m)
			Ponded Water	Fill	Peat / Topsoil	Clay/ Sand with Organics	Upper Silty Sand to Sand to Silt	Silty Clay to Clayey Silt	Lower Sand to Silty Sand to Silt	
U1	292.9	292.9	0.6	-	0.5	-	3.0	-	-	-
U2	293.0	293.0	0.6	-	0.9	-	3.3	-	-	-
U3	292.6	292.6	-	-	8.7	-	-	1.9	1.6	-
U4	294.6	294.6	0.1	-	7.7	-	-	2.2	1.6	-
U5	293.6	292.9	-	3.3	1.1	-	8.5	-	-	-
U6	293.5	292.3	-	5.2	-	-	2.3	0.3	11.0	-
U7	295.8	292.9		1.9	-	-	-	1.0	6.4	-
U8	293.6	292.2	-	1.4	-	-	-	-	9.4	-
U9	293.8	292.4	-	3.7	-	-	-	-	-	-
U10	296.2	-	-	1.5	-	-	-	-	-	-
U11	294.1	292.6	-	-	0.2	-	-	-	4.3	-
U12	293.0	292.2	-	-	0.2	-	-	-	5.8	-
U13	293.4	292.0	-	-	0.3	-	-	-	8.2	-
U14	293.0	292.2	-	-	0.2	-	-	-	9.6	-
U15	292.5	292.5	-	-	0.5	0.9 / 0.4 Peat	-	-	2.5	-
U16	292.9	292.3	-	-	0.3	0.5 / 2.2 Peat	3.0 / 0.3 Peat	1.0	-	-










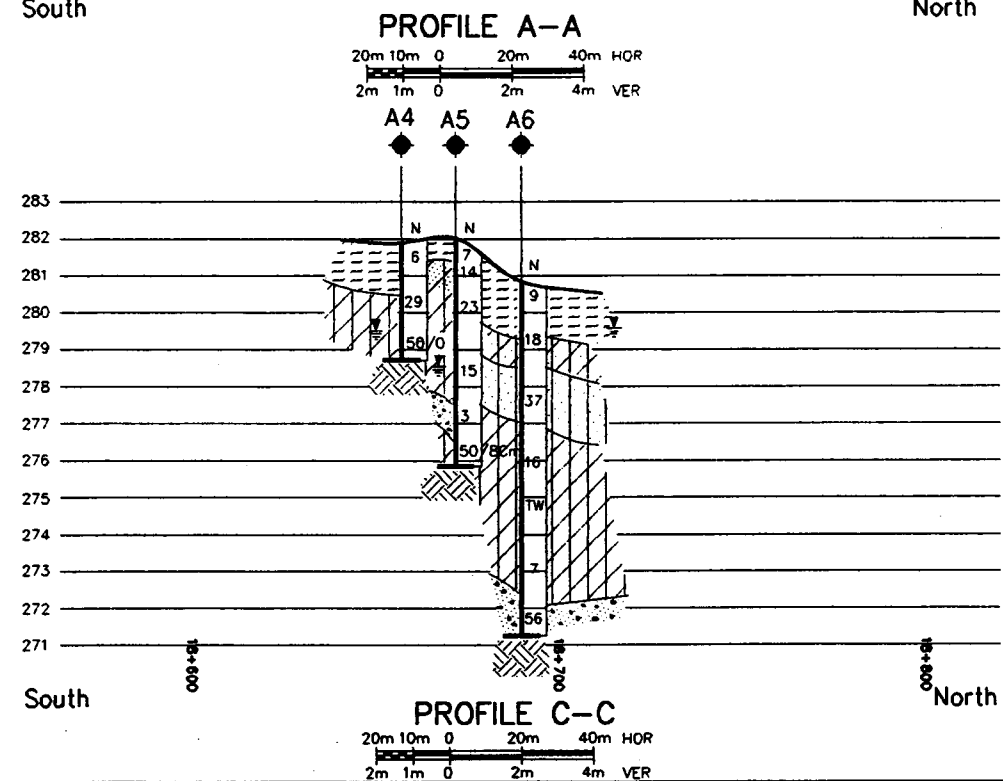
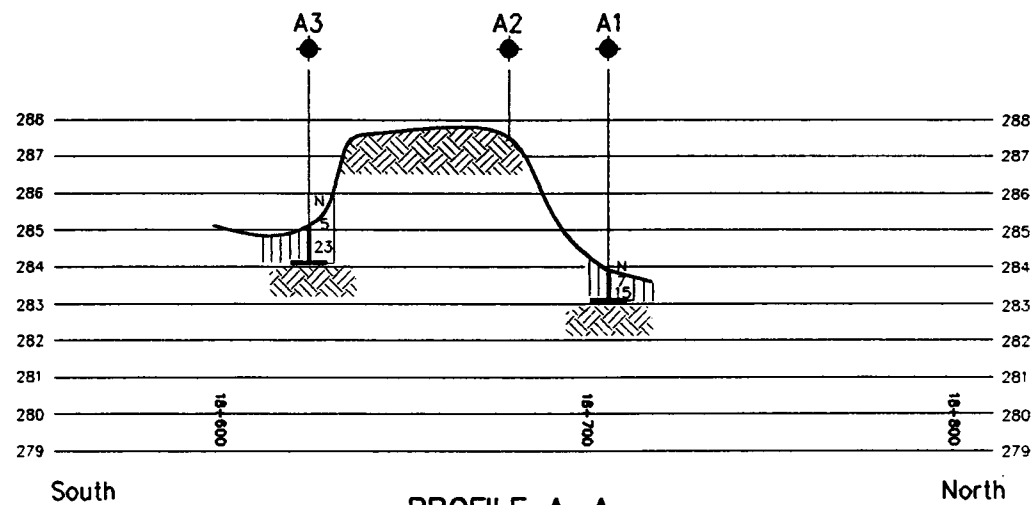
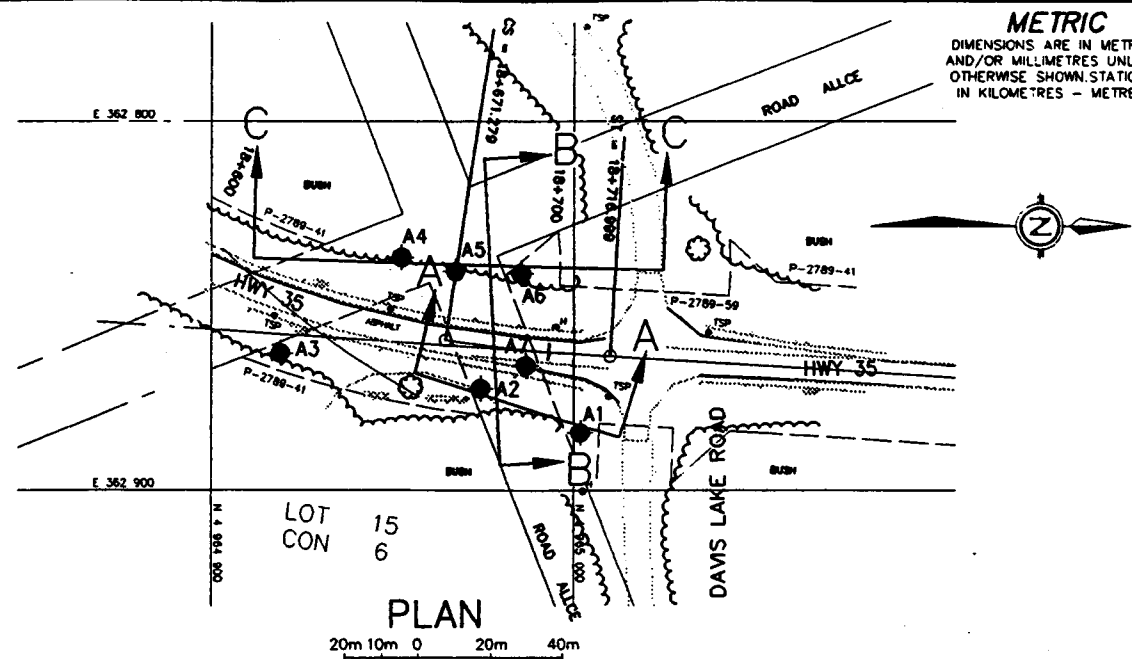


**TABLE III**  
**INDEX PROPERTIES OF OEDOMETER TEST SAMPLES**

Borehole No.	E2	H4	L5	M6	M8	M11	N4	O1
Sample No.	6	6	7	4	8	7	6	5A
Depth (m)	8.8	4.3	4.7	2.7	5.6	5.6	4.8	3.3
Water Content(%)	35	39	28	50	34	37	45	35
Liquid Limit (%)	31	39	25	36	38	35	37	36
Plasticity Index (%)	11	17	7	18	16	15	15	15
Unit Weight (kN/m <sup>3</sup> )	19.1	18.6	19.9	18.3	19.0	18.8	17.8	19.1
Initial Void Ratio	0.95	1.07	0.76	1.25	0.98	1.02	1.27	0.97
Estimated Compression Index (Cc)	0.14	0.12	0.05	0.14	0.05	0.32	0.15	0.07
Estimated Preconsolidation Pressure (kPa)	80	200	135	50	65	110	40	450
Insitu EffectiveOverburden Stress (kPa)	25	35	60	20	60	100	20	60
% Sand	0	0	1	0	0	0	0	0
% Silt	84	59	84	59	80	77	53	75
% Clay	16	41	15	41	20	23	47	25
Specific Gravity	2.77	2.77	2.73	2.79	2.78	2.77	2.78	2.79



	<b>BEDROCK</b>
	<b>SILTY SAND Dense</b>
	<b>ROCKFILL</b>
	<b>SAND to SAND &amp; GRAVEL Occasional cobbles Very Loose to Dense</b>
	<b>SAND or SILTY FILL</b>
	<b>PEAT</b>
	<b>SILTY CLAY to CLAYEY SILT Firm to Hard</b>



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

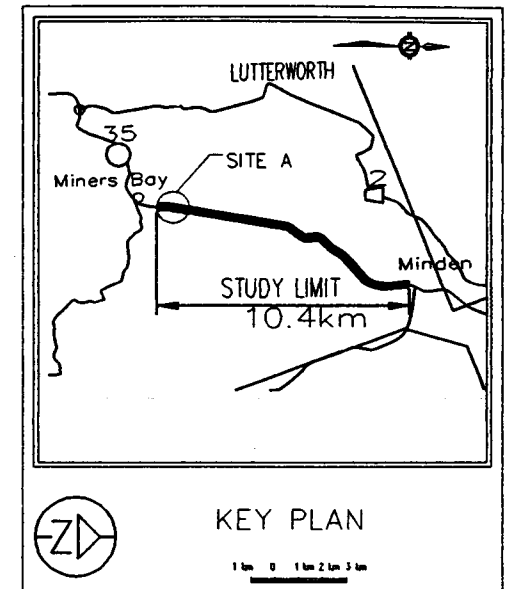
G.W.P. No. 81-99-00



SITE A. STATION 18+600 to 18+700  
BOREHOLE LOCATIONS & SOIL STRATA

**SHEET**

AMEC Earth & Environmental Limited



## LEGEND

Bore Hole

Dynamic Cone Penetration Test (Cone)

Bore Hole & Cone

'N'

Blows/0.3m (Std Pen Test, 475 J/blow)

CONE

Blows/0.3m (60° Cone, 475 J/blow)

WL at time of investigation—  
(Nov., Dec. 00, Jan. 01)

WL in Piezometer

Piezometer

End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
A1	283.9	4965002	362884
A2	287.5	4964974	362872
A3	285.2	4964919	362863
A4	281.9	4964953	362837
A5	282.0	4964967	362841
A6	280.9	4964985	362841
A7	289.8	4964987	362866

-NOTE-

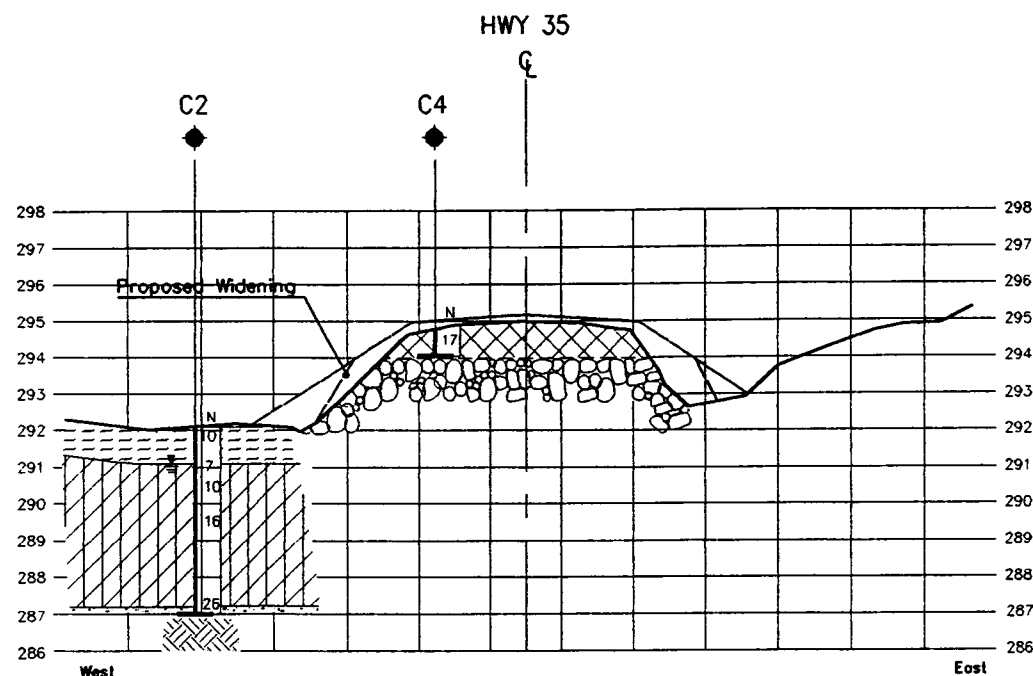
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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

REV.	Sept. 01	NS	
DATE	BY		DESCRIPTION

HWY No 35			DIST 52
SUBM'D AD	CHECKED KSH	DATE Feb..2001	SITE
DRAWN NS	CHECKED	APPROVED	DWG A



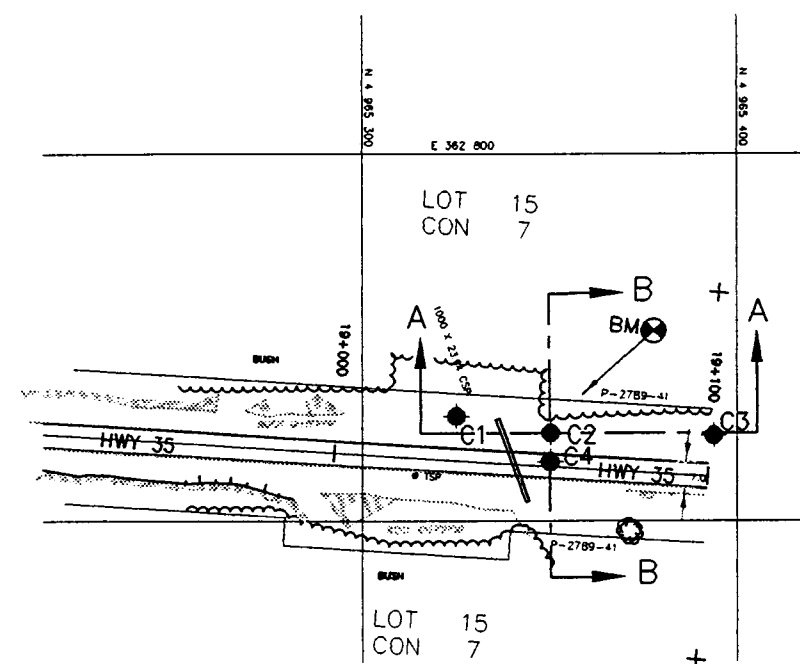
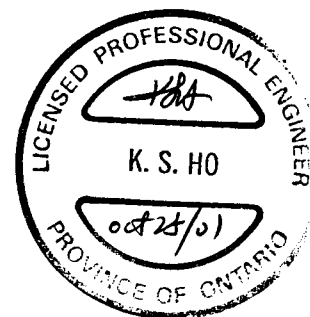


SECTION B-B

4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER

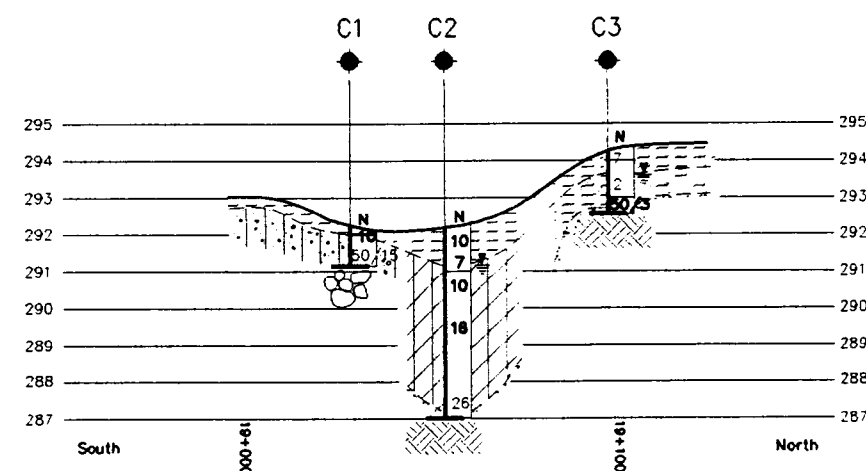
SOIL STRATIGRAPHY LEGEND

- BEDROCK
- ROCKFILL
- SAND (FILL)  
With Gravel  
Compact
- SILTY CLAY to  
CLAYEY SILT  
Stiff to Very Stiff
- PEAT  
Soft to Firm
- SILTY SAND With GRAVEL  
Very Dense to  
SAND and GRAVEL
- SANDY SILT  
FREQUENT PEAT LAYERS  
TRACE GRAVEL  
Very Loose



PLAN

20m 10m 0 20m 40m



PROFILE A-A

20m 10m 0 20m 40m H.C.P.  
2m 1m 0 2m 4m VER

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

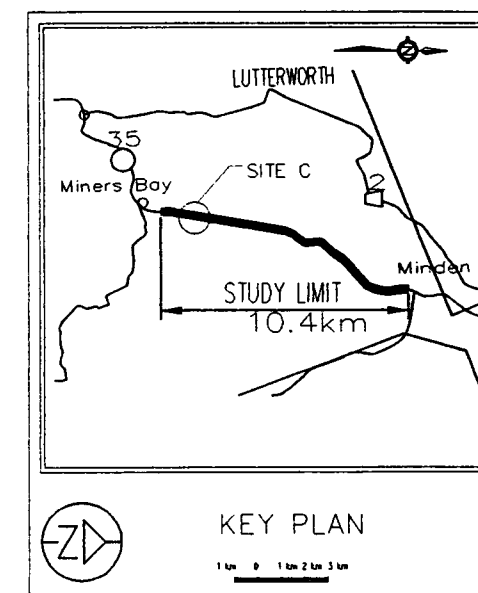
G.W.P. No. 81-99-00



SITE C, STATION 19+030 to 19+100  
BOREHOLE LOCATIONS & SOIL STRATA

SHEET

AMEC Earth & Environmental Limited



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation  
(Nov. 00, Jan. 01)
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES NORTHING	EASTING
C1	292.2	4965325	362871
C2	292.1	4965352	362876
C3	294.2	4965394	362877
C4	294.8	4965352	362884

NOTE

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

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

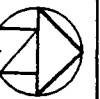
DATE	DESCRIPTION
Sept. 2001	NS

HWY No 35	DIST 54
SUBM'D AD	CHECKED KSH DATE Feb., 2001
DRAWN NS	CHECKED
	SITE
	DWG C

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

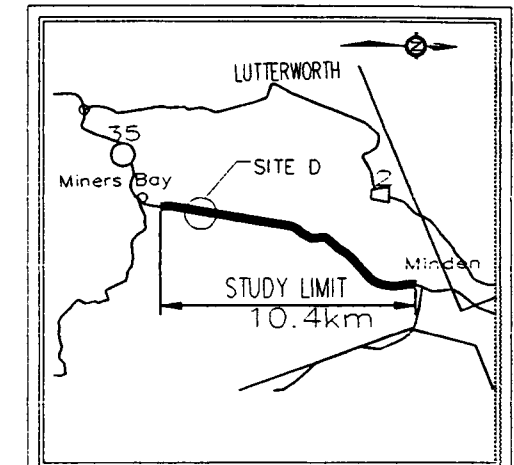
G.W.P. No. 81-99-00



**SITE D, STATION 19+060 to 19+200**  
**BORE HOLE LOCATIONS & SOIL STRATA**

**SHEET**

AMEC Earth & Environmental Limited



**KEY PLAN**

1:10,000 0.1m 1:10,000 0.1m

**LEGEND**

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation (Nov.-Dec. 00, Jan. 01)
- WL in Piezometer
- ⊥ Piezometer
- ⊥ End of Borehole

No	ELEVATION	CO-ORDINATES NORTHING	EASTING
D1	292.4	4965382	362903
D2	292.4	4965436	362906
D3	292.7	4965488	362909
D4	295.6	4965433	362895

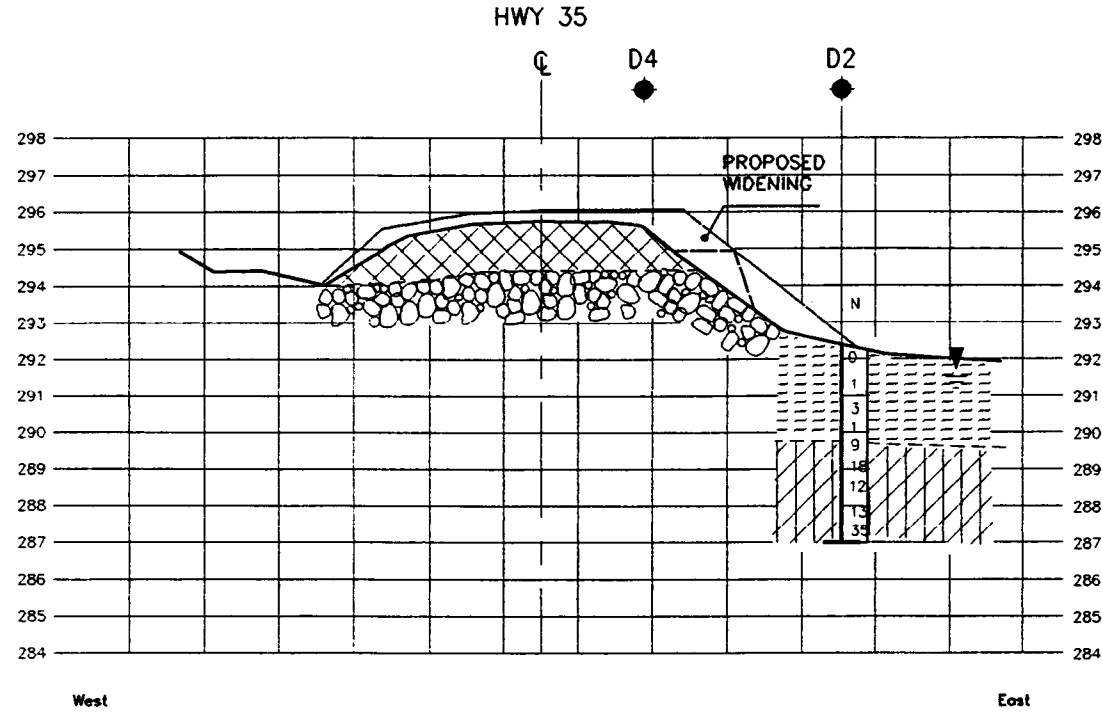
**-NOTE-**

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

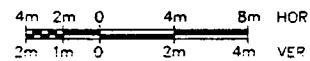
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 6C.2.01 of OPS Gen. Cond.

DATE	BY	DESCRIPTION
Sept. 2001	NS	

HWY No 35	DIST 52
SUBM'D AD	CHECKED KSH
DATE Feb., 2001	SITE
DRAWN NS	CHECKED
	DWG 0

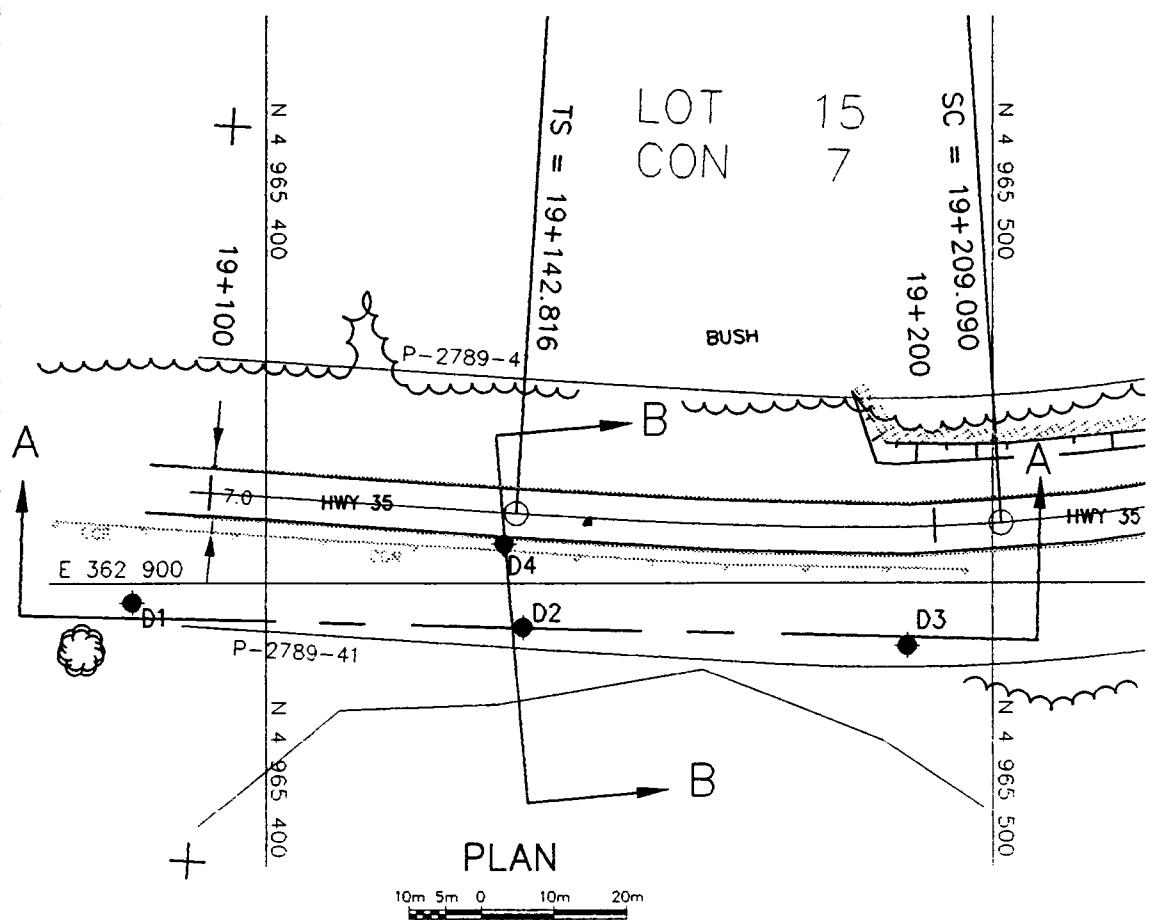


**SECTION B-B**

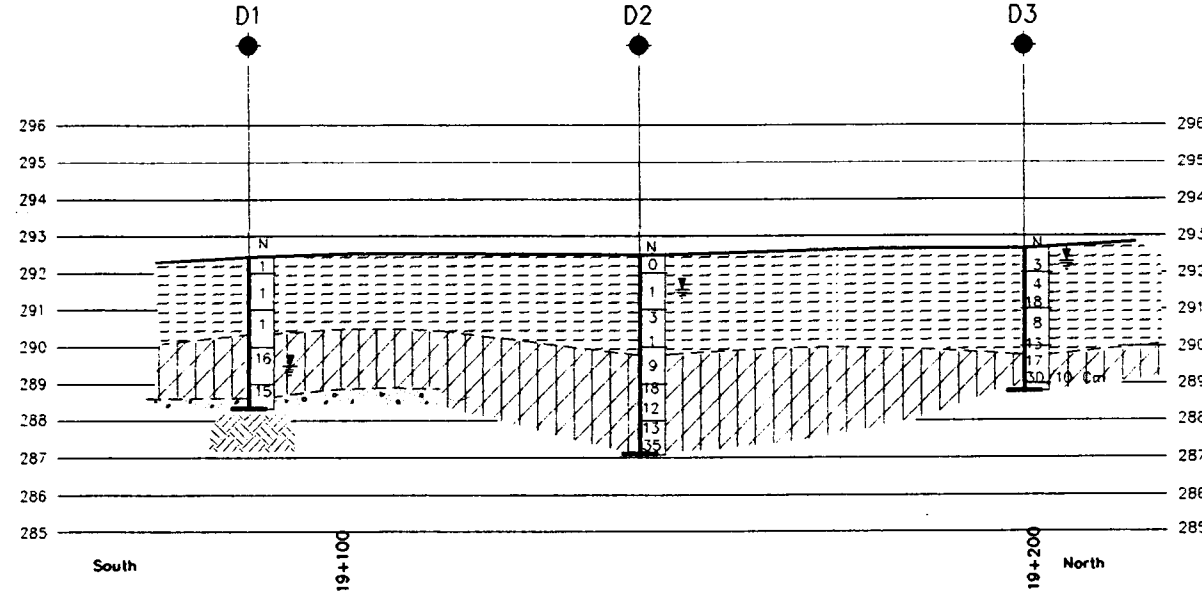


**SOIL STRATIGRAPHY LEGEND**

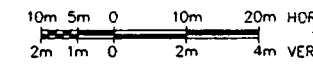
- BEDROCK
- SAND (Fill)
- ROCKFILL
- CLAYEY SILT to SILTY CLAY  
Stiff to Hard
- PEAT  
Very Soft to Firm
- SAND (Fill)



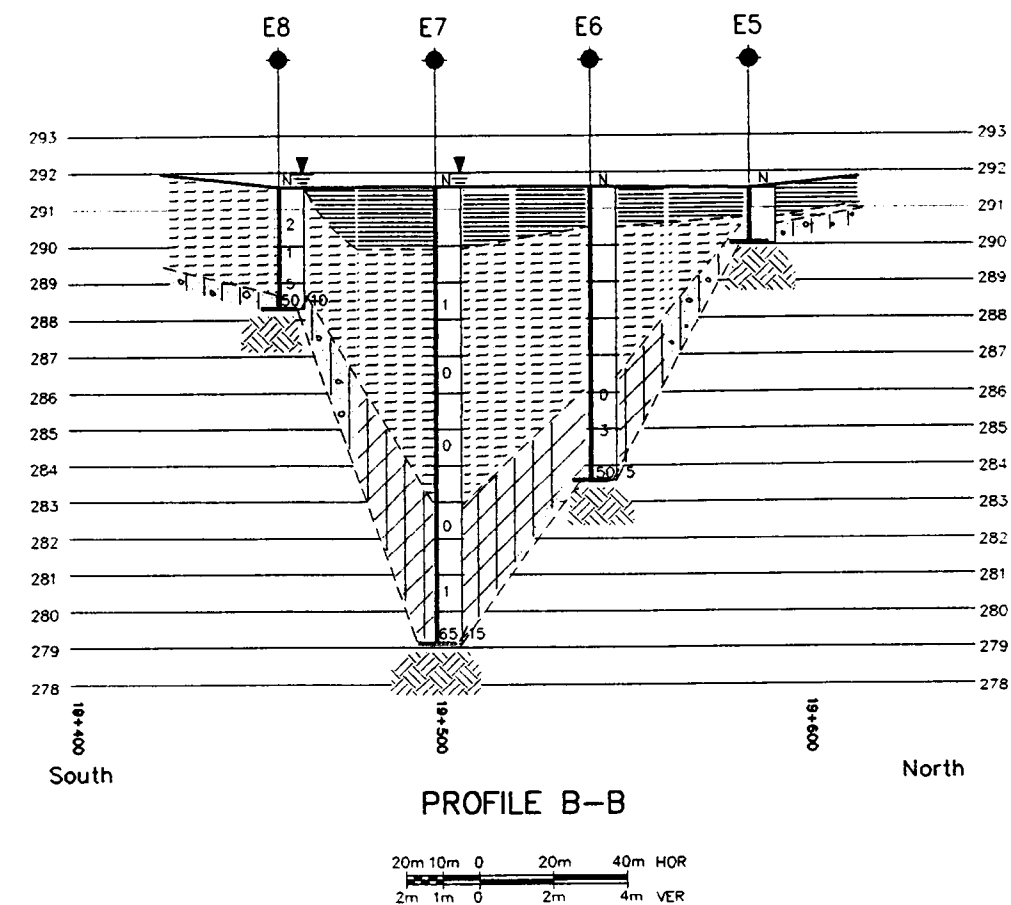
**PLAN**



**PROFILE A-A**

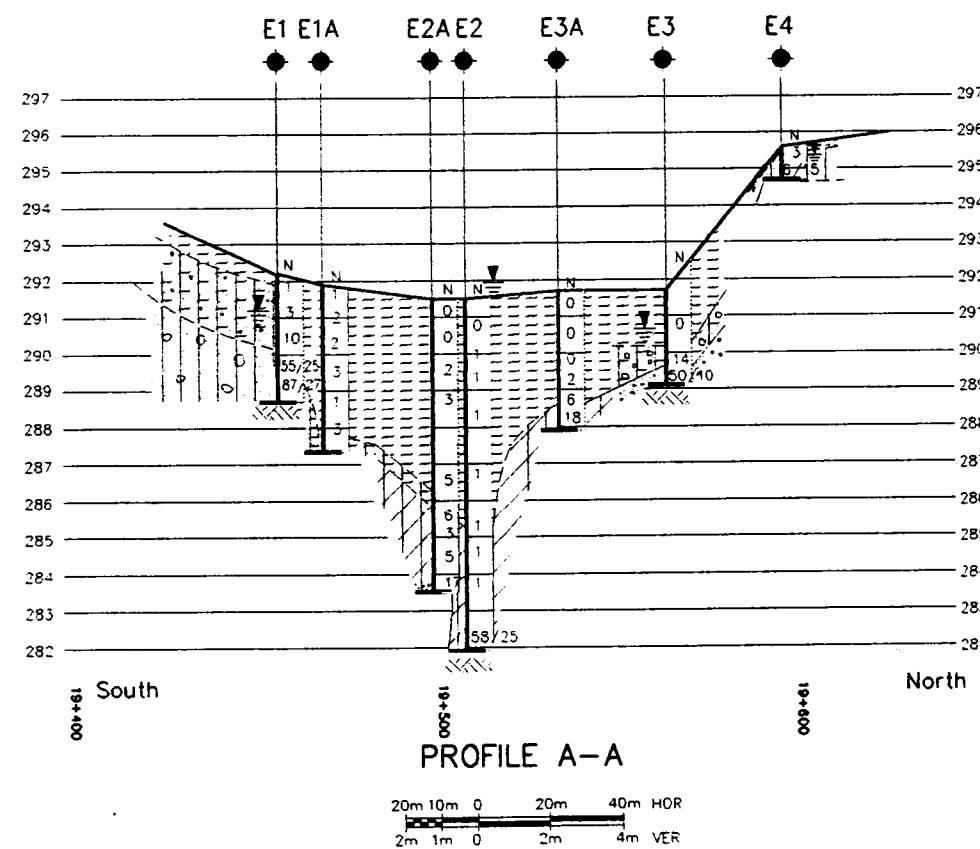
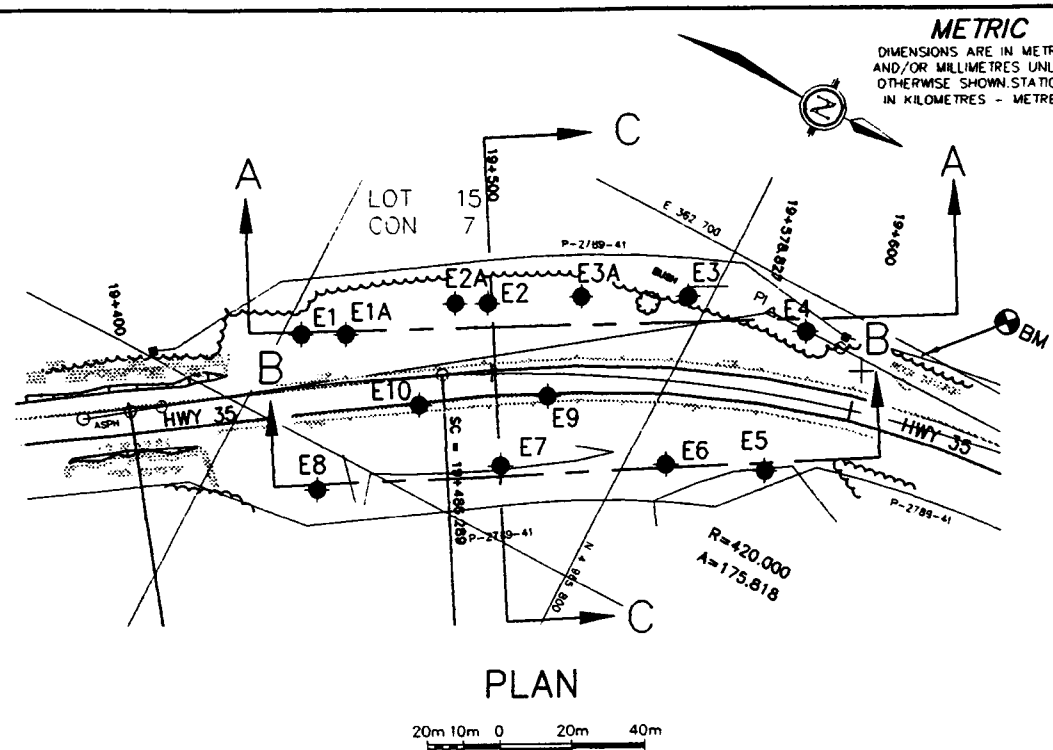
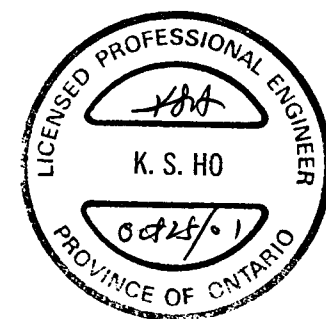


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#### SOIL STRATIGRAPHY LEGEND

- WATER
- SILTY SAND with GRAVEL very loose to loose
- BEDROCK
- SILTY SAND to SAND Occasional Cobbles Compact to Very Dense
- ROCKFILL
- CLAYEY SILT to SILTY CLAY Very Soft to Very Stiff
- SAND (Fill) With Gravel
- PEAT Very Soft to Soft
- ORGANIC SANDY SILT to SILTY SAND With Occasional Peat Layers Trace Gravel Very Loose to compact/Soft to Firm



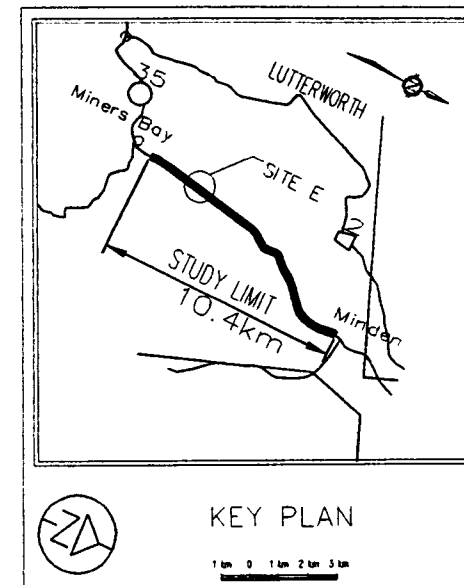
G.W.P. No. 81-99-00

SITE E. STATION 19+430 to 19+600  
BOREHOLE LOCATIONS & SOIL STRATA



SHEET

AMEC Earth & Environmental Limited



#### LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation (Nov-Dec, 00, Jan, 01)
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
E1	292.2	4965705	362776
E1A	291.9	4965717	362776
E2	291.5	4965746	362744
E2A	291.5	4965747	362744
E3	291.7	4965794	362717
E3A	291.7	4965782	362717
E4	295.6	4965828	362710
E5	291.5	4965835	362749
E6	291.6	4965810	362760
E7	291.6	4965770	362782
E8	291.6	4965728	362811
E9	297.5	4965772	362759
E10	297.5	4965737	362759

#### NOTE

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

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DATE	BY	DESCRIPTION
19 Sept 2001	NS	

HWY No 35	DIST 52
SUBM'D AD	CHECKED KSH
DRAWN NS	CHECKED

FILE: E:\GEO\HWY35\PROJ\GEO\19430-19600\19430-19600.DWG



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

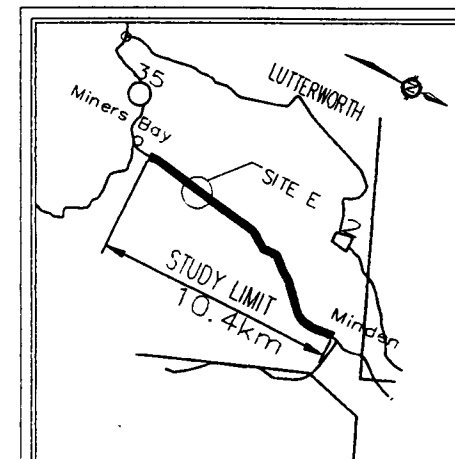
G.W.P. No. 81-99-00



**SITE E, STATION 19+430 to 19+600**  
**BOREHOLE LOCATIONS & SOIL STRATA**

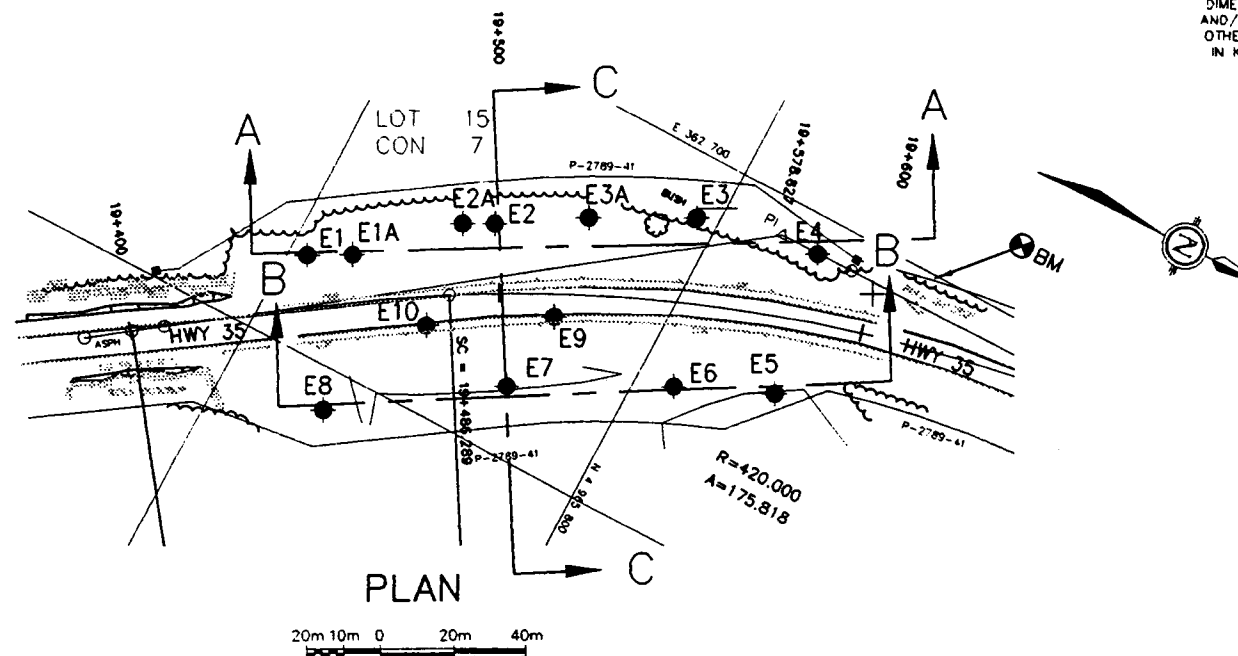
**SHEET**

AMEC Earth & Environmental Limited

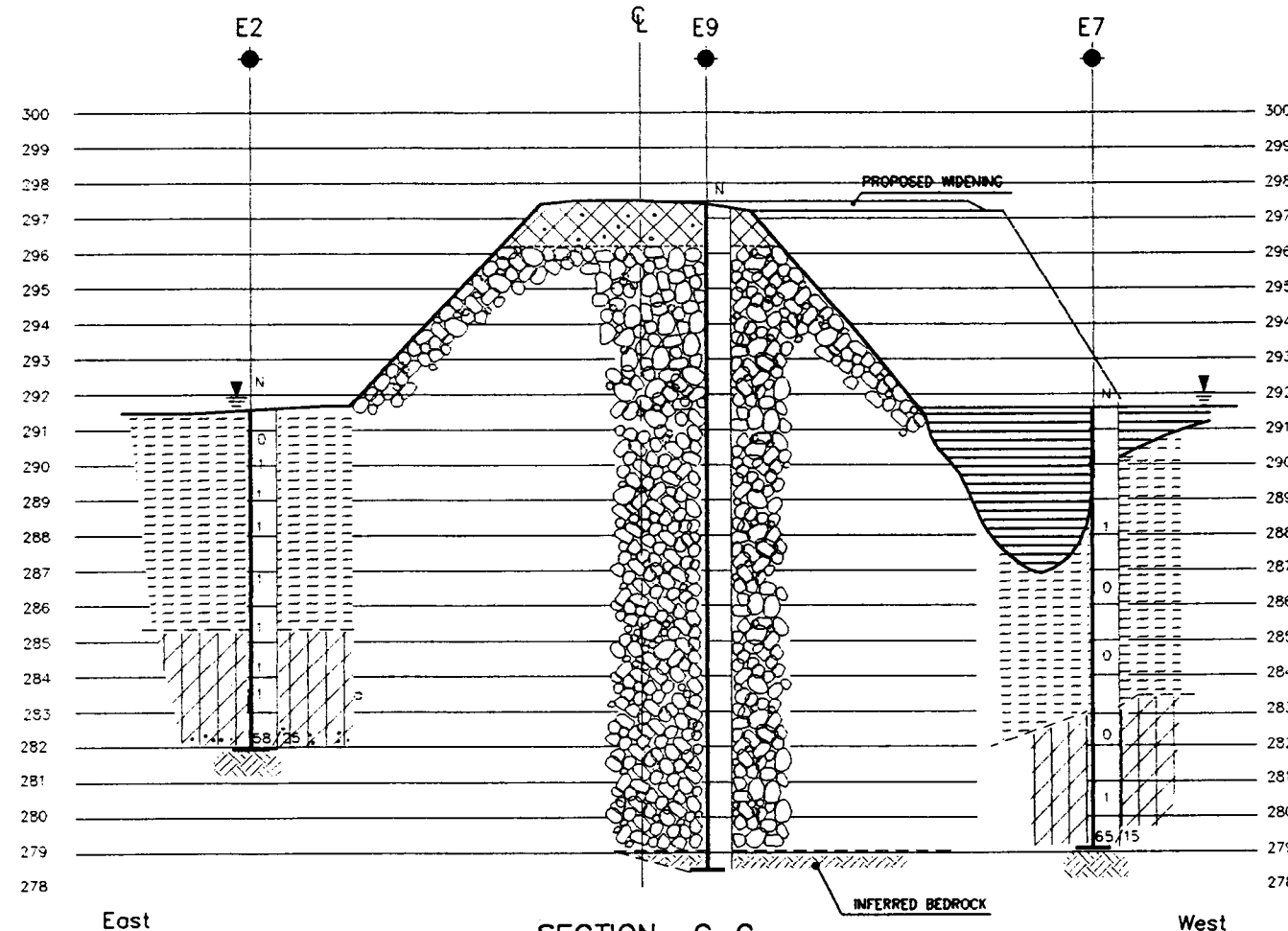


**KEY PLAN**

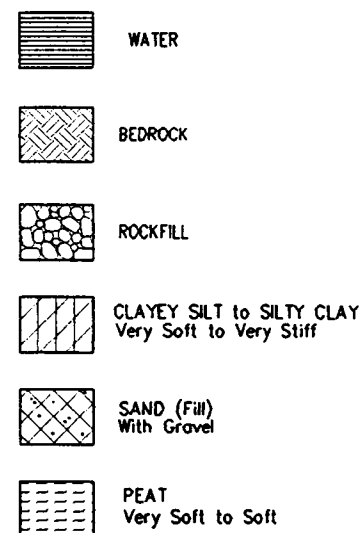
1 km 0 1 km 2 km 3 km



HWY 35



**SOIL STRATIGRAPHY LEGEND**



**LEGEND**

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation (Nov.-Dec. 00, Jan. 01)
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
E1	292.2	4965705	362776
E1A	291.9	4965717	362776
E2	291.5	4965746	362744
E2A	291.5	4965747	362744
E3	291.7	4965794	362717
E3A	291.7	4965782	362717
E4	295.6	4965828	362710
E5	291.5	4965835	362749
E6	291.6	4965810	362750
E7	291.6	4965770	362782
E8	291.6	4965728	362811
E9	297.5	4965772	362759
E10	297.5	4965737	362759

**-NOTE-**

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

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DATE	BY	DESCRIPTION
Sept. 2001	NS	

HWY No 35			DIST 52
SUBM'D AD	CHECKED KSH	DATE Feb. 2001	SITE
DRAWN NS	CHECKED	DATE	DWG E-2

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

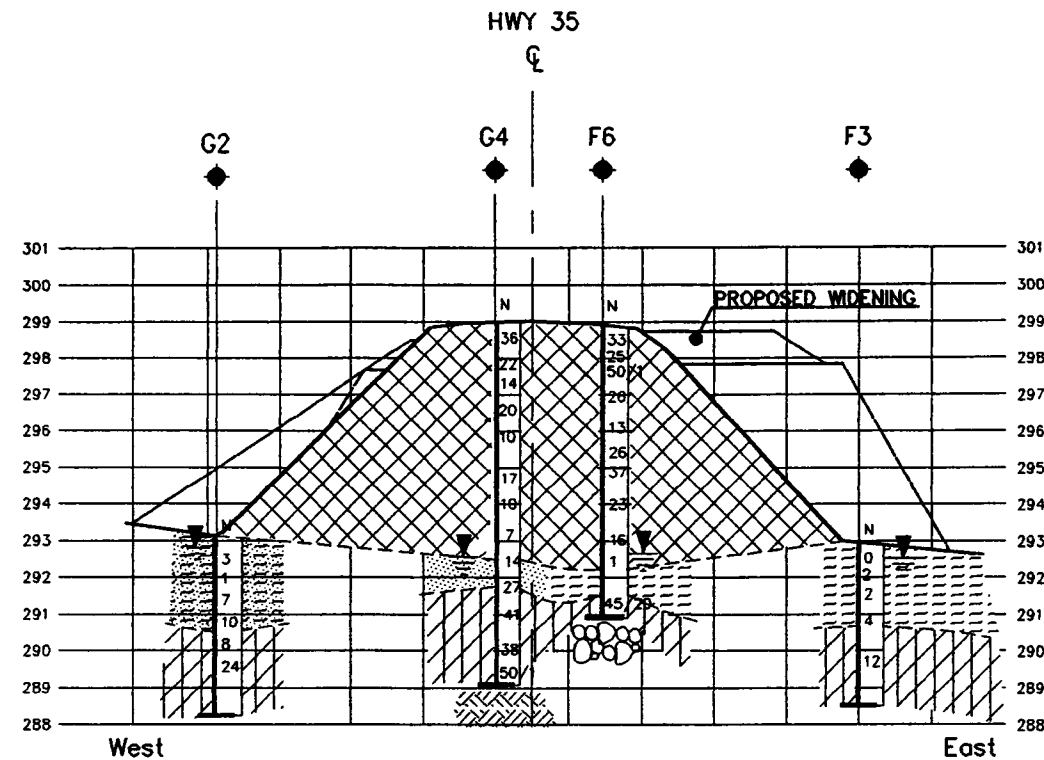
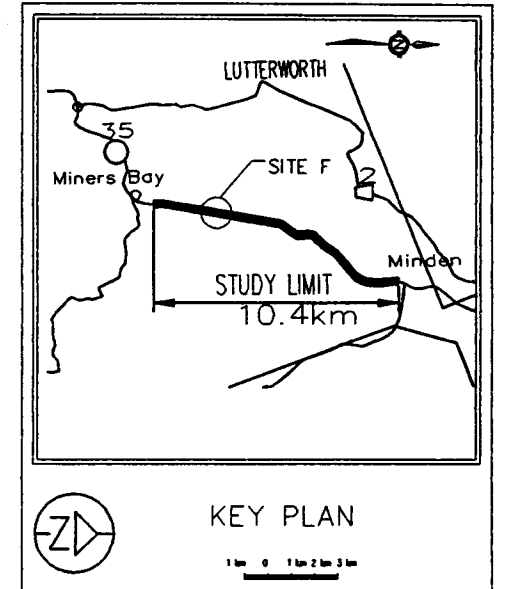
G.W.P. No. 81-99-00



SITE F, STATION 19+680 to 19+900  
BOREHOLE LOCATIONS & SOIL STRATA

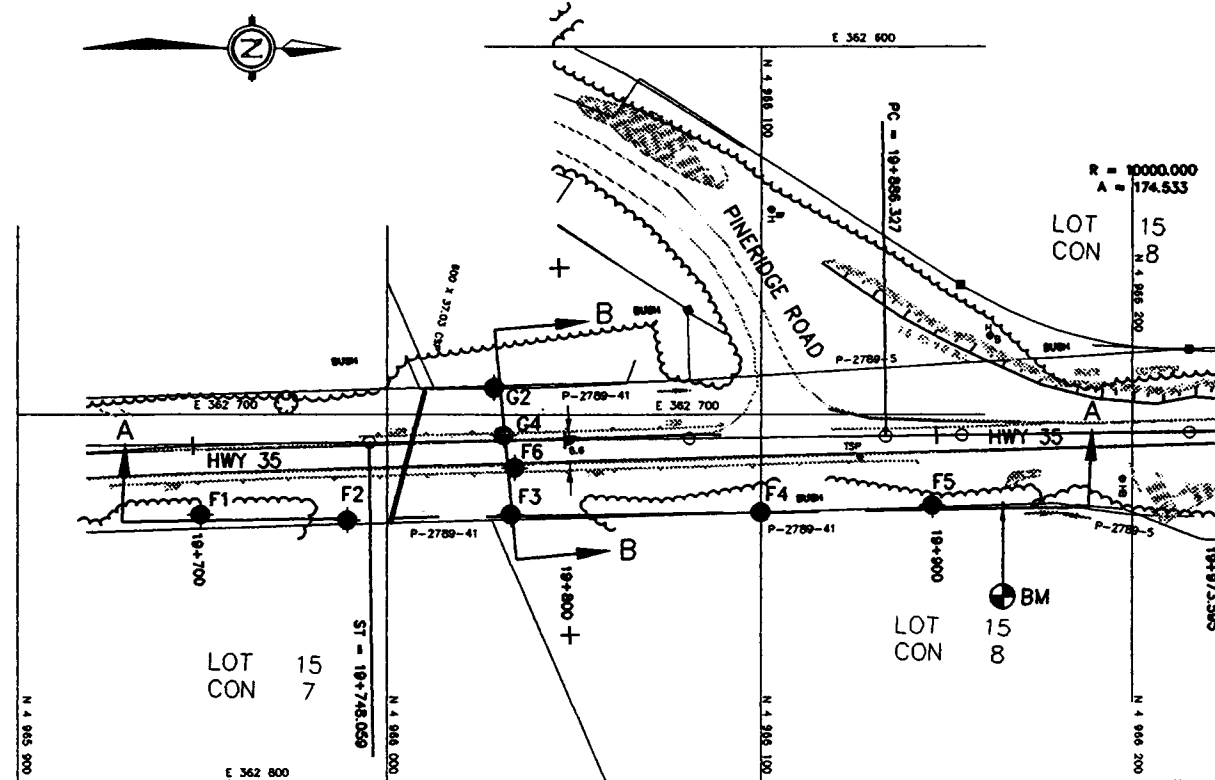
SHEET

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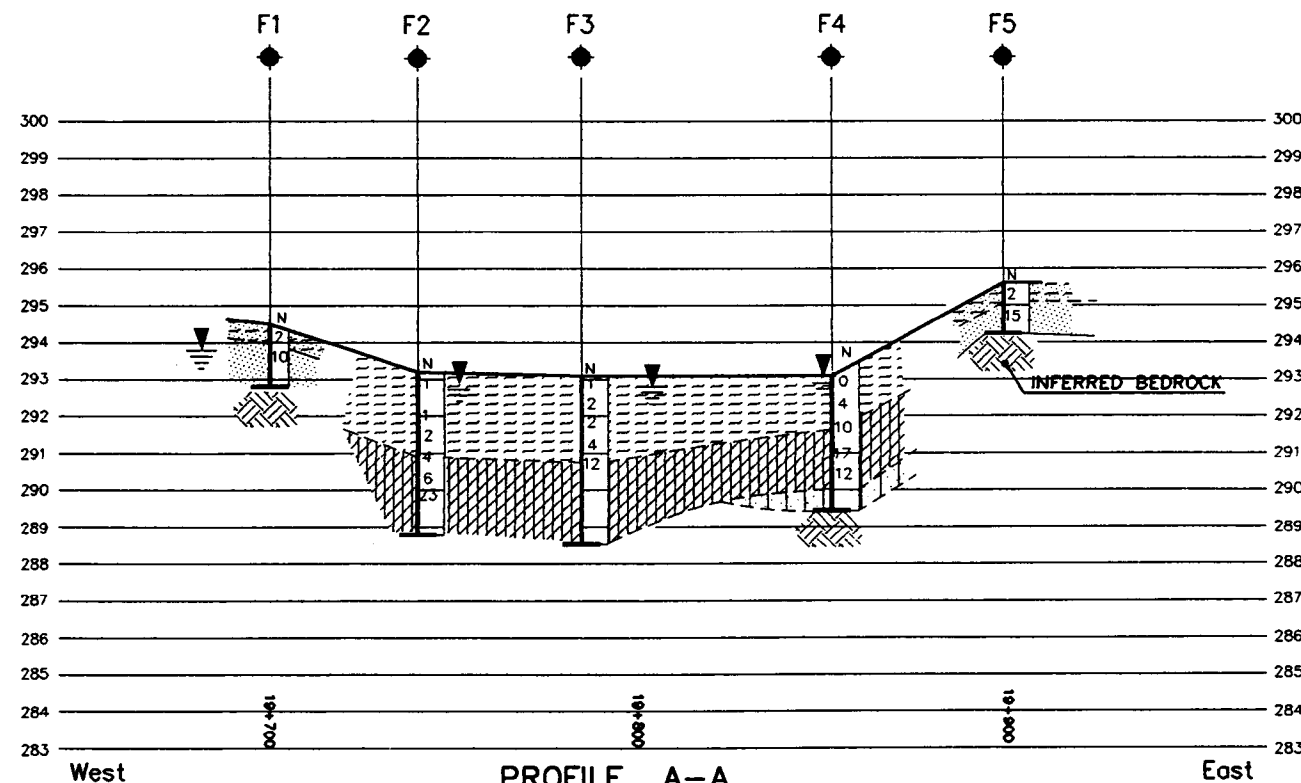
SECTION B-B

4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER



PLAN

20m 10m 0 20m 40m



PROFILE A-A

20m 10m 0 20m 40m HOR  
2m 1m 0 2m 4m VER

**SOIL STRATIGRAPHY LEGEND**

- SAND to GRAVELLY SAND (Fill)  
With Gravel, IrTrace Silt, Cobbles  
Compact to Dense
- SILTY SAND WITH GRAVEL
- SAND  
Trace Gravel  
Compact
- SAND  
Trace Organic With Peat Layers  
Very Loose to Compact
- CLAYEY SILT  
Firm to Very Stiff
- PEAT  
Very Soft to Firm
- Bedrock



**LEGEND**

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation (Nov.-Dec., 00)
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES NORTHING	EASTING
F1	294.5	4965949	362727
F2	293.2	4965989	362729
F3	293.1	4966033	362727
F4	293.1	4966100	362727
F5	295.6	4966154	362724
F6	298.9	4966034	362715
G2	293.3	4966028	362693
G4	298.9	4966031	362706

**NOTE**

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

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

REV	DATE	BY	DESCRIPTION
1	2001	NS	

HWY No 35	CHECKED KSH	DATE Feb., 2001	DIST 52
SUBM'D AD	CHECKED		SITE
DRAWN NS	CHECKED		DWG F

FILE: K:\GEO-TRANSPORT\PROJECTS\1720668\m35\dwg5\h1110-hwy 35/DWG-F



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

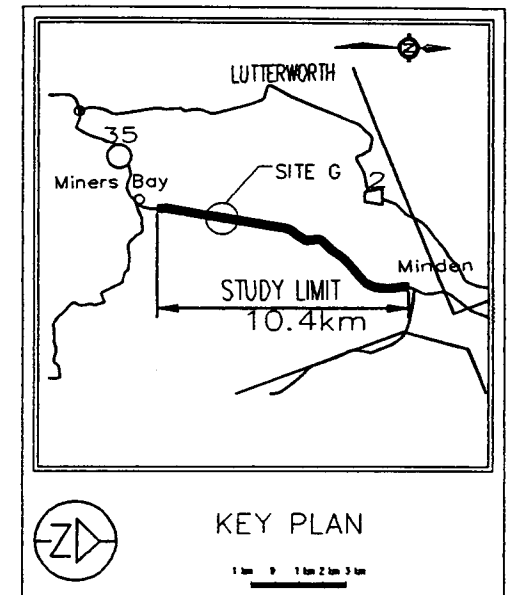
G.W.P. No. 81-99-00



SITE G, STATION 19+750 to 19+840  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

AMEC Earth & Environmental Limited



KEY PLAN

1km 2km 3km

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation (Nov.-Dec., 00)
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES STATION	OFFSET
G1	294.4	4966004	362695
G2	293.3	4966028	362693
G3	293.9	4966066	362692
G4	298.9	4966031	362706
F3	293.1	4966033	362727
F6	298.9	4966034	362715

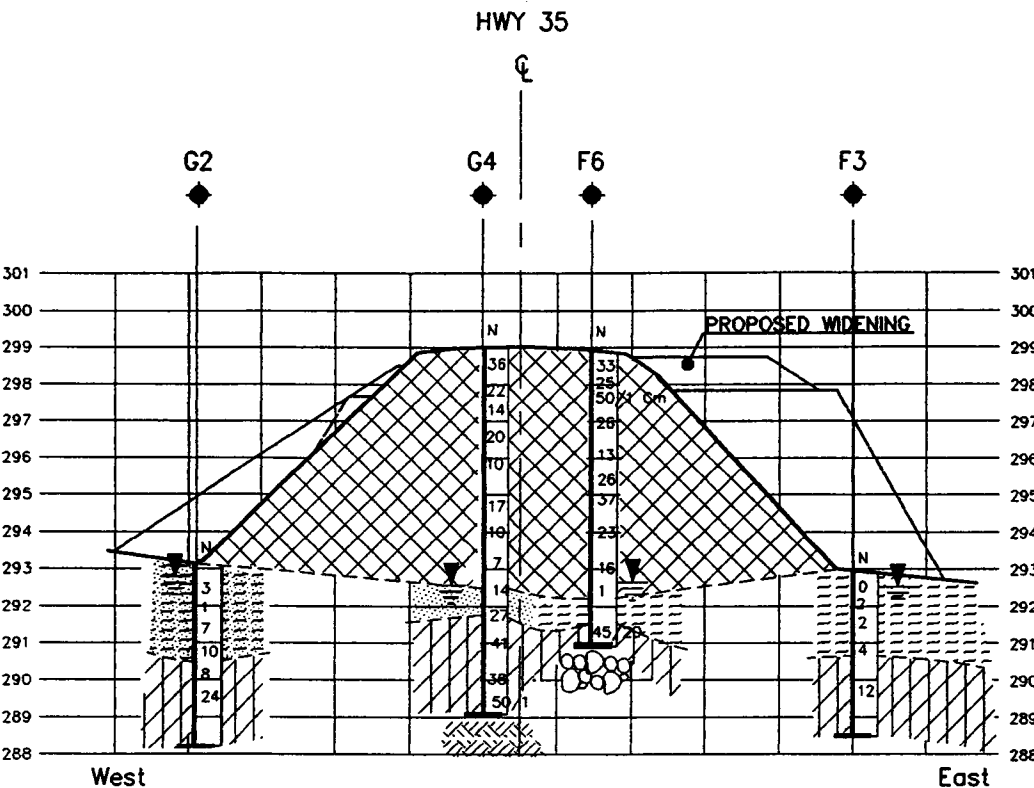
-NOTE-

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

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

DATE	BY	DESCRIPTION
19/01/2001	NS	

HWY No 35	DIST 52
SUBM'D AD	CHECKED KSH
DATE Feb., 2001	SITE
DRAWN NS	CHECKED
	DWG G

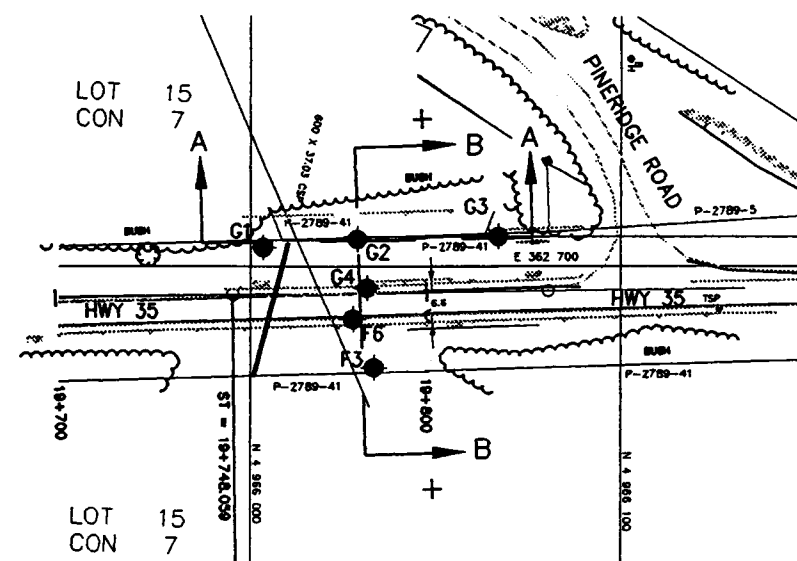
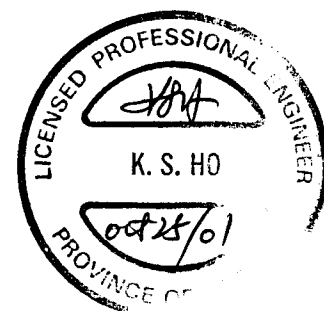


SECTION B-B

4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER

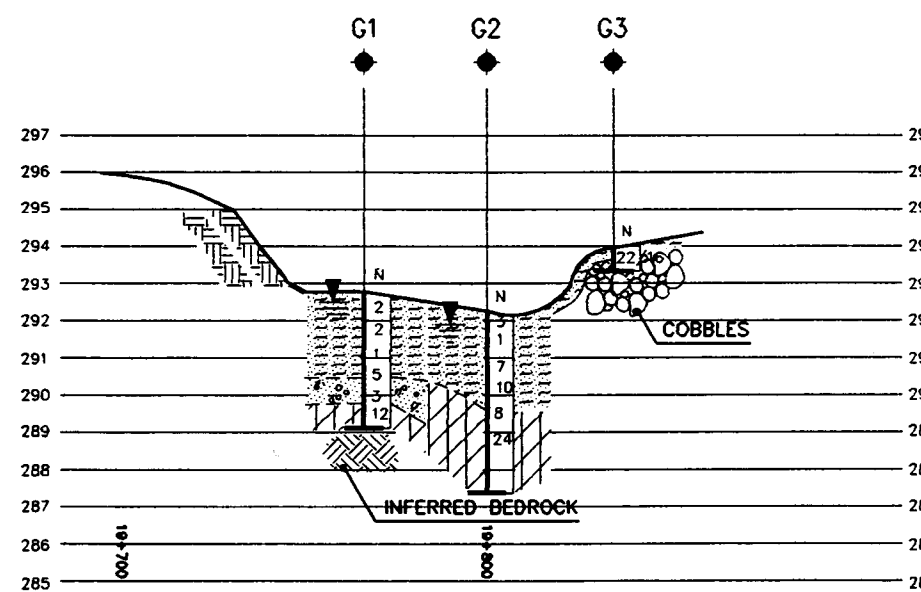
SOIL STRATIGRAPHY LEGEND

- BEDROCK (INFERRED)
- FILL  
Sand with Gravel to Gravelly Sand  
Trace Silt Cobbles Compact to Loose
- GRAVELLY SAND  
Very Loose
- CLAYEY SILT  
Stiff to Very Stiff
- SAND WITH PEAT LAYERS  
Very Loose to Compact
- PEAT



PLAN

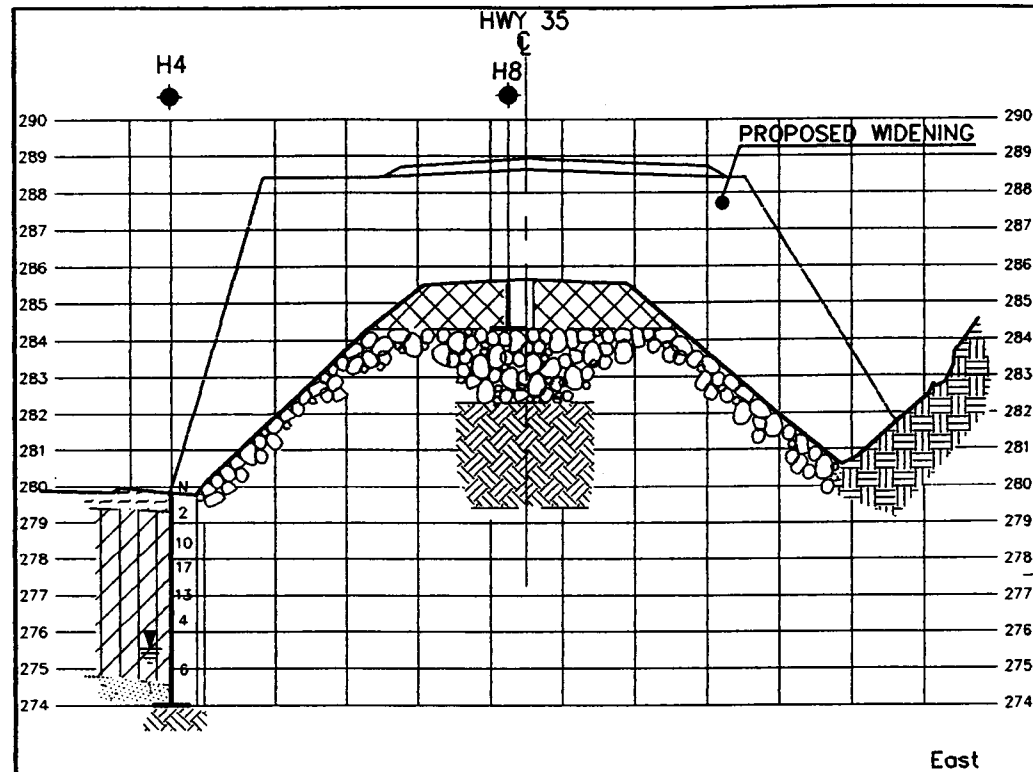
20m 10m 0 20m 40m



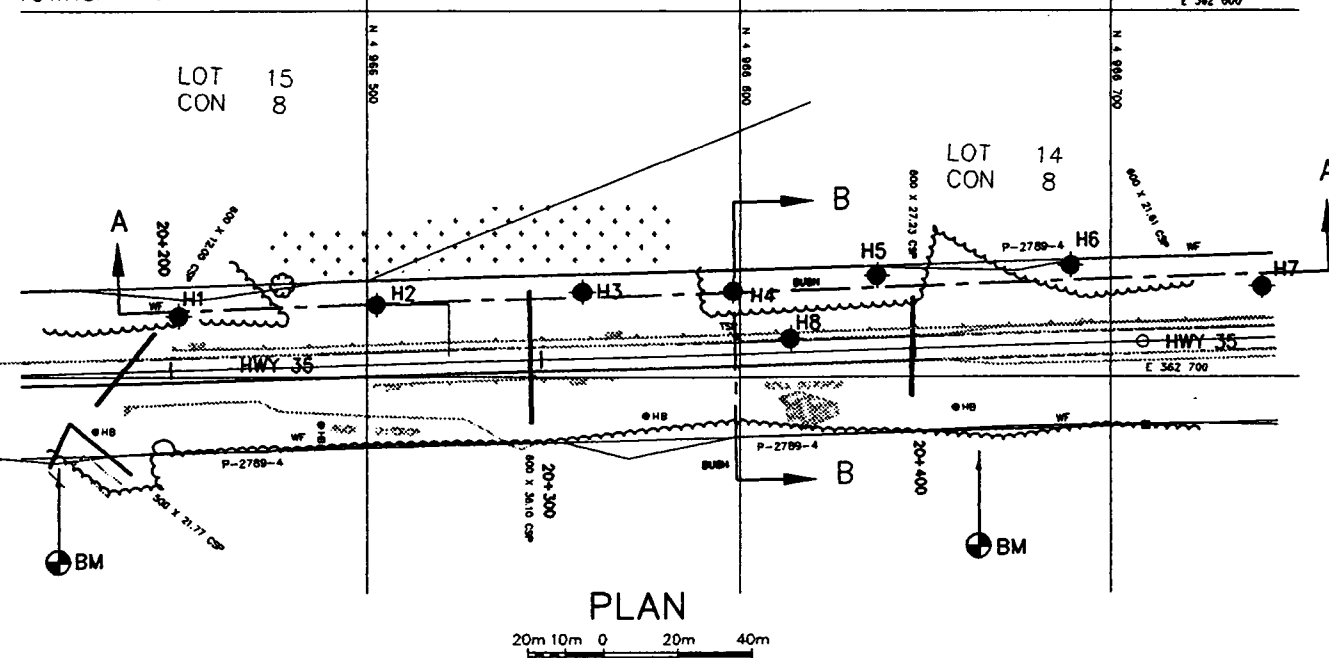
PROFILE A-A

20m 10m 0 20m 40m HOR  
2m 1m 0 2m 4m VER

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COUNTY OF HALIBURTON  
TOWNSHIP OF LUTTERWORTH



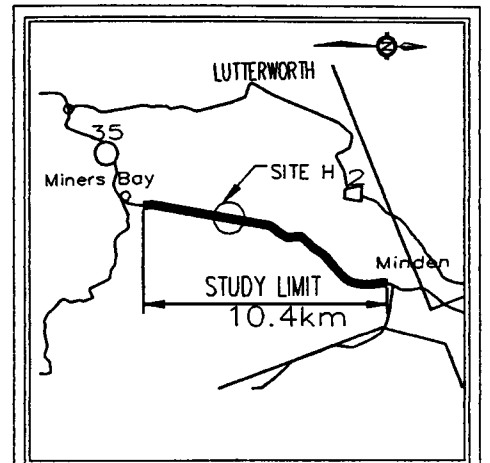
G.W.P. No. 81-99-00

SITE H, STATION 20+200 to 20+500  
BOREHOLE LOCATIONS & SOIL STRATA



SHEET

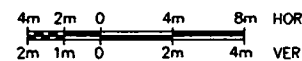
AMEC Earth & Environmental Limited



KEY PLAN

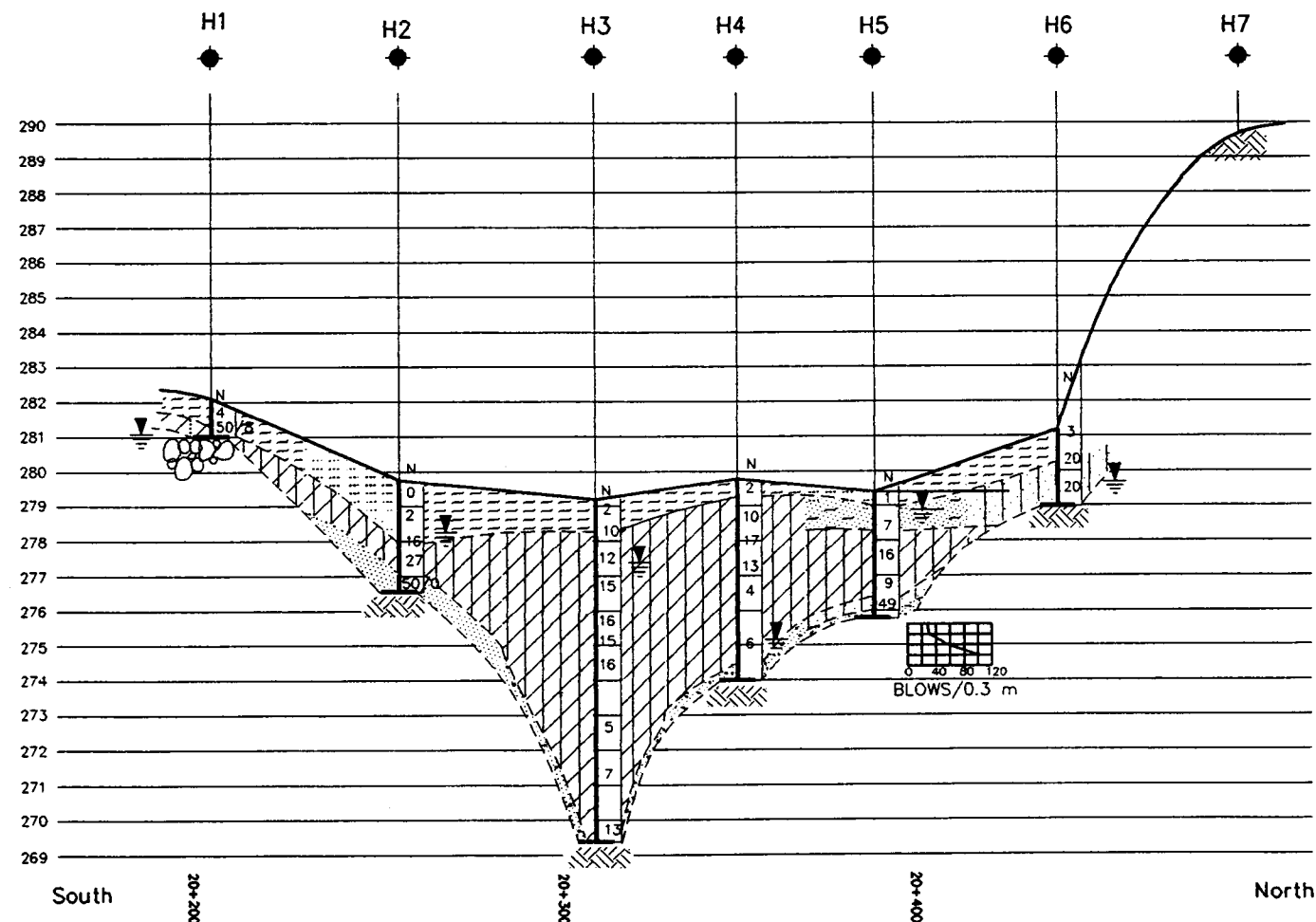
West

SECTION B-B

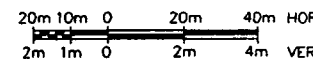


SOIL STRATIGRAPHY LEGEND

- SAND (FILL) trace of Gravel with Cobbles
- BEDROCK
- SAND Trace Silt, Organics Loose
- SAND Trace Silt, Gravel
- ROCKFILL
- CLAYEY SILT to SILTY CLAY Firm to Hard
- PEAT Very Soft to Firm
- SANDY SILT to SILT Compact to Dense



PROFILE A-A



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation - Jan. 01
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES NORTHING	EASTING
H1	282.1	4966449	362685
H2	279.8	4966503	362680
H3	279.2	4966558	362677
H4	279.8	4966598	362676
H5	279.4	4966637	362672
H6	281.2	4966689	362670
H7	289.5	4966741	362675
H8	285.6	4966614	362689

NOTE

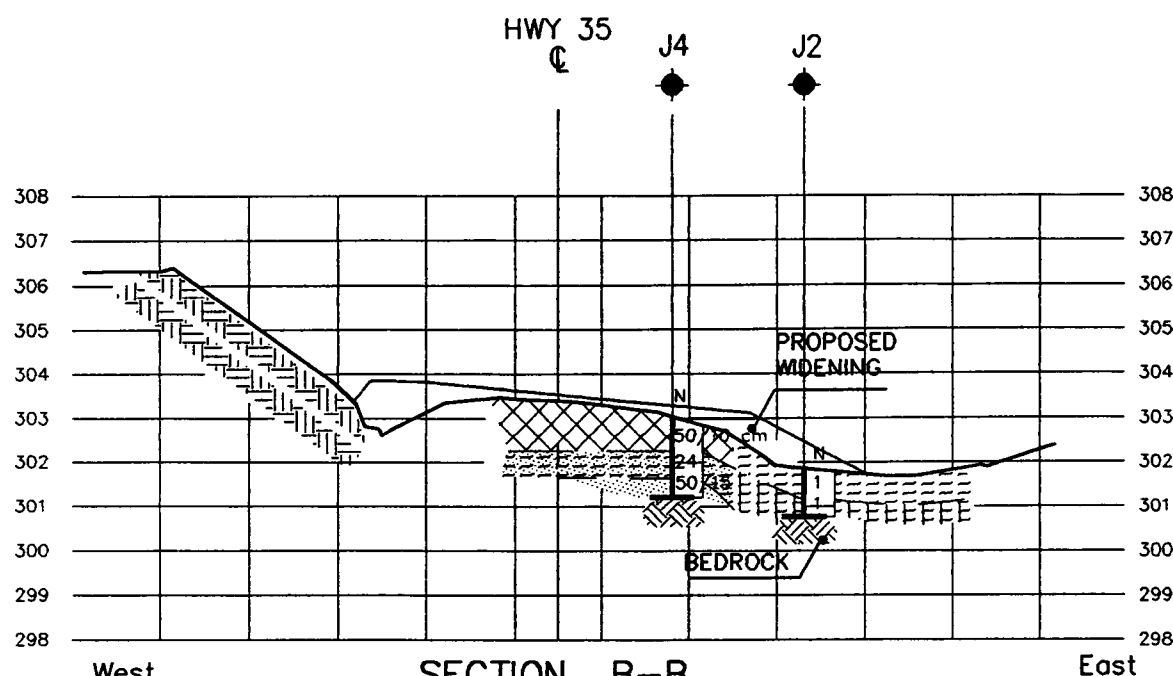
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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

DATE	BY	DESCRIPTION
10/25/01	NS	

HWY No 35	CHECKED KSH	DATE DEC., 2001	DIST 52
SUBM'D AD	CHECKED		SITE
DRAWN NS	CHECKED		DWG H

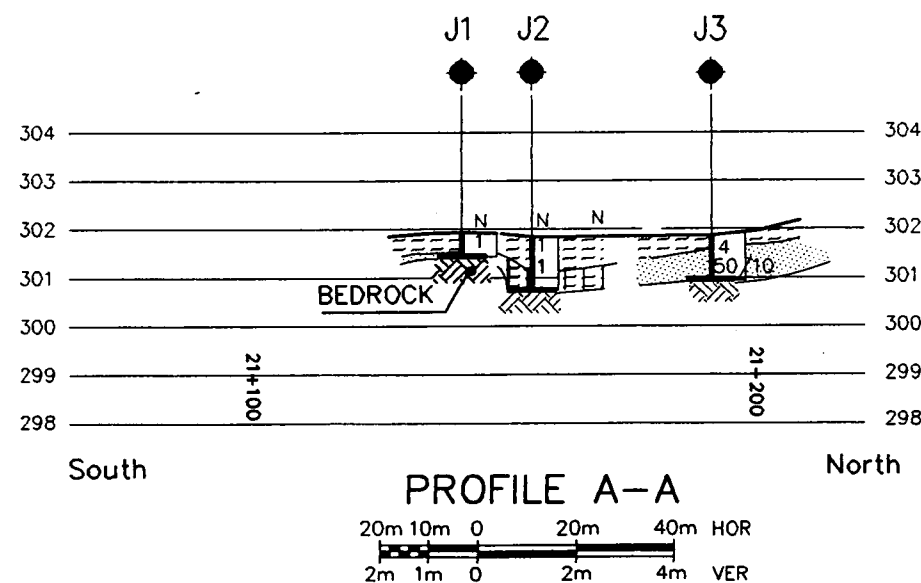
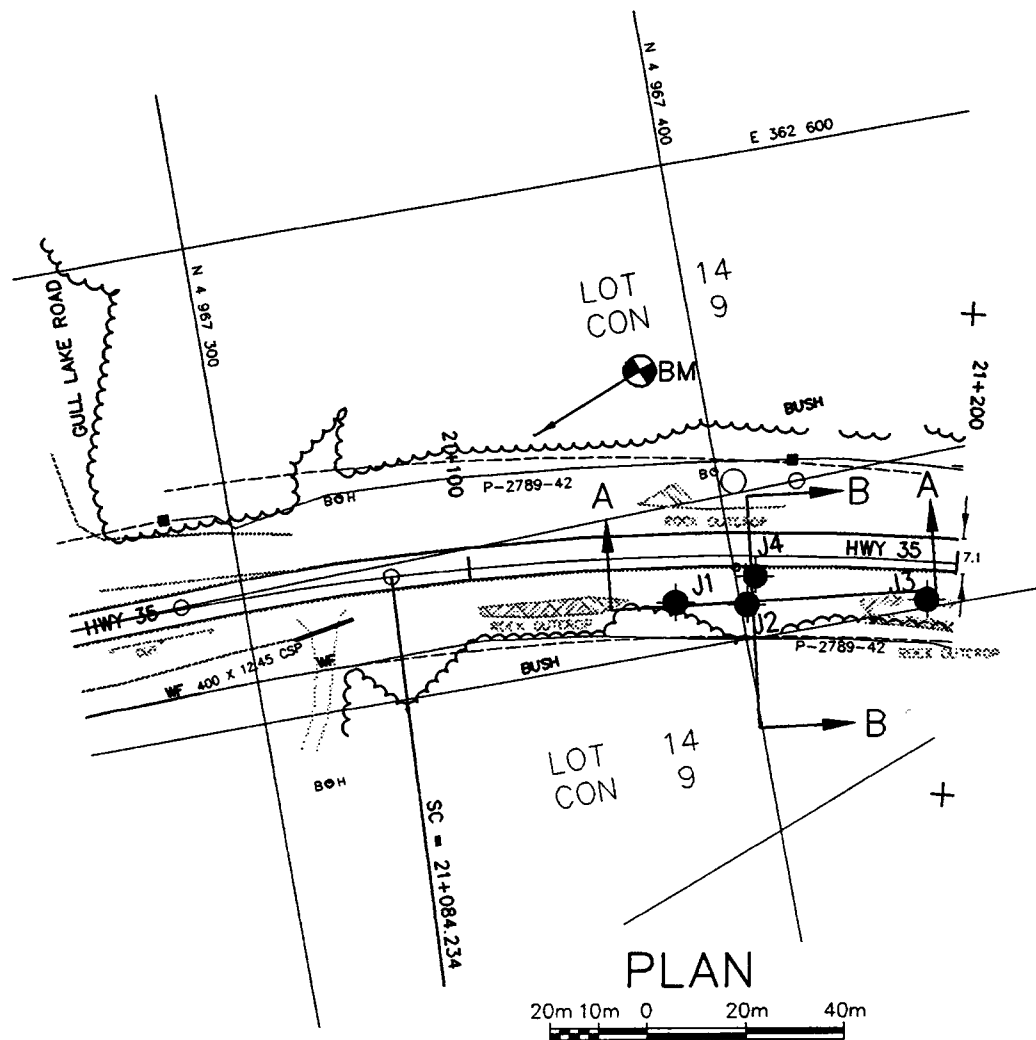
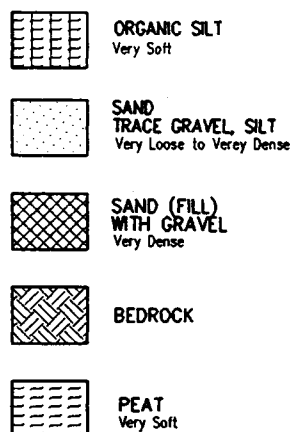
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4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER



#### SOIL STRATIGRAPHY LEGEND



20m 10m 0 20m 40m HOR  
2m 1m 0 2m 4m VER



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

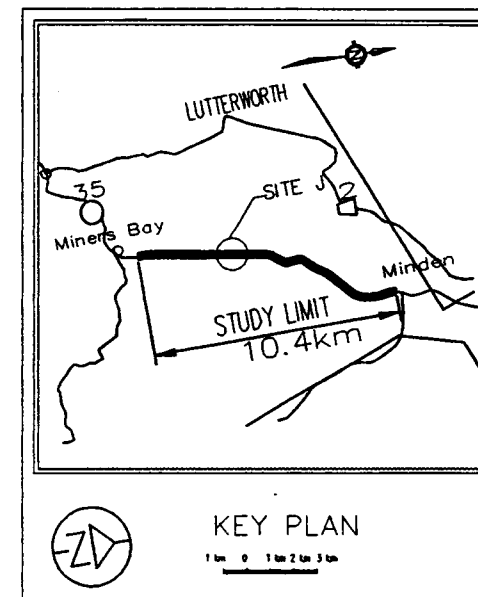
G.W.P. No. 81-99-00



SITE J, STATION 21+140 to 21+190  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

AMEC Earth & Environmental Limited



KEY PLAN  
1m 0 1m 2m 3m

#### LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation (Nov.-Dec., 00)
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES STATION	OFFSET
J1	301.9	4967387	362690
J2	301.8	4967401	362693
J3	301.9	4967411	362694
J4	303.0	4967404	362687

#### -NOTE-

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

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

DATE	BY	DESCRIPTION
10/20/01	NS	

HWY No 35	CHECKED KSH	DATE Feb., 2001	DIST 52
SUBM'D AD	CHECKED		SITE
DRAWN NS	CHECKED		DWG J

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

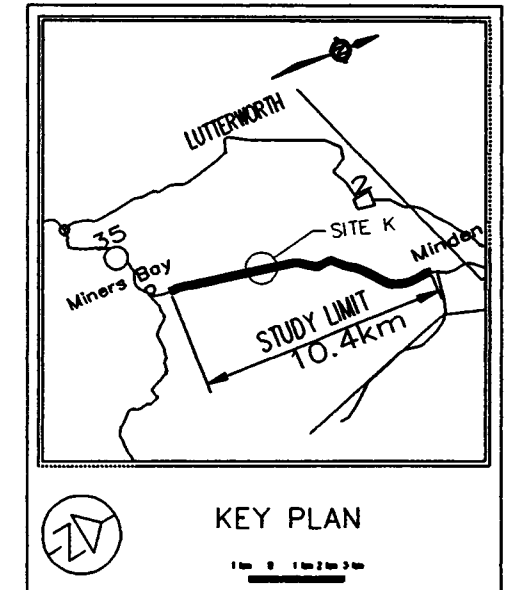
G.W.P. No. 81-99-00



SITE K, STATION 21+250 to 21+350  
BOREHOLE LOCATIONS & SOIL STRATA

SHEET

AMECEarth & Environmental Limited



**LEGEND**

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- ↓ WL at time of investigation - Nov. 00
- ↓ WL in Piezometer
- Piezometer
- ⊥ End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
K1	300.9	4967495	362687
K2	298.8	4967535	362703
K3	299.9	4967556	362711
K4	304.0	4967541	362718

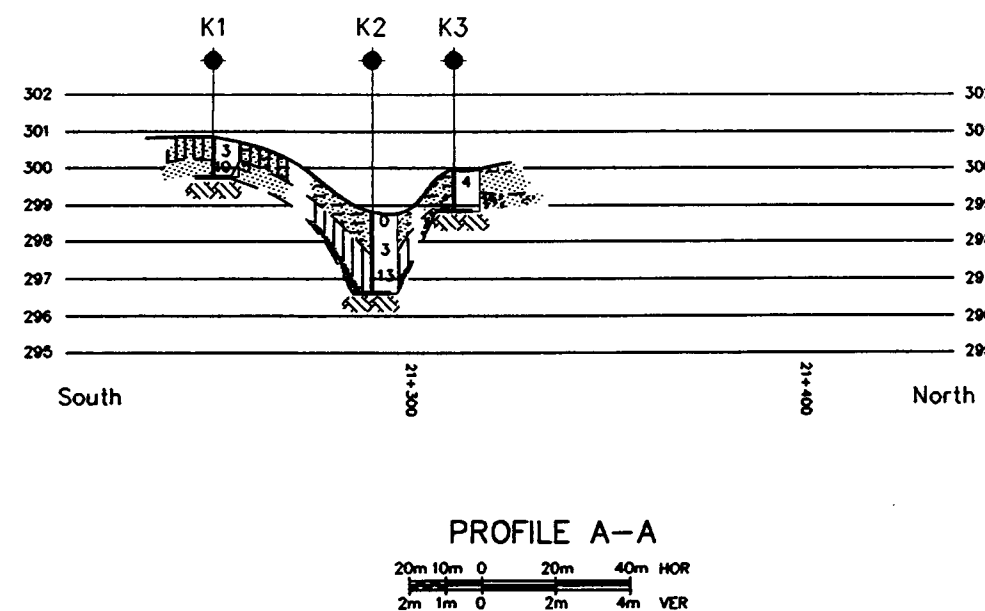
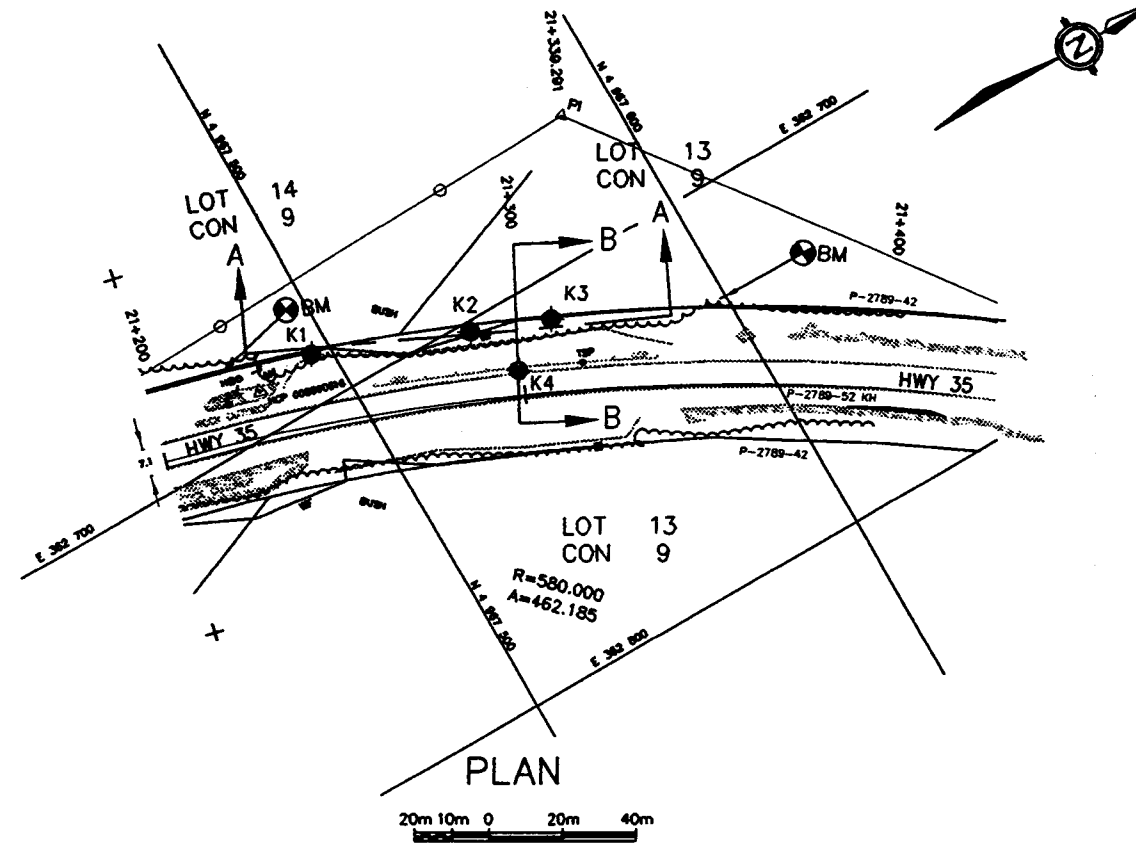
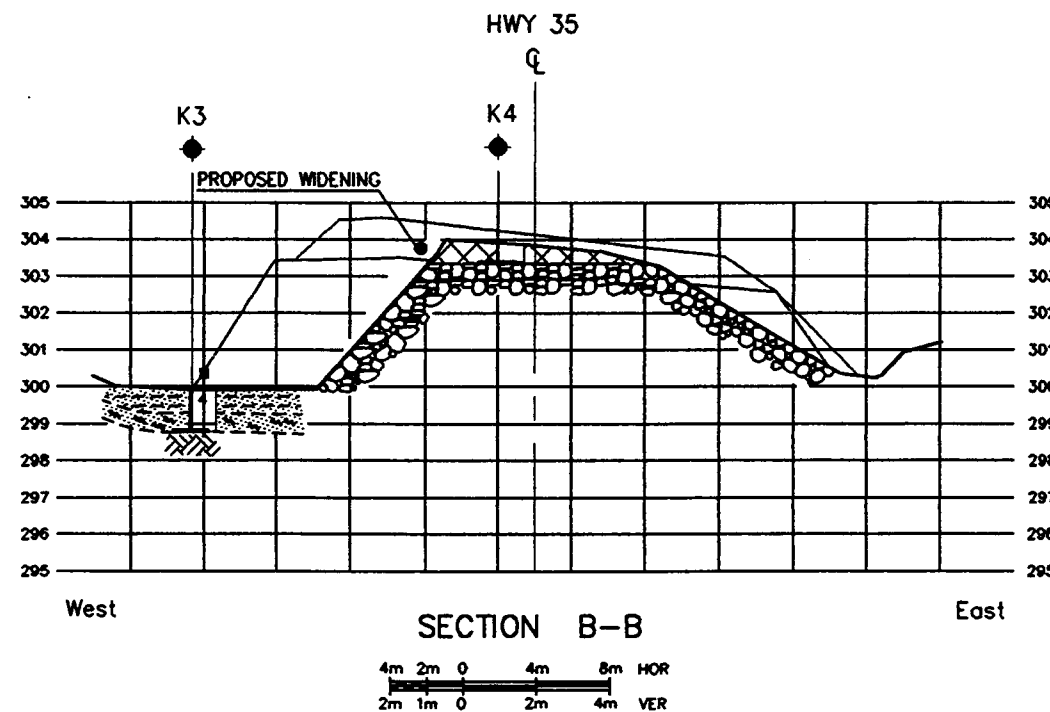
**-NOTE-**

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

DATE	BY	DESCRIPTION
10/2/00	NS	

HWY No 35		DIST 52	
SUBM'D AD	CHECKED KSH	DATE Feb., 2001	SITE
DRAWN NS	CHECKED	DWG K	

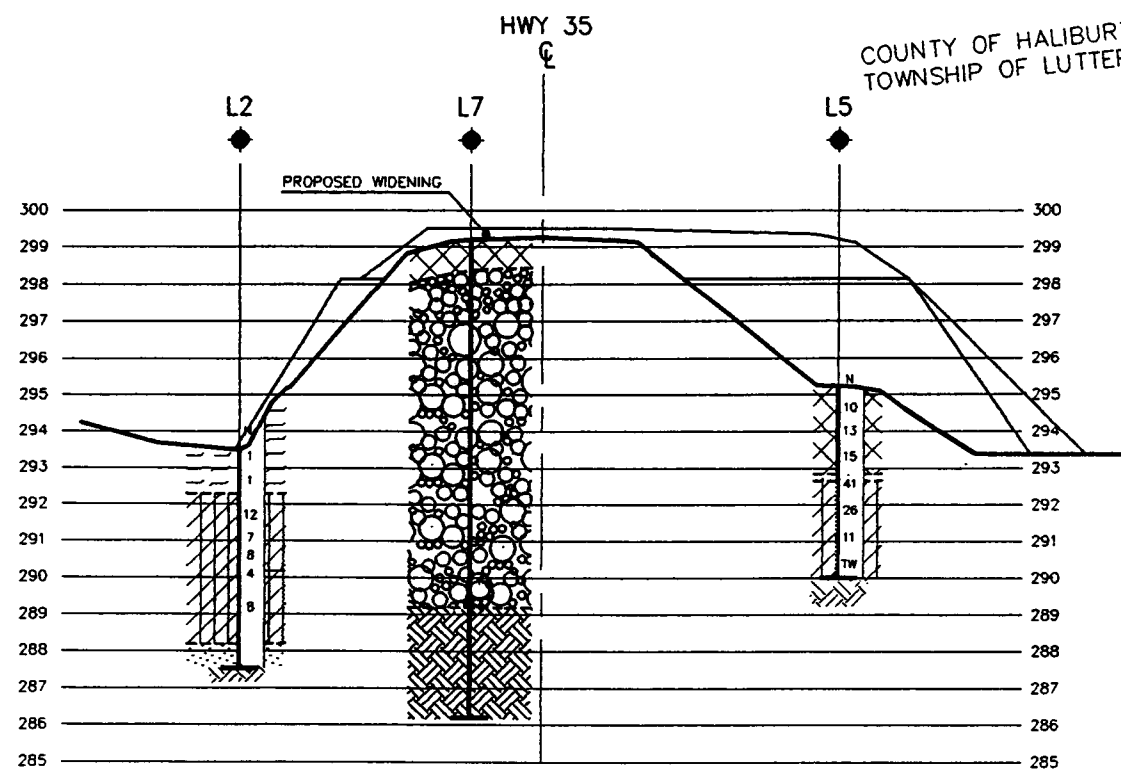


**SOIL STRATIGRAPHY LEGEND**

- BEDROCK
- SAND with PEAT LAYERS  
trace Gravel  
very loose
- SILT  
trace CLAY  
very loose to compact
- SILTY SAND to SAND  
trace Gravel  
very loose to compact
- SAND (FILL)  
with GRAVEL
- ROCKFILL



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SECTION C-C

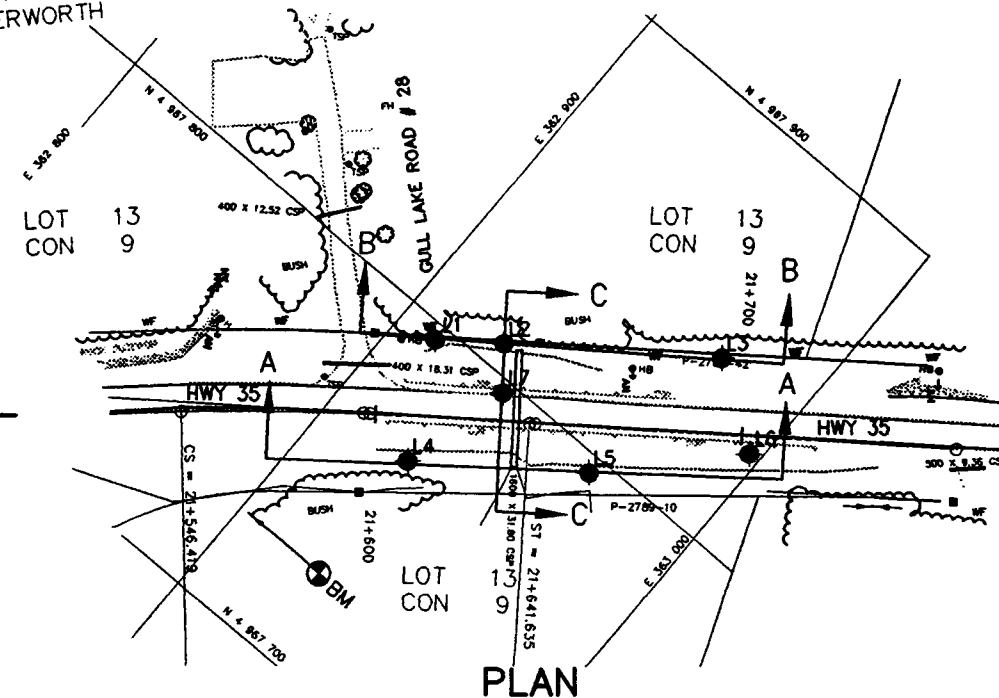
4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER

# SOIL STRATIGRAPHY LEGEND

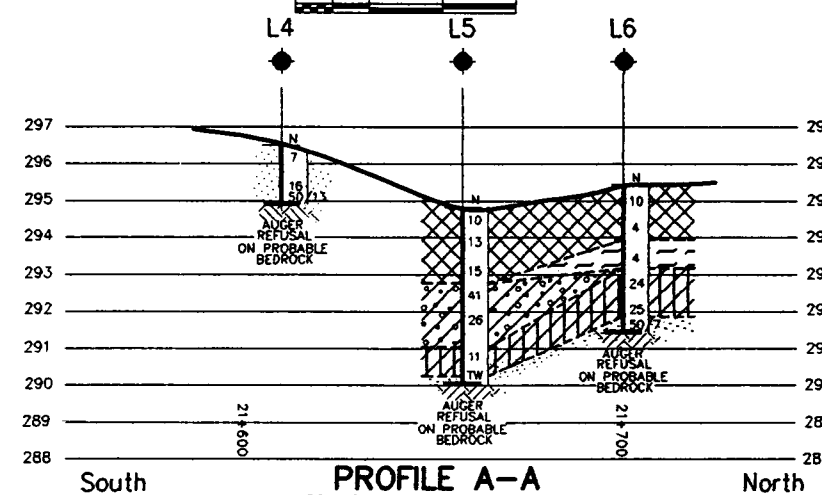
- CLAYEY SILT  
With Peat Layers  
Very Soft
- ROCKFILL
- CLAYEY SILT  
Massive to Varved  
Firm to Stiff
- SAND  
With Gravel to with Silt  
Loose to Very Dense
- Inferred  
BEDROCK
- SAND (FILL)  
trace Gravel, Silt, Organics  
Occasional Cobbles  
Compact
- PEAT  
Very Soft to Soft
- CLAYEY SILT  
(GLACIAL TILL)  
Very Stiff to Hard



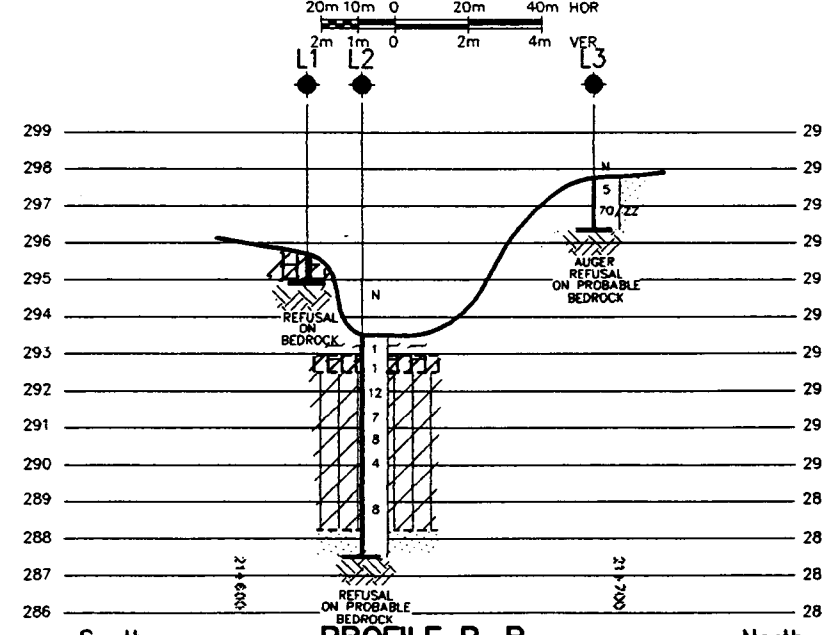
COUNTY OF HALIBURTON  
TOWNSHIP OF LUTTERWORTH



PLAN



PROFILE A-A



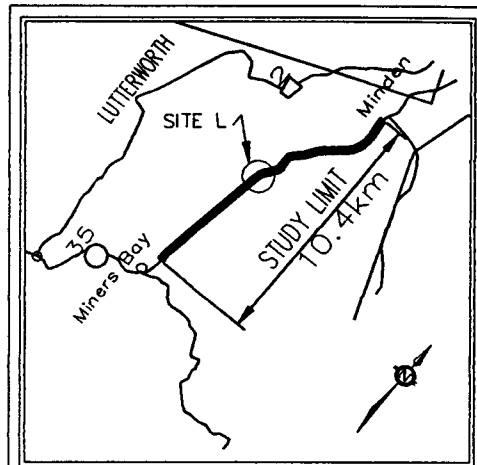
PROFILE B-B

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

G.W.P. No. 081-99-00

SITE L, STATION 21+600 to 21+700  
BOREHOLE LOCATION & SOIL STRATA

AMEC Earth & Environmental Limited



KEY PLAN

# LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation - Nov 2000
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES NORTHING	EASTING
L1	295.7	4967795	362911
L2	293.5	4967807	362926
L3	297.7	4967835	362974
L4	296.5	4967765	362926
L5	294.8	4967795	362966
L6	295.4	4967820	362996
L7	299.4	4967796	362934

# -NOTE-

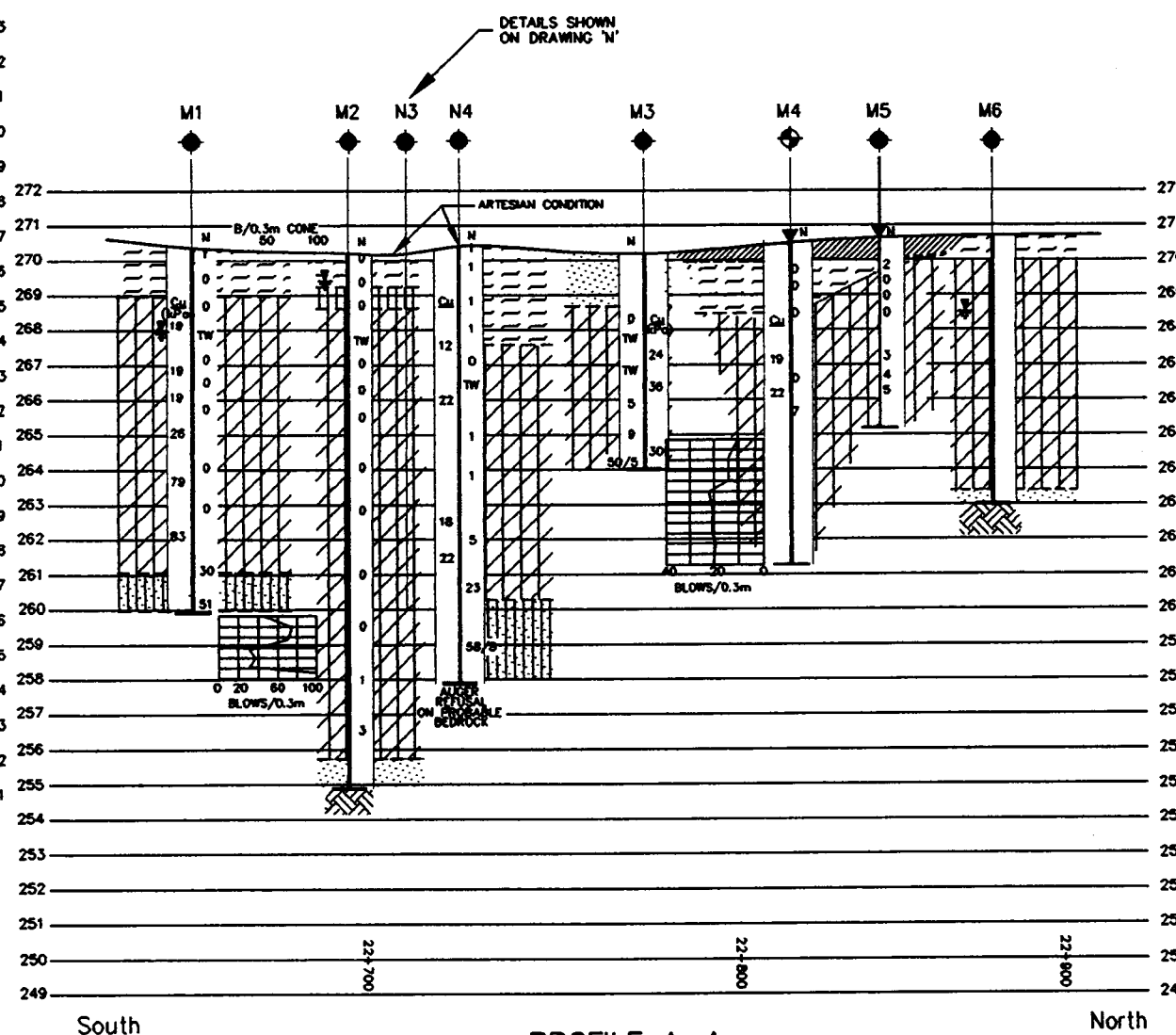
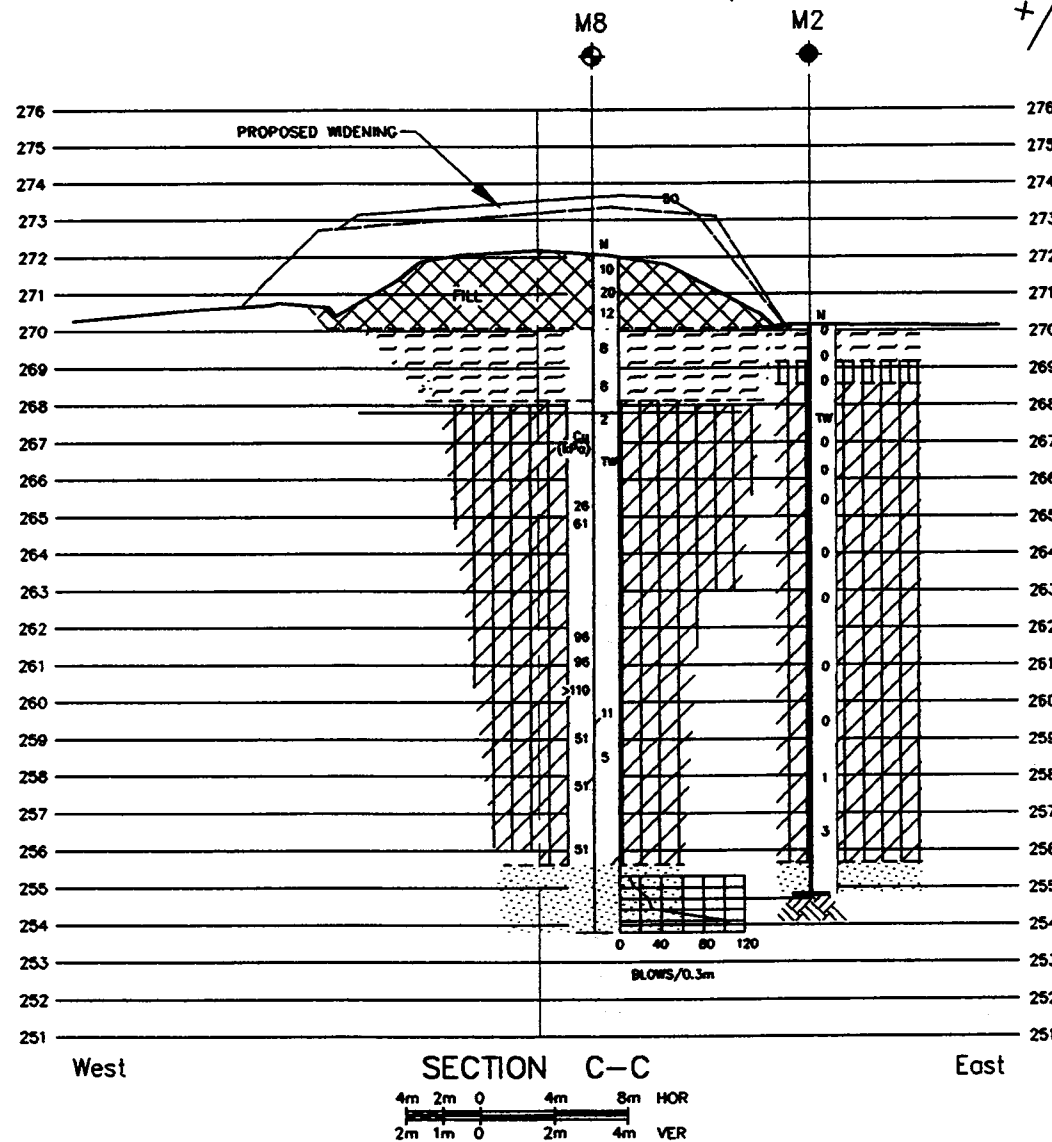
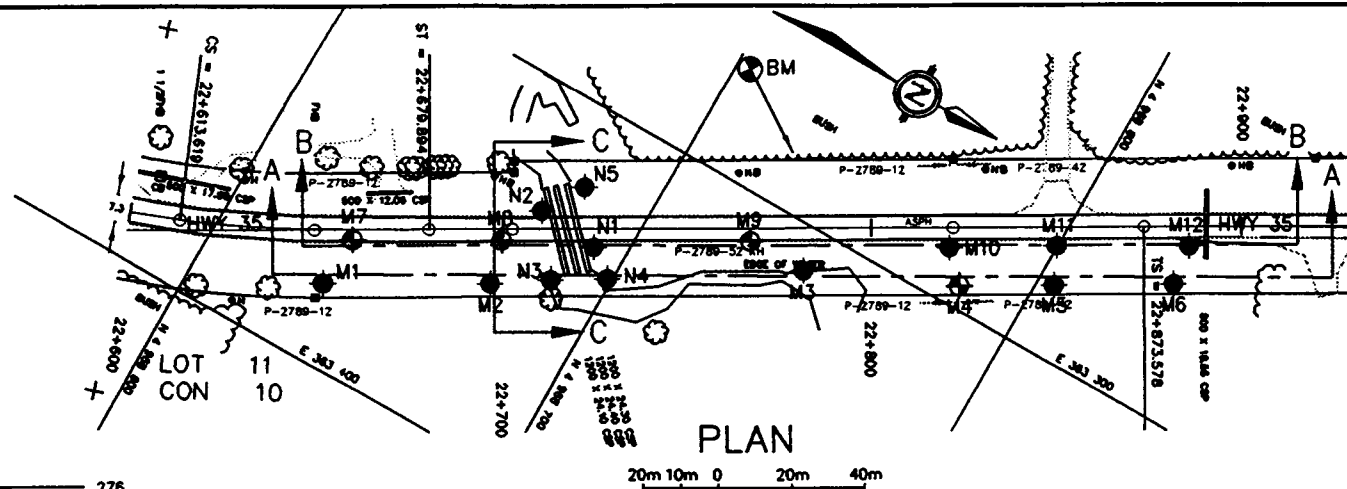
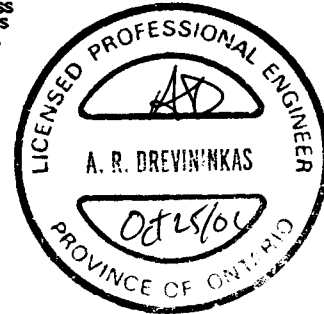
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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

DATE	BY	DESCRIPTION
12/1/2001	NS	

HWY No 35	CHECKED KSH	DATE Jan., 2001	DIST 52
SUBM'D AD	CHECKED		SITE
DRAWN KW	CHECKED		DWG L

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



**SOIL STRATIGRAPHY LEGEND**

- |                                  |  |   |
|----------------------------------|--|---|
| SAND TO SILTY SAND (FILL)        | SAND (trace to with Gravel)                  | CLAYEY SILT TO SILTY CLAY                       |
| TRACE GRAVEL Compact             | SAND (trace to with Silt)                    | Massive to Varved                               |
| PEAT                             | BEDROCK                                      | SILTY SAND TO SILTY SAND (trace to with Gravel) |
| CLAYEY SILT (FILL)               | SILTY SAND TO CLAYEY SILT WITH PEAT/ORGANICS | WATER   |
| SILTY SAND TO CLAYEY SILT (FILL) | Very Loose to Loose                          |   |
| Very Loose to Compact            |  |   |

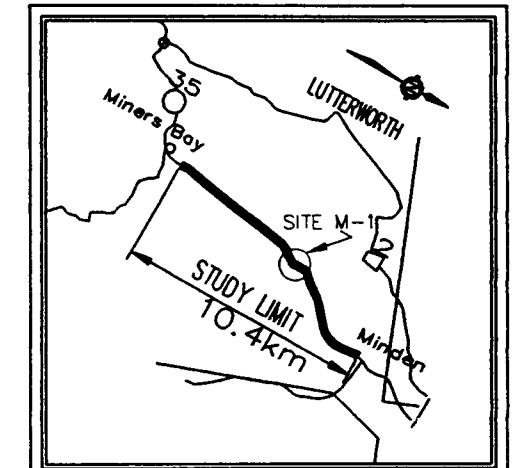
G.W.P. No. 081-99-00

SITE M, STATION 22+650 to 22+900  
BOREHOLE LOCATION & SOIL STRATA



SHEET

AMEC Earth & Environmental Limited



KEY PLAN

1 km 0 1 km 2 km 3 km

**LEGEND**

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation - Nov - Dec 2000, Jan 2001
- WL in Piezometer
- Piezometer
- End of Borehole
- Cu Undrained Shear Strength of Cohesive Soil (kPa)

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
M1	270.4	4968632	363379
M2	270.2	4968671	363366
M3	270.2	4968743	363311
M4	270.5	4968762	363283
M5	270.6	4968804	363281
M6	270.7	4968832	363284
M7	271.5	4968633	363365
M8	271.6	4968668	363345
M9	272.2	4968727	363312
M10	272.7	4968774	363286
M11	272.9	4968799	363271
M12	273.6	4968830	363253
N3	270.2	4968685	363347
N4	270.4	4968686	363330

**-NOTE-**

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

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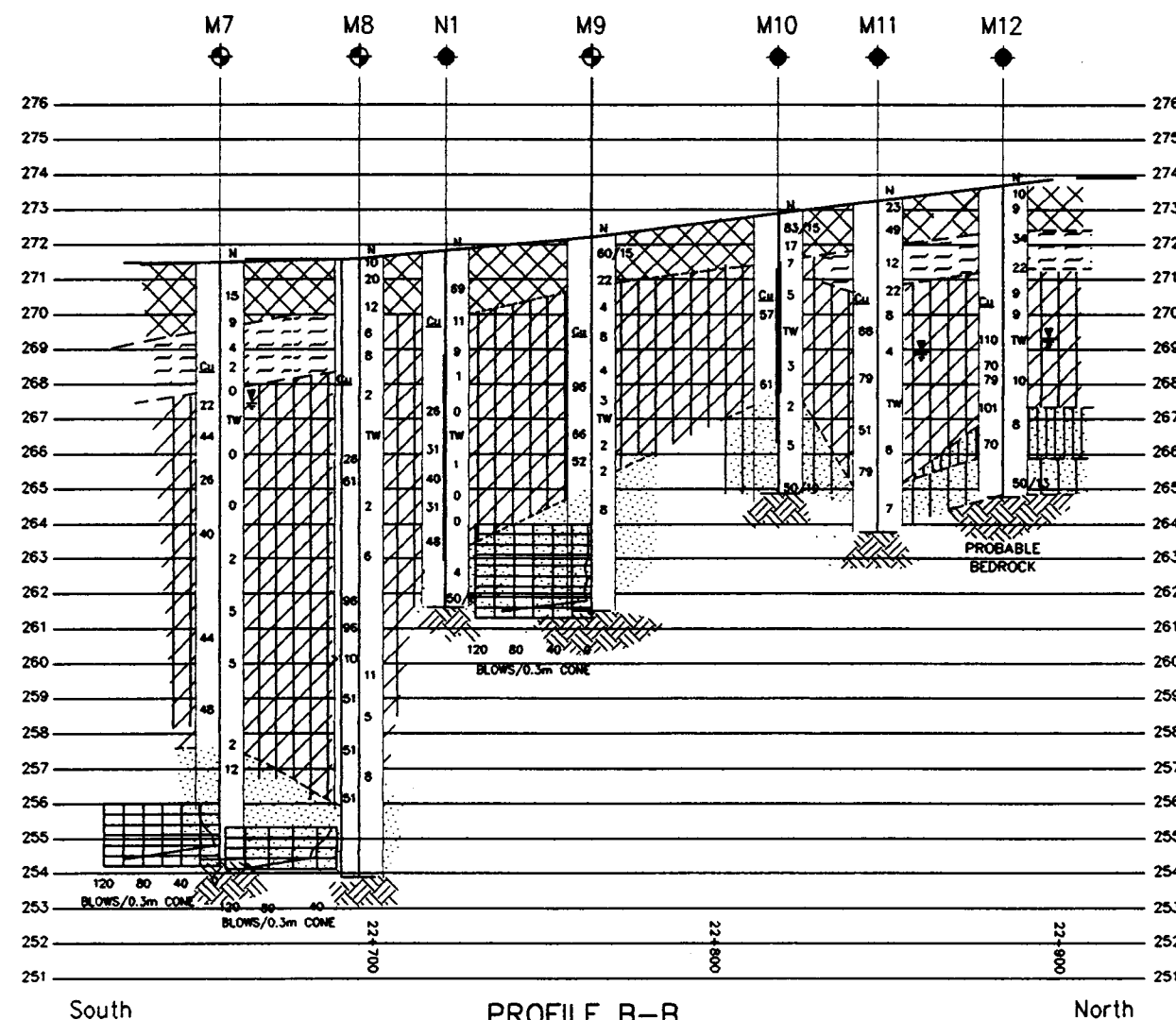
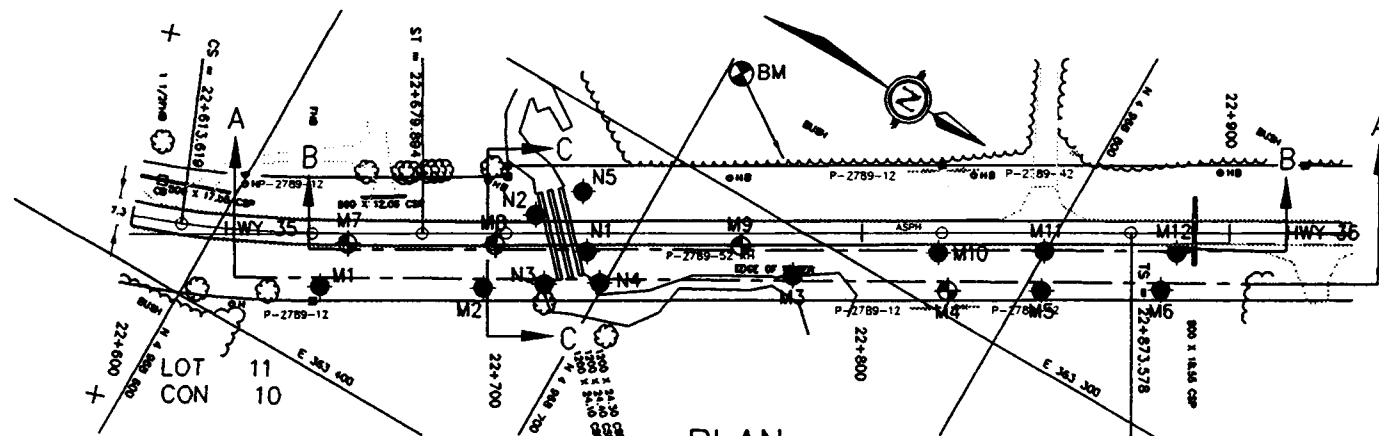
DATE	BY	DESCRIPTION

HWY No 35	CHECKED KSH	DATE Jan, 2001	DIST 52
SUBM'D AD	CHECKED		SITE
DRAWN KW	CHECKED		DWG M-1



#### SOIL STRATIGRAPHY LEGEND

- CLAYEY SILT TO SILTY CLAY  
Massive to Varved  
Very Soft to Stiff
- SANDY SILT TO SILTY SAND  
Trace to with Gravel  
Very Loose to Compact
- BEDROCK
- SILTY SAND TO CLAYEY SILT  
WITH PEAT/ORGANICS  
Very Loose/Very Soft
- CLAYEY SILT  
(FILL)  
Stiff
- SAND  
Trace to with Gravel  
Trace to with Silt  
Very Loose to Loose
- SAND TO SILTY SAND  
(FILL)  
TRACE GRAVEL  
Compact
- PEAT



20m 10m 0 20m 40m HOR  
2m 1m 0 2m 4m VER

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

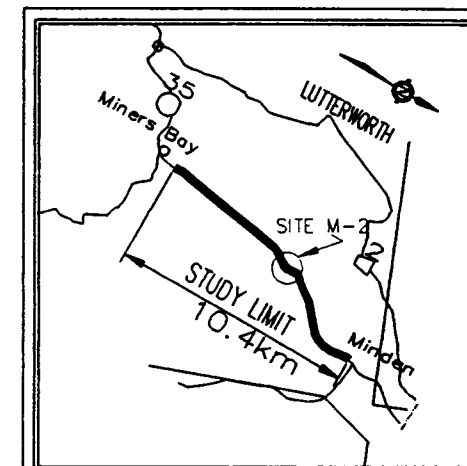
G.W.P. No. 081-99-00



SITE M, STATION 22+650 to 22+900  
BOREHOLE LOCATION & SOIL STRATA

SHEET

AMEC Earth & Environmental Limited



KEY PLAN

#### LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- Blows/0.3m (Std Pen Test, 475 J/blow)
- Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation -  
Nov - Dec 2000, Jan 2001
- WL in Piezometer
- Piezometer
- End of Borehole
- Undrained Shear Strength  
of Cohesive Soil (KPa)

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
M1	270.4	4968632	363379
M2	270.2	4968671	363366
M3	270.2	4968743	363311
M4	270.5	4968782	363293
M5	270.6	4968804	363281
M6	270.7	4968832	363264
M7	271.5	4968633	363365
M8	271.6	4968668	363345
M9	272.2	4968727	363312
M10	272.7	4968774	363286
M11	272.9	4968799	363271
M12	273.6	4968830	363253
N1	272.0	4968691	363334

#### -NOTE-

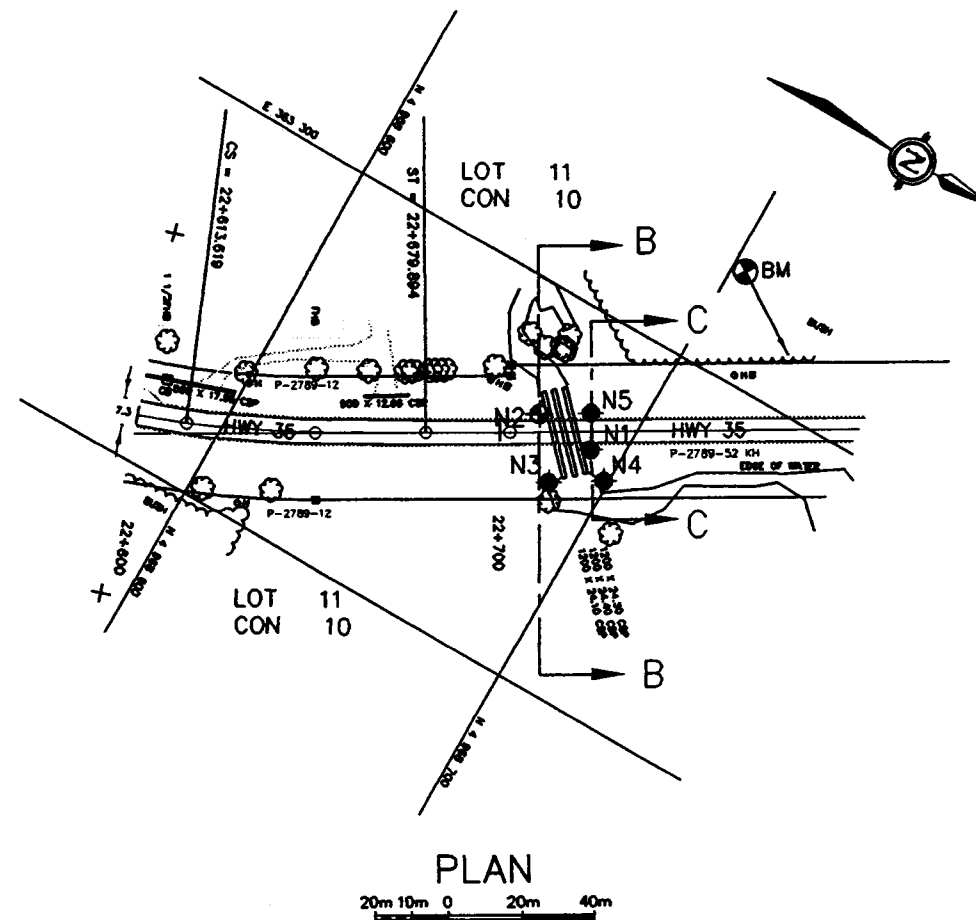
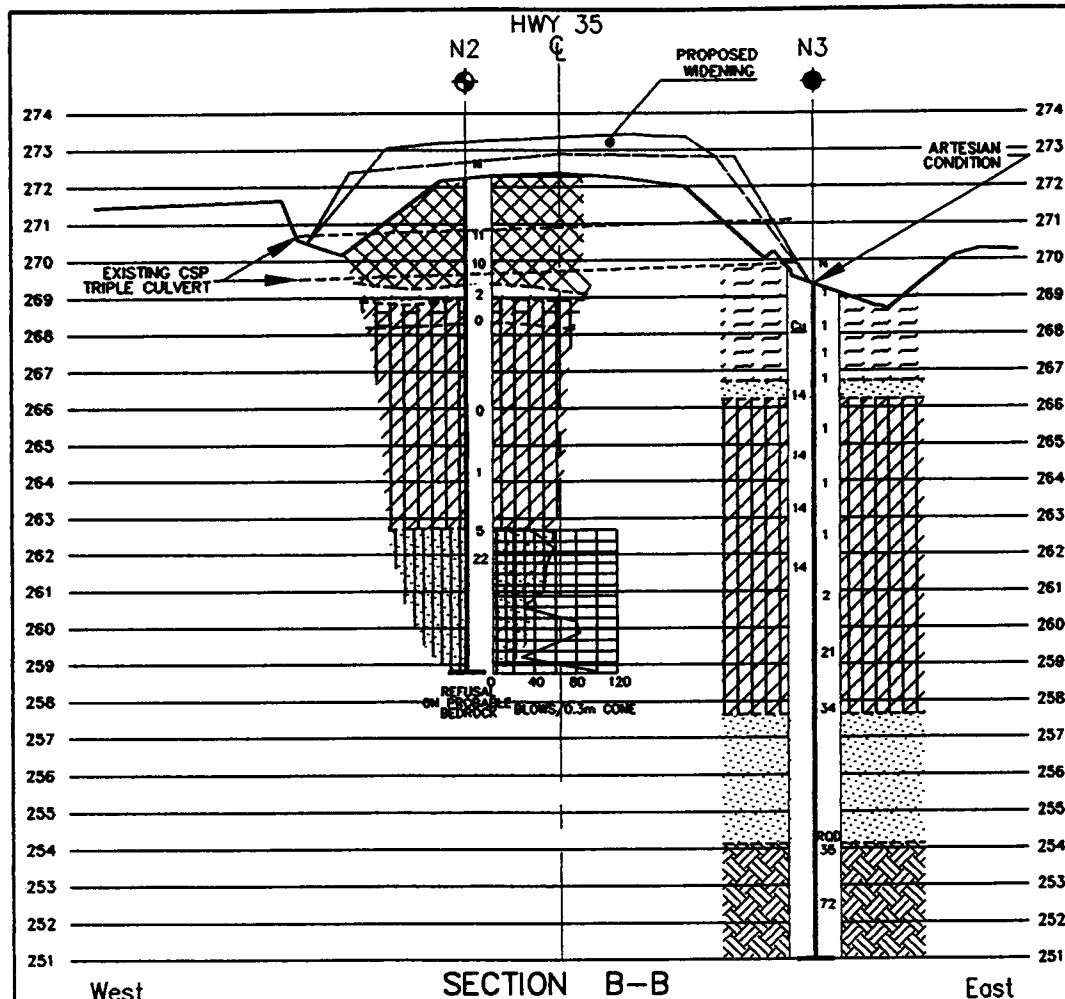
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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REV	DATE	BY	DESCRIPTION
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HWY No 35			DIST 52
SUBM'D AD	CHECKED KSH	DATE Jan., 2001	SITE
DRAWN KW	CHECKED	<del>DATE</del>	DWG M-2





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

G.W.P. No. 081-99-00

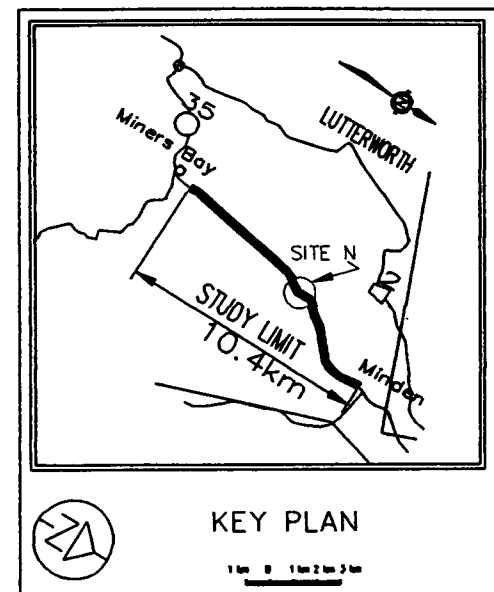
SITE N, STATION 23+700 to 23+725

BORE HOLE LOCATIONS & SOIL STRATA



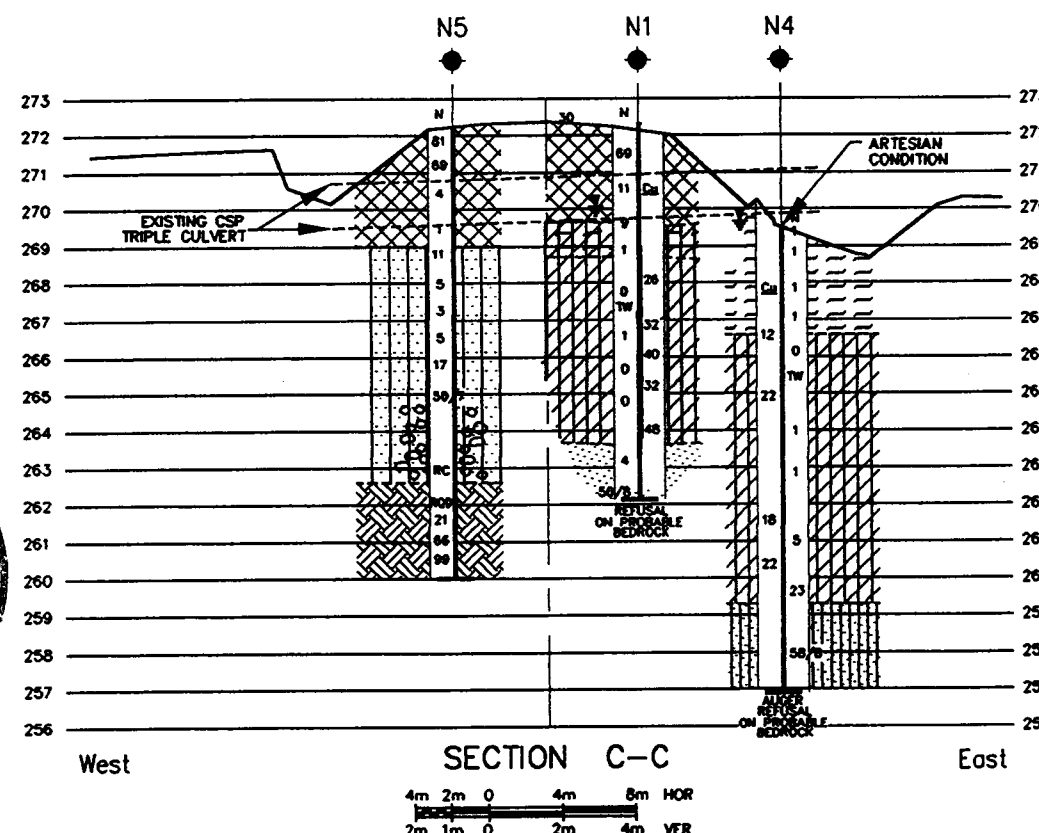
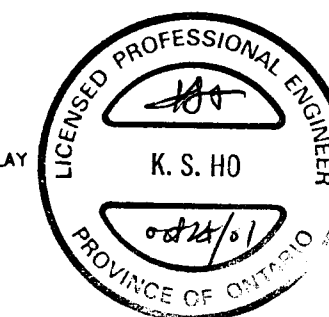
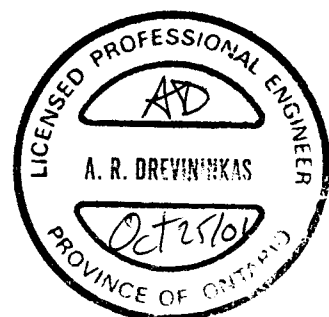
SHEET

AMEC Earth & Environmental Limited



# SOIL STRATIGRAPHY LEGEND

- SANDY GRAVEL  
very loose to compact
- SILTY SAND  
with Gravel  
Compact
- CLAYEY SILT TO SILTY CLAY  
Massive  
Very Soft to Stiff
- PEAT  
Soft
- CLAYEY SILT  
with Organics  
very soft
- SAND (FILL)  
with Gravel, trace Silt  
Occasional Cobbles  
Compact



LEGEND			
◆	Bore Hole		
⊕	Dynamic Cone Penetration Test (Cone)		
◆	Bore Hole & Cone		
'N'	Blows/0.3m (Std Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60° Cone, 475 J/blow)		
↓	WL at time of investigation - Nov - Dec 2000, Jan 2001		
↓	WL in Piezometer		
⊥	Piezometer		
⊥	End of Borehole		
Cu	Undrained Shear Strength of Cohesive Soil (KPa)		

No	ELEVATION	CO-ORDINATES NORTHING	EASTING
N1	272.0	4968691	363334
N2	272.0	4968674	363332
N3	270.2	4968685	363347
N4	270.4	4968696	363330
N5	272.1	4968684	363325

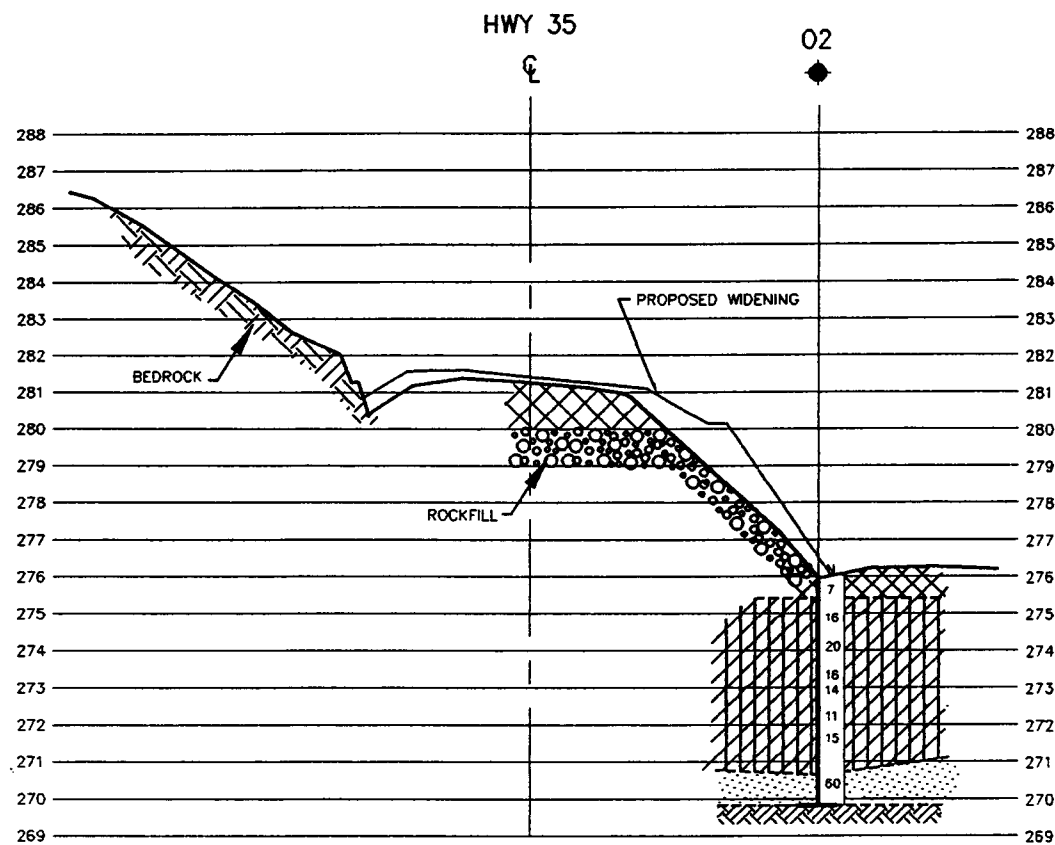
NOTE -  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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DATE	BY	DESCRIPTION
10/24/01	NS	

HWY No 35	CHKD KSH	DATE Jan, 2001	DIST 52
SUPV'D AD	CHKD KSH	DATE Jan, 2001	SITE
DRAWN KW	CHKD	DATE	DWG N



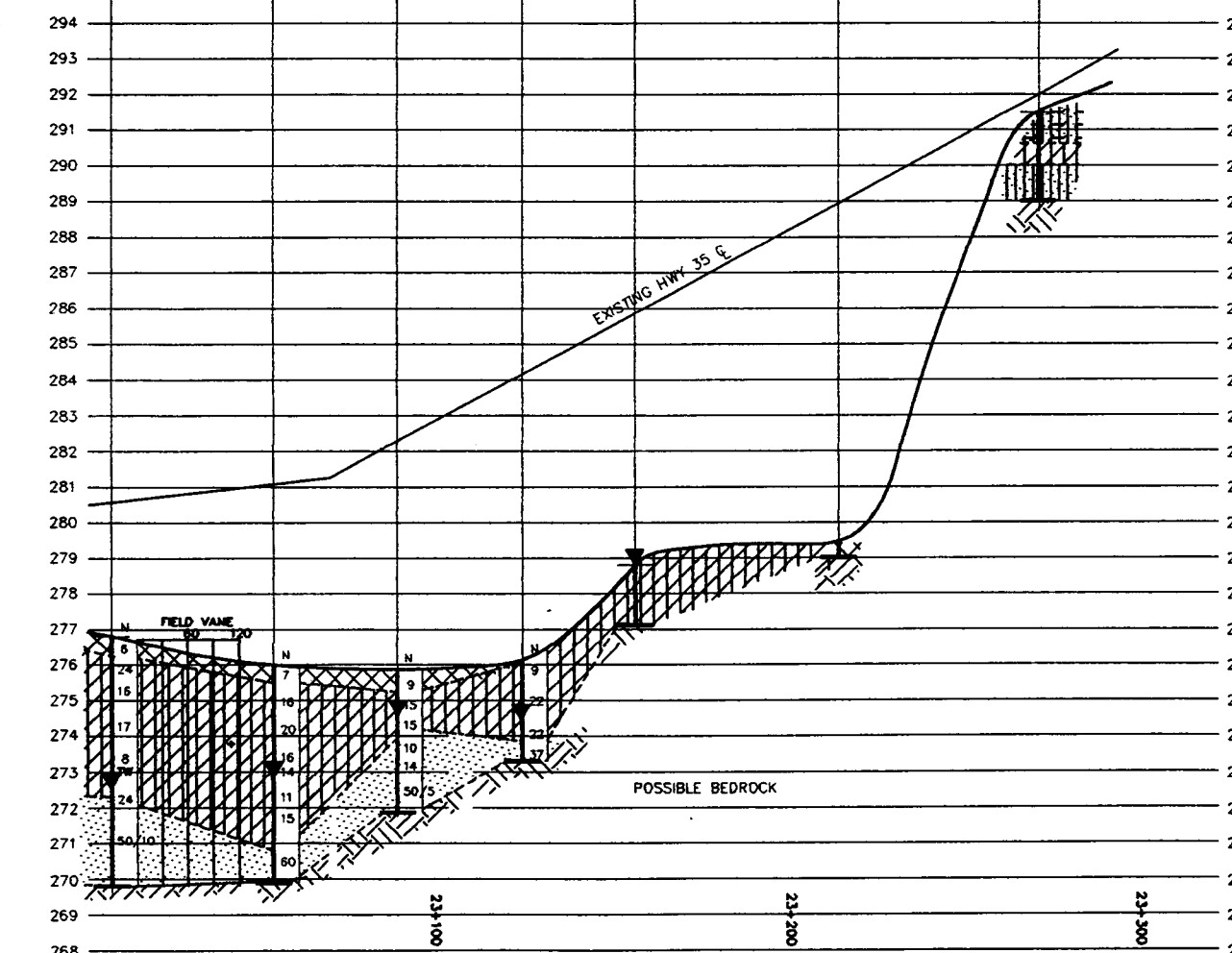
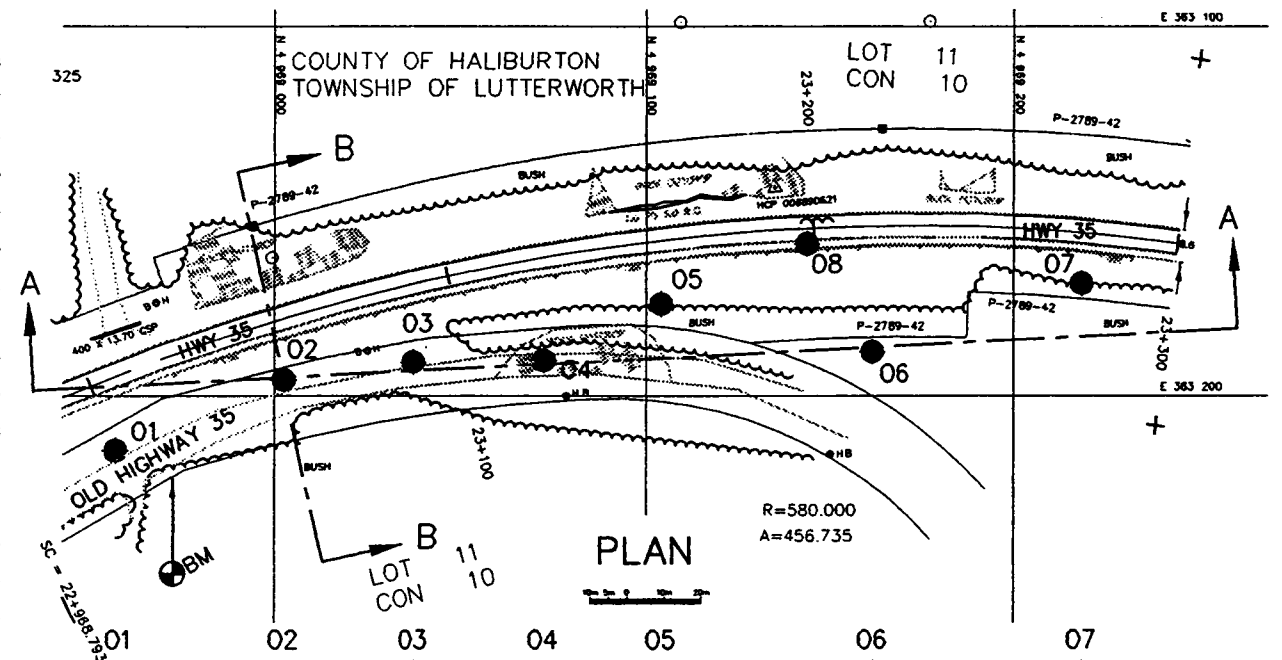
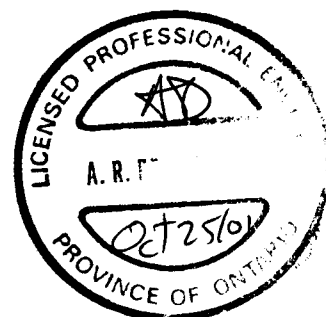


SECTION B-B

4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER

SOIL STRATIGRAPHY LEGEND

- SAND (FILL) WITH GRAVEL
- LOOSE CLAYEY SILT (FILL)
- SILTY SAND TRACE GRAVEL
- CLAYEY SILT Varved
- BEDROCK
- CLAYEY SILT WITH ROOTLETS WOOD FRAGMENTS
- SAND TRACE TO WITH GRAVEL FREQUENT COBBLES
- Compact to Very Dense



PROFILE A-A

20m 10m 0 20m 40m HOR  
2m 1m 0 2m 4m VER

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

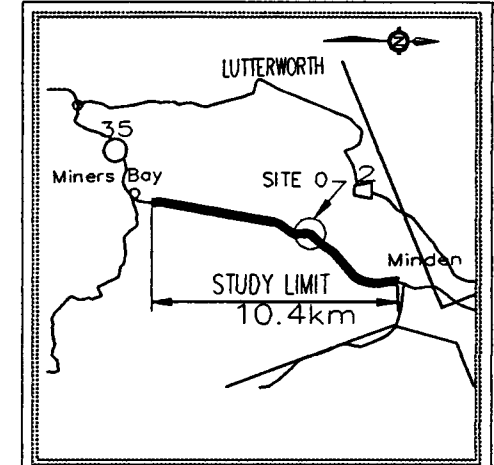
G.W.P. No. 081-99-00

SITE 0. STATION 23+000 to 23+300  
BORE HOLE LOCATIONS & SOIL STRATA



SHEET

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KEY PLAN

1 km 0 1 km 2 km 3 km

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation - Nov 2000
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES NORTHING	EASTING
01	276.8	4968957	363208
02	275.9	4969002	363195
03	275.8	4969037	363190
04	276.1	4969072	363190
05	278.8	4969104	363175
06	279.5	4969161	363188
07	291.5	4969218	363169
08	289.3	4969143	363158

NOTE

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DATE	2001	NS	DESCRIPTION
DIST	52		
SUB'D AD	CHECKED KSH	DATE Jan., 2001	SITE
DRAWN KW	CHECKED		DWG 0

COUNTY OF HALIBURTON  
TOWNSHIP OF LUTTERWORTH

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

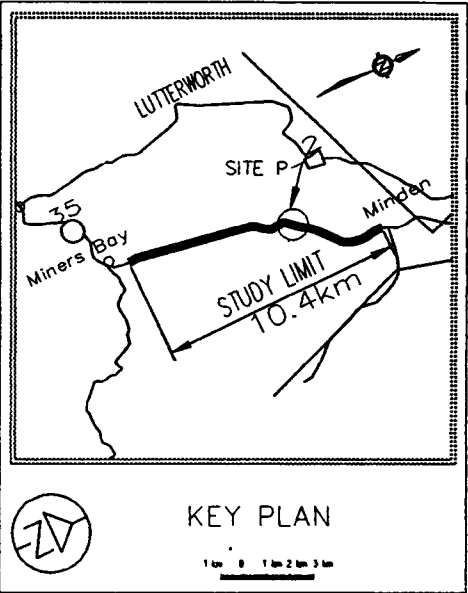
W.P. No. 081-99-00



SITE P. STATION 23+500 to 23+650  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

AMEC Earth & Environmental Limited



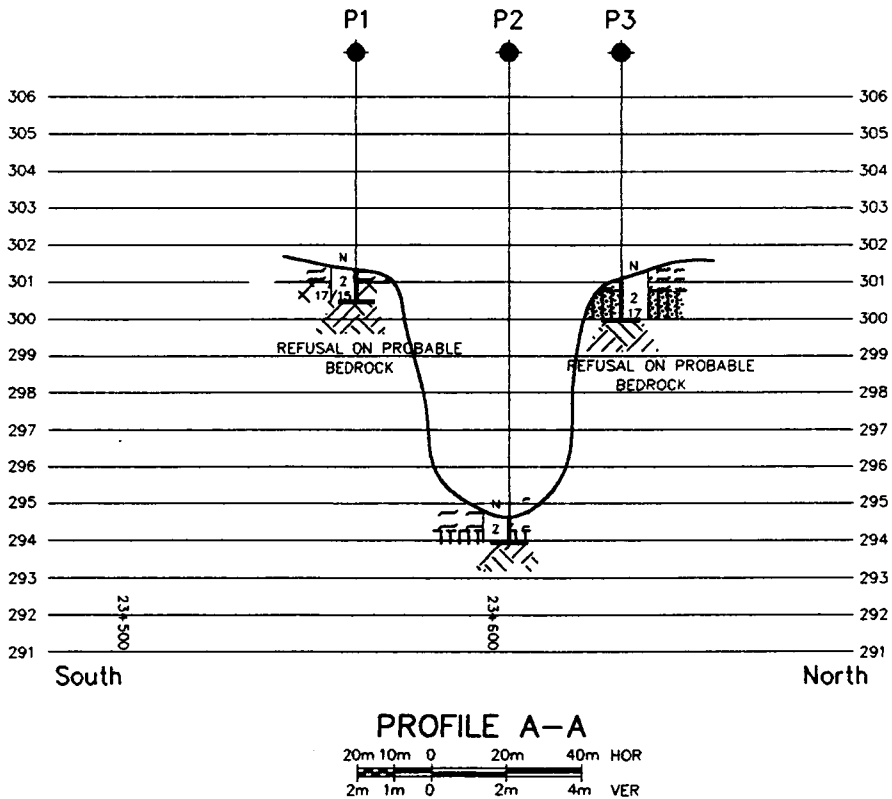
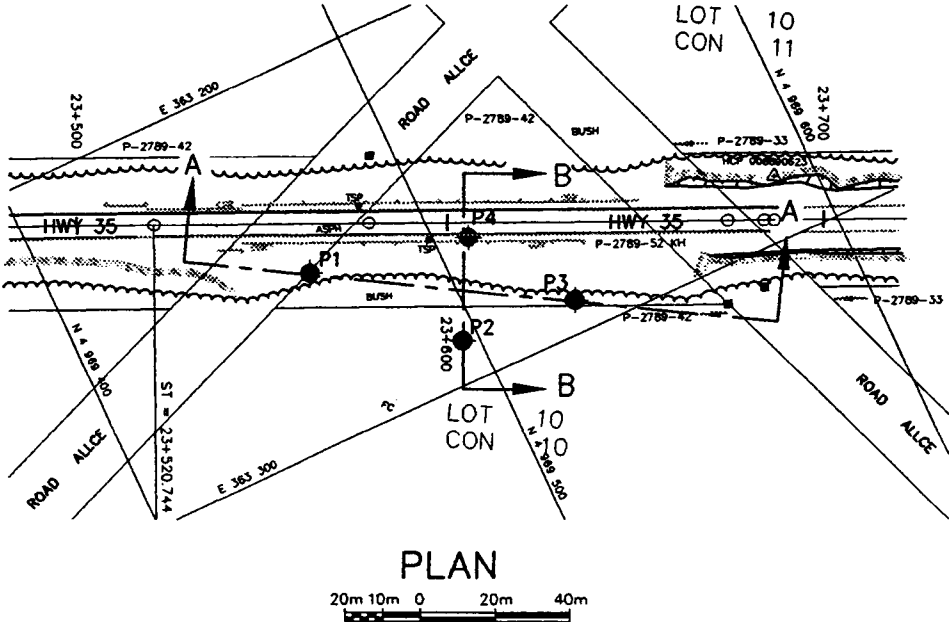
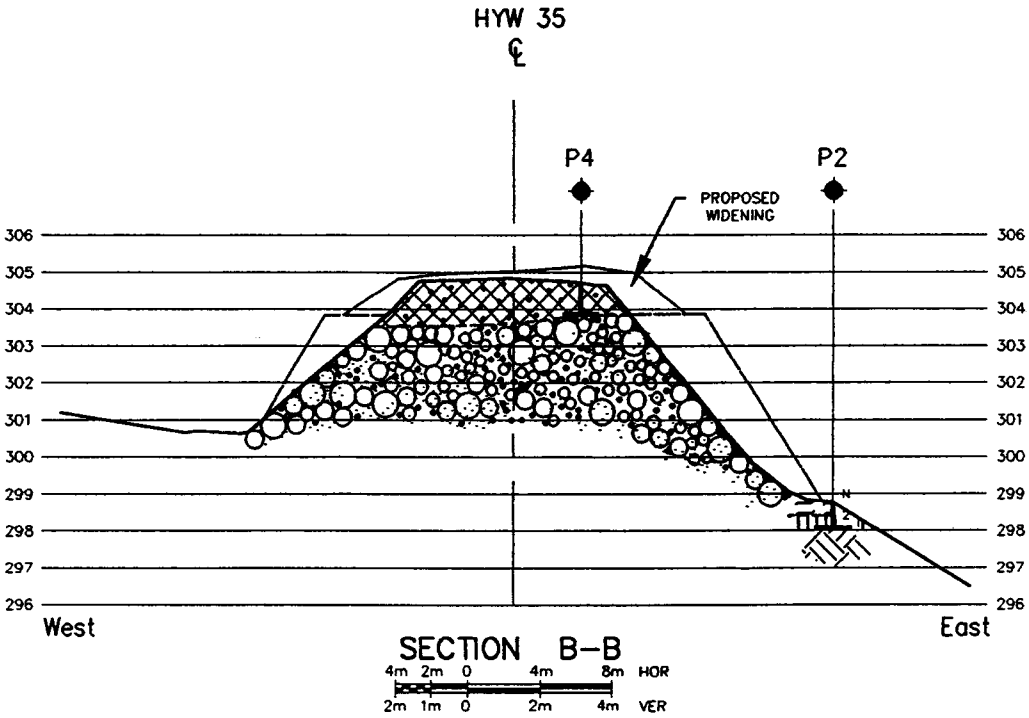
LEGEND			
●	Bore Hole		
⊕	Dynamic Cone Penetration Test (Cone)		
⊗	Bore Hole & Cone		
'N'	Blows/0.3m (Std Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60' Cone, 475 J/blow)		
WL	WL at time of investigation - Nov 2001		
WL	WL in Piezometer		
Piezometer	Piezometer		
End of Borehole	End of Borehole		
No	ELEVATION	CO-ORDINATES NORTHING	EASTING
P1	301.2	4969466	363254
P2	294.6	4969495	363288
P3	301.1	4969527	363291
P4	304.8	4969508	363263

-NOTE-  
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REV	DATE	NS	DESCRIPTION
		BY	

HWY No 35	CHECKED KSH	DATE Jan., 2001	DIST 52
SUBM'D AD	CHECKED		SITE
DRAWN KW	CHECKED		DWG P



SOIL STRATIGRAPHY LEGEND

- SAND  
SOME SILT  
Very Loose to Compact
- ROCKFILL
- SAND (FILL)  
with Gravel
- SAND (FILL)  
TRACE GRAVEL, ROOTLETS, SILT  
Very Loose to Compact
- TOPSOIL
- SILT  
very loose





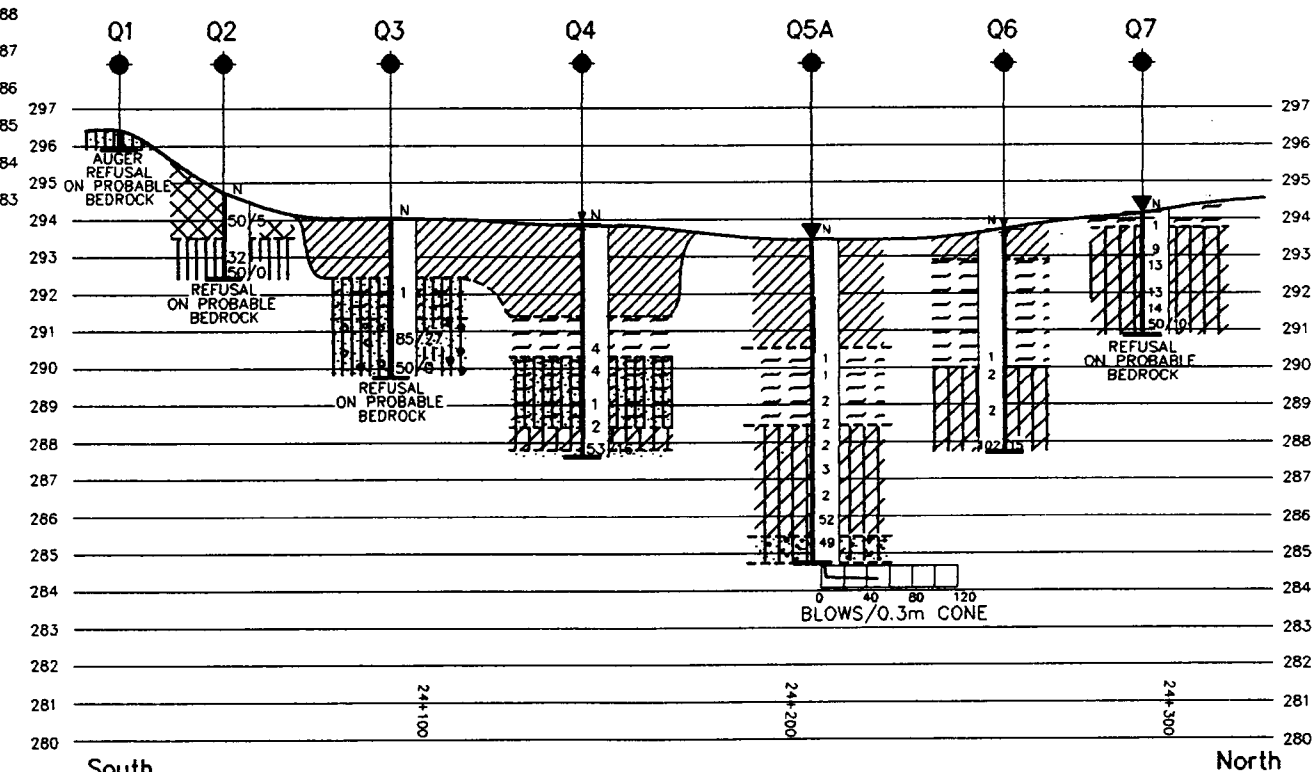
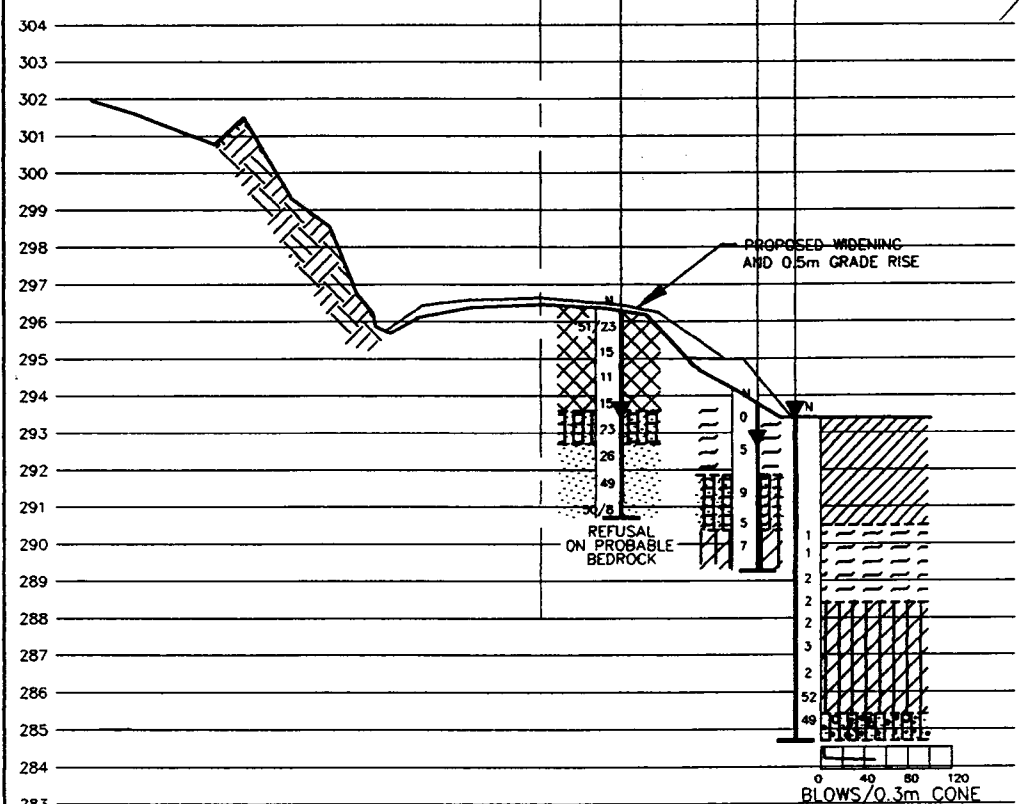
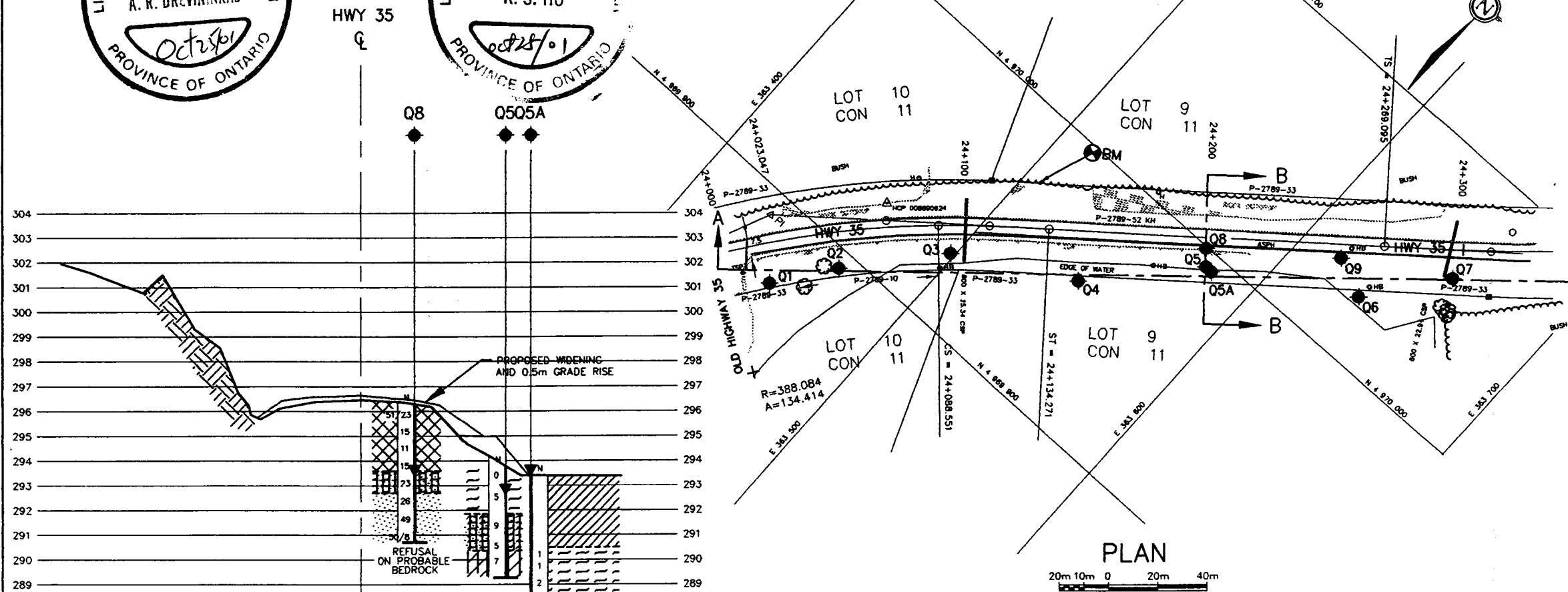
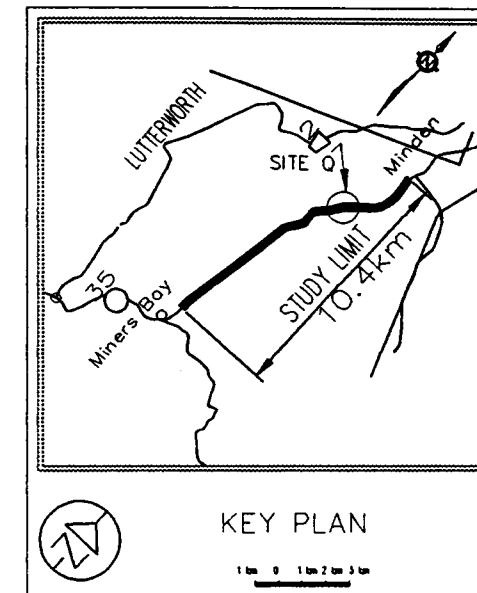
G.W.P. No. 081-99-00



SHEET

SITE Q, STATION 24+000 to 24+300  
BORE HOLE LOCATIONS & SOIL STRATA

AMEC Earth & Environmental Limited



SOIL STRATIGRAPHY LEGEND

- |  |  |  |   |  |                              |
|--|--|--|---|--|------------------------------|
|  | WATER                                      |  | SILTY SAND<br>WITH PEAT LAYERS, TRACE GRAVEL<br>Very Loose to Compact |  | PEAT<br>Very Soft to Firm    |
|  | SAND AND GRAVEL<br>WITH COBBLES<br>Compact |  | PEAT<br>Very Soft to Firm   |  | CLAYEY SILT<br>Soft to Stiff |
|  | SAND (FILL)<br>trace Gravel                |  |   |  |                              |

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation - Dec 2000, Jan 2001
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
Q1	296.4	4969869	363450
Q2	294.7	4969892	363468
Q3	294.1	4969927	363501
Q4	294.1	4969960	363539
Q5	293.5	4969993	363579
Q5A	293.5	4969993	363579
Q6	293.7	4970030	363627
Q7	294.1	4970055	363655
Q8	296.4	4969999	363574
Q9	296.4	4970032	363617

NOTE

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REV	DATE	BY	DESCRIPTION
1	Sept 2001	NS	

HWY No 35	CHECKED KSH	DATE Jan..2001	DIST 52
SUBM'D AD	CHECKED KSH	DATE Jan..2001	SITE
DRAWN KW	CHECKED		DWG Q



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

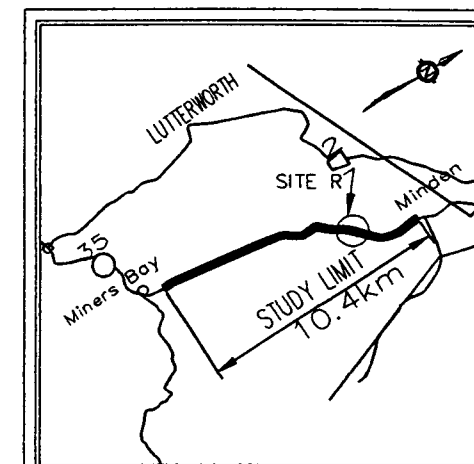
G.W.P. No. 081-99-00



SHEET

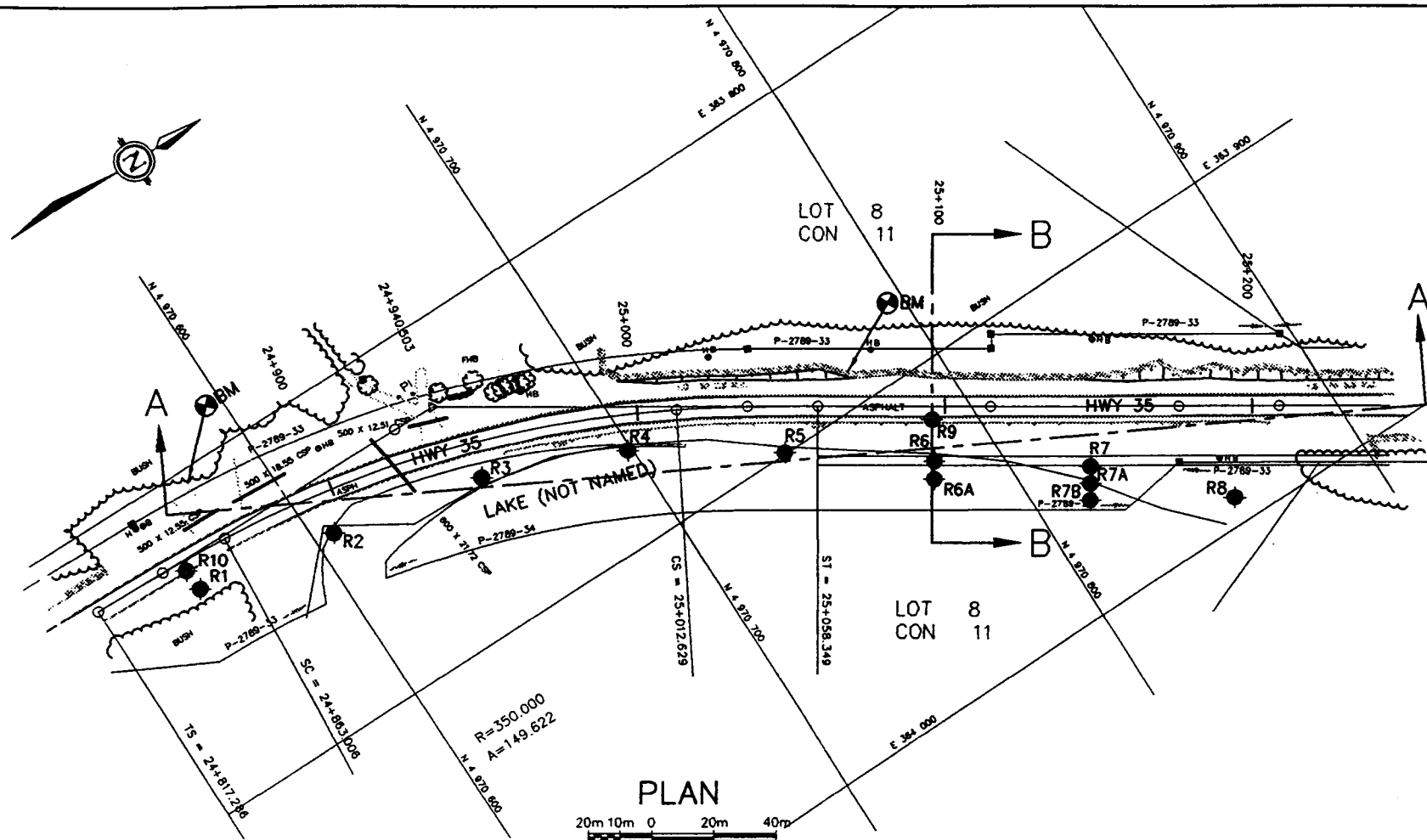
SITE R. STATION 24+850 to 25+200  
BORE HOLE LOCATIONS & SOIL STRATA

AMEC Earth & Environmental Limited



KEY PLAN

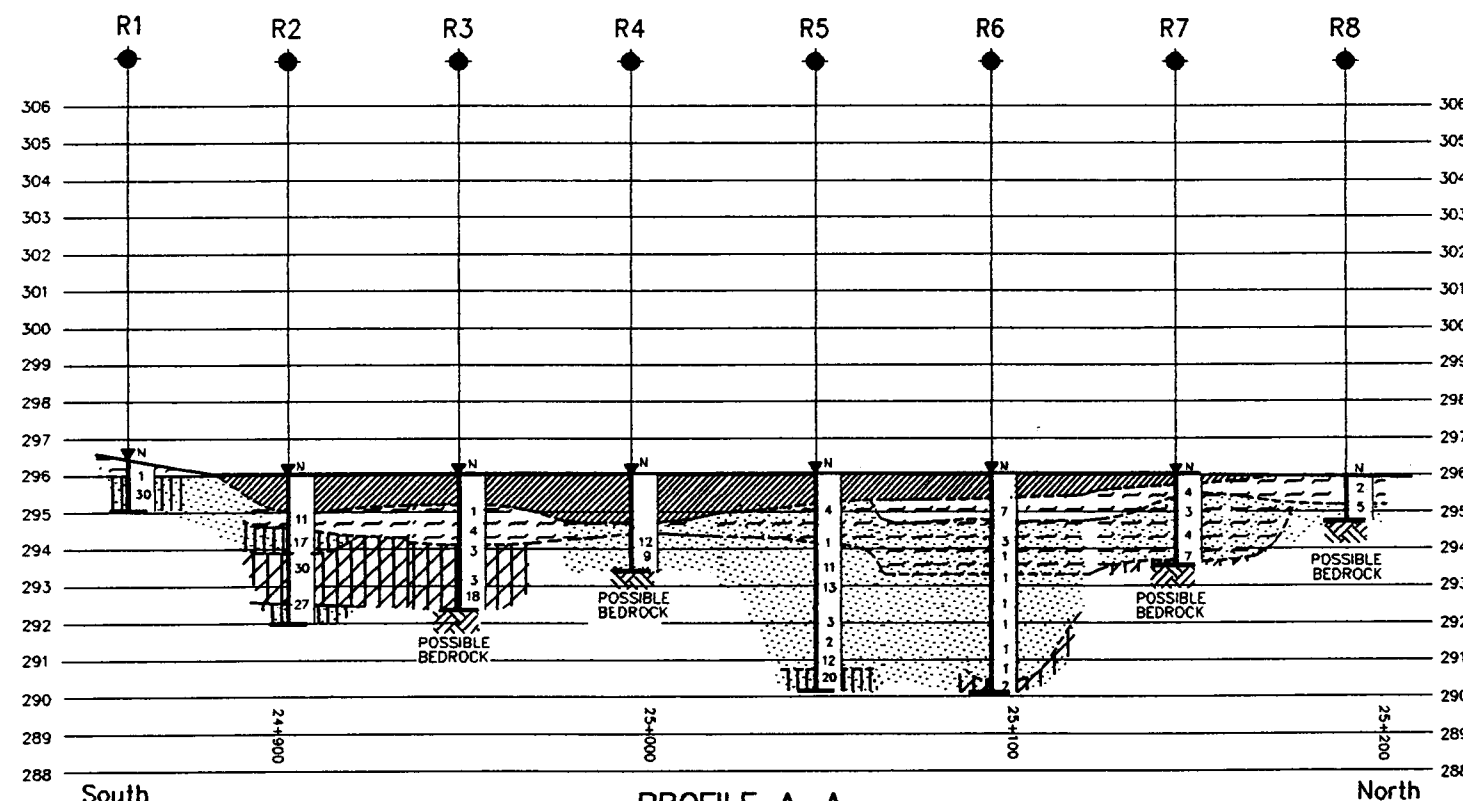
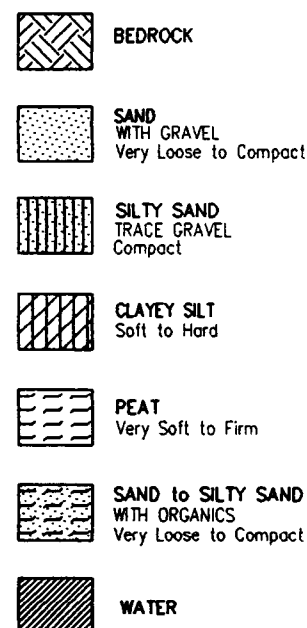
1 km 0 1 km 2 km 3 km



PLAN

20m 10m 0 20m 40m

**SOIL STRATIGRAPHY LEGEND**



PROFILE A-A

20m 10m 0 20m 40m HOR  
2m 1m 0 2m 4m VER

**LEGEND**

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation - Dec 2000, Jan 2001
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
R1	296.5	4970562	363835
R2	296.0	4970606	363842
R3	296.0	4970655	363853
R4	296.0	4970698	363871
R5	296.0	4970740	363899
R6	296.0	4970780	363928
R6A	296.0	4970777	363933
R7	296.2	4970822	363957
R7A	296.2	4970819	363962
R7B	296.2	4970816	363967
R8	296.4	4970856	363991
R9	301.0	4970786	363916
R10	297.8	4970561	363828

**-NOTE-**

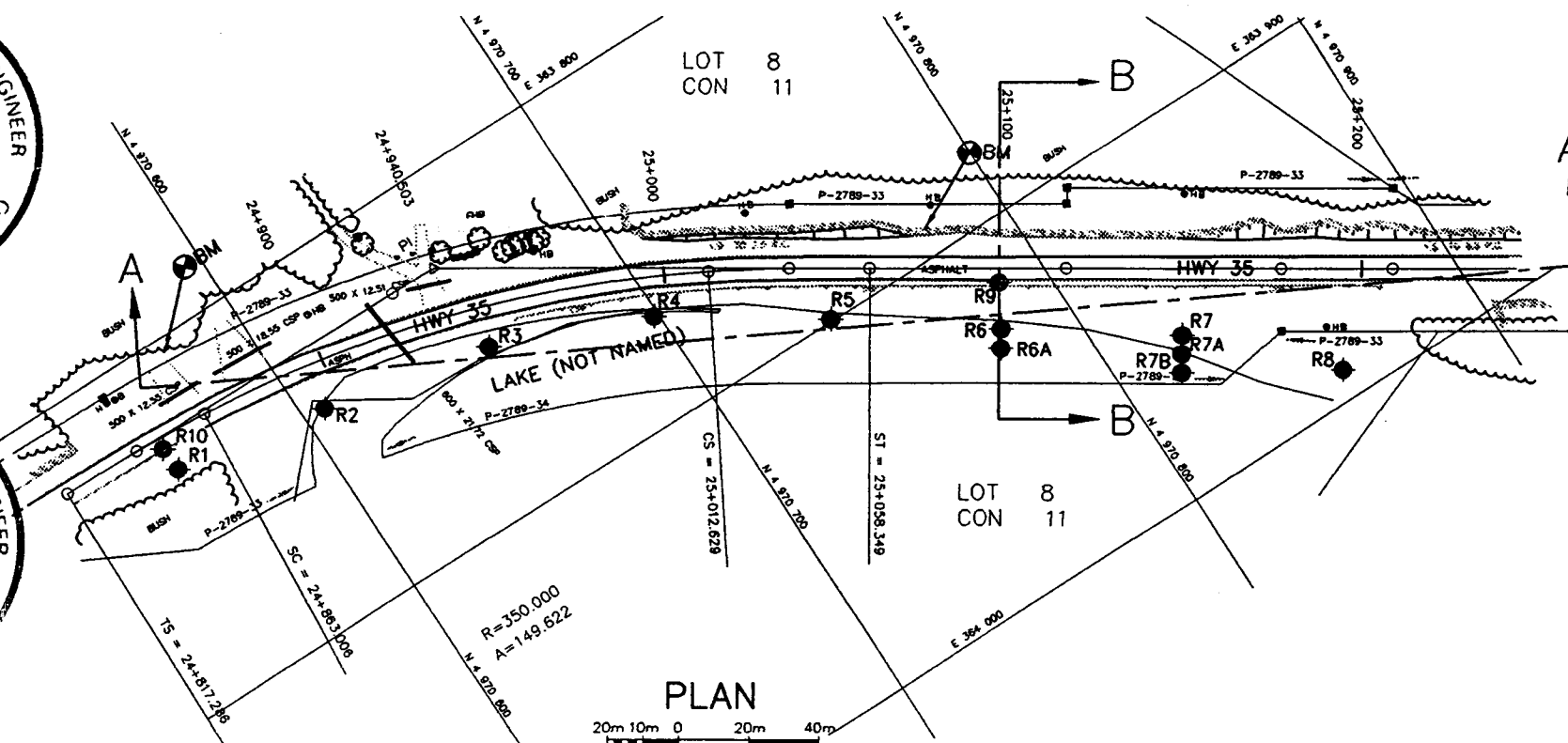
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REV	DATE	BY	DESCRIPTION
1	Sept 2001	NS	
2	Jan 2001	KSH	
3	Jan 2001	KW	

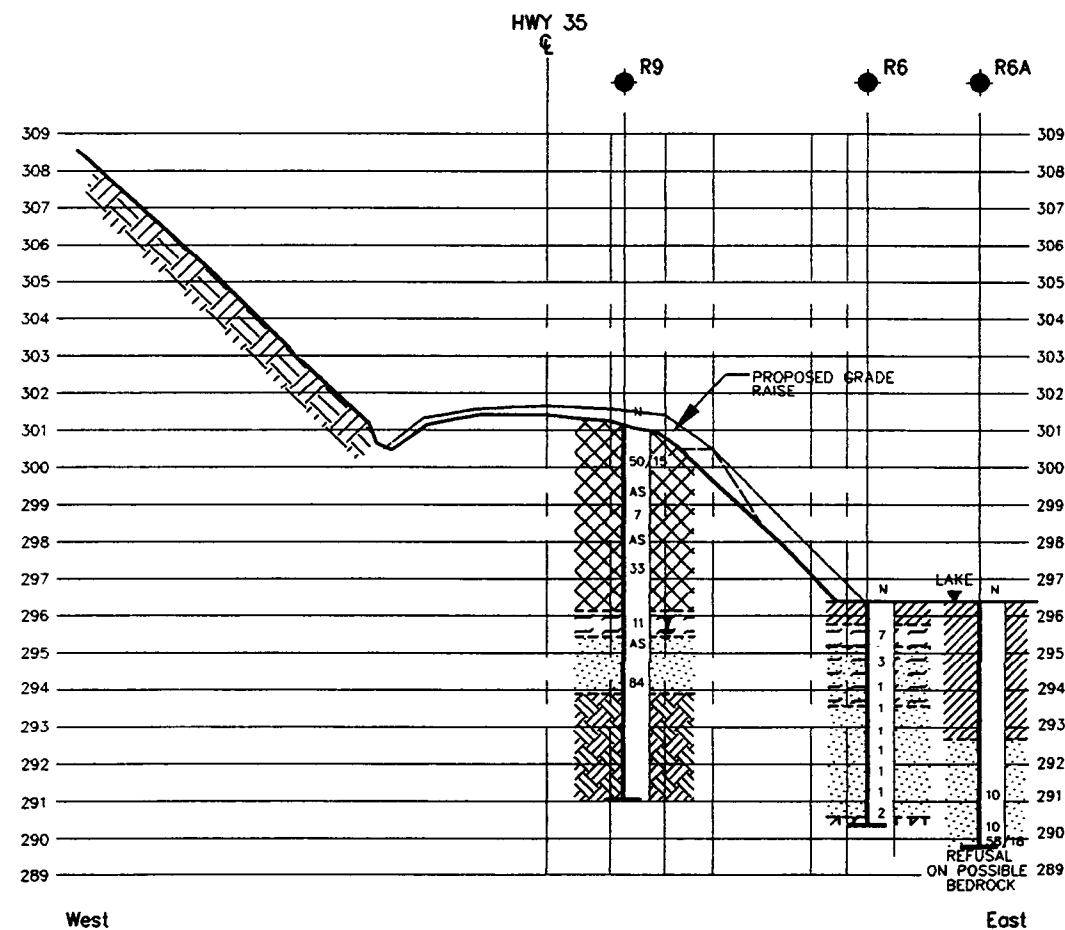
HWY No 35	DIST 52
SUBM'D AD CHECKED KSH	DATE Jan. 2001
DRAWN KW	CHECKED



PLAN

#### SOIL STRATIGRAPHY LEGEND

- SAND (FILL)  
trace gravel  
loose to dense
- BEDROCK
- SAND to SILTY SAND  
With Gravel or Cobbles  
Very Loose to Very Dense
- SILTY SAND  
Trace Gravel  
Compact
- CLAYEY SILT  
Soft to Hard
- PEAT  
Very Soft to Firm
- SAND to SILTY SAND  
WITH ORGANICS  
Very Loose to Compact
- WATER



SECTION B-B

4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER

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

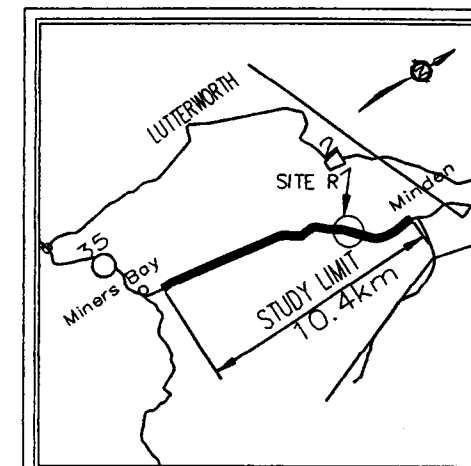
G.W.P. No. 081-99-00

SITE R. STATION 24+850 to 25+200  
BORE HOLE LOCATIONS & SOIL STRATA



SHEET

AMEC Earth & Environmental Limited



KEY PLAN

1 km 0 1 km 2 km 3 km

#### LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation -  
Dec 2000, Jan 2001
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
R1	296.5	4970562	363835
R2	296.0	4970606	363842
R3	296.0	4970655	363853
R4	296.0	4970698	363871
R5	296.0	4970740	363899
R6	296.0	4970780	363928
R6A	296.0	4970777	363933
R7	296.2	4970822	363957
R7A	296.2	4970819	363962
R7B	296.2	4970816	363967
R8	296.4	4970856	363991
R9	301.0	4970786	363916
R10	297.8	4970561	363828

#### NOTE

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DATE	BY	DESCRIPTION
12/1/2001	NS	

HWY No 35	DIST 52
SUBMITTAL AD	CHECKED KSH
DATE Jan. 2001	SITE
DRAWN KW	CHECKED
	DWG R-2



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

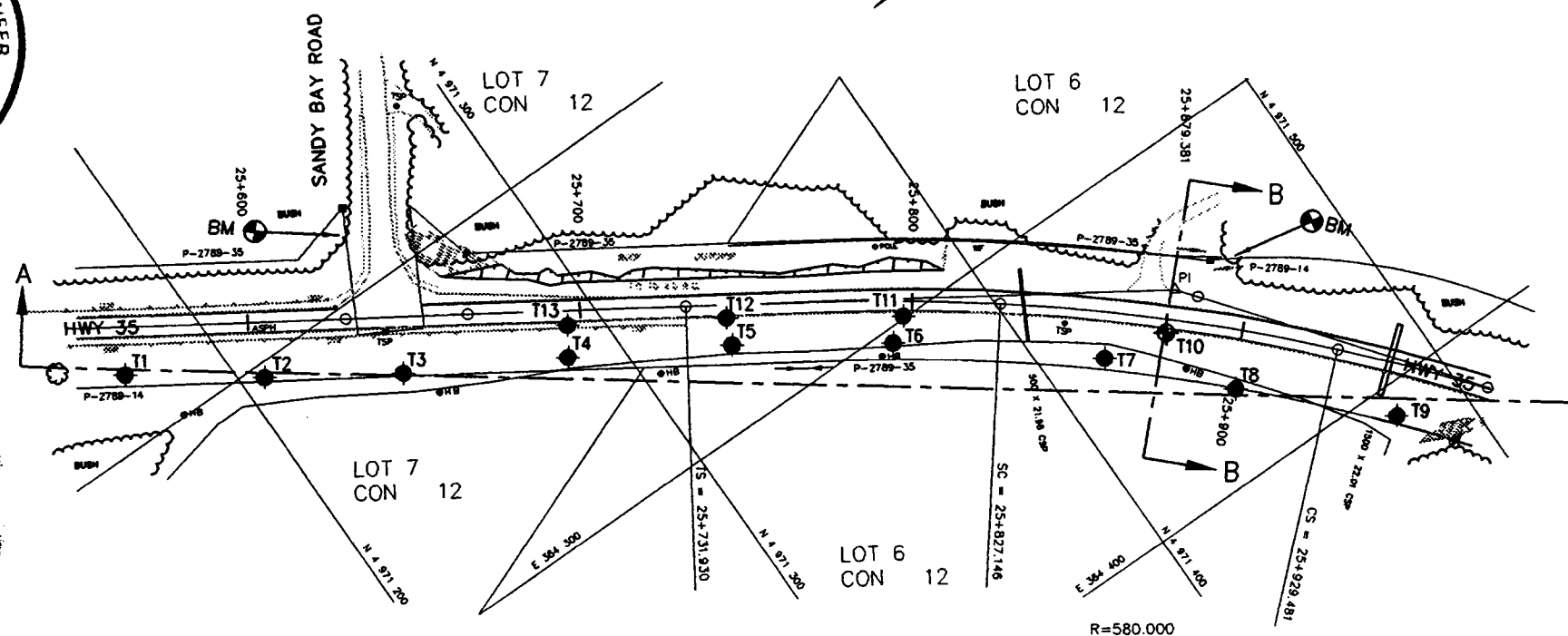
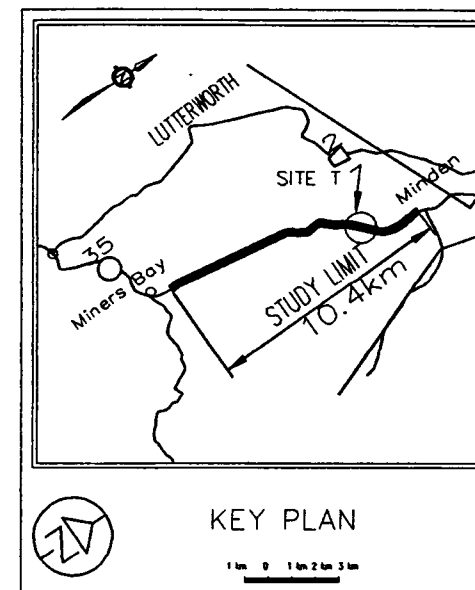
G.W.P. No. 081-99-00



**SITE T. STATION 25+550 to 25+950**  
**BORE HOLE LOCATIONS & SOIL STRATA**

**SHEET**

AMEC Earth & Environmental Limited



**PLAN**

20m 10m 0 20m 40m

**SOIL STRATIGRAPHY LEGEND**

**SANDY SILT**  
TO SILTY SAND TO SILT  
Very Loose to Dense

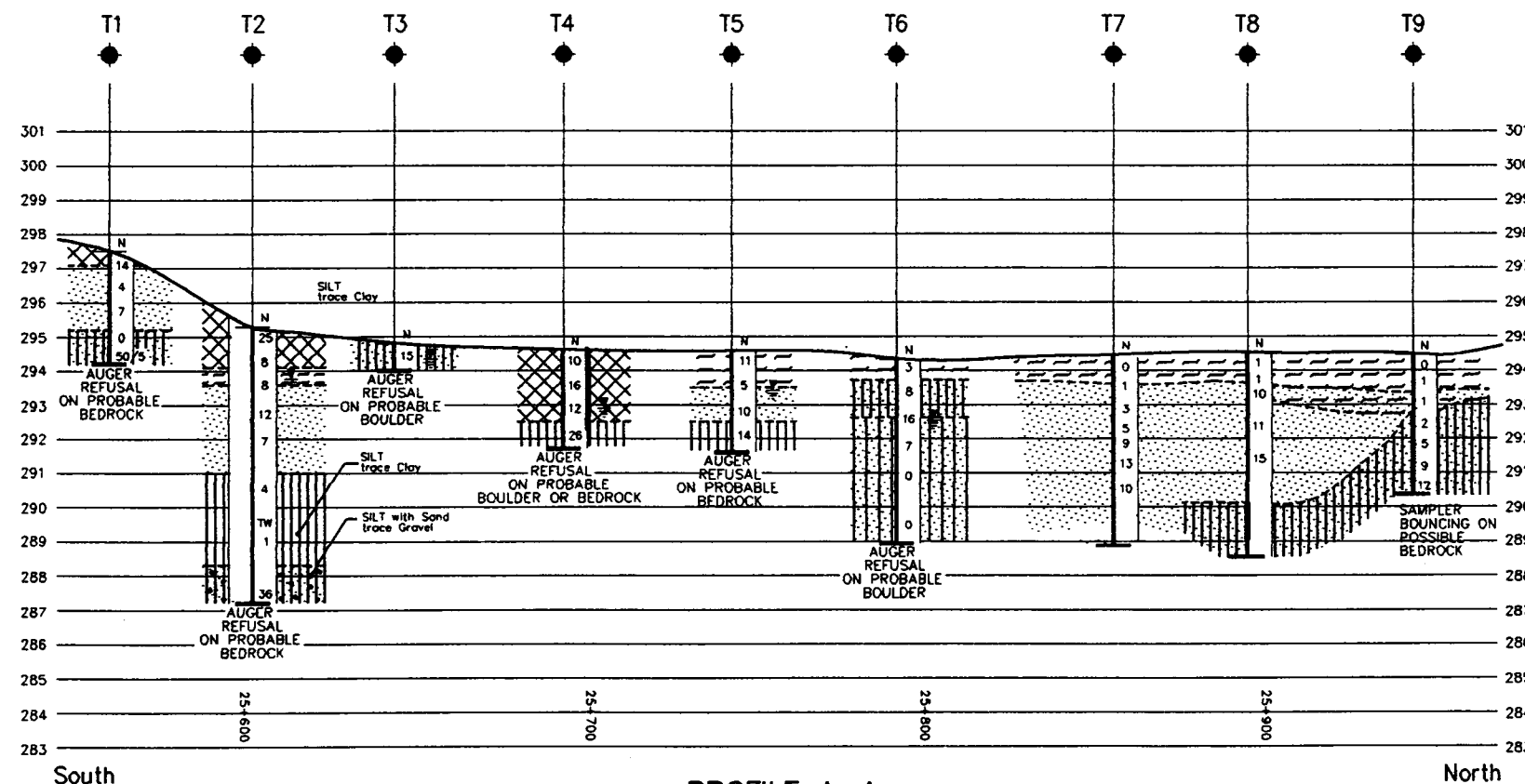
**SAND TO SILTY SAND**  
with Peat Layers  
compact

**SAND (FILL)**  
TRACE to with GRAVEL  
Loose to Compact

**SILTY CLAY TO CLAYEY SILT**  
Very Soft to Stiff

**PEAT**  
Very Soft to Soft

**SAND TRACE**  
to with SILT, Trace GRAVEL  
Very Loose to Dense



**PROFILE A-A**

20m 10m 0 20m 40m HOR  
2m 1m 0 2m 4m VER

**LEGEND**

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation - Nov - Dec 2000, Jan 2001
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
T1	297.5	4971172	361179
T2	295.3	4971206	364204
T3	294.8	4971241	364227
T4	294.6	4971284	364251
T5	294.6	4971327	364276
T6	294.3	4971367	364304
T7	294.3	4971417	364345
T8	294.4	4971444	364374
T9	294.0	4971480	364409
T10	295.8	4971436	364348
T11	296.3	4971374	364299
T12	297.3	4971330	364269
T13	298.3	4971290	364243

**NOTE-**

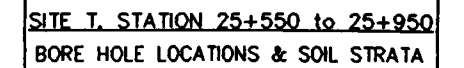
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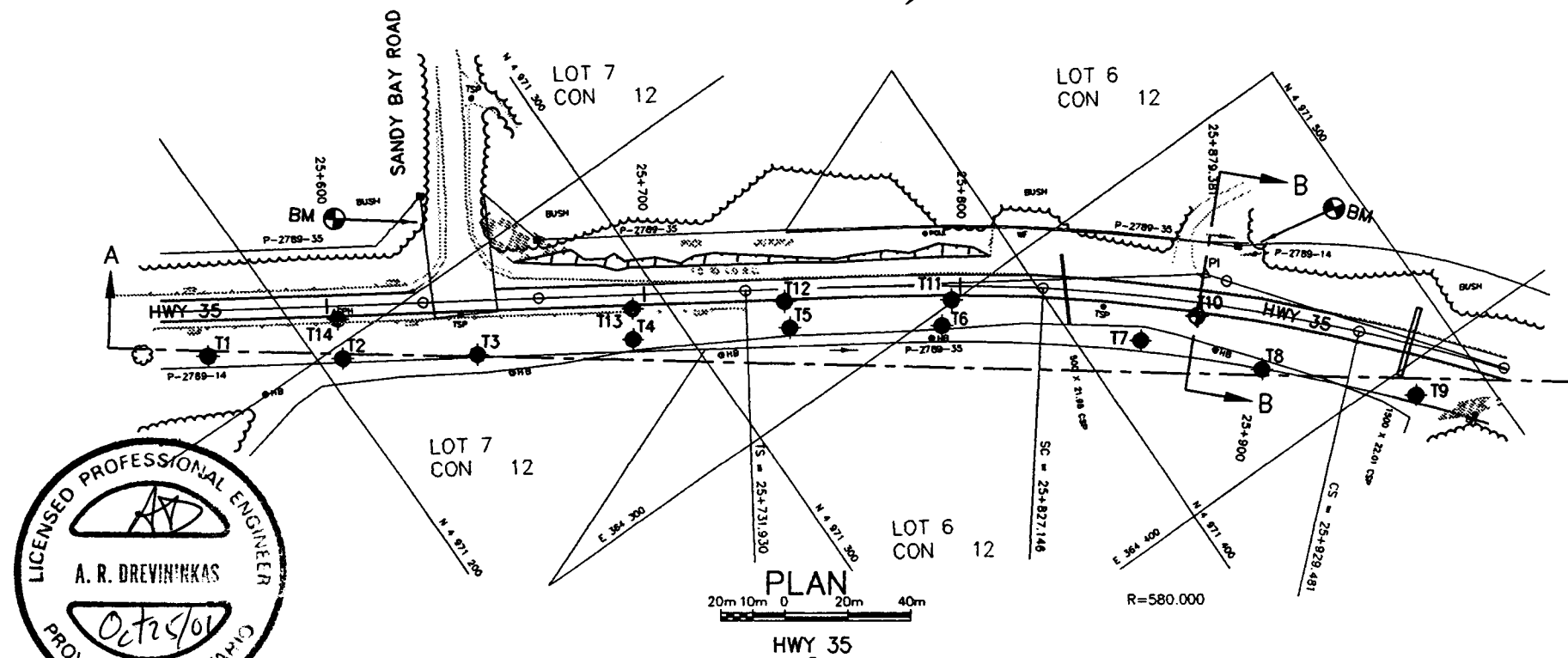
REV	DATE	BY	DESCRIPTION
1	Sept 2001	NS	

HWY No 35	CHECKED KSH	DATE Jan., 2001	DIST 52
SUBM'D AD	CHECKED	DATE	SITE
DRAWN KW	CHECKED	DATE	OWG T-1

G.W.P. No. 081-99-00



AMEC Earth &amp; Environmental Limited



31


LICENSED PROFESSIONAL ENGINEER

A. R. DREVININKAS

06225/01

PROVINCE OF ONTARIO


A circular professional seal for a Licensed Professional Engineer in the Province of Ontario. The outer ring contains the text "LICENSED PROFESSIONAL ENGINEER" at the top and "PROVINCE OF ONTARIO" at the bottom. In the center, there is a stylized signature "K.S.HO" above the printed name "K. S. HO". Below the name is a semi-circular area containing the license number "0825/01".



**SANDY SILT  
TO SILTY SAND TO SILT  
Very Loose to Dense**



**SAND TO SILTY SAND**  
with Peat Layers  
**Compact**

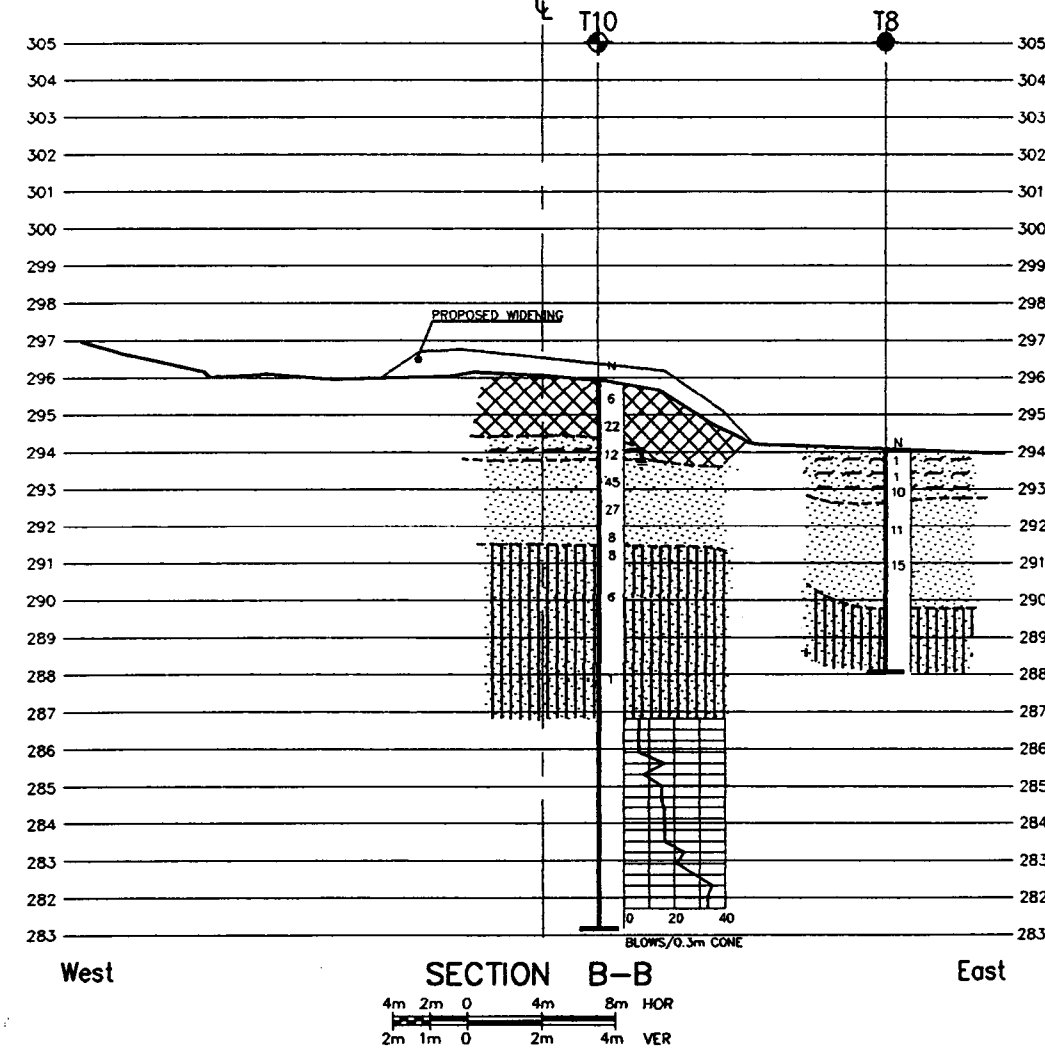









**SAND (FILL)**  
TRACE to with GRAVEL  
Loose to Compact



PEAT  
Very Soft to Soft

 **SAND**  
TRACE SILT  
Loose to Dense



LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Test (Cone)		
	Bore Hole & Cone		
'N'		Blows/0.3m (Std Pen Test, 475 J/blow)	
CONE		Blows/0.3m (60° Cone, 475 J/blow)	
	WL at time of investigation—	Now – Dec2000, Jan2001	
	WL in Piezometer		
	Piezometer		
	End of Borehole		
No	ELEVATION	CO—ORDINATES	
		NORTHING	EASTING
T1	297.5	4971172	361179
T2	295.3	4971206	364204
T3	294.8	4971241	364227
T4	294.6	4971284	364251
T5	294.6	4971327	364276
T6	294.3	4971367	364304
T7	294.3	4971417	364345
T8	294.4	4971444	364374
T9	294.0	4971480	364409
T10	295.8	4971436	364348
T11	296.3	4971374	364299
T12	297.3	4971330	364269
T13	298.3	4971290	364243

-NOTE-

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

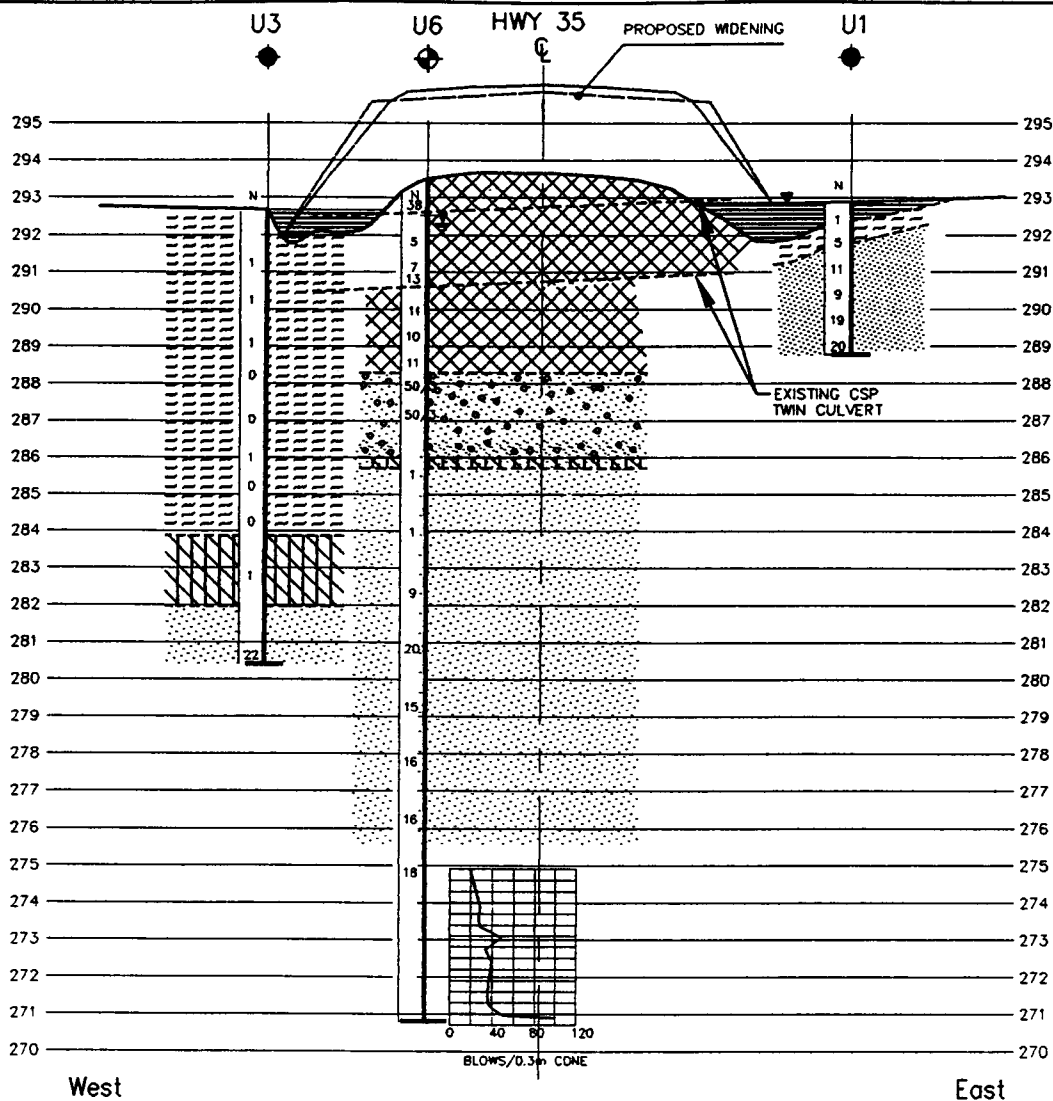
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REV.	Sept. 2001	NS		
	DATE	BY	DESCRIPTION	

HWY No 35			DIST 52
SUBMIT'D AD	CHECKED KSH	DATE Jan., 2001	SITE
DRAWN KW	CHECKED	09990403	DWG T-2



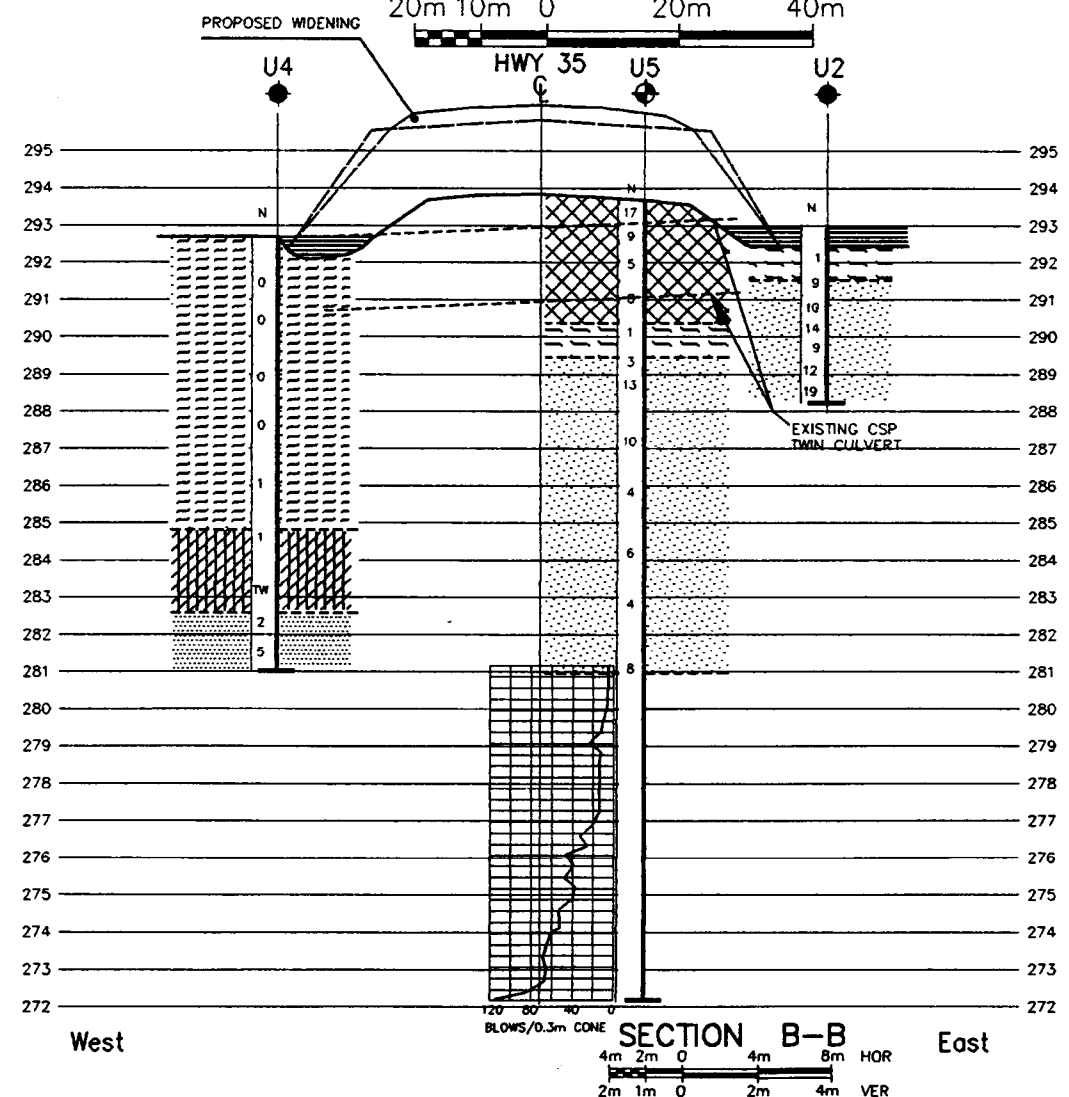
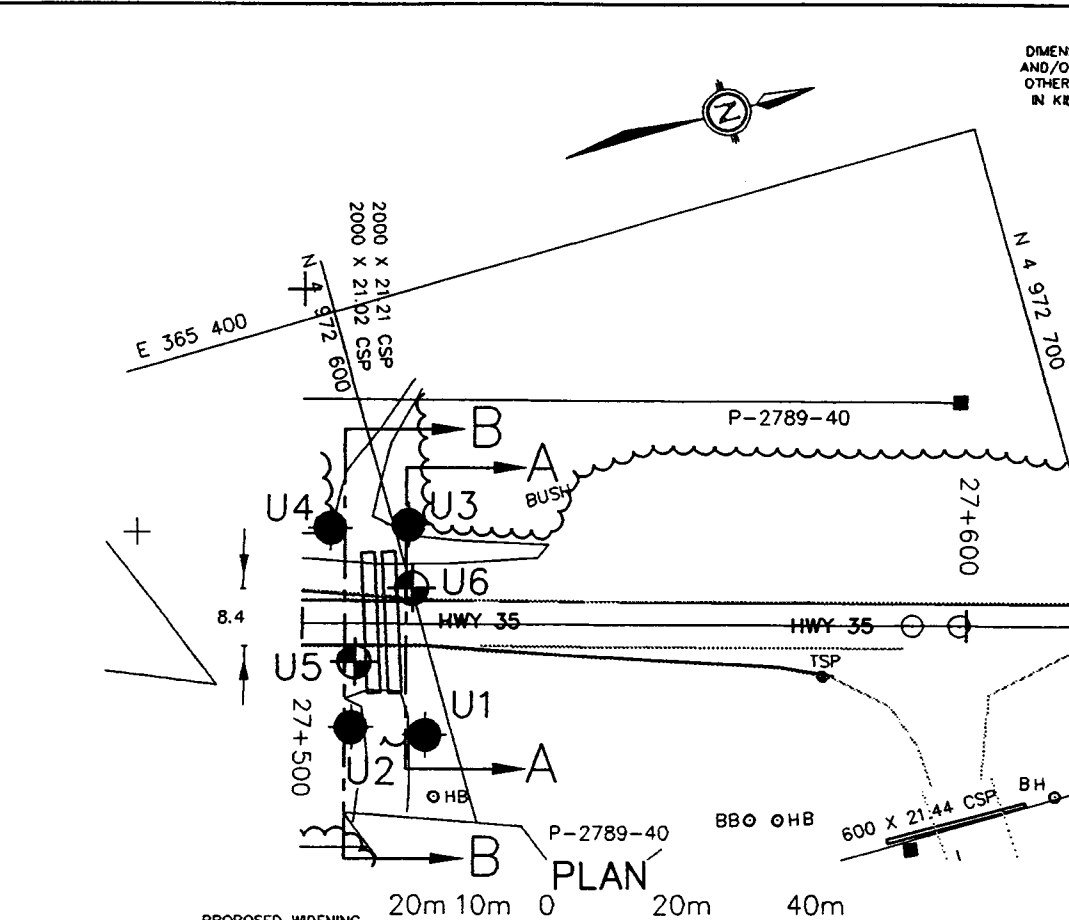
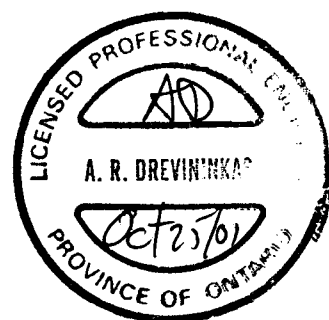


SECTION A-A

4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER

SOIL STRATIGRAPHY LEGEND

- WATER
- CLAYEY SILT  
FREQUENT SAND SEAMS  
VERY SOFT
- SAND  
WITH COBBLES
- SAND (FILL)  
with Gravel, trace Silt, Peat  
occasional Cobbles, Peat Layers  
loose to compact
- PEAT  
very soft to firm
- SAND  
trace to with Gravel, Silt  
very loose to compact



SECTION B-B

4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER

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

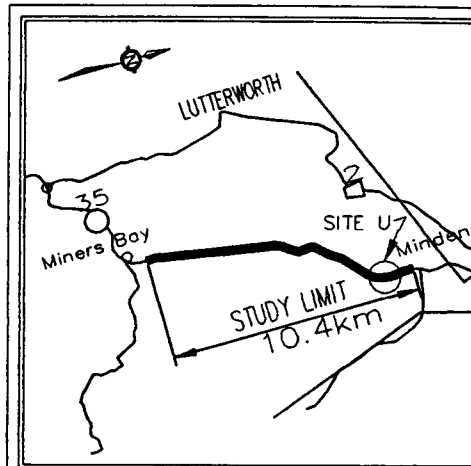
G.W.P. No. 081-99-00

SITE U. STATION 27+500 to 27+520  
BOREHOLE LOCATIONS & SOIL STRATA



SHEET

AMEC Earth & Environmental Limited



KEY PLAN

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation -  
Dec 2000, Jan 2001
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES NORTHING	EASTING
U1	292.9	4972595	365464
U2	293.0	4972585	365460
U3	292.6	4972602	365433
U4	292.6	4972590	365431
U5	293.6	4972588	365451
U6	293.5	4972600	365443

-NOTE-

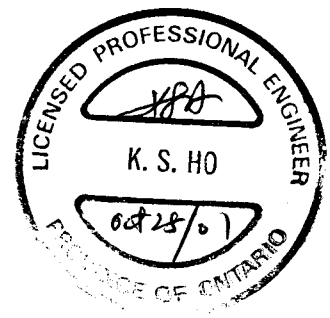
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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DATE	BY	DESCRIPTION
10/25/01	NS	
10/25/01	BY	
10/25/01	BY	

HWY No 35	CHECKED KSH	DATE Jan., 2001	DIST 52
SUBM'D AD	CHECKED	DATE Jan., 2001	SITE
DRAWN KW	CHECKED	DATE Jan., 2001	DWG U1





### SOIL STRATIGRAPHY LEGEND



TOP SOIL/PEAT



SAND  
Trace to with Gravel, Silt  
Very Loose to Very Dense



Gravelly SAND Fill  
Trace Silt  
Compact



**SILTY CLAY to CLAYEY SILT**  
Very Soft to Hard

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

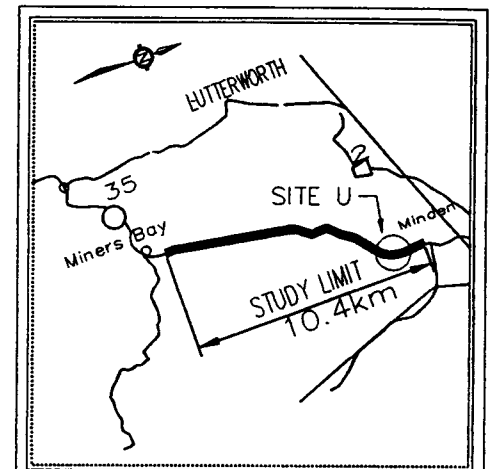
G.W.P. No. 81-99-00



SHEET

SITE U, STATION 27+400 to 27+600  
BOREHOLE LOCATIONS & SOIL STRATA








AMEC Earth & Environmental Limited



KEY PLAN

1 June 0 1 June 2 June 3 June

### LEGEND

- |   |   |
|---|---|
|   | Bore Hole                               |
|  | Dynamic Cone Penetration Test (Cone)    |
|  | Bore Hole & Cone                        |
| 'N'   | Blows/0.3m (Std Pen Test, 475 J/blow)   |
| CONE  | Blows/0.3m (60° Cone, 475 J/blow)       |
|  | WL at time of investigation – 1999,2001 |
|  | WL in Piezometer                        |
|  | Piezometer                              |
|  | End of Borehole                         |

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
U1	292.9	4 972 595	365 464
U2	293.0	4 972 585	365 460
U3	292.6	4 972 602	365 433
U4	292.6	4 972 590	365 431
U5	293.6	4 972 588	365 461
U6	293.5	4 972 600	365 443
U7	295.8	4 972 481	365 421
U8	293.6	4 972 540	365 418
U9	293.8	4 972 630	365 461
U10	296.2	4 972 687	365 483
U11	294.1	4 972 481	365 427
U12	293.0	4 972 488	365 401
U13	293.4	4 972 546	365 422
U14	293.0	4 972 532	365 438
U15	292.5	4 972 614	365 466
U16	292.9	4 972 537	365 448
U17	293.2	4 972 657	365 483
U18	295.1	4 972 692	365 464

-NOTE-

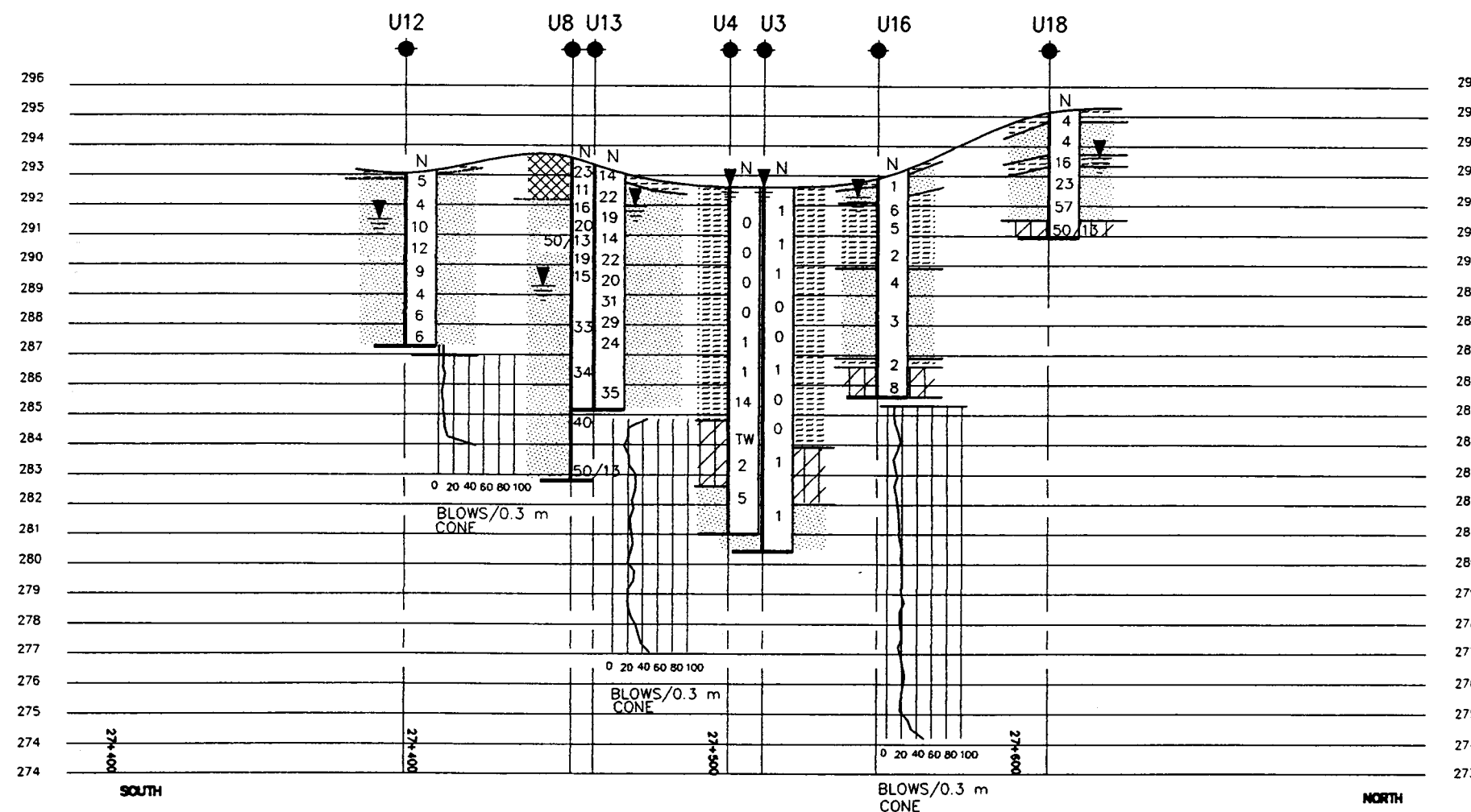
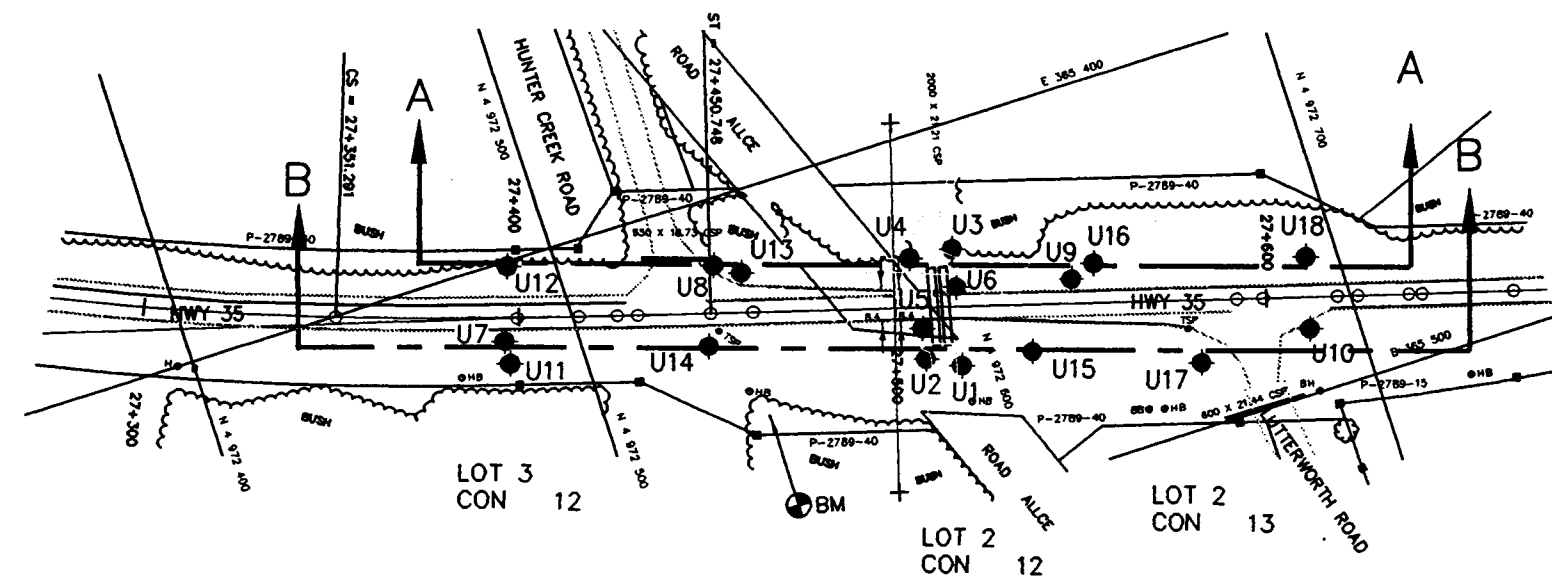
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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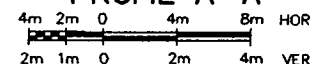
REV.	Sep 1 2001	NS	
	DATE	BY	DESCRIPTION

HWY No 35		DIST 52	
SUBM'D AD	CHECKED KSH	DATE SEPT., 2001	SITE
DRAWN NS	CHECKED	APPROVED	DWG U2

FILE: K:/GEO-TRANS./PROJECTS/2000/120888/HWY35/LWGS/DWG-02



PROFIE A-A



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

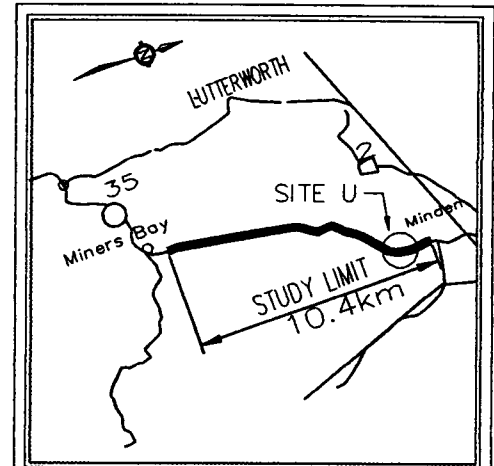
G.W.P. No. 81-99-00



SITE U, STATION 27+400 to 27+600  
BOREHOLE LOCATIONS & SOIL STRATA

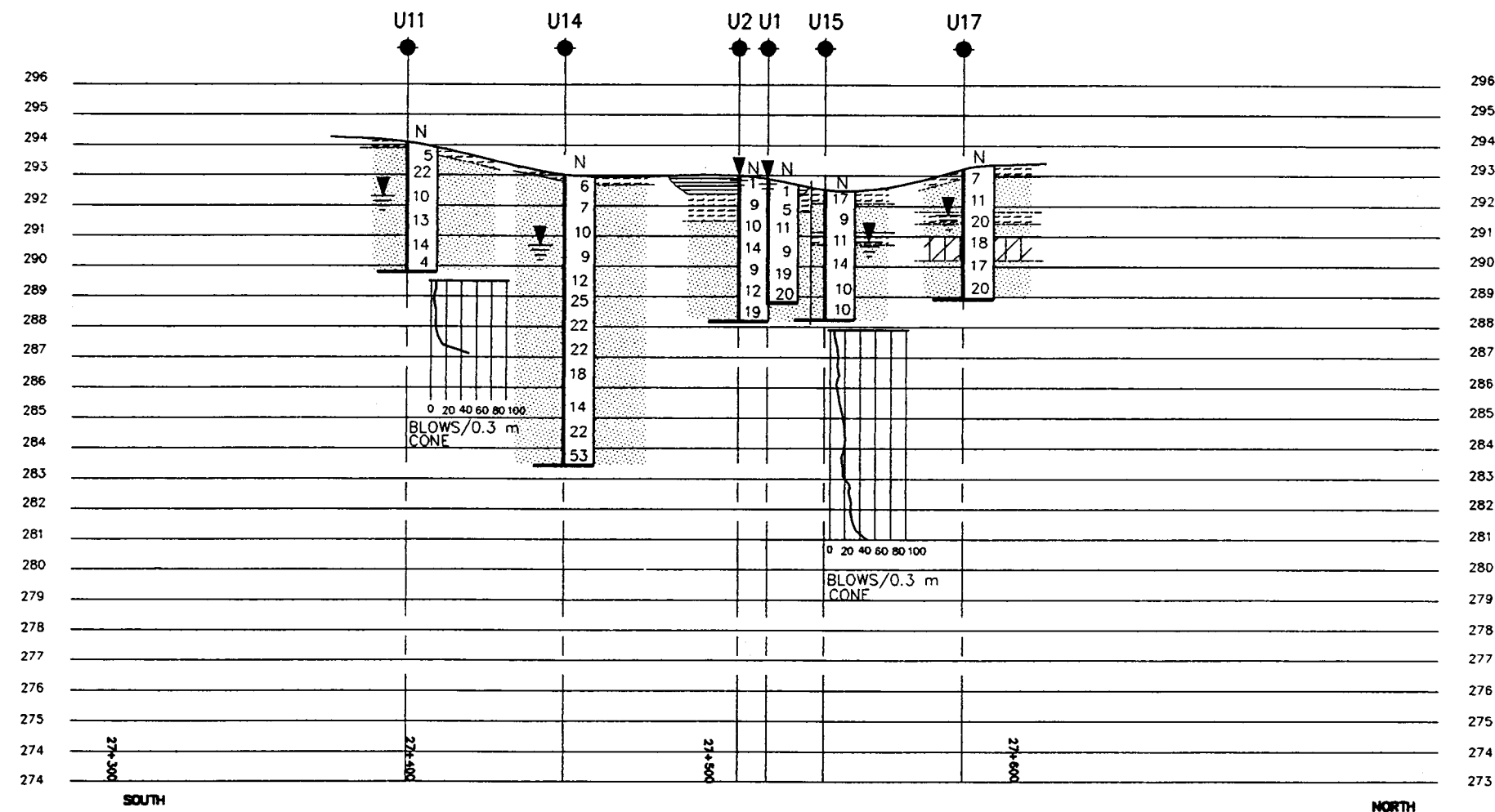
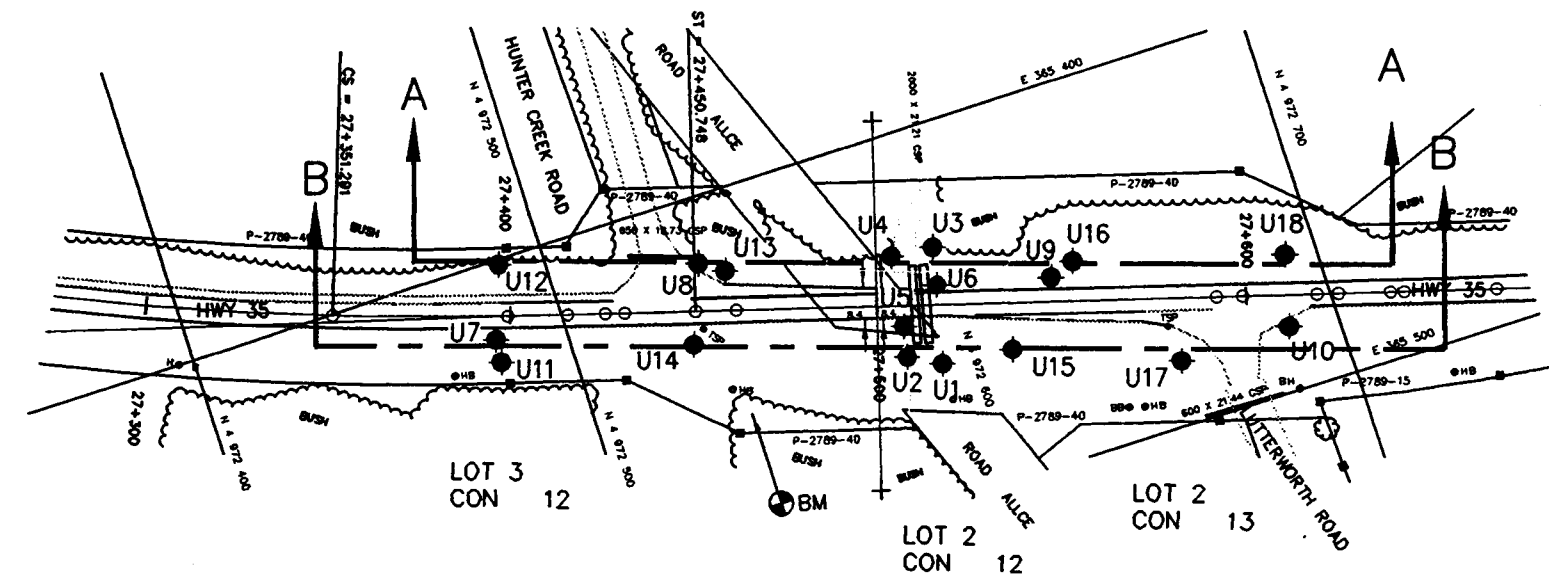
SHEET

AMEC Earth & Environmental Limited



KEY PLAN

1 km 0 1 km 2 km 3 km



PROFILE B-B

4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation - 1999, 2001
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
U1	292.9	4 972 595	365 464
U2	293.0	4 972 585	365 460
U3	292.6	4 972 602	365 433
U4	292.6	4 972 590	365 431
U5	293.8	4 972 588	365 451
U6	293.5	4 972 600	365 443
U7	295.8	4 972 481	365 421
U8	293.6	4 972 540	365 418
U9	293.8	4 972 630	365 451
U10	296.2	4 972 687	365 483
U11	294.1	4 972 481	365 401
U12	293.0	4 972 488	365 401
U13	293.4	4 972 546	365 422
U14	293.0	4 972 532	365 438
U15	292.5	4 972 614	365 466
U16	292.9	4 972 637	365 448
U17	293.2	4 972 657	365 483
U18	295.1	4 972 692	365 464

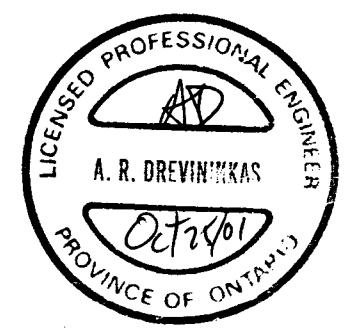
-NOTE-

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

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

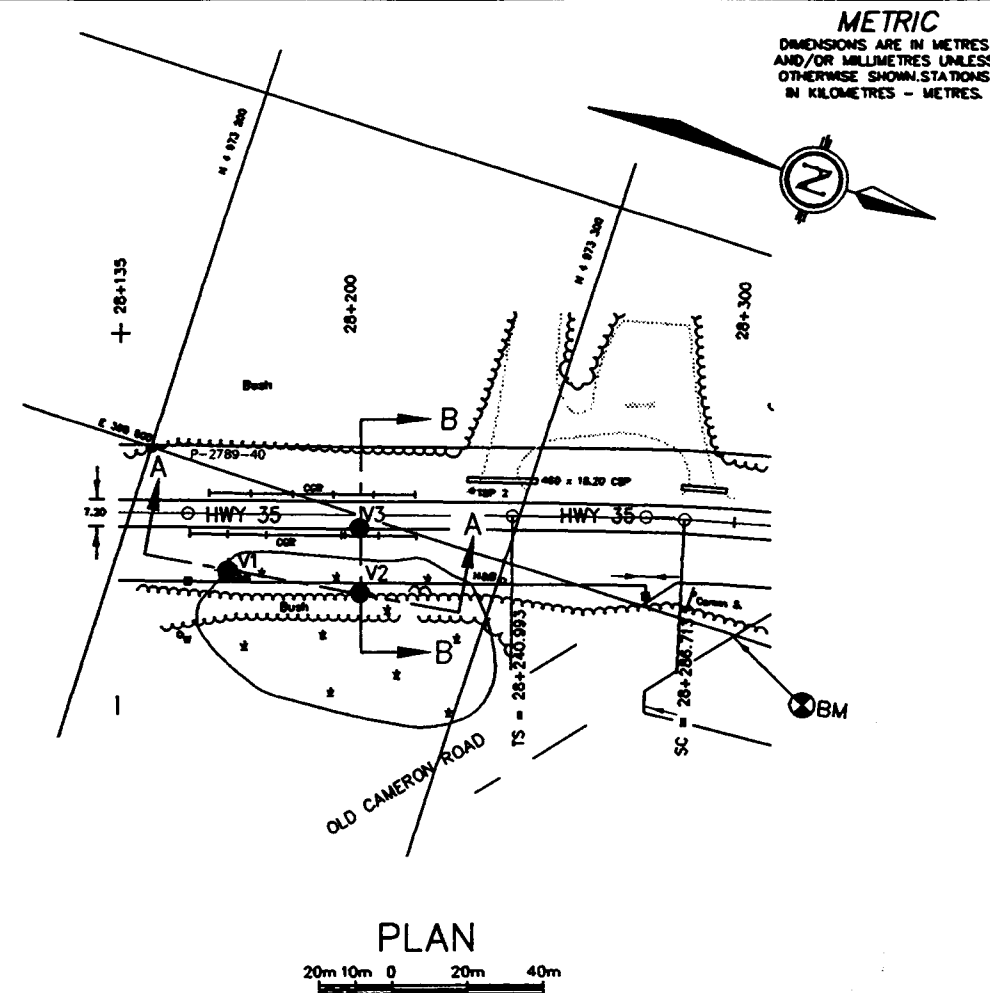
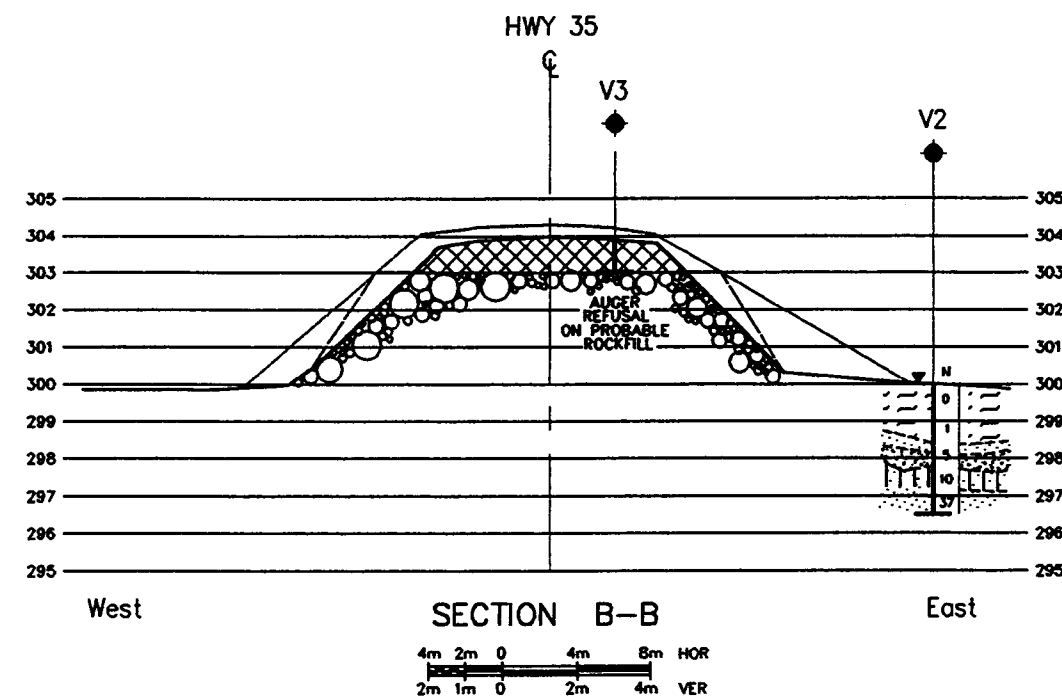
DATE	BY	DESCRIPTION
Sept 2001	NS	

HWY No 35	CHECKED KSH	DATE SEPT., 2001	DIST 52
SUBMITT AD	CHECKED	DATE	SITE
DRAWN NS	CHECKED	DATE	DWG U3

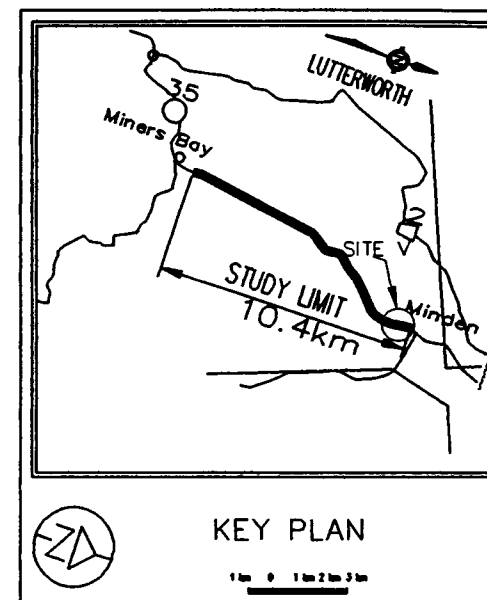


SOIL STRATIGRAPHY LEGEND

- WATER
- TOP SOIL
- SAND Trace to with Gravel, Silt Very Loose to Very Dense
- SILTY CLAY to CLAYEY SILT Very Soft to Hard

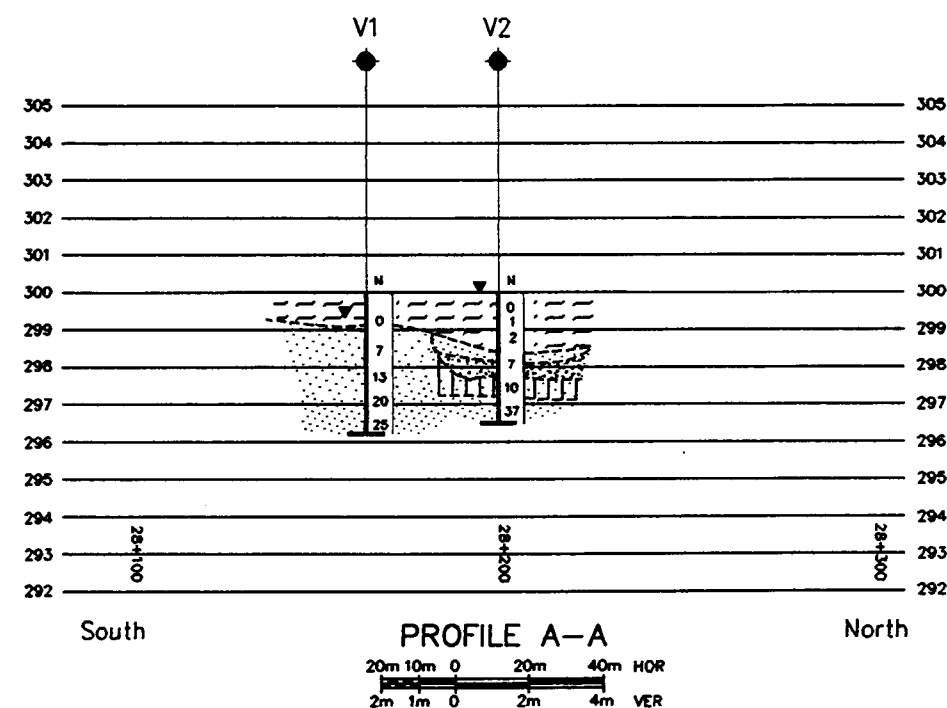


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# SOIL STRATIGRAPHY LEGEND

- INFERRED ROCKFILL
- SAND AND GRAVEL Loose
- SAND trace to SOME SILT, TRACE GRAVEL Loose to Dense
- SAND (FILL) WITH GRAVEL
- SANDY SILT SOME GRAVEL, TRACE CLAY Compact
- PEAT Very Soft
- SAND WITH PEAT Very Loose



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation - Nov to Dec, 2001
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
V1	300.1	4973238	366613
V2	300.1	4973264	365506
V3	303.8	4973250	365489

NOTE:

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

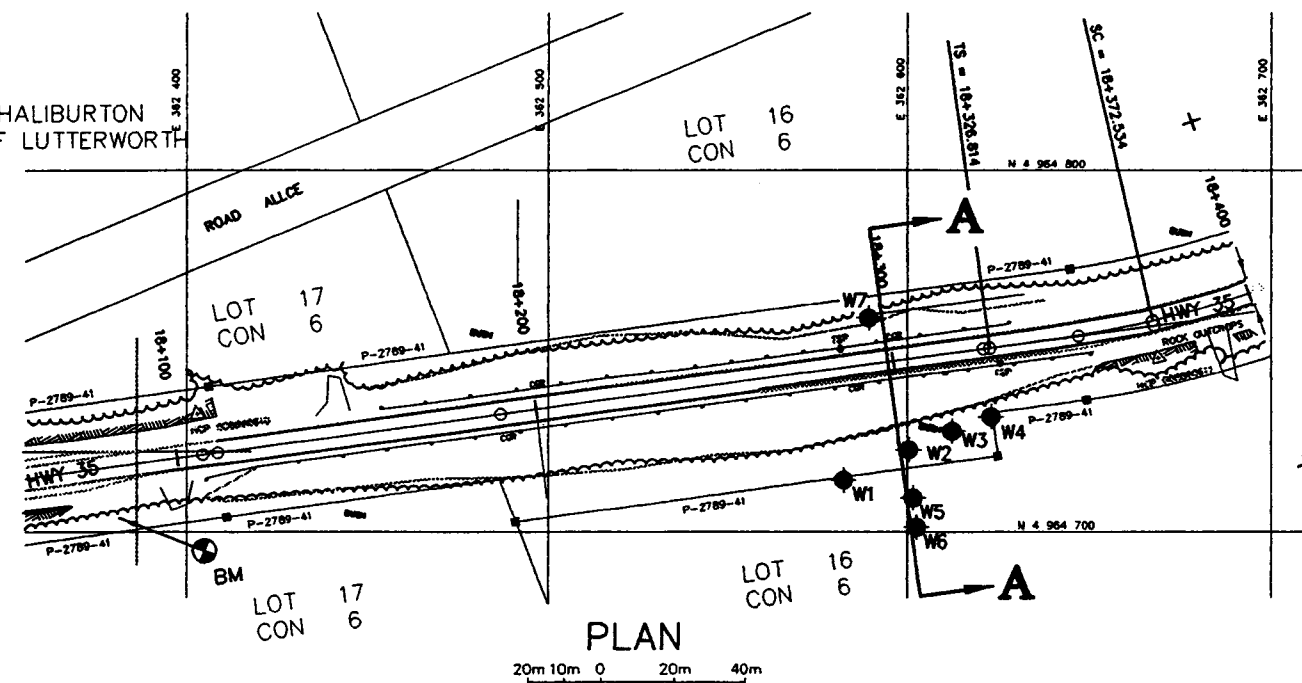
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DATE	BY	DESCRIPTION
2001	NS	

HWY No 35	DIST S2
SUBM'D AD	CHECKED KSH
DATE Jan. 2001	SITE
DRAWN KW	CHECKED
	DWG V



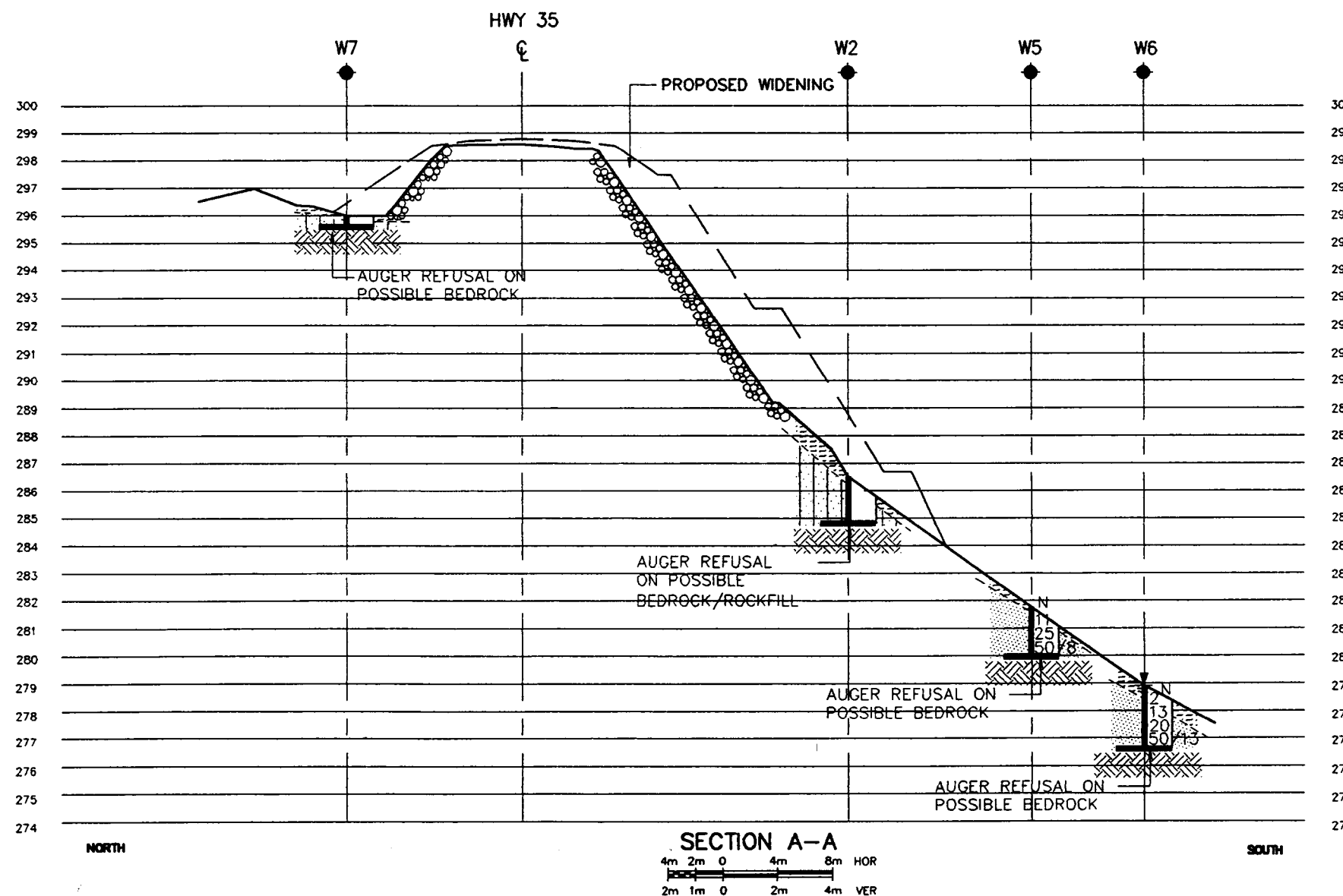
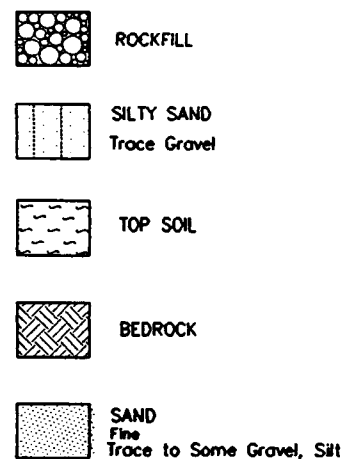
COUNTY OF HALIBURTON  
TOWNSHIP OF LUTTERWORTH



PLAN

20m 10m 0 20m 40m

SOIL STRATIGRAPHY LEGEND



SECTION A-A

4m 2m 0 4m 8m HOR  
2m 1m 0 2m 4m VER

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



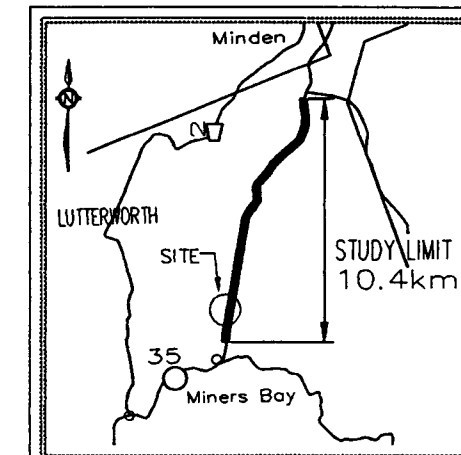
G.W.P. No. 81-99-00

SITE W. STATION 18+250 to 18+330  
BOREHOLE LOCATIONS & SOIL STRATA



SHEET

AMEC Earth & Environmental Limited



KEY PLAN

1km 0 1km 2km 3km

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation - July 2001
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
W1	283.3	4 964 714	362 582
W2	286.5	4 964 723	362 601
W3	288.3	4 964 728	362 612
W4	290.2	4 964 732	362 622
W5	281.7	4 964 709	362 602
W6	278.9	4 964 701	362 602
W7	296.0	4 964 759	362 589

NOTE

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

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REV.	DATE	BY	DESCRIPTION
1	SEP 2001	NS	

HWY No 35	DIST 52
SUBM'D AD CHECKED KSH	DATE SEPT., 2001
DRAWN NS	CHECKED

FILE: K:\GEO-TRANS\PROJECTS\2001\TOWNSHIP\TOWNSHIP.DWG

APPENDIX B  
BOREHOLE LOCATION AND SOIL STRATA DRAWINGS

APPENDIX C  
RECORD OF BOREHOLE SHEETS

## NOTES TO BOREHOLE LOGS

### DRILLING DATA

Method:  
 SolSt Augering - Solid Stem Augering  
 HolSt Augering - Hollow Stem Augering  
 WB - Washed Boring

### SAMPLES

TYPE:  
 SS - Split Spoon  
 AS - Auger Sample  
 TW - Thinwall Open  
 TP - Thinwall Piston  
 WS - Washed Sample  
 BS - Block Sample  
 RC - Rock Core  
 PH - Sample Advanced Hydraulically  
 PM - Sample Advanced Manually

### LABORATORY DATA

WP - Plastic Limit (%)  
 W - Water Content (%)  
 WL - Liquid Limit (%)  
 $\gamma$  - Natural Unit Weight (kN/m<sup>3</sup>)  
 UNDR STRNG or  $C_u$  - Undrained Shear Strength (kPa)  
 Field Vane: St-sensitivity  
 pp - Pocket Penetrometer  
 UC - Unconfined Compression  
 UU - Unconsolidated Undrained at Overburden Pressure  
 CU - Consolidated Undrained  
 CD - Consolidated Drained  
 TOV - Total Organic Vapours

**Standard Penetration Test, 'N'-values**  
 The Standard Penetration Test (SPT) 'N'-values are the number of blows required to cause a standard 51 millimetre o.d. split barrel sample to penetrate 0.3 metres into undisturbed ground in a borehole when driven by a hammer with a mass of 63.5 kilograms falling freely a distance of 0.76 metres. For penetrations of less than 0.3 metres, N-values are indicated as the number of blows for the penetration achieved (e.g. 50/25: 50 blows for 25 centimetre penetration).

**Dynamic Cone Penetration Test:**  
 Continuous penetration of a conical steel point (51 millimetre 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 0.3 metres advance of the conical point into the undisturbed ground.

Soils are described by their composition and consistency or compactness.

**CONSISTENCY:** Cohesive soils are described on the basis of their undrained shear strength ( $C_u$ ) or 'N'-values as follows:

$C_u$ (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD
N (blows/0.3 metres)	0 - 2	2 - 4	4 - 8	8 - 15	15 - 30	> 30

**COMPACTNESS:** Cohesionless soils are described on the basis of compactness as indicated by 'N'-values as follows:

N (blows/0.3 metres)	0 - 4	4 - 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.

### ROCK QUALITY

**DESIGNATION (RQD):** Sum of those intact core pieces, 100 millimetres in length expressed as a percent of the length of the coring run. Classification of a rock based on the RQD value as follows:

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

### JOINTING AND BEDDING:

SPACING	50 millimetres	50 - 300 millimetres	0.3 - 1.0 millimetres	1.0 - 3.0 millimetres	> 3.0 millimetres
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

# RECORD OF BOREHOLE No A1



1 OF 1

G.W.P. 81-99-00 LOCATION 4965002 N, 362884 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
283.9									20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	0.2m TOPSOIL		1	SS	7										
283.0	SILT, trace SAND.		2	SS	15										
0.9	brown, loose to compact, moist End of Borehole							283							
	Pionjar Refusal and Auger Refusal														
	Water level in open bore on completion: none														



**amec**

1 OF 1

G.W.P.	81-99-00	LOCATION	4964974 N. 362872 E	ORIGINATED BY	NNK
DIST	52	HWY	35	COMPILED BY	NNK
DATUM	Geodetic	DATE	21 November 2000 - 21 November 2000	CHECKED BY	AD
PROJECT	Highway 35 Widening			JOB NO.	TT20868

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	SHEAR STRENGTH KPa	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE										
287.5														
0.0	EXPOSED BEDROCK						287							

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

# RECORD OF BOREHOLE No A3



1 OF 1

G.W.P. 81-99-00 LOCATION 4964919 N, 362863 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
285.2 0.0	0.2m TOPSOIL		1	SS	5		285							
	SILT, trace SAND, brown, loose to compact, damp		2	SS	23		284							
283.7 1.5	End of Borehole  Pionjar Refusal and Auger Refusal  Water level in open bore on completion: none													

# RECORD OF BOREHOLE No A4



1 OF 1

G.W.P. 81-99-00 LOCATION 4964953 N, 362837 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 12 January 2000 - 12 January 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
281.9									20 40 60 80 100						
0.0	0.1m SILT(FILL)		1	SS	6				○ UNCONFINED + FIELD VANE						
	PEAT, black, firm, damp						1	281	● QUICK TRIAXIAL x LAB VANE						
280.5									20 40 60 80 100						
1.4	SILTY CLAY, brown, very stiff to hard, damp		2	SS	29		2	280						41	
278.7							3	279							
3.2	End of Borehole  Refusal on Probable Bedrock  Water level in open bore on completion:2.6m		3	SS	50/0										

# RECORD OF BOREHOLE No A5



1 OF 1

G.W.P. 81-99-00 LOCATION 4964967 N, 362841 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 12 January 2000 - 12 January 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
282.0									20 40 60 80 100						
0.0	PEAT, trace Sand, Gravel		1	SS	7				○ UNCONFINED + FIELD VANE						
281.4	black, firm, damp								● QUICK TRIAXIAL × LAB VANE						
0.6	some sand		2	SS	14		1	281	20 40 60 80 100						
	SILTY CLAY		3	SS	23		2	280						19.7	
	grey, stiff to very stiff, damp						3	279						19.2	
			4	SS	15		4	278							
277.5	SAND,						5	277							
4.5	Occasional Cobbles, Boulders.		5	SS	3										
	brown, very loose, wet														
276.5	SILTY CLAY,														
5.5	grey, hard, damp						6	276							
275.8	End of Borehole														
6.2	Refusal on Probable Bedrock														
	Water level in open bore on completion: 3.5m														

+ 3. X 3.

Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No A6



1 OF 1

G.W.P. 81-99-00 LOCATION 4964985 N, 362841 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 15 January 2001 - 15 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa	WATER CONTENT (%)					
280.9 0.0	PEAT, occasional cobbles, black, frozen		1	SS	9			280	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
279.4 1.5	SILTY CLAY with Sand, brown, very stiff, wet		2	SS	18		1	279							
278.6 2.3	SILTY SAND brown, dense, wet		3	SS	37		2	278							
277.1 3.8	SILTY CLAY occasional Sand and Silt seams, grey, firm to very stiff, damp to moist		4	SS	16		3	277							
			5	TW			4	276							
			6	SS	7		5	275							
272.4 8.5	SAND AND GRAVEL occasional Cobbles, brown, very dense, wet		7	SS	56		6	274							
271.3 9.6	End of Borehole  Auger Refusal on Cobbles/Boulders  Water level in open bore on completion: 1.5m						7	273							
							8	272							
							9								

+ 3 X 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No A7



G.W.P. <u>81-99-00</u>		LOCATION <u>4964987 N, 362866 E</u>		1 OF 1	
DIST <u>52</u> HWY <u>35</u>		BOREHOLE TYPE <u>Hand Augering</u>		ORIGINATED BY <u>NNK</u>	
DATUM <u>Geodetic</u>		DATE <u>29 November 200 - 29 November 200</u>		COMPILED BY <u>NNK</u>	
PROJECT <u>Highway 35 Widening</u>				CHECKED BY <u>AD</u>	
				JOB NO. <u>TT20868</u>	

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa				WATER CONTENT (%)						
289.8																
0.0	80mm ASPHALTIC CONCRETE															
	0.4m SAND AND GRAVEL(FILL)															
	GRAVELLY SAND (FILL),															
	brown, damp															
288.8																
1.0	End of Borehole															
	Auger Refusal on Rockfill															
	Water level in open bore on completion: none															

# RECORD OF BOREHOLE No B1



1 OF 1

G.W.P. 81-99-00 LOCATION 4965006 N. 362896 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Pionjar Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 20 November 2000 - 20 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
286.0	0.3m TOPSOIL		1	PJ				20 40 60 80 100					
0.0	SILTY SAND (FILL), brown, moist							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
285.0								20 40 60 80 100					
1.1	End of Borehole Refusal on Probable Bedrock												

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

# RECORD OF BOREHOLE No B2

1 OF 1

G.W.P. 81-99-00	LOCATION 4965034 N. 362885 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Continuous Sampling	COMPILED BY NNK
DATUM Geodetic	DATE 20 November 2000 - 20 November 2000	CHECKED BY AD
PROJECT Highway 35 Widening	JOB NO. TT20868	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
282.4 0.0	0.3m TOPSOIL		1	SS	0									
	0.2m SAND (FILL), brown, very loose, wet		2	SS	18									
280.9 1.5	CLAYEY SILT, brown, verystiff, damp		3	SS	29									
	End of Borehole													
	Refusal on Bedrock. confirmed by test pitting.													



# RECORD OF BOREHOLE No B3

amec

G.W.P. 81-99-00	LOCATION 4965042 N. 362838 E	1 OF 1	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Wash Boring	COMPILED BY NNK	
DATUM Geodetic	DATE 9 February 2001 - 9 February 2001	CHECKED BY AD	
PROJECT Highway 35 Widening		JOB NO. TT20868	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
279.1	0.3m TOPSOIL		1	SS	1											
0.0	trace Topsoil		2	SS	7											
	firm		3	SS	25											
			4	SS	48											
	SILTY CLAY, trace Gravel, Sand, grey, very stiff to hard, damp		5	SS	49											
			6	SS	32											
			7	SS	34											
274.8	End of Borehole															
4.3	Water level in open bore on completion: at surface															

**amec**

1 OF 1

G.W.P.	81-99-00	LOCATION	4965000 N. 362844 E	ORIGINATED BY	NNK
DIST	52	HWY	35	COMPILED BY	NNK
DATUM	Geodetic	DATE	11 January 2000 - 12 January 2000	CHECKED BY	AD
PROJECT	Highway 35 Widening			JOB NO.	TT20868

[illegible]

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

# RECORD OF BOREHOLE No B5



1 OF 1

G.W.P. 81-99-00 LOCATION 4965056 N. 362870 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hand Augering COMPILED BY NNK  
 DATUM Geodetic DATE 29 November 200 - 29 November 200 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE				"N" VALUES	SHEAR STRENGTH kPa					
289.8	0.3m SAND AND GRAVEL (FILL)					3	3	20 40 60 80 100	10 20 30					GR SA SI CL
288.8	SAND(FILL), trace Gravel, Cobbles brown, damp					1	289	20 40 60 80 100	10 20 30					
1.0	End of Borehole													
	Auger Refusal on Rockfill													

+ 3 x 3: Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No C1



G.W.P. 81-99-00 LOCATION 4965325 N 362871 E 1 OF 1  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY NNK  
 DATUM Geodetic DATE 16 January 2001 - 16 January 2001 COMPILED BY NNK  
 PROJECT Highway 35 Widening CHECKED BY AD  
 JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
292.2	0.2m TOPSOIL		1	SS	10											
291.1	SILTY SAND, with Gravel, brown, very dense, frozen		2	SS	50/15											
1.1	End of Borehole Auger Refusal															
	Water level in open bore on completion:none															

# RECORD OF BOREHOLE No C2



1 OF 1

G.W.P. 81-99-00 LOCATION 4965352 N, 362876 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 15 January 2001 - 15 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
292.1 0.0	frozen		1	SS	10		292							
291.1 1.0	PEAT, black, soft to firm, wet		2	SS	7		291							
	SILTY CLAY to CLAYEY SILT, occasional Sand and Gravel seams, grey, stiff to very stiff, damp to moist		3	SS	10		290							
			4	SS	16		289							
			5	SS	26		288							
287.0 5.1	0.1m SAND AND GRAVEL End of Borehole Auger Refusal						287							
	Water level in open bore on completion: 1.2m													
	Water level in Piezometer on Feb 14, 2001: 0.3m													

+ 3, X 3. Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No C3



1 OF 1

G.W.P. 81-99-00 LOCATION 4965394 N. 362877 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 16 January 2001 - 16 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
294.2 0.0	PEAT, black, frozen		1	SS	7			294	20 40 60 80 100					
293.6 0.6	SANDY SILT, with frequent Peat layers, trace Gravel, brown to grey, very loose, wet		2	SS	2		1	293	20 40 60 80 100					
292.7														
292.5	SAND AND GRAVEL		3	SS	50/3									
291.7	End of Borehole Auger Refusal													
	Water level in open bore on completion: 0.9m													SS3 no recovery

# RECORD OF BOREHOLE No C4

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4965352 N, 362884 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 23 November 2000 - 23 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
294.8														
0.0	SAND (FILL), with gravel		1	SS	17									
294.1	brown, compact, damp													
0.7	End of Borehole						294							
	Auger Refusal on Rockfill													
	Water level in open bore on completion: none													

# RECORD OF BOREHOLE No D1



1 OF 1

G.W.P. 81-99-00 LOCATION 4965382 N. 362903 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 24 January 2001 - 24 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100						WATER CONTENT (%)
292.4 0.0	PEAT, black, very soft, moist to wet		1	SS	1			292	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		WATER CONTENT (%) 10 20 30		kN/m³		Sampler wet at 1.2m	
			2	SS	1		1	291								
			3	SS	1		2	290								
290.3 2.1	SILTY CLAY to CLAYEY SILT grey, very stiff, damp		4	SS	16			289								
			5	SS	15		3	288								
288.6 3.8	SAND, with Gravel grey, wet							287								
288.3 4.1	End of Borehole						4	286								
Auger Refusal on probable Bedrock  Water in Piezometer Jan 24, 2001: 3.2m  Water level in Piezometer on Feb 14, 2001: 0.7m																

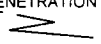


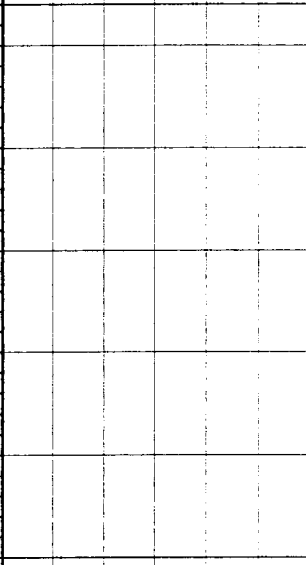
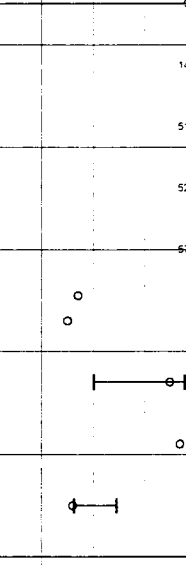





# RECORD OF BOREHOLE No D2

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4965436 N. 362906 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 29 November 2000 - 29 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
292.4 0.0	PEAT, trace Wood fragments, black, very soft to soft, wet		1	SS	0		292					0 1 67 32		
			2	SS	1		291							
			3	SS	3		290							
			4	SS	1		289							
289.7 2.7			5	SS	9		288							
287.0 5.4	SILTY CLAY to CLAYEY SILT, grey, stiff to hard, damp		6	SS	18									
			7	SS	12									
			8	SS	13									
			9	SS	35									
	End of Borehole													
	Water level in open bore on completion: 1.2 m													

# RECORD OF BOREHOLE No D3



1 OF 1

G.W.P. 81-99-00 LOCATION 4965488 N, 362909 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 28 November 2000 - 28 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH (m)	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
292.7									20 40 60 80 100							
0.0	PEAT, trace Wood fragments, black, soft to firm, damp to wet		1	SS	3		0	292							SS3: Wood piece in sampler	
			2	SS	4		1									
	----- Tree Roots		3	SS	18		2									
			4	SS	8											
	----- with Sand layers		5	SS	13											
289.8			6	SS	17		3									
2.9	SILTY CLAY to CLAYEY SILT, occasional Sand lenses, grey, very stiff to hard, damp		7	SS	30/10											
288.8	End of Borehole							289								
3.9	Sampler broke at 3.9m  Water level in open bore on completion: 0.6m															

# RECORD OF BOREHOLE No D4



1 OF 1

G.W.P. 81-99-00 LOCATION 4965433 N 362895 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 30 November 200 - 30 November 200 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa										
295.6	80mm ASPHALTIC CONCRETE															
294.3	SAND(FILL), brown, damp															
1.3	End of Borehole Auger Refusal on Rockfill															

+ 3 × 3. Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No E1



1 OF 1

G.W.P. 81-99-00 LOCATION 4965705 N. 362776 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 30 January 2001 - 30 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa	WATER CONTENT (%)					
292.2 0.0	0.3m TOPSOIL								20 40 60 80 100	10 20 30					
	SILTY SAND, occasional Peat layers, trace gravel, brown to grey, very loose to compact, wet		1	SS	1		292		○ UNCONFINED + FIELD VANE						
			2	SS	3		291		● QUICK TRIAXIAL × LAB VANE						
			3	SS	10										
290.1 2.1	SILTY SAND, occasional Cobbles, brown, very dense, wet		4	SS	55/25		290							0 64 35 1	
							289								
288.7 3.5	End of Borehole  Auger Refusal on probable Bedrock Refusal to DCPT  Water level in open bore on completion: 1.4m		5	SS	87/27										

# RECORD OF BOREHOLE No E1A



1 OF 1

G.W.P. 81-99-00 LOCATION 4965717 N, 362776 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)
291.9	PEAT black, very soft, wet		1	SS	1											
			2	SS	2											
			3	SS	2											
			4	SS	3											
			5	SS	1											
287.6	ORGANIC SANDY SILT, with shells, dark grey, soft, wet SILTY SAND, some clay, trace Gravel, grey, compact to dense, damp End of Borehole		6	SS	3											
284.3			7	SS	18/15											
284.6	Water in open bore on completion: at Ground Surface															

# RECORD OF BOREHOLE No E2

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4965746 N, 362744 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 30 January 2000 - 30 January 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		w <sub>p</sub>	w	w <sub>L</sub>	WATER CONTENT (%)						
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE				10	20	30				
291.5									20	40	60	80	100							
0.0	PEAT, black, very soft, wet		1	SS	0		291													
			2	SS	1		290													
			3	SS	1		289													
			4	SS	1		288													
			5	SS	1		287													
285.3	SILTY CLAY to CLAYEY SILT, grey, very soft to stiff, moist		6	SS	0		286													
6.2			7	SS	0		285													
			8	SS	1		284													
			9	TW			283													
			10	SS	58/25		282													
281.9	trace Gravel																			
9.6	End of Borehole																			
	Auger Refusal on probable Bedrock DCPT Refusal																			
	Water level in open bore on completion: at surface																			

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

# RECORD OF BOREHOLE No E2A



1 OF 1

G.W.P. 81-99-00 LOCATION 4965747 N. 362744 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
291.5 0.0	PEAT black, very soft to soft, wet		1	SS	0	▽	291							SS 1 to 4 : No recovery	
			2	SS	0		1								
			3	SS	2		2								
			4	SS	3		289								
							3								
							288								
							4								
							287								
286.3 5.2	ORGANIC SILT, trace shells, dark grey, firm, wet		5	SS	5		5							0 0 68 32	
285.9 5.6			6	SS	6	6									
	SILTY CLAY to CLAYEY SILT, grey, soft to firm, wet		7	SS	3		7								
			8	SS	5										
			9	SS	17										
283.6 8.0	very stiff														
	End of Borehole														
	Water in open bore on completion: at Ground Surface														

+ 3, x 3: Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No E3



1 OF 1

G.W.P. 81-99-00 LOCATION 4965794 N. 362717 E. ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 30 January 2001 - 30 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
291.7 0.0	PEAT, black, very soft, wet		1	SS	0		1	291	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		10 20 30		135		Auger refusal at 1.4m. Borehole moved 1.5m west. Auger refusal at 1.4m. borehole moved 2.4m south west.
290.2 1.5									20 40 60 80 100		10 20 30				
289.6 2.1															
289.1 2.6	SAND, trace Gravel, brown, very dense, wet		3	SS	50/10										
289.1 2.6	End of Borehole  Auger Refusal on probable bedrock DCPT Refusal  Water level in open bore on completion: 1.5m														

+ 3 . x 3. Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE









# RECORD OF BOREHOLE No E3A



1 OF 1

G.W.P. 81-99-00 LOCATION 4965782 N. 362717 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
291.7									20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	PEAT, with Wood Fragments, black, very soft, wet		1	SS	0	1	291								
			2	SS	0		290								
			3	SS	0										
			4	SS	2										
			5	SS	6										
288.6	CLAYEY SILT, trace sand, grey, firm to very stiff, wet		6	SS	18	3	289								
288.0							288								
3.8	End of Borehole														
	Water in open bore on completion: at Ground Surface														

# RECORD OF BOREHOLE No E4



1 OF 1

G.W.P. 81-99-00 LOCATION 4965828 N, 362710 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 200 - 21 November 200 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
295.6 0.0	0.2m TOPSOIL		1	SS	3									
294.7 0.9	SILTY SAND, with Gravel, brown, very loose to loose, wet End of Borehole Auger Refusal on possible Bedrock  Water in Open Bore on completion: 0.3m		2	SS	6/15		295							

# RECORD OF BOREHOLE No E5



1 OF 1

G.W.P. 81-99-00 LOCATION 4965835 N. 362749 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash boring COMPILED BY NNK  
 DATUM Geodetic DATE 7 February 2001 - 7 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH E	E ELEVATION SCALE E	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
291.5 0.0	Water														
290.8 0.7	PEAT, black, wet														
290.5 1.0	SILTY SAND, with Gravel, brown, wet		1	SS	50/12		1								SS1: Stone in sampler
290.0 1.5	Refusal on possible Bedrock														
	Water in Open Bore on completion: at surface														

# RECORD OF BOREHOLE No E6



1 OF 1

G.W.P. 81-99-00 LOCATION 4965810 N, 362760 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash boring COMPILED BY NNK  
 DATUM Geodetic DATE 7 February 2001 - 7 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100					
291.6 0.0	Water							291										
290.6 1.0	PEAT black, wet							290										
								289										
								288										
								287										
286.3 5.4	CLAYEY SILT to SILTY CLAY. grey, very soft to firm, wet		1	SS	0			286										
								285										
			2	SS	3			284										
283.7 5.4	SILTY SAND. grey, very dense, wet		3	SS	50/5			283										
282.6 8.0	End of Borehole																	
	Refusal on probable Bedrock																	
	Water in Open Bore on completion: at surface																	

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

# RECORD OF BOREHOLE No E7

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4965770 N, 362782 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash boring COMPILED BY NNK  
 DATUM Geodetic DATE 6 February 2001 - 6 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
291.6	0.0	Water												
290.0	1.6	PEAT, blac, very soft, wet												
			1	SS	1									
			2	SS	0									
			3	SS	0									
			4	SS	0									
			5	SS	1									
			6	SS	65/15									
282.9	8.7	CLAYEY SILT to SILTY CLAY grey, very soft, wet												
			4	SS	0									
			5	SS	1									
279.1	12.5	End of Borehole  Refusal on probable Bedrock  Water in Open Bore on completion: at surface												

+ 3 . X 3 : Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No E8



1 OF 1

G.W.P. 81-99-00 LOCATION 4965728 N, 362811 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash boring COMPILED BY NNK  
 DATUM Geodetic DATE 5 February 2001 - 5 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	E ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
291.6 0.0	PEAT, occasional Sand seams, black, very soft to firm, wet		1	SS	2		1	291							
			2	SS	1		2	290							
288.6			3	SS	5		3	289							
288.3 3.3	SILTY SAND, with gravel grey, very dense, wet End of Borehole		4	SS	50/10										
	Refusal to casing advancement on possible bedrock														
	Water in open bore on completion: at surface														

**amec**

G.W.P. 81-99-00	LOCATION 4965772 N, 362759 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Air Track	COMPILED BY NNK
DATUM Geodetic	DATE 12 February 2001 - 12 February 2001	CHECKED BY AD
PROJECT Highway 35 Widening		JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT $w_p$	NATURAL MOISTURE CONTENT $w$	LIQUID LIMIT $w_L$	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20		40				60
297.5	100mm ASPHALTIC CONCRETE														
0.0	0.3m GRAVELLY SAND(FILL)						297								
296.3	SAND(FILL). trace Gravel, Cobbles. brown, damp						1								
1.2							296								
							2								
							295								
							3								
							294								
							4								
							293								
							5								
							292								
							6								
							291								
							7								
							290								
							8								
							289								
							9								
							288								
							10								
	ROCKFILL with Sand, damp						287								
							11								
							286								
							12								
							285								
							13								
							284								
							14								
							283								

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

# RECORD OF BOREHOLE No E9

2 OF 2

G.W.P.	81-99-00	LOCATION	4965772 N. 362759 E	2 OF 2	ORIGINATED BY	NNK	
DIST	52	HWY	35	BOREHOLE TYPE	Air Track	COMPILED BY	NNK
DATUM	Geodetic	DATE	12 February 2001 - 12 February 2001	CHECKED BY	AD		
PROJECT	Highway 35 Widening				JOB NO.	TT20868	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE				"N" VALUES	SHEAR STRENGTH kPa					
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE					
279.2						16	282							
18.3						17	281							
278.6	INFERRED BEDROCK					18	280							
18.9	End of Borehole Borehole dry on completion 2 hrs later: dry						279							



# RECORD OF BOREHOLE No E10



1 OF 2

G.W.P. 81-99-00 LOCATION 4965737 N, 362759 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Air Track COMPILED BY NNK  
 DATUM Geodetic DATE 12 February 2001 - 12 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
297.5	100mm ASPHALTIC CONCRETE						0.0								
296.2	SAND(FILL), with Gravel, Cobbles brown, damp						1.3								
							1								
							2								
							3								
							4								
							5								
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							100								

Continued Next Page

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

# RECORD OF BOREHOLE No E10



2 OF 2

G.W.P. 81-99-00 LOCATION 4965737 N, 362759 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Air Track COMPILED BY NNK  
 DATUM Geodetic DATE 12 February 2001 - 12 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE 20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
280.1	17.4	INFERRED BEDROCK					282							
278.6	18.9	End of Borehole Water in Open Bore on completion: none					279							

# RECORD OF BOREHOLE No F1



1 OF 1

G.W.P. 81-99-00 LOCATION 4965949 N, 362727 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Pionjar Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 28 November 2000 - 28 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100					
294.5																		
0.0	SAND, trace Organics, brown, very loose, moist		1	SS	2													
294.0																		
0.5	SAND, trace Gravel, occasional Clayey Silt seams brown, compact, moist		2	SS	10													
			3	PJ														
292.9			4	PJ														
1.7	wet Pionjar Refusal on Probable Bedrock																	
	Water level in open bore on completion: 0.6m 1 hr. after completion: 0.6m																	

# RECORD OF BOREHOLE No F2

G.W.P. 81-99-00	LOCATION 4965989 N. 362729 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Continuous Sampling	COMPILED BY NNK
DATUM Geodetic	DATE 28 November 2000 - 28 November 2000	CHECKED BY AD
PROJECT Highway 35 Widening	JOB NO. TT20868	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)					
293.2 0.0	PEAT, with Sand layers, trace wood fragments black to brown, very soft to soft, wet		1	SS	1		293							0 11 69 20							
			2	SS	1		292														
			3	SS	2		291														
290.9 2.3			4	SS	4		290														
	CLAYEY SILT, grey, firm to very stiff, wet		5	SS	6										289						
			6	SS	23																
			7	PJ																	
288.9 4.4	Pionjar Refusal																				
	Water level in open bore  on completion: 0.3m 2.5 hrs. after completion: 0.3m																				

# RECORD OF BOREHOLE No F3



1 OF 1

G.W.P. 81-99-00 LOCATION 4966033 N, 362727 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 28 November 2000 - 28 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)	GR SA SI CL			
293.1 0.0	PEAT, with Sand layers, black to brown, very soft to soft, wet		1	SS	0		293							17.5	0 0 78 22
		2	SS	2	1		292								
		3	SS	2	2		291								
290.8 2.3		4	SS	4	3		290								
	CLAYEY SILT, grey, firm to stiff, wet		5	SS	12		4	289							
			6	PJ											
288.6 4.5	Pionjar Refusal														
	Water level in open bore on completion: 0.3m 1 hr. after completion: 0.3m														

# RECORD OF BOREHOLE No F4



1 OF 1

G.W.P. 81-99-00 LOCATION 4966100 N. 362727 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 29 November 2000 - 29 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT		UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		$w_p$	$w$	$w_L$	
293.1								20 40 60 80 100					
0.0	PEAT, with Sand layers, trace Gravel, black to brown, very soft to firm, wet		1	SS	0		293	○ UNCONFINED + FIELD VANE					
			2	SS	4		292	● QUICK TRIAXIAL x LAB VANE					
291.6			3	SS	10								
1.5	CLAYEY SILT, grey, stiff to very stiff, moist		4	SS	17		291						0 10 75 15
			5	SS	12								
290.0			6	PJ			290						
3.1	SILTY SAND, with Gravel, brownish orange, damp												
289.5	Pionjar Refusal												
3.6	Water level in open bore on completion: at ground surface												

+ 3 x 3

Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No F5

1 OF 1

G.W.P. 81-99-00 LOCATION 4966154 N, 362724 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 29 November 2000 - 29 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100					
295.6 0.0	SAND, trace Organics, Gravel brown, very loose, moist		1	SS	2													
295.1 0.5	SAND, trace Gravel brown, compact, moist		2	SS	15		1											
294.3 1.4	Pionjar Refusal on Possible Bedrock or Boulder		3	PJ														
	Water level in open bore on completion: none																	

# RECORD OF BOREHOLE No F6

1 OF 1

G.W.P. 81-99-00 LOCATION 4966034 N. 362715 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 1 December 2000 - 1 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)			
									20 40 60 80 100										
298.9	150mm ASPHALTIC CONCRETE																		
0.0			1	SS	33														
			2	SS	25		1	298											
			3	SS	50/1		2	297							SS3 Sampler refusal on Cobble				
	GRAVELLY SAND to SAND (FILL) with Gravel trace Silt, cobbles brown, compact to dense, damp		4	SS	26		3	296											
			5	SS	13		4	295											
			6	SS	26		5	294							4" 5" (5)				
			7	SS	37		6	293											
			8	SS	23		7	292											
			9	SS	16														
292.2	wet																		
6.7	PEAT, with Sand, Gravel black, very soft, wet		10	SS	1														
291.5																			
7.4	CLAYEY SILT trace Organics, Rootlets, grey, stiff to very stiff		11	SS	45/20										C 13 72 15				
291.0																			
8.0	Auger Refusal on possible bedrock or Boulder																		
	Water level in open bore on completion: 6.2m																		



# RECORD OF BOREHOLE No G1

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4966004 N, 362695 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 27 November 2000 - 27 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40						60	80	100	20	40	60	80	100
294.4 0.0	SAND, with Peat layers, trace Gravel brown, very loose to loose, wet		1	SS	2		1	294					26	24	72	(4)							
			2	SS	2																		
			3	SS	1																		
			4	SS	5																		
292.1 2.3	SAND, with gravel, trace silt grey, very loose, wet		5	SS	3																		
291.4 3.0			6	SS	12																		
290.8 3.6	CLAYEY SILT, with Sand, trace Sand seams, trace Gravel, grey, stiff, moist End of Borehole																						
	Sampler bouncing on Possible Bedrock Pionjar refusal																						
	Water level in open bore on completion: 0.3m 1.5 hrs. after completion: 0.3m																						

# RECORD OF BOREHOLE No G2

1 OF 1

G.W.P. 81-99-00	LOCATION 4966028 N. 362693 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Continuous Sampling	COMPILED BY NNK
DATUM Geodetic	DATE 27 November 2000 - 27 November 2000	CHECKED BY AD
PROJECT Highway 35 Widening	JOB NO.	TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100							SHEAR STRENGTH kPa		WATER CONTENT (%)	
									○ UNCONFINED	+ FIELD VANE						● QUICK TRIAXIAL	× LAB VANE	10 20 30	kN/m <sup>3</sup>
293.3																			
0.0	SAND, with Peat layers, trace Gravel, brown, very loose to compact, wet		1	SS	3		293								SS1, 3 No recovery				
			2	SS	1		1												
			3	SS	7		292												
			4	SS	10		2												
290.7	CLAYEY SILT, trace Sand, grey, stiff to very stiff, moist		5	SS	8		291												
2.6			6	SS	24		3												
							4												
			7	PJ		289													
288.5															0 0 80 20				
4.8	Pionjar Refusal																		
	Water level in open bore on completion: 0.3m																		

# RECORD OF BOREHOLE No G3

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4966066 N. 362685 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 27 November 2000 - 27 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100					
293.9																		
293.6	TOPSOIL, with Sand, black, damp		1	SS	22/16												Hand Dig from 0.3 to 0.5m	
290.3	Cobbles																	
0.5	Pionjar Refusal																	
	On Probable Boulder						293											
	Water in open bore on completion: none																	

# RECORD OF BOREHOLE No G4

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4966031 N. 362706 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 1 December 2000 - 1 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
298.9	150mm ASPHALTIC CONCRETE		1	SS	36										
0.0			2	SS	22		1	298							Auger Refusal at 1.4m on Cobbles, move borehole to highway shoulder and continue sampling at 1.6m
	Gravelly dense						2	297							19 76 (5)
			3	SS	14										
			4	SS	20		3	296							
			5	SS	10		4	295							
	SAND (FILL), some to with Gravel, trace Silt, occasional Cobbles, brown, compact, damp		6	SS	17		5	294							
			7	SS	10		6	293							
			8	SS	7		7	292							
292.2	wet														
6.7	SAND with Gravel, trace Silt, Decaying wood fragments, brown, compact, wet		9	SS	14		8	291							28 67 (5)
291.4	trace Rootlets, Gravel, Organic seams		10	SS	27		9	290							
7.5			11	SS	41										
	CLAYEY SILT, trace Gravel, Sand, grey, very stiff to hard, wet		12	SS	38										
289.0			13	SS	50										
9.9	End of Borehole  Auger Refusal on Possible Bedrock  Water level in open bore on completion: 6.4m														

# RECORD OF BOREHOLE No H1

1 OF 1

G.W.P. 81-99-00	LOCATION 4966449 N. 362685 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Hollow Stem Augering	COMPILED BY NNK
DATUM Geodetic	DATE 22 January 2001 - 22 January 2001	CHECKED BY AD
PROJECT Highway 35 Widening		JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
282.1	PEAT, trace Sand, gravel, black, firm, wet		1	SS	4			282							
281.3	CLAYEY SILT, grey, hard, moist		2	SS	50/8		1								
281.0	End of Borehole														
1.1	Auger Refusal on Possible Boulder														
	Water level in open bore on completion: 1m														

# RECORD OF BOREHOLE No H2

1 OF 1

G.W.P. 81-99-00	LOCATION 4966503 N, 362680 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Hollow Stem Augering	COMPILED BY NNK
DATUM Geodetic	DATE 22 January 2001 - 22 January 2001	CHECKED BY AD
PROJECT Highway 35 Widening	JOB NO.	TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
279.8	0.0		1	SS	0										
	PEAT, occasional silt zones, black to grey, very soft, wet		2	SS	2		1	279							
278.0	1.8		3	SS	16		2	278							
	CLAYEY SILT, occasional sand seams, grey, very stiff, moist		4	SS	27										
277.1	2.7		5	SS	50/0		3	277							
276.6	3.2														
	SAND, trace silt, gravel, grey, wet														
	End of Borehole														
	Auger Refusal on Possible Bedrock														
	Water level in open bore on completion: 1.5m														

+ 3 × 3 Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No H3

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4966558 N, 362677 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 18 January 2001 - 19 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
279.2									20 40 60 80 100						
0.0	PEAT		1	SS	2		279		○ UNCONFINED + FIELD VANE						
	occasional Sand layers, black, soft, wet								● QUICK TRIAXIAL × LAB VANE						
278.3			2	SS	10		1		20 40 60 80 100						
0.9															
	CLAYEY SILT to SILTY CLAY		3	SS	12		2								
	occasional varved zones, grey, stiff to very stiff, moist														
			4	SS	15		3								
			5	SS	16		4								
			6	SS	15		5								
			7	SS	16		6								
	firm														
			8	SS	5		7								
			9	TW			8								
			10	SS	7		9								
	stiff														
269.6			11	SS	13										
269.6	SAND with Gravel														
9.8	End of Borehole														
	Auger Refusal on Possible Bedrock														
	Water level in open bore on completion: 1.8m														
	Water level in Piezometer on Feb 14, 2001: 0.0 m (frozen)														

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

# RECORD OF BOREHOLE No H4



1 OF 1

G.W.P. 81-99-00 LOCATION 4966598 N, 362676 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 19 January 2001 - 19 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	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 <sub>p</sub> NATURAL MOISTURE CONTENT w LIQUID LIMIT w <sub>L</sub> WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES							
279.8	PEAT, occasional Cobbles black, very soft, wet		1	SS	2							
279.3												
0.5	brown CLAYEY SILT to SILTY CLAY, firm to very stiff, moist grey		2	SS	10		1	279				
			3	SS	17		2	278				
			4	SS	13		3	277				
			5	SS	4		4	276	2			
			6	TW			5	275				
			7	SS	6							
274.5	SAND with Gravel, grey, wet							274				
5.3												
274.0	End of Borehole											
5.8	Auger refusal on Possible Bedrock  Water level in open bore on completion: 4.6m  Cave on completion: 5.2m											



# RECORD OF BOREHOLE No H5

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4966637 N. 362672 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 19 January 2001 - 19 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
279.4	PEAT, black, very soft, wet		1	SS	1				20 40 60 80 100						
279.0	SAND, trace Silt, Organics		2	SS	7				20 40 60 80 100						
278.3	CLAYEY SILT to SILTY CLAY, grey, stiff to very stiff, moist		3	SS	16				20 40 60 80 100						
276.4	SANDY SILT, grey, dense, wet		4	SS	9				20 40 60 80 100						
276.0	SAND, with gravel, occasional cobbles		5	SS	49				20 40 60 80 100						
275.8	grey, wet								20 40 60 80 100						
274.8	End of Borehole								20 40 60 80 100						
274.8	DCPT conducted from 3.6m to 4.6m								20 40 60 80 100						
4.6	End of DCPT								20 40 60 80 100						
	DCPT Refusal on Possible Bedrock								20 40 60 80 100						
	Water level in open bore on completion: 0.8m								20 40 60 80 100						
	Cave on completion: 3.1m								20 40 60 80 100						

# RECORD OF BOREHOLE No H6

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4966689 N, 362670 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 22 January 2001 - 22 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH E	ELEVATION SCALE E	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>		
281.2															
0.0	PEAT, with Sand, trace Gravel, black, soft, wet to frozen		1	SS	3			281							
280.3															
0.9	SANDY SILT, with Gravel, brown, compact, moist to wet		2	SS	20			280							
			3	SS	20										
279.0															
2.2	End of Borehole on Possible Bedrock  Water level in open bore on completion: 1.5m														

+ 3 x 3 Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No H7

1 OF 1

G.W.P. 81-99-00	LOCATION 4966741 N 362675 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE n/a	COMPILED BY NNK
DATUM Geodetic	DATE 20 November 2000 - 20 November 2000	CHECKED BY AD
PROJECT Highway 35 Widening		JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
289.5	EXPOSED BEDROCK						289							
0.0														

# RECORD OF BOREHOLE No H8

1 OF 1

G.W.P. 81-99-00	LOCATION 4966614 N 362689 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Air Track Drilling	COMPILED BY NNK
DATUM Geodetic	DATE 12 February 2001 - 12 February 2001	CHECKED BY AD
PROJECT Highway 35 Widening		JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
285.6	110mm ASPHALTIC CONCRETE						0.0	285							
284.4	0.3m SAND(FILL) with Gravel, brown, frozen						1.2	284							
	GRAVELLY SAND(FILL), with frequent cobbles, brown, damp														
	ROCKFILL with Sand														
282.4							3.2	282							
	INFERRED BEDROCK														
279.5							6.1	280							
	Water level in open bore on completion: none														

# RECORD OF BOREHOLE No J1

1 OF 1

G.W.P.	81-99-00	LOCATION	4967387 N 362690 E	ORIGINATED BY	NNK
DIST	52	HWY	35	BOREHOLE TYPE	Solid Stem Augering
DATUM	Geodetic	DATE	11 December 2000 - 11 December 2000	COMPILED BY	NNK
PROJECT	Highway 35 Widening	CHECKED BY	AD	JOB NO.	TT20868

[illegible]

# RECORD OF BOREHOLE No J2

1 OF 1

G.W.P. 81-99-00 LOCATION 4967401 N, 362693 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 11 December 2000 - 11 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40					
301.8															
0.0	PEAT, black, very soft, wet		1	SS	0										
301.1															
0.7	ORGANIC SILT, trace Sand, Rootlets, Peat,		2	SS	1										
300.7	grey, very soft, wet														
1.1	End of Borehole														
	Auger Refusal on Probable Bedrock														
	Water in open bore on completion: at Ground Surface														

Borehole moved  
1m north & 1m  
south. Auger  
refusal at 1.1m  
depth.

# RECORD OF BOREHOLE No J3

1 OF 1

G.W.P. 81-99-00 LOCATION 4967411 N, 362694 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 11 December 2000 - 11 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE				"N" VALUES	20						40	60
301.9	0.2m TOPSOIL		1	SS	4											
301.0	SAND, trace Silt, brown, very loose, wet		2	SS	50/10											
0.9	End of Borehole  Auger Refusal on probable Bedrock  Water in open bore on completion: at Ground Surface															Borehole moved 1m north & 1m south. Auger refusal at 0.9m depth.

# RECORD OF BOREHOLE No J4

1 OF 1

G.W.P. 81-99-00 LOCATION 4967404 N, 362687 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 23 November 2000 - 23 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100		
303.0															
0.0	0.2m SANDY GRAVEL (FILL)		1	SS	50/10										
302.3	SAND (FILL), with Gravel, brown, damp														
0.8	SAND, with frequent Peat layers, brown to black, compact, wet		2	SS	24		1	302							
301.6															
1.4	SAND, trace Gravel, brown, very dense, damp		3	SS	50/15										
301.2															
1.8	End of Borehole														
	Auger Refusal on Probable Bedrock														
	Water in open bore on completion: 1.5m														



# RECORD OF BOREHOLE No K1

1 OF 1

G.W.P. 81-99-00 LOCATION 4967495 N. 362687 E ORIGINATED BY NNK  
DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
DATUM Geodetic DATE 29 November 2000 - 29 November 2000 CHECKED BY AD  
PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100					
300.9																		
0.0	SILTY SAND. brown, very loose, moist		1	SS	3													
300.3			2	SS	10/5													
0.6	SAND. trace Gravel.		3	PJ														
299.9	brown, compact, moist						1	300										
1.1	End of Borehole																	
	Refusal on probable Bedrock																	
	Water level in open bore on completion: none																	

+ 3 X 3

Numbers refer to Sensitivity

O 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No K2

1 OF 1

G.W.P. 81-99-00 LOCATION 4967535 N, 362703 E ORIGINATED BY NNK  
DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
DATUM Geodetic DATE 24 November 2000 - 24 November 2000 CHECKED BY AD  
PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40					
298.8	SAND, with Peat layers. trace gravel, brown to grey, very loose, wet		1	SS	0										
297.7	SILT, trace Clay grey, very loose to compact, moist		2	SS	3										
296.6	0.1m Gravelly Sand End of Borehole		3	SS	13										
295.6	Refusal on Possible Bedrock or Boulder (Sampler Bouncing)		4	PJ											
294.6	Water level in open bore on completion: at Ground Surface														

# RECORD OF BOREHOLE No K3

1 OF 1

G.W.P. 81-99-00 LOCATION 4967556 N, 362711 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 29 November 2000 - 29 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	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 <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES										
299.9															
0.0	SAND, with Organics brown, very loose, moist		1	SS	4										
299.3															
0.6	SAND, trace Gravel brown, moist		2	PJ											
298.9															
1.1	End of Borehole														
	Refusal on Probable Bedrock														
	Water level in open bore on completion: 0.3m														

+ 3 X 3

Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No K4

1 OF 1

G.W.P. 81-99-00 LOCATION 4967541 N. 362718 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 5 December 2000 - 5 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
304.0									20 40 60 80 100	10 20 30					
0.0	110mm ASPHALTIC CONCRETE														
303.5	SAND(FILL), with Gravel, brown, damp														
0.5	End of Borehole														
	Refusal on Rockfill														
	Water level in open bore on completion: none														

+ 3 x 3

Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No L1

1 OF 1

G.W.P. 81-99-00 LOCATION 4967795 N. 362911 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Pionjar Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 22 November 2000 - 22 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
295.7									20 40 60 80 100	20 40 60 80 100					
0.0	CLAYEY SILT, with Peat layers, with rootlets black, damp		1	PJ					○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
295.0									20 40 60 80 100	20 40 60 80 100					
0.8	End of Borehole Refusal on Bedrock														

+ 3 x 3

Numbers refer to Sensitivity

○ 3%

STRAIN AT FAILURE

# RECORD OF BOREHOLE No L2

1 OF 1

G.W.P. 81-99-00 LOCATION 4967807 N, 362926 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 30 November 2000 - 30 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
293.5									20 40 60 80 100						
0.0	PEAT, with SAND, trace Gravel, trace Silt, black to brown, very loose, moist		1	SS	1			293	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
292.9									20 40 60 80 100						
0.6	CLAYEY SILT with Peat layers, trace Rootlets, brown, very soft, damp with Gravel, Sand		2	SS	1		1	292							20 20 45 15
292.4															
1.1			3	SS	12		2	291							
			4	SS	7		3	290							0 1 86 13
	CLAYEY SILT, grey, firm to stiff, wet		5	SS	8		4	289							
			6	SS	4		5	288							3 8 82 7
	Varved		7	SS	8		6								
	trace Gravel														
287.9			8	PJ											
5.6	SAND, with Gravel, grey, moist														
287.5															
6.0	End of Borehole (Pionjar refusal) Refusal on Probable Bedrock														
	Water level in open bore on completion: at Ground Surface														

# RECORD OF BOREHOLE No L3

1 OF 1

G.W.P. 81-99-00	LOCATION 4967835 N. 362974 E	ORIGINATED BY PPM
DIST 52 HWY 35	BOREHOLE TYPE Solid Stem Augering	COMPILED BY PPM
DATUM Geodetic	DATE 11 December 2000 - 11 December 2000	CHECKED BY AD
PROJECT Highway 35 Widening		JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
297.7									20 40 60 80 100					
0.0	0.1m TOPSOIL		1	SS	5				○ UNCONFINED + FIELD VANE					
296.6	SAND, with Gravel, occasional Cobbles, trace Silt, Organics, Rootlets		2	SS	70/22		1	297	● QUICK TRIAXIAL x LAB VANE					
1.1	brown, loose to very dense, damp End of Borehole								20 40 60 80 100					
	Auger Refusal on Probable Bedrock													

# RECORD OF BOREHOLE No L4

1 OF 1

G.W.P. 81-99-00 LOCATION 4967765 N. 362926 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 11 December 2000 - 11 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	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 <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
296.5	0.0	0.1m TOPSOIL	1	SS	7									
		SAND, with Silt, occasional Cobbles, trace Gravel, Rootlets loose to compact. damp	2	SS	16									
294.9	1.7	End of Borehole	3	SS	50/13									
		Auger Refusal on Probable Bedrock												



# RECORD OF BOREHOLE No L5

1 OF 1

G.W.P. 81-99-00 LOCATION 4967795 N, 362966 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 11 December 2000 - 11 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							
294.8									20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
0.0	0.15m TOPSOIL		1	SS	10											
	SAND (FILL), trace Gravel, occasional Cobbles, trace Silt, Organics brown, compact, damp to moist (Possible FILL)		2	SS	13		1	294								
			3	SS	15		2	293								
292.7	trace decaying wood fragments		4	SS	41		3	292								
2.1	CLAYEY SILT (GLACIAL TILL), trace Sand, occasional Gravel.		5	SS	26		4	291								
291.1	grey, very stiff to hard, damp varved, grey, stiff, wet		6	SS	11											
3.7			7	TW												
290.1	SAND, grey, wet															
290.0	End of Borehole															
4.8	Auger Refusal on Probable Bedrock															
	Water level in Piezometer on Feb 14, 2001: 1.3m															

+ 3. X 3. Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No L6

1 OF 1

G.W.P. 81-99-00 LOCATION 4967820 N. 362996 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 11 December 2000 - 11 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
295.4	0.1m TOPSOIL		1	SS	10			295							
293.8	SAND (FILL) trace Gravel, occasional Cobbles trace Silt, Rootlets brown, very loose to loose, damp		2	SS	4		1	294							
1.6	PEAT, black, soft, wet		3	SS	4		2	293							
293.3	CLAYEY SILT to SILTY CLAY grey, very stiff, damp		4	SS	24		3	292							
291.8	SAND with Gravel, trace Silt		5	SS	25										
3.6	grey, very dense, wet		6	SS	50/7										
291.3	End of Borehole														
3.9	Auger Refusal on Probable Bedrock														

# RECORD OF BOREHOLE No L7

1 OF 1

G.W.P. 81-99-00	LOCATION 4967796 N. 362934 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Air Track	COMPILED BY NNK
DATUM Geodetic	DATE 6 February 2001 - 6 February 2001	CHECKED BY AD
PROJECT Highway 35 Widening	JOB NO. TT20868	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	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 <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
299.4	0.0	100 mm ASPHALTIC CONCRETE												
298.6	0.8	SAND(FILL) with Gravel. brown, damp to frozen					1	299						
							2	298						
							3	297						
							4	296						
							5	295						
		ROCKFILL with Sand, damp					6	294						
							7	293						
							8	292						
							9	291						
							10	290						
289.4	10.0	INFERRED BEDROCK					11	289						
							12	288						
							13	287						
286.4	13.0	End of Borehole												
		Water level in open bore on completion: none												

# RECORD OF BOREHOLE No M1

1 OF 1

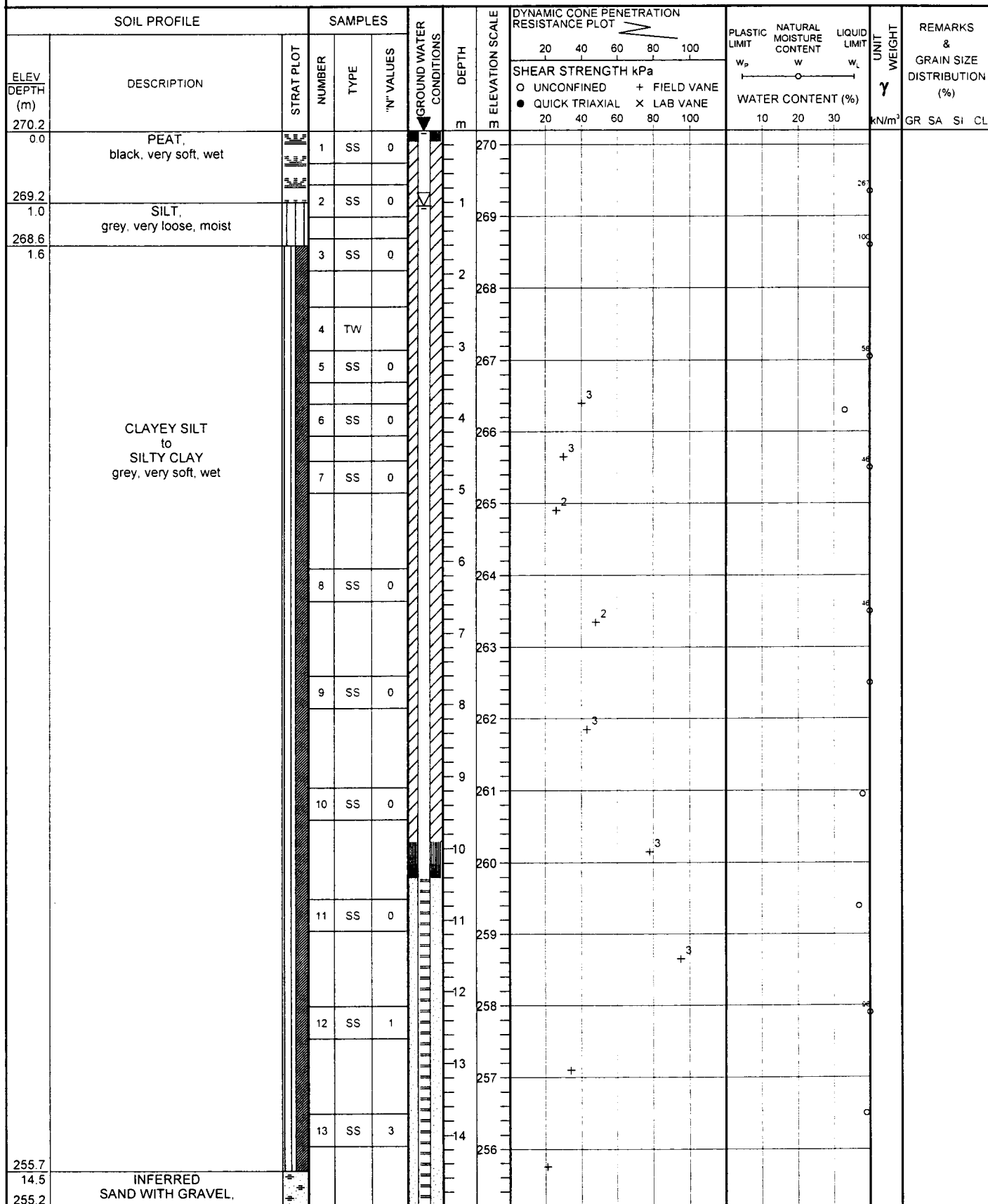
G.W.P. 81-99-00 LOCATION 4968632 N. 363379 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 17 January 2001 - 17 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
270.4									20 40 60 80 100	10 20 30 40						
0.0	PEAT, black, very soft, wet		1	SS	1		270									
269.1			2	SS	0		1									
1.4	CLAYEY SILT to SILTY CLAY grey, very soft, wet		3	SS	0		269									
			4	TW			268	+							0 0 73 27	
			5	SS	0		267	+								
			6	SS	0		266									
			7	SS	0		265									
			8	SS	0		264									
							263									
			9	SS	0		262									
							261									
261.1	SILTY SAND, with Gravel grey, dense to very dense, wet		10	SS	30		260									
260.0			11	SS	51		259									
10.4	End of Borehole Auger Refusal on Probable Boulders															
	DCPT conducted from 10.4 to 12.2m															
258.2	DCPT Refusal on Possible Bedrock															
12.2	Water level in open bore on completion: 2.5m  Cave on completion: 8.0m															

# RECORD OF BOREHOLE No M2

1 OF 2

G.W.P. 81-99-00 LOCATION 4968671 N 363356 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 16 January 2001 - 17 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868



# RECORD OF BOREHOLE No M2

2 OF 2

G.W.P. 81-99-00 LOCATION 4968671 N 363356 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 16 January 2001 - 17 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
15.0 254.9 15.3	<div>COBBLES, wet</div> <div>End of Borehole</div> <div>Auger Refusal on Boulder</div> <div>DCPT conducted from 15.0m to 15.3m</div> <div>End of DCPT</div> <div>DCPT Refusal on Possible Bedrock</div> <div>Water level in open bore on completion: 1.1m</div> <div>Water level in Piezometer on Feb 14, 2001: 0.0m</div> <div>Cave on completion: 3.4m</div>						255								

# RECORD OF BOREHOLE No M3

1 OF 1

G.W.P. 81-99-00 LOCATION 4968743 N, 363311 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash Boring COMPILED BY NNK  
 DATUM Geodetic DATE 8 February 2001 - 8 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100					
270.2	0.1m ICE							270										
269.9	WATER																	
268.7	SAND, with frequent PEAT layers, black, wet						1	269										
1.5	CLAYEY SILT to SILTY CLAY grey, very soft to stiff, wet		1	SS	0		2	268										
			2	TW			3	267										
			3	TW			4	266										
			4	SS	5		5	265										
			5	SS	9		6											
264.1	SILTY SAND, grey, very dense, wet End of Borehole		6	SS	50.5													
268.1																		
6.2																		

+ 3 . X 3

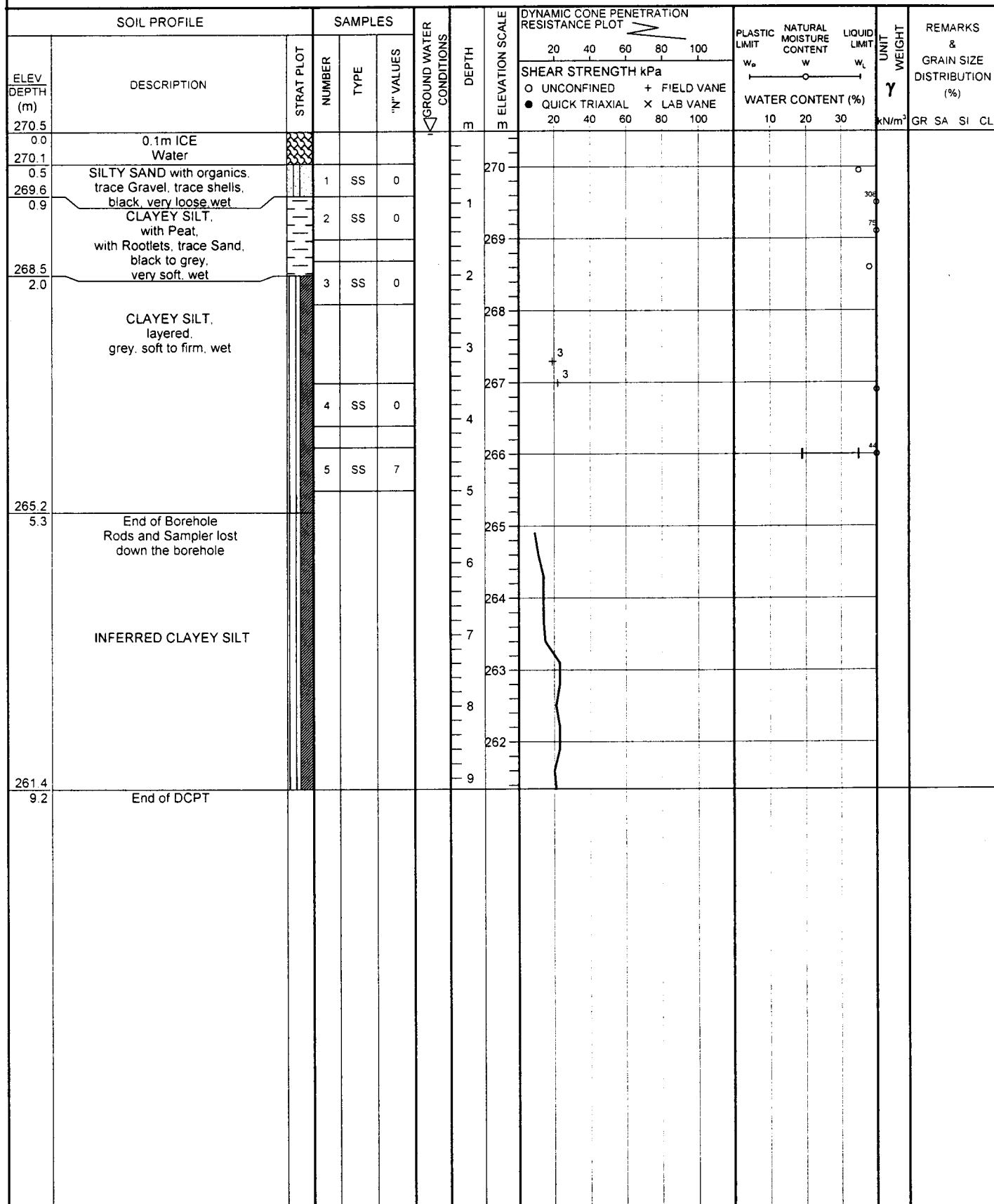
Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No M4

1 OF 1

G.W.P.	81-99-00	LOCATION	4968782 N, 363293 E	ORIGINATED BY	NNK
DIST	52	HWY	35	BOREHOLE TYPE	50mm Manual
DATUM	Geodetic	DATE	6 December 2000 - 6 December 2000	COMPILED BY	NNK
PROJECT	Highway 35 Widening			CHECKED BY	AD
				JOB NO.	TT20868



**+ 3, × 3:** Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE



# RECORD OF BOREHOLE No M5

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4968804 N, 363281 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 6 December 2000 - 6 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

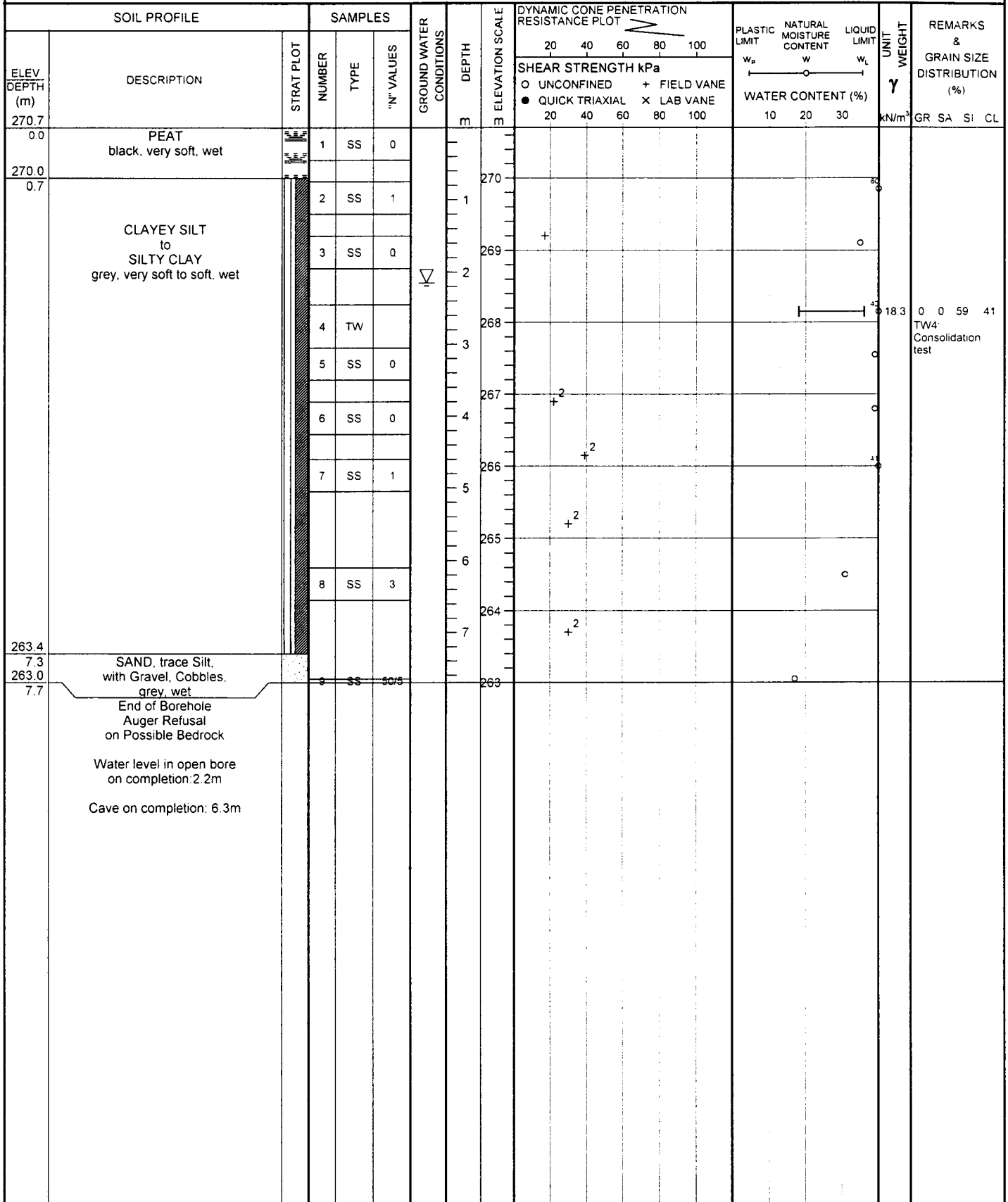
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40					
270.6 0.0	Water														
270.0 269.9 0.9	PEAT, black, very soft, wet		1	SS	2		1	270							
	CLAYEY SILT, layered, occasional silt layers, grey, very soft to firm, wet		2	SS	0		2	269							
			3	SS	0		3	268							
			4	SS	0		4	267							
			5	SS	1		5	266							
			6	SS	3										
			7	SS	4										
			8	SS	5										
265.2 5.4	End of Borehole														

# RECORD OF BOREHOLE No M6

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4968832 N. 363264 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 18 January 2001 - 18 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868



# RECORD OF BOREHOLE No M7

1 OF 2

G.W.P. 81-99-00 LOCATION 4968633 N, 363365 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 8 January 2000 - 10 January 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40						60	80	100	20
271.5	0.3m Sandy Gravel (FILL)		1	AS															
	frozen		2	SS	15														
			3	SS	9														
269.1	Sand (FILL) with Gravel, trace Silt, occasional Cobbles		4	SS	4														
268.6	brown, loose to compact, damp to moist																		
268.6	Sandy Silt (FILL)		5	SS	2														
267.6	grey, very loose, moist																		
267.6	PEAT		6	SS	0														
3.9	black, very soft, moist																		
	SILTY CLAY to CLAYEY SILT		7	TW	-														
	varved, grey, very soft to firm, wet																		
			8	SS	0														
			9	SS	0														
			10	SS	2														
			11	SS	5														
			12	SS	5														
			13	SS	2														
			14	SS	12														

Continued Next Page

+ 3 x 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Jan. 8  
Jan. 10

SS12 No recovery on first attempt

# RECORD OF BOREHOLE No M7

2 OF 2

G.W.P. 81-99-00 LOCATION 4968633 N 363365 E ORIGINATED BY PPM  
DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
DATUM Geodetic DATE 8 January 2000 - 10 January 2000 CHECKED BY AD  
PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
254.4							256							
17.1	End of Borehole Refusal on Probable Bedrock Water level in open bore on completion: 4.0m						17		100/15					

# RECORD OF BOREHOLE No M8

amec

1 OF 2

G.W.P. 81-99-00 LOCATION 4968668 N, 363345 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 23 November 2000 - 24 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40						60
271.6	Sand (FILL), with Gravel, brown, compact, damp		1	SS	10											
			2	SS	20											
	trace tar		3	SS	12											
269.5	SAND, with Peat, with Gravel, trace Silt, black, loose, wet		4	SS	8											
2.1			5	SS	8											
267.9	trace rootlets		6	SS	2											
3.7			7	TW	-											
	SILTY CLAY to CLAYEY SILT, layered, grey, soft to stiff, wet		8	TW	-											
			9	SS	2											
			10	SS	6											
			11	SS	11											
			12	SS	5											

Continued Next Page

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

# RECORD OF BOREHOLE No M8

2 OF 2

G.W.P. 81-99-00 LOCATION 4968668 N. 363345 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 23 November 2000 - 24 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

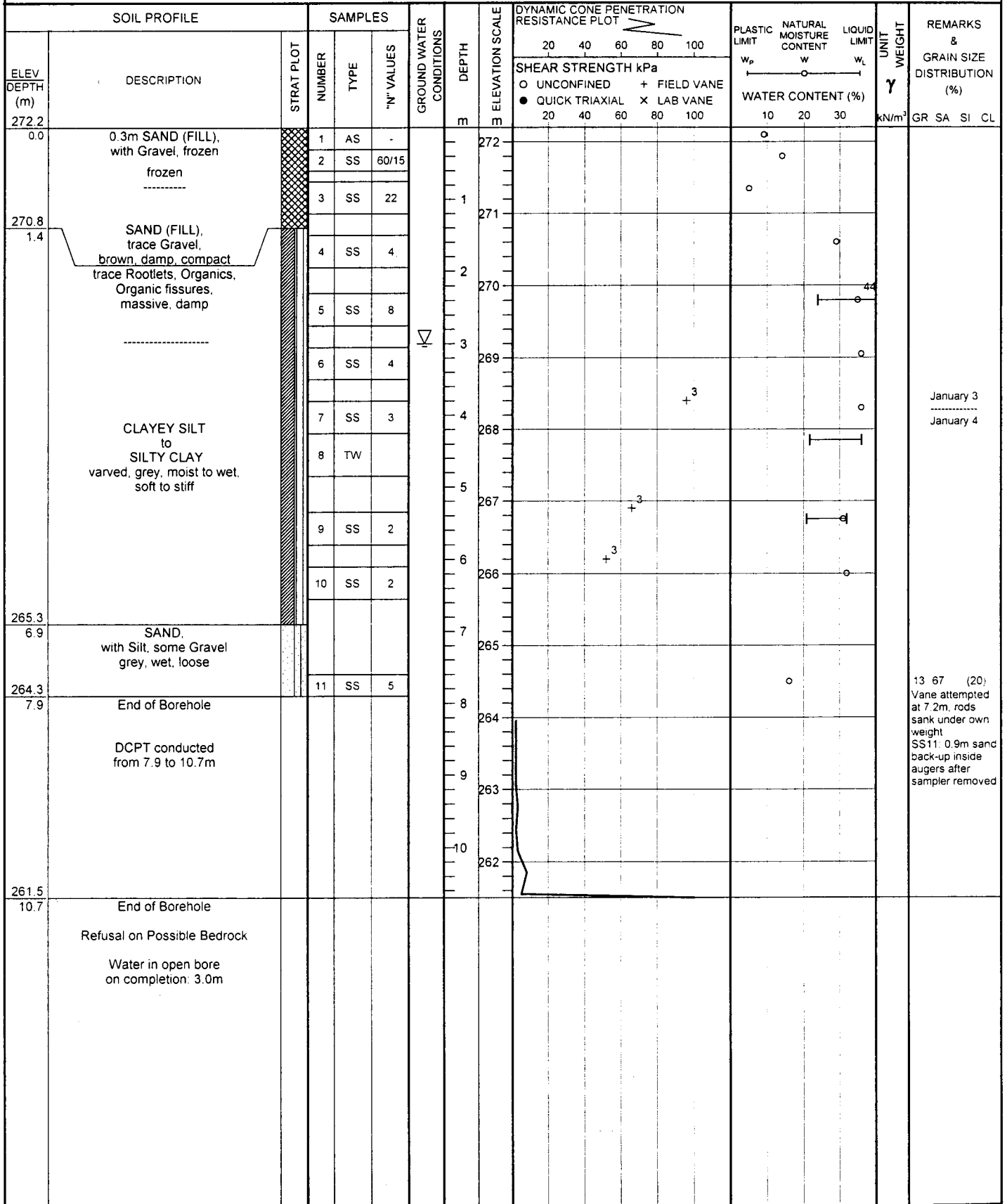
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	E ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
255.4	SILT to CLAYEY SILT		13	SS	8		16	256						
16.2	End of Borehole						17	255						
	INFERRED SAND AND GRAVEL							254						
253.8	End of DCPT													
17.8	Water in Open Bore on completion: 2.1m													

# RECORD OF BOREHOLE No M9

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4968727 N. 363312 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 3 January 2001 - 4 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

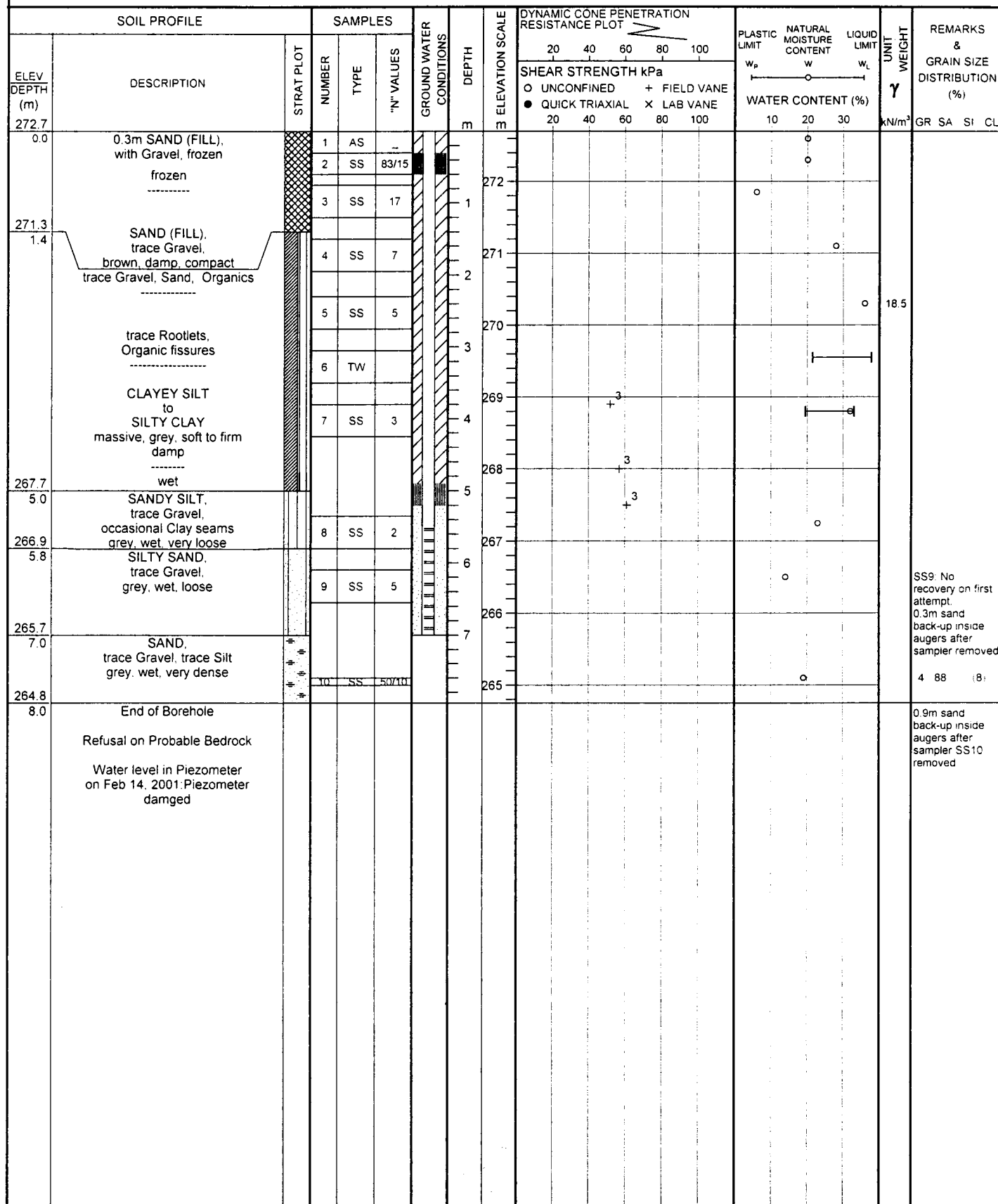


+ 3, X 3: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No M10

1 OF 1

G.W.P. 81-99-00 LOCATION 4968774 N, 363286 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 3 January 2001 - 3 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868



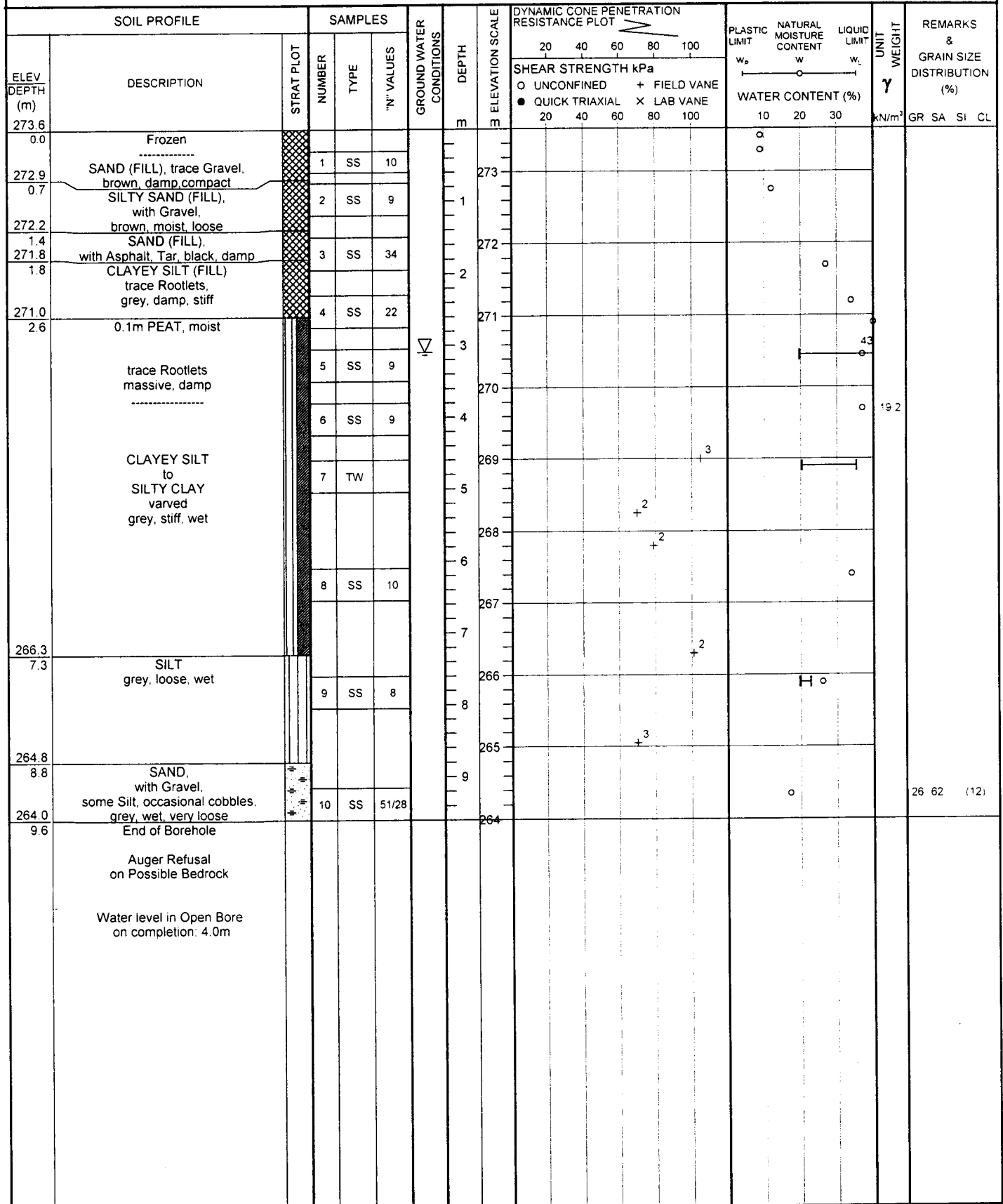


# RECORD OF BOREHOLE No M12



1 OF 1

G.W.P. 81-99-00 LOCATION 4968830 N. 363253 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 15 December 2000 - 15 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868



+ 3 . X 3. Numbers refer to Sensitivity 0 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No N1

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4968691 N, 363334 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 4 January 2001 - 4 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE				20 40 60 80 100	20 40 60 80 100					
272.0 0.0	Frozen		1	AS	-									
			2	SS	69	1	271							
			3	SS	11	2	270							
269.4 2.6	SAND (FILL), with Gravel, occasional Cobbles, brown, damp, loose to compact		4	SS	9									
268.5 3.5	CLAYEY SILT, with Organics, Decaying Wood, trace Rootlets, brown to grey, damp, very soft		5	SS	1	3	269							
	CLAYEY SILT to SILTY CLAY massive, grey, wet, very soft to firm		6	SS	0	4	268	+						
			7	TW		5	267							
			8	SS	1	6	266	+						
			9	SS	0	7	265	+						
			10	SS	0	8	264	+						
263.2 8.8	SANDY GRAVEL, brown, very loose to compact, wet		11	SS	4	9	263							
261.9 10.2	End of Borehole Refusal on Probable Bedrock Water level in open bore on completion 2.5m		12	SS	50/7.5	10	262							

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

# RECORD OF BOREHOLE No N2



1 OF 1

G.W.P. 81-99-00 LOCATION 4968674 N. 363332 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 10 January 2001 - 11 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
272.0									20 40 60 80 100	20 40 60 80 100	10 20 30				GR SA SI CL
0.0	SAND (FILL), with Gravel, trace Silt, occasional Cobbles, brown, compact, damp to frozen		1	AS	-										
			2	SS	11		1	271							
270.6															
1.4	SAND (FILL), trace Silt, Tar, black, compact, wet		3	SS	10		2	270							
269.3			4	SS	2										
269.2	PEAT, black, soft, moist														
268.7	CLAYEY SILT, with Organics, grey, moist, very soft		5	SS	0		3	269							
268.7															
3.3	CLAYEY SILT to SILTY CLAY, grey, varved, very soft to stiff, wet		6	TW			4	268							
							5	267							
							6	266							
			7	SS	0										
							7	265							
			8	SS	1		8	264							
							9	263							
262.6			9	SS	5										
9.4	SILTY SAND, with Gravel grey, compact, wet						10	262							
261.7			10	SS	22										
10.4	End of Borehole														
	DCPT conducted between 10.4m to 13.3m depth						11	261							
							12	260							
							13	259							
258.7															
13.3	End of DCPT														
	Refusal on Probable Bedrock														
	Water level in open bore on completion: 6.4m														

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

# RECORD OF BOREHOLE No N3

1 OF 2

G.W.P. 81-99-00 LOCATION 4968685 N. 363347 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 23 January 2001 - 24 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40						60	80	100	20
270.2	0.1m ICE						270												
0.0	PEAT, black, very soft, wet		1	SS	1		1												
267.6			2	SS	1		2												
2.6	SAND, trace Silt, brown, very loose, wet		3	SS	1		3												
267.1			4	SS	1		4												
3.1	CLAYEY SILT to SILTY CLAY grey, very soft, wet		5	SS	1		5												
			6	SS	1		6												
			7	SS	1		7												
			8	SS	2		8												
			9	SS	21		9												
	very stiff with Gravel, occasional cobbles		10	SS	34		10												
258.6	SAND, trace to some Gravel, trace Silt, frequent Cobbles, occasional Boulders grey, dense, wet		11	RC			11												
11.6							12												
							13												
							14												

Continued Next Page

+ 3 X 3

Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

Jan 23

# RECORD OF BOREHOLE No N3

amec

2 OF 2

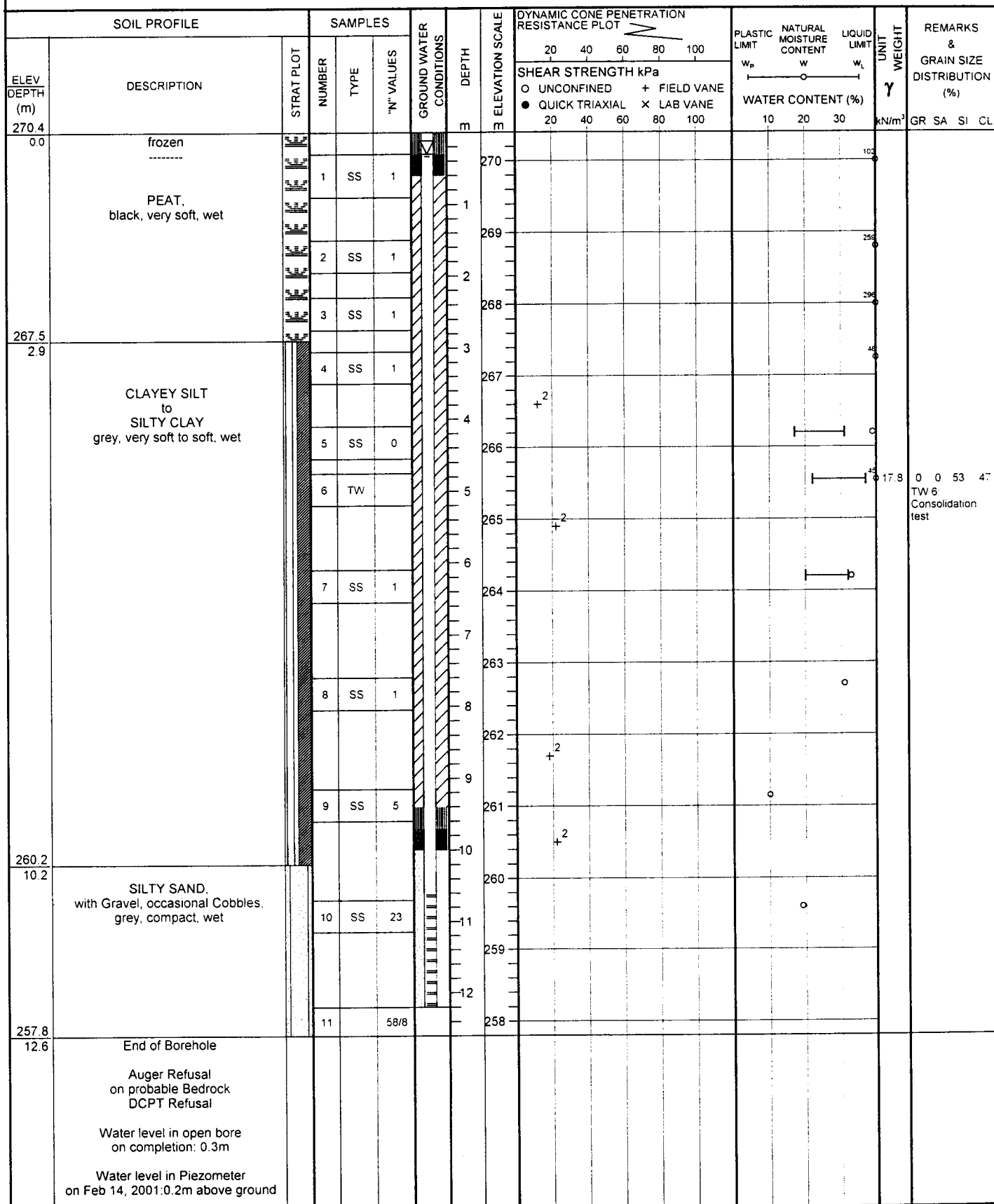
G.W.P. 81-99-00 LOCATION 4968685 N. 363347 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 23 January 2001 - 24 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa								
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE							
255.0 15.3	MIGMATITE BEDROCK, moderately closely jointed to closely jointed, occasional Calc-Silicate zones.		12	RC												Jan 24 RC 13: REC = 100%. RQD = 35%	
			13	RC													
			14	RC													
251.9 18.3	End of Borehole																
	Water overflowing casing 0.6m above ground at 15m.																

# RECORD OF BOREHOLE No N4

1 OF 1

G.W.P.	81-99-00	LOCATION	4968698 N, 363339 E	ORIGINATED BY	NNK
DIST	52	HWY	35	BOREHOLE TYPE	Hollow Stem Augering
DATUM	Geodetic	DATE	29 January 2001 - 29 January 2001	COMPILED BY	NNK
PROJECT	Highway 35 Widening			CHECKED BY	AD
				JOB NO.	TT20868



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

# RECORD OF BOREHOLE No N5

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4968684 N. 363325 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
272.1 0.0	frozen		1	SS	81			272	20 40 60 80 100						
	SAND(FILL), with Gravel, brown, very dense, damp		2	SS	69		1	271	20 40 60 80 100						
270.7 1.4	moist wet		3	SS	4		2	270	20 40 60 80 100						
	SAND(FIL), trace Gravel, brown, very loose		4	SS	1		3	269	20 40 60 80 100						
268.9 3.2	0.1m SILTY CLAY		5	SS	11		4	268	20 40 60 80 100						
	SILTY SAND some Gravel, occasional Cobbles, grey, very loose to compact, wet		6	SS	5		5	267	20 40 60 80 100						
			7	SS	3		6	266	20 40 60 80 100						
			8	SS	5		7	265	20 40 60 80 100						
			9	SS	17		8	264	20 40 60 80 100						
			10	SS	50/7		9	263	20 40 60 80 100						
	frequent Cobbles and Boulders		11	RC			10	262	20 40 60 80 100						
262.5 9.6	MIGMATITE BEDROCK, massive, moderately closely jointed to closely jointed, occasional Calc-Silicate zones, vugs at 11.0m		12	RC			11	261	20 40 60 80 100						
			13	RC			12	260	20 40 60 80 100						
			14	RC											
			15	RC											
259.9 12.2	End of Borehole														
	Water in Open Bore on completion: 1.6m														

+ 3 . x 3<sup>3</sup> Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RC 13.  
REC = 75%  
RQD = 21%  
RC 14:  
REC = 75%  
RQD = 66%

RC 15.  
REC = 100%  
RQD = 99%

# RECORD OF BOREHOLE No 01

1 OF 1

G.W.P. 81-99-00 LOCATION 4968957 N, 363208 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 20 November 2000 - 20 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
276.8									20 40 60 80 100						
0.0	0.05m TOPSOIL		1	SS	6				○ UNCONFINED + FIELD VANE						
276.1	SAND(FILL), with Gravel, brown, loose, moist		2	SS	24		1	276	● QUICK TRIAXIAL x LAB VANE						
0.7									20 40 60 80 100						
	CLAYEY SILT, to SILTY CLAY frequent silt seams, occasional sand seams varved, grey, stiff to very stiff, moist		3	SS	16		2	275						17.9	0 1 66 33
			4	SS	17		3	274							TW taken at 3m depth 2m north of borehole TW Consolidation Test
			5	SS	8		4	273						18.6	
			5A	TW			5	272						19.1	0 0 75 25
271.9			6	SS	24		6	271							SS6: sampler wet 25 32 42 1
4.9	SANDY SILT, with Gravel, occasional Cobbles and Boulders brown, compact, wet		7	SS	50/10		7	270							SS7: sampler on cobble
269.8															
7.0	End of Borehole Auger refusal Possible Bedrock														
	Auger broken after encountering refusal														
	Water level in open bore on completion: 4.6m														
	Water level in Piezometer on Dec. 5, 2000: Piezometer damaged														



# RECORD OF BOREHOLE No 02

1 OF 1

G.W.P. 81-99-00 LOCATION 4969002 N 363195 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
275.9	0.1m SAND (FILL), with Gravel, with rootlets		1	SS	7										
275.2	SAND(FILL) with Gravel, trace Rootlets, trace Asphalt fragments, brown loose, moist trace Rootlets brown grey		2	SS	16		1	275							
0.7			3	SS	20		2	274						45	0 1 64 35
			4	SS	16		3	273						18.5	
	SILTY CLAY, to CLAYEY SILT, occasional silt seams, varved, stiff to very stiff, moist		5	SS	14		4	272						16.7	
			6	SS	11		5	271							
270.3			7	SS	15		6	270							
5.6	SAND, with Gravel some Silt, frequent Cobbles, brown, very dense, wet		8	SS	60										20 69 (11)
269.8	End of Borehole Augers tilted on probable Bedrock														
6.1	Water level in Open Bore on completion: 3.4m														

# RECORD OF BOREHOLE No 03

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4969037 N, 363190 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
275.8	0.2m TOPSOIL, Sandy, brown, wet		1	SS	9									
275.0	CLAYEY SILT(FILL) trace Rootlets, trace Organics, grey, stiff, moist		2	SS	15		1	275						Auger refusal at 1.9m on boulder, move borehole 1m north, auger to 1.5m and begin sampling  8 66 25 1
0.8	SILTY CLAY to CLAYEY SILT, varved, stiff to very stiff, moist brown		3	SS	15		2	274						
273.7	grey SAND, with Silt, trace Gravel, frequent Cobbles, brown, compact, wet		4	SS	10		3	273						
2.1			5	SS	14		4	272						
271.8			6	SS	50/5									
4.0	End of Borehole Auger refusal on possible Bedrock  Water level in Open Bore on completion: 1.5m													Move borehole 1m north, auger refusal at 4.0m.

# RECORD OF BOREHOLE No 04



1 OF 1

G.W.P. 81-99-00 LOCATION 4969072 N, 363190 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
276.1	0.15m SAND (FILL), with Gravel, with Asphalt fragments brown, moist		1	SS	9		276								
274.0	SILTY CLAY to CLAYEY SILT, trace Rootlets varved, stiff to very stiff, damp to moist		2	SS	22		275							20.8	
273.4	SILTY SAND, trace Gravel, brown, dense, wet		3	SS	22		274							19.2	
273.4	End of Borehole Auger refusal on possible Bed Rock		4	SS	37										3 58 39 0
2.1	Water level in Open Bore on completion: 1.4m														
2.8	Water level in Piezometer on Dec. 5, 2000: Piezometer damaged														

+ 3, X 3, Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 05

1 OF 1

G.W.P. 81-99-00 LOCATION 4969104 N, 363175 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Pionjar Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 22 November 2000 - 22 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
278.8	Water														
278.6	0.1m TOPSOIL														
0.2	brown		1	PJ											
	grey														
277.1	SILTY CLAY to CLAYEY SILT, occasional Sand seams, varved damp Pionjar Refusal on possible Bedrock		2	PJ											
1.7	Water level in Open Bore on completion: none														

# RECORD OF BOREHOLE No 06

1 OF 1

G.W.P. 81-99-00	LOCATION 4969161 N. 363188 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Pionjar Sampling	COMPILED BY NNK
DATUM Geodetic	DATE 22 November 2000 - 22 November 2000	CHECKED BY AD
PROJECT Highway 35 Widening		JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	E ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20						40	60
279.5																
0.0	0.2m TOPSOIL		1	PJ												
279.1	SAND(FILL), with Gravel, with cobbles, brown, damp															
0.5	Pionjar Refusal and Auger Refusal on possible Bedrock							279								Borehole moved 3m east, refusal at 0.5m. Borehole moved 3m north, refusal at 0.5m.
	Water level in Open Bore on completion: none															

# RECORD OF BOREHOLE No 07

1 OF 1

G.W.P. 81-99-00 LOCATION 4969218 N. 363169 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Pionjar Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 22 November 2000 - 22 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH (m)	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa					
291.5									20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>		
0.0	0.3m TOPSOIL		1	PJ					20 40 60 80 100					
290.3	CLAYEY SILT. with Rootlets, with wood fragments, brown, damp		2	PJ			1	291						
290.0	SILTY CLAY to CLAYEY SILT. trace Rootlets, varved, grey, moist							290						
1.5	CLAYEY SILT. trace Rootlets, varved, grey, moist		3	PJ			2							
289.1	SILTY SAND trace Gravel, brown, damp													
2.5	Pionjar Refusal on possible Bedrock													
	Water level in Open Bore on completion: none													

# RECORD OF BOREHOLE No 08

1 OF 1

G.W.P. 81-99-00 LOCATION 4969143 N, 363158 E ORIGINATED BY NNK  
DIST 52 HWY 35 BOREHOLE TYPE Hand Augering COMPILED BY NNK  
DATUM Geodetic DATE 14 December 2000 - 14 December 2000 CHECKED BY AD  
PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES				20	40					
289.3 0.0	100mm ASPHALTIC CONCRETE														
288.8 0.5	SAND(FILL), with Gravel, brown, damp End of Borehole Auger Refusal on Rockfill														

# RECORD OF BOREHOLE No P1

1 OF 1

G.W.P. 81-99-00 LOCATION 4969466 N, 363254 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 23 November 2000 - 23 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
301.2									20 40 60 80 100					
300.8	TOPSOIL		1	SS	2			301						
0.2	SAND (FILL) trace Gravel, Rootlets, Silt, brown, very loose to compact, damp		2	SS	17/15									
300.3	End of Borehole													
0.9	Sampler and Auger Refusal on Probable Bedrock													
	Water level in open bore on completion: none													



# RECORD OF BOREHOLE No P2

1 OF 1

G.W.P. 81-99-00	LOCATION 4969495 N. 363288 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Continuous Sampling	COMPILED BY NNK
DATUM Geodetic	DATE 23 November 2000 - 23 November 2000	CHECKED BY AD
PROJECT Highway 35 Widening	JOB NO. TT20868	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
294.6									20 40 60 80 100						
0.0	TOPSOIL		1	SS	2										
294.2	SILT, trace sand, brown, very loose, moist														
293.9	End of Borehole							294							
0.7	Sampler and Auger Refusal on Probable Bedrock														
	Water level in open bore on completion: none														

# RECORD OF BOREHOLE No P3

1 OF 1

G.W.P. 81-99-00 LOCATION 4969527 N, 363291E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 23 November 2000 - 23 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
301.1	0.3m TOPSOIL		1	SS	2			301							
0.0	SAND, some Silt, brown, very loose to compact, moist		2	SS	17			1							
300.0	End of Borehole							300							
1.1	Sampler and Auger Refusal on Probable Bedrock														
	Water level in open bore on completion: none														

# RECORD OF BOREHOLE No P4

1 OF 1

G.W.P. 81-99-00 LOCATION 4969508 N, 363263 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 15 December 2000 - 15 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	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 <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
304.8														
0.0	SAND(FILL), With Gravel, trace Silt, brown, damp													
303.7														
1.1	End of Borehole													
	Auger Refusal on Rockfill													

# RECORD OF BOREHOLE No Q1

1 OF 1

G.W.P. 81-99-00 LOCATION 4969869 N, 363450 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hand Auger/ Wash Boring COMPILED BY NNK  
 DATUM Geodetic DATE 12 February 2001 - 12 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
296.4									SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE		WATER CONTENT (%) 10 20 30		kn/m <sup>3</sup>	GR SA SI CL	
0.0	SILTY SAND, trace Rootlets, brown, moist							296							
295.9	End of Borehole														
0.5	Auger Refusal on probable Bedrock														
	Borehole moved 1.2m, 4.6m and 7.6m east, refusal at 0.5m.														
	Water in open bore on completion: none														

# RECORD OF BOREHOLE No Q2

1 OF 1

G.W.P. 81-99-00 LOCATION 4969892 N, 363468 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash Boring COMPILED BY NNK  
 DATUM Geodetic DATE 12 February 2001 - 12 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
294.7 0.0	80mm ASHALTIC CONCRETE														
293.5 1.2	SAND(FILL), with Gravel, brown, very dense, moist		1	SS	50/5		1	294							
	SILT, trace sand, grey, dense, wet		2	SS	32		2	293							
292.4 2.3	End of Borehole		3	SS	50/0										SS3: Sampler bouncing
	Refusal on probable Bedrock														
	Water in Open Bore on completion: none														

# RECORD OF BOREHOLE No Q3

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4969927 N, 363501 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash Boring COMPILED BY NNK  
 DATUM Geodetic DATE 12 February 2001 - 12 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
294.1 0.0	0.1m ICE WATER							294							
292.5 1.6	SILTY SAND, with Organics black, very loose, wet		1	SS	1			292							
291.4 2.7	SILTY SAND, trace Gravel grey, very dense, wet		2	SS	85/27			291							
290.2 3.9	End of Borehole Refusal on probable Bedrock		3	SS	50/0										SS3: Sampler bouncing

# RECORD OF BOREHOLE No Q4

1 OF 1

G.W.P. 81-99-00 LOCATION 4969960 N. 363539 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash boring COMPILED BY NNK  
 DATUM Geodetic DATE 12 February 2001 - 12 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		WATER CONTENT (%)				
294.1									20 40 60 80 100		W <sub>p</sub> W W <sub>L</sub>				
0.0	0.15m ICE								20 40 60 80 100						
	WATER														
291.7															
2.5	PEAT, with Silt, Sand, black, soft, wet														
290.5			1	SS	4										
3.6	SAND, trace Silt, Gravel, occasional Peat layers, brown, very loose, wet		2	SS	4										
			3	SS	1										
288.6			4	SS	2										
5.5	CLAYEY SILT, grey, soft, wet		5	SS	53/16										
288.0															
288.0	SAND, brown, loose, wet														
6.3	End of Borehole														
	Refusal to wash boring and DCPT on possible Bedrock														
	Water level in open bore on completion: at surface														

# RECORD OF BOREHOLE No Q5



1 OF 1

G.W.P. 81-99-00 LOCATION 4969993 N, 363579 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 7 December 2000 - 7 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100		
293.5 0.0	PEAT, with Sand trace Gravel, black to brown, very soft to firm, wet		1	SS	0		1	293							
			2	SS	5		2	292							
291.7 1.8	SILTY SAND, with frequent Peat layers, trace Gravel, trace Rootlets, trace Decaying Wood, black to brown, very loose to loose, wet		3	SS	9		3	291							
			4	SS	5		4	290							
289.9 3.6	CLAYEY SILT, grey, firm, wet		5	SS	7										0 1 85 14
289.0 4.5	End of Borehole							289							
	Water level in open bore on completion: 0.5m														



# RECORD OF BOREHOLE No Q5A



1 OF 1

G.W.P. 81-99-00 LOCATION 4969993 N, 363579 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash boring COMPILED BY NNK  
 DATUM Geodetic DATE 13 February 2011 - 13 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
293.5 0.0	0.15m ICE								20 40 60 80 100						
	WATER								○ UNCONFINED + FIELD VANE						
									● QUICK TRIAXIAL × LAB VANE						
									20 40 60 80 100						
290.6 2.9	PEAT, black, very soft, wet		1	SS	1										
			2	SS	1										
			3	SS	2										
288.5 5.0	CLAYEY SILT, trace Sand, Gravel, grey, soft, wet		4	SS	2										SS4: No recovery
			5	SS	2										
			6	SS	3										
			7	SS	2										
			8	SS	52										SS8: Sampler driving a stone
285.5 8.0	SILTY SAND, trace Gravel, grey, dense, wet		9	SS	49										
285.0 8.6	End of Borehole														
284.3 9.2	DCPT conducted from 8.6m to 9.2m depth Refusal to DCPT														

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

# RECORD OF BOREHOLE No Q6

1 OF 1

G.W.P. 81-99-00 LOCATION 4970030 N. 363627 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash boring COMPILED BY NNK  
 DATUM Geodetic DATE 13 February 2001 - 13 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40						60	80	100	20
293.7	0.15m ICE																		
293.0	WATER																		
0.8	PEAT, black, very soft, wet																		
			1	SS	1														
290.0	CLAYEY SILT, trace Sand, gravel, frequent Sand seams/layers grey, soft, wet		2	SS	2														
3.7																			
			3	SS	2														
287.8	End of Borehole		4	SS	102/15														
6.0	Refusal to wash boring and DCPT on possible Bedrock																		

+ 3 × 3

Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No Q7

amec

G.W.P. 81-99-00 LOCATION 4970055 N, 363655 E 1 OF 1 ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 7 December 2000 - 7 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
294.1															
293.8	PEAT, black, very soft, wet		1	SS	1			294							
0.3	CLAYEY SILT, some Sand, grey, stiff, damp to moist		2	SS	9		1	293						21.5	
			3	SS	13									22.3	0 12 73 15
	trace Rootlets		4	SS	13		2	292							
			5	SS	14										
290.9	End of Borehole		6	SS	15/10		3	291							
3.3	Sampler Refusal Bouncing on Probable Bedrock														
	Water level in open bore on completion: at Ground Surface														

# RECORD OF BOREHOLE No Q8

1 OF 1

G.W.P. 81-99-00 LOCATION 4969999 N. 363574 E. ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 23 January 2001 - 23 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
296.4									20 40 60 80 100						GR SA SI CL
0.0	frozen -----		1	SS	51/23		296					o			SS1. Sampler pushing a stone
			2	SS	15		1					o			28 64 (8)
	SAND(FILL), with Gravel, trace Silt, occasional Cobbles. brown, compact, damp to moist		3	SS	11		2					o			
293.7			4	SS	15		294					o			
2.7	SILTY SAND, with Gravel, occasional peat layers. grey, compact, wet		5	SS	23		293					o			
292.8			6	SS	26		4					o			
3.6	SILTY SAND, trace Silt, Gravel, grey, compact to very dense, wet		7	SS	49		292					o			
			8	SS	50/8		291					o			
290.8	End of Borehole														
5.6	Auger Refusal on Probable Bedrock														
	Water level in open bore on completion: at 3.0m														

# RECORD OF BOREHOLE No Q9

1 OF 1

W.P.	81-99-00	LOCATION	4970032 N, 363617 E	ORIGINATED BY	NNK
DIST	52	HWY	35	BOREHOLE TYPE	Hollow Stem Augering
DATUM	Geodetic	DATE	25 January 2001 - 25 January 2001	COMPILED BY	NNK
PROJECT	Highway 35 Widening			CHECKED BY	AD
				JOB NO.	TT20868

[illegible]

# RECORD OF BOREHOLE No R1

1 OF 1

G.W.P. 81-99-00 LOCATION 4970562 N. 363835 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 1 December 2000 - 1 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa	WATER CONTENT (%)					
296.5	PEAT		1	SS	1										
296.0	black, very soft, wet														
0.5	SILTY SAND, trace Gravel, brown, compact, wet		2	SS	30										
295.1	End of Borehole														
1.4	Water level in open bore on completion: at Ground Surface														

# RECORD OF BOREHOLE No R2

1 OF 1

G.W.P. 81-99-00 LOCATION 4970606 N, 363842 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 5 December 2000 - 5 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
296.0	0.1m ICE														
295.2	Water														
0.8	SILTY SAND, trace Rootlets,		1	SS	11		1	295							
294.8	trace Wood fragments, black, compact, wet														
1.2	SILTY SAND		2	SS	17		2	294							
294.1	grey, compact, damp														
1.9	CLAYEY SILT, grey, very stiff to hard, damp		3	SS	30		3	293							0 2 88 10
292.5			4	SS	27										
292.6	SILTY SAND, grey, compact, damp														
3.6	End of Borehole														

# RECORD OF BOREHOLE No R3

1 OF 1

G.W.P. 81-99-00 LOCATION 4970655 N, 363853 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 5 December 2000 - 5 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
296.0									20 40 60 80 100	20 40 60 80 100					GR SA SI CL
0.0	0.1m ICE														
295.4	Water														
0.6	PEAT, with Sand layers black, very soft to firm, wet		1	SS	1		1	295							SS1, 2: No recovery
			2	SS	4										
			3	SS	3		2	294							
293.9	CLAYEY SILT grey, soft to very stiff, wet		4	SS	3										0 1 73 25
2.1			5	SS	18		3	293							
292.6	End of Borehole														
3.5	Sampler Refusal bouncing on Probable Bedrock														

+ 3 × 3

Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE



# RECORD OF BOREHOLE No R4

1 OF 1

G.W.P. 81-99-00 LOCATION 4970698 N. 363871 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 5 December 2000 - 5 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
296.0	0.1m ICE														
0.0	Water														
294.8							1	295							
1.2	SAND, with organics		1	SS	12										
294.4	black, compact, wet														
1.6	SAND, with Gravel,		2	SS	9		2	294							
293.6	brown, loose, wet														
2.4	End of Borehole														
	Sampler refusal on Possible bedrock														

# RECORD OF BOREHOLE No R5

1 OF 1

G.W.P. 81-99-00 LOCATION 4970740 N. 363899 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 4 December 2000 - 5 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
296.0	0.1m ICE														
295.4	Water		1	SS	4		1	295							
0.6	SAND, with Gravel, trace Organics, brown to black, very loose, wet		2	SS	1										
294.3			3	SS	11		2	294							
1.7			4	SS	13		3	293							
	SAND, with Gravel, trace Silt brown to yellow, very loose to compact, wet		5	SS	3										
			6	SS	2		4	292							
			7	SS	12										
			8	SS	20		5	291							
290.5			9	PJ	-		6	290							
5.5	SILTY SAND, trace Gravel, brown, wet														
290.0															
6.0	End of Borehole														

# RECORD OF BOREHOLE No R6

1 OF 1

G.W.P. 81-99-00 LOCATION 4970780 N 363928 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 4 December 2000 - 4 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
296.0									20 40 60 80 100						
0.0	0.1m ICE								○ UNCONFINED + FIELD VANE						
295.4									● QUICK TRIAXIAL x LAB VANE						
0.6	Water								20 40 60 80 100						
294.8	PEAT, with Sand, trace Gravel, black, firm, wet		1	SS	7		1	295							
1.2	SAND, with Organics and Peat layers, trace Gravel, Silt brown to black, very loose, wet		2	SS	3		2	294							SS 3.5.6 : No recovery
293.3			3	SS	1		3	293							10 85 (5)
2.7			4	SS	1		4	292							
	SAND, trace Gravel, Silt, grey, very loose, wet		5	SS	1		5	291							
			6	SS	1		6	290							
			7	SS	1										
	trace Organics		8	SS	1										10 83 (7)
290.2			9	SS	2										
296.8	CLAYEY SILT, grey, very soft, wet														
6.0	End of Borehole														

# RECORD OF BOREHOLE No R6A



1 OF 1

G.W.P. 81-99-00 LOCATION 4970777 N, 363933 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash Boring COMPILED BY NNK  
 DATUM Geodetic DATE 14 February 2001 - 14 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		WATER CONTENT (%)				
296.0									20 40 60 80 100		W <sub>p</sub> W W <sub>L</sub>				
									○ UNCONFINED + FIELD VANE						
									● QUICK TRIAXIAL x LAB VANE						
0.0	0.23m ICE								20 40 60 80 100		10 20 30				
	Water														
292.4															
3.7															
	SAND, trace Silt, Gravel, brown to grey, compact, wet		1	SS	10										
			2	SS	10										
			3	SS	58/18										
289.5															
6.6	End of Borehole  Refusal to wash boring and DCPT on possible Bedrock														

# RECORD OF BOREHOLE No R7

1 OF 1

G.W.P. 81-99-00 LOCATION 4970822 N. 363957 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 6 December 2000 - 6 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
296.2									20 40 60 80 100						
295.9	WATER							296							
295.8	PEAT with Sand, black, firm, wet		1	SS	4										
0.6	SAND, with organics, occasional Peat Layers, brown to black, very loose to loose, wet		2	SS	3			1							
			3	SS	4										
			4	SS	7					2					
293.9	CLAYEY SILT, grey, firm, moist End of Borehole							294							
292.6	Sampler bouncing on possible bedrock														
2.4	Water level in open bore on completion:at Ground surface														

# RECORD OF BOREHOLE No R7A

1 OF 1

G.W.P. 81-99-00 LOCATION 4970819 N, 363962 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash Boring COMPILED BY NNK  
 DATUM Geodetic DATE 13 February 2001 - 13 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
296.2	0.20m ICE							296							
295.3	Water														
0.9	PEAT, with Silt, sand black, very soft, wet		1	SS	0		1	295							SS1: No recovery
			2	SS	2		2								
293.9	CLAYEY SILT, trace Gravel, grey, soft, wet		3	SS	3			294							
2.3															
293.5															
2.7	Refusal to wash boring and DCPT on possible Bedrock														

# RECORD OF BOREHOLE No R7B

1 OF 1

G.W.P. 81-99-00 LOCATION 4970816 N, 363967 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash Boring COMPILED BY NNK  
 DATUM Geodetic DATE 13 February 2001 - 13 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
296.2	0.25m ICE							296							SS1: No recovery
295.3	Water														
0.9	PEAT, black, firm, wet		1	SS	5		1	295							
294.7	SILTY SAND, trace Gravel, Wood fragments, occasional Peat layers, grey, dense, wet		2	SS	31		2	294							SS3: Wood piece in sampler
1.5			3	SS	41										
293.3							3	293							
2.9	SAND, trace Gravel, Silt, grey, very loose to compact, wet		4	SS	4										
291.9			5	SS	80/18		4	292							
4.3	End of Borehole  Refusal to Wash boring and DCPT on possible Bedrock														

# RECORD OF BOREHOLE No R8

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4970856 N, 363991 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 6 December 2000 - 6 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40					
296.4	0.0	PEAT, with Sand layers, brown to black, very soft, frozen	1	SS	2		296								
295.6	0.8	SAND, trace Gravel, brown, loose, wet	2	SS	5		1								
295.2	1.2	End of Borehole													
		Sampler Refusal Pionjar Refusal on possible Bedrock													
		Water in open bore on completion: at Ground surface													



# RECORD OF BOREHOLE No R9

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4970786 N 363916 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering / Air track COMPILED BY NNK  
 DATUM Geodetic DATE 6 February 2001 - 6 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
301.0	110 mm ASPHALTIC CONCRETE		1	SS	50/15										
	0.3m GRAVELLY SAND (FILL)														
	SAND(FILL), trace Gravel, Silt, brown, loose to dense, damp		2	AS	-		1	300							
			3	SS	7		2	299							
			4	AS	-		3	298							
	----- frequent cobbles		5	SS	33		4	297							
296.0	----- wet PEAT, black, wet		6	SS	11		5	296							
295.3			7	AS	-		6	295							
294.3	SILTY SAND, with cobbles, grey, very dense, wet		8	SS	84		7	294							
290.9	INFERRED BEDROCK						8	293							
10.1	End of Borehole						9	292							
	Bedrock inferred by airtrack drill						10	291							
	Water in open bore on completion: 5.0m														

# RECORD OF BOREHOLE No R10

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4970561 N, 363828 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 25 January 2001 - 25 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
297.8 0.0	SAND(FILL). with Gravel. brown, moist to frozen		1	AS											
296.9 0.9	PEAT. black, frozen		2	SS	1C										
296.4 1.4	SILTY SAND to SAND brown, very loose to compact, moist to wet		3	SS	11										
			4	SS	2										
294.7 3.1	End of Borehole  Auger refusal on possible bedrock  Water level in open bore on completion: 1.8		5	SS	SC-3										

# RECORD OF BOREHOLE No T1

1 OF 1

G.W.P. 81-99-00 LOCATION 4971172 N, 364179 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 24 January 2001 - 24 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH kPa 20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES										
0.0	0.1m SILT 0.1m ASPHALTIC CONCRETE 0.4m SAND(FILL), trace Gravel		1	SS	14										
	SAND, trace Gravel, Silt, brown, very loose to loose, damp		2	SS	4		1								
			3	SS	7		2								
295.2															
2.3	SILT, with Sand trace Gravel, brown, very loose, moist		4	SS	0		3								
294.3			5	SS	50/5										
3.3	End of Borehole  Auger refusal on possible bedrock  Water level in open bore on completion: none														

G.W.P.	81-99-00	LOCATION	4971206 N, 364204 E	ORIGINATED BY	NNK
DIST	52	HWY	35	COMPILED BY	NNK
DATUM	Geodetic	DATE	23 January 2001 - 24 January 2001	CHECKED BY	AD
PROJECT	Highway 35 Widening			JOB NO.	TT20868

[illegible]

# RECORD OF BOREHOLE No T3

1 OF 1

G.W.P. 81-99-00 LOCATION 4971241 N. 364227 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 23 January 2001 - 23 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH (m)	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)							
						20 40 60 80 100					10	20	30					
294.8 0.0	SILTY SAND, trace Gravel, Organics, occasional Cobbles, brown, compact, moist		1	SS	15													
294.0 0.8	End of Borehole  Auger refusal on possible boulder  Water level in open bore on completion 0.6m																	

# RECORD OF BOREHOLE No T4

1 OF 1

G.W.P. 81-99-00 LOCATION 4971284 N, 364251 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 23 January 2001 - 23 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
294.6	0.3m PEAT 0.1m ASPHALTIC CONCRETE		1	SS	10										
	SAND(FILL), some Silt trace Gravel, trace Organics, brown to black, compact, wet		2	SS	16		1	294							
292.5			3	SS	12		2	293							0 85 (15)
2.1	SILT, trace Sand, grey, compact, moist		4	SS	26			292							
291.7															
2.9	End of Borehole  Auger refusal on possible Boulder or Bedrock  Water level in open bore on completion: 1.8m														

# RECORD OF BOREHOLE No T5

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4971327 N, 364276 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 23 January 2001 - 23 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40					
294.6	0.0	PEAT, with Sand, Gravel, brown to black, frozen to wet	1	SS	11										
293.5	1.1	SAND, trace Silt, brown to grey, loose to compact, wet	2	SS	5										
292.5	2.1	SILT, grey, compact, moist	3	SS	10										
291.6	3.0	End of Borehole Auger refusal on possible Bedrock Water level in open bore on completion: 1.2m	4	SS	14										

+ 3, X 3

Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No T6

1 OF 1

G.W.P. 81-99-00 LOCATION 4971367 N, 364304 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 23 January 2001 - 23 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)
294.3									○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE							
0.0	PEAT, with Sand, black to brown, soft, wet		1	SS	3		294									
293.7																
0.6	SILTY SAND, brown to grey, loose, wet		2	SS	8		293									
292.6			3	SS	16		292									
1.7	SILT, trace Sand, grey, very loose to compact, moist		4	SS	7		291									
			5	SS	0		290									
					6	SS	0	289								
289.0																
5.4	End of Borehole  Auger refusal on probable Boulder  Water level in open bore on completion: 1.8m															

+ 3 x 3

Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE



# RECORD OF BOREHOLE No T7

1 OF 1

G.W.P. 81-99-00 LOCATION 4971417 N, 364345 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 1 December 2000 - 1 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100					
294.3																		
0.0	WATER							294										
293.8																		
0.5	PEAT		1	SS	0		1											
293.4	black, very soft, wet																	
0.9	SAND,																	
293.1	with Organics		2	SS	1													
1.2	brown, very loose, wet																	
			3	SS	3		2											
	SAND,																	
	some to with Silt		4	SS	5													0 87 (23)
	grey, very loose to compact, wet																	
			5	SS	9		3											
			6	SS	13		4											0 83 (17)
			7	SS	10													
							5											
			8	PJ				289										
288.7	End of Borehole																	
5.6	Refusal to Pionjar																	

+ 3 x 3

Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No T8

1 OF 1

G.W.P. 81-99-00 LOCATION 4971444 N. 364374 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 30 November 2000 - 30 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100					
294.4																		
0.0	PEAT, with Sand layers black to brown very loose to very soft, wet		1	SS	1			294										
293.2			2	SS	1			1										
1.2	SAND, trace silt grey, compact, wet		3	SS	10			293										
			4	SS	11			2										
			5	SS	15			292										
								3										
								291										
290.1			6	PJ				4										
4.3	SILT, trace Sand grey, wet							290										
								5										
288.4			7	PJ				289										
6.0	End of Borehole							6										
	Water level in open bore on completion: at Ground Surface																	

# RECORD OF BOREHOLE No T9

1 OF 1

G.W.P. 81-99-00 LOCATION 4971480 N, 364409 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 4 December 2000 - 4 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	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 <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES										
294.0															
0.0	PEAT, black, very soft, wet		1	SS	0										SS1, 2 : No recovery
293.0			2	SS	1		1	293							
1.0	SAND, with Organics, brown, very loose, wet		3	SS	1										
292.3			4	SS	2		2	292							1 56 42 1
1.7	SILTY SAND, grey to brown, very loose to compact, wet		5	SS	5										
			6	SS	9		3	291							
290.0			7	SS	12		4	290							
4.1	End of Borehole  Sampler bouncing on Possible Bedrock  Refusal to Pionjar  Water level in open bore on completion: at Ground Surface														

# RECORD OF BOREHOLE No T10



1 OF 1

G.W.P. 81-99-00 LOCATION 4971438 N, 364348 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
295.8	0.1m Sandy Gravel (Fill)		1	SS	6										
294.4	SAND (FILL), trace Gravel brown, loose to compact, damp to moist		2	SS	22		1	295							
293.7	SAND, with Peat layers, black, compact, moist		3	SS	12		2	294							
291.4	SAND, trace Silt, occasional Silt seams, brown compact to dense, wet		4	SS	45		3	293							0 90 (10)
289.9	SAND, trace Silt, occasional Silt seams, brown compact to dense, wet		5	SS	27		4	292							SS6: Sand backing up in open hole (N-value probably disturbed)
289.9	SAND, trace Silt, occasional Silt seams, brown compact to dense, wet		6	SS	8		5	291							
286.7	SILTY SAND, brown, loose, wet		7	SS	8		6	290							0 5 95 0
281.3	SILT, trace sand grey, very loose to loose, wet		8	SS	6		7	289							
281.3	SILT, trace sand grey, very loose to loose, wet		9	SS	1		8	288							SS9: Sampler sank 0.4m under own weight
281.3	End of Borehole						9	287							
281.3	DCPT conducted from 9.1m to 14.5m						10	286							
281.3	DCPT conducted from 9.1m to 14.5m						11	285							
281.3	DCPT conducted from 9.1m to 14.5m						12	284							
281.3	DCPT conducted from 9.1m to 14.5m						13	283							
281.3	DCPT conducted from 9.1m to 14.5m						14	282							
281.3	Dynamic cone refusal Water in Open Bore on completion: 2.1														End of day

# RECORD OF BOREHOLE No T11

1 OF 1

G.W.P. 81-99-00 LOCATION 4971374 N, 364299 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
296.3									20 40 60 80 100						
0.0	0.2m GRAVELLY SAND (FILL)		1	SS	12			296							
295.6	SAND (FILL) trace Gravel, brown, compact, damp														
0.8	End of Borehole Auger Refusal on probable Rockfill														More borehole 1m North and 1m South, auger refusal at 0.8m
	Water level in open bore on completion:none														

# RECORD OF BOREHOLE No T12

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4971330 N. 364269 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 21 November 2000 - 21 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
297.3 0.0	0.2m GRAVELLY SAND (FILL)		1	SS	21			297						
296.6 0.8	SAND (FILL) trace Gravel, brown, compact, damp End of Borehole Auger Refusal on probable Rockfill  Water level in open bore on completion: none													More borehole 1m North and 1m South auger refusal at 0.8m

# RECORD OF BOREHOLE No T13

1 OF 1

G.W.P. 81-99-00 LOCATION 4971290 N, 364243 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 21 December 200 - 21 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40					
298.3	130mm ASPHALTIC CONCRETE 0.3m SAND(FILL), with Gravel.							298							
297.6	SAND(FILL), trace Gravel, brown, damp End of Borehole														
0.7	Auger Refusal on possible Bedrock Water level in open bore on completion:none														

# RECORD OF BOREHOLE No U1

1 OF 1

G.W.P. 81-99-00 LOCATION 4972595 N, 365464 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 8 December 2000 - 8 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
292.9															
0.0	0.1m Ice														
292.3	Water														
0.6	PEAT,														
291.8	black, very soft, wet		1	SS	1		1	292							
1.1	trace Organic layers		2	SS	5										
			3	SS	11		2	291							
			4	SS	9										
	SAND, trace Gravel, Silt brown to yellow, loose to compact, wet		5	SS	19		3	290							9 81 (10)
288.9			6	SS	20		4	289							
4.1	End of Borehole														



# RECORD OF BOREHOLE No U2

1 OF 1

G.W.P. 81-99-00 LOCATION 4972585 N. 365460 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 8 December 2000 - 8 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	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		
293.0	0.1m Ice														
292.4	Water														
0.6	PEAT, black, very soft to firm, wet		1	SS	1		1	292							SS1: No Recovery
291.5			2	SS	9										
1.5			3	SS	10		2	291							
	SAND, some Gravel, trace Silt brown to yellow, loose to compact, wet		4	SS	14		3	290							
			5	SS	9										
			6	SS	12		4	289							13 78 (9)
			7	SS	19										
288.2	End of Borehole														
4.8	Spoon bouncing on Possible Boulder														

# RECORD OF BOREHOLE No U3

1 OF 1

G.W.P. 81-99-00	LOCATION 4972602 N. 365433 E	ORIGINATED BY NNK
DIST 52 HWY 35	BOREHOLE TYPE Wash boring	COMPILED BY NNK
DATUM Geodetic	DATE 1 February 2001 - 1 February 2001	CHECKED BY AD
PROJECT Highway 35 Widening		JOB NO. TT20868

[illegible]

# RECORD OF BOREHOLE No U4



1 OF 1

G.W.P. 81-99-00 LOCATION 4972590 N, 365431 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Wash boring COMPILED BY NNK  
 DATUM Geodetic DATE 2 February 2001 - 2 February 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE # ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>		
292.6 0.0	0.1m ICE														
			1	SS	0		292								SS 1, 2 : No recovery
			2	SS	0		291								
			3	SS	0		290								
	PEAT black, very soft, wet		4	SS	0		289								
			5	SS	1		288								
			6	SS	1		287								
284.8 7.8	SILTY CLAY, trace Sand, grey, very soft, wet		7	TN	-		286								
			8	SS	2		285								
			9	SS	5		284								
282.6 10.0	SAND grey, very loose, wet						283								TW 7: No Recovery
							282								
281.0 11.6	End of Borehole						281								
	Water level in open bore on completion: at surface														

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

# RECORD OF BOREHOLE No U5

amec

1 OF 2

G.W.P. 81-99-00 LOCATION 4972588 N, 365451 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 14 December 2000 - 14 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40					
293.6 0.0	trace Rootlets		1	SS	17		293								
292.9 0.7	SAND(FILL), with Gravel, brown, compact, damp		2	SS	9		292								SS2: Sampler wet
	SAND (FILL), With Gravel, trace Silt, Peat, occasional Cobbles Grey, loose, wet		3	SS	5		291								
			4	SS	8		290								
290.3 3.3	PEAT black, very soft, wet		5	SS	1		289								Solid Stem Hollow Stem
289.4 4.2	SAND, with Gravel trace Silt, brown, very loose to compact, wet		6	SS	3		288								
			7	SS	13		287								
			8	SS	10		286								20 76 (4)
	occasional Cobbles		9	SS	4		285								20 76 (4)
			10	SS	6		284								3 91 (6)
	trace Gravel		11	SS	4		283								
	no gravel		12	SS	8		282								0 93 (7)
281.0 12.7	End of Borehole						281								
	DCPT conducted from 12.65m to 21.5m						280								
							279								

Continued Next Page

+3, X3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No U5

2 OF 2

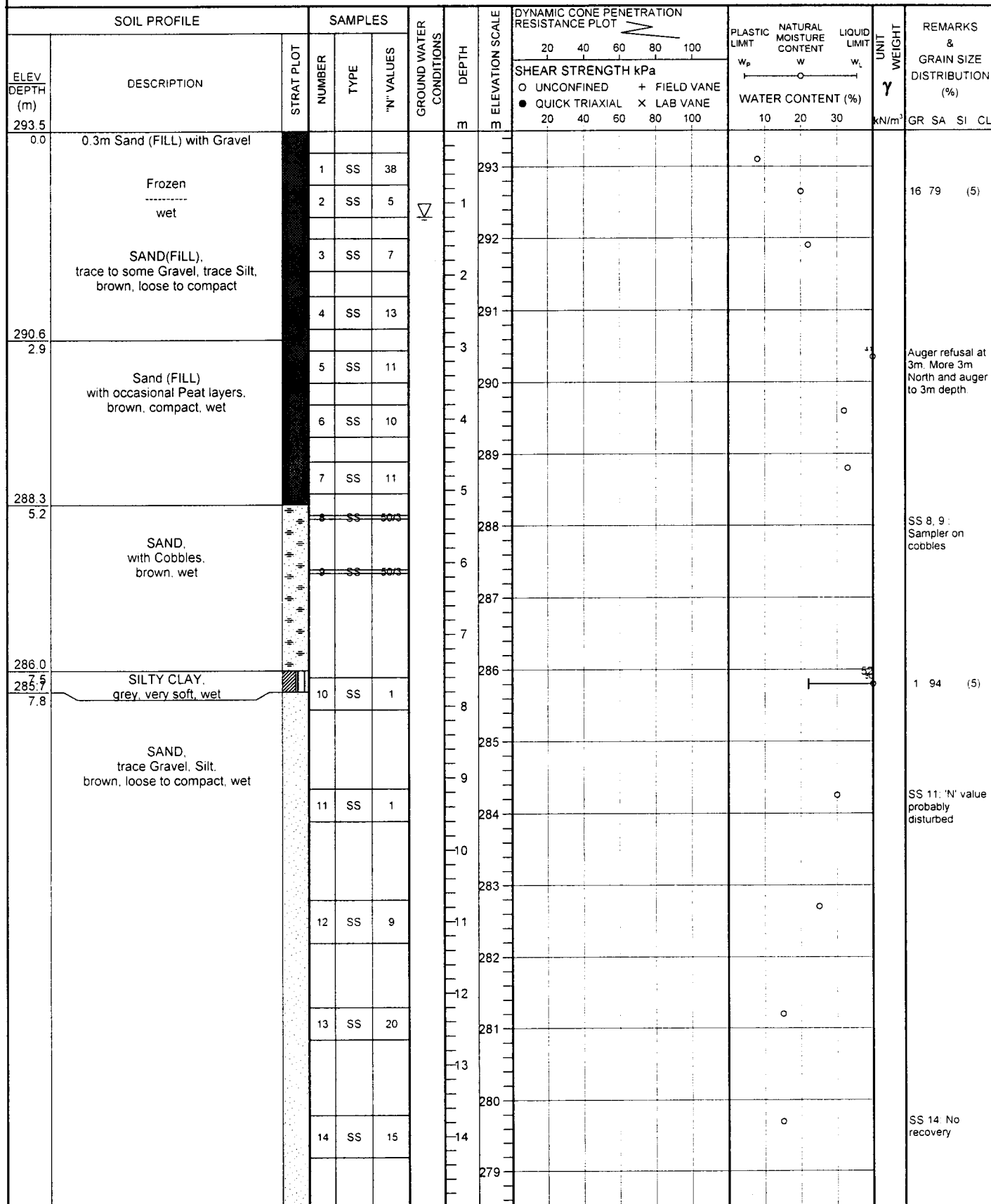
G.W.P. 81-99-00 LOCATION 4972588 N. 365451 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 14 December 2000 - 14 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
									20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	10 20 30					
272.1							278								
21.5	Dynamic cone refusal Borehole moved 1m south, auger refusal at 0.9m. More borehole 3m North, auger refusal at 1.5m. Water level in open bore on completion: 0.7m						277								
							276								
							275								
							274								
							273								
							272								

# RECORD OF BOREHOLE No U6

1 OF 2

W.P.	81-99-00	LOCATION	4972600 N. 365443 E	ORIGINATED BY	PPM
DIST	52	HWY	35	BOREHOLE TYPE	Hollow Stem Augering
DATUM	Geodetic	DATE	23 January 2001 - 23 January 2001	COMPILED BY	PPM
PROJECT	Highway 35 Widening			CHECKED BY	AD
				JOB NO.	TT20868



Continued Next Page

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

# RECORD OF BOREHOLE No U6

amec

2 OF 2

G.W.P. 81-99-00 LOCATION 4972600 N. 365443 E ORIGINATED BY PPM  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augering COMPILED BY PPM  
 DATUM Geodetic DATE 23 January 2001 - 23 January 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	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 <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
			15	SS	16		278							
							277							
			16	SS	16		276							
							275							
274.8	End of Borehole		17	SS	18		274							
18.8	DCPT conducted from 18.3m to 22.7m						273							
							272							
							271							
270.9	End of DCPT													
22.7	Water level in open bore on completion: 1.2m													

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

# RECORD OF BOREHOLE No U7



1 OF 1

G.W.P. 81-99-00 LOCATION 4972481 N, 365421 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 1 August 2001 - 1 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
295.8									20 40 60 80 100	20 40 60 80 100					
0.0	Sand and Gravel FILL trace Silt, brown, compact, damp		1	SS	11										
			2	SS	24		1	295							SS2: driving a stone
293.9			3	SS	13			294							
1.9	CLAYEY SILT, trace Sand, Gravel, brown, Hard, damp		4	SS	62		2								
292.9			5	SS	21		3	293							2 88 (10)
2.9			6	SS	50/13		4	292							SS6: augers sinking. Water added to stabilize hydrostatic pressure
	SAND, Fine to Medium, trace Silt, brown, compact to very dense, wet		7	SS	50/12		5	291							
	grey, loose		8	SS	7		6	290							
			9	SS	8		7	289							
			10	SS	6		8	288							
							9	287							SS11: sampler refusal on possible cobbles
286.5			11	SS	50/6										
9.3	End of Borehole														
	Groundwater in open bore on completion: 4.6														
	Cave on completion: 5.2														



# RECORD OF BOREHOLE No U8



1 OF 1

G.W.P. 81-99-00 LOCATION 4972540 N, 365418 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 1 August 2001 - 1 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	w <sub>p</sub>	w	w <sub>L</sub>		
293.6	100mm ASPHALT													
0.0	Gravelly sand FILL, trace Silt, brown, compact, damp		1	SS	23		293							
			2	SS	11		1							
292.2							292							
1.4			3	SS	16		2							
	SAND trace to with Gravel, Silt, grey, compact to very dense, wet		4	SS	20		291							24 71 (5)
			5	SS	50/13		3							
			6	SS	19		4							
			7	SS	15		5							
			8	SS	33		6							
			9	SS	34		8							
			10	SS	40		9							
282.8			11	SS	50/13		10							
10.8	End of Borehole						283							
	Groundwater in open bore on completion: 4.3m													
	Cave on completion: 4.6m													

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

# RECORD OF BOREHOLE No U9

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4972630 N. 365451 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 1 August 2001 - 1 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		$w_p$	$w$	$w_L$			WATER CONTENT (%)
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
293.8									20 40 60 80 100						GR SA SI CL	
0.0	Gravelly Sand FILL, trace Asphalt fragments, brown, compact, damp to moist		1	SS	15											
			2	SS	10											
292.4																
1.4	SAND FILL, with Silt, trace Gravel, brown, compact to very dense, wet, occasional Cobbles inferred below 2.6m		3	SS	24											5 73 (22)
			4	SS	97											
			5	SS	69											Hard Augering below 2.6m
290.1																
3.7	End of Borehole  Auger refusal on Probable Boulders  Groundwater in open bore on completion: none  Cave on completion: none															

+ 3 X 3

Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No U10



1 OF 1

G.W.P. 81-99-00 LOCATION 4972687 N, 365483 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 1 August 2001 - 1 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
296.2	0.1m ASPHALT  Sand FILL with Gravel, some Silt, brown, dense, damp		1	AS											
0.0															
294.7	End of Borehole  Auger Refusal on Rockfill  Groundwater in open bore on completion: none  BH moved 6.7 E , 1.5 N refusal at 1.4m. BH moved 3m east, refusal at 1.4m. BH moved 5.5 E , 7.0 N refusal at 1.2m.		2	SS	30										
1.5															

# RECORD OF BOREHOLE No U11



1 OF 1

G.W.P. 81-99-00 LOCATION 4972481 N, 365427 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 9 August 2001 - 9 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
294.1	0.2m TOPSOIL		1	SS	5		294									
	trace Rootlets															
	-----		2	SS	22			293								
	damp															
	wet		3	SS	10			292								
	SAND, Fine, trace Silt															
	brown very loose to compact		4	SS	13			291								
			5	SS	14		290									
			6	SS	4		289									
289.8	End of Borehole															
4.3	Groundwater in open bore on completion: 1.8m						5									
	Cave on completion: 2.6m															
	DCPT couducted from 4.3m to 7.0m						6									
287.1	End of DCPT						7									
7.0																

# RECORD OF BOREHOLE No U12

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4972488 N, 365401 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 10 August 2001 - 10 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
293.0	0.2m TOPSOIL with Rootlets ----- damp ----- wet		1	SS	5										
	very loose ----- compact		2	SS	4		1	292							
	SAND, trace Silt brown ----- grey		3	SS	10		2	291							3 91 (6)
	very loose to loose with Silt		4	SS	12		3	290							
			5	SS	9		4	289							0 75 25 0
			6	SS	4		5	288							
			7	SS	6		6	287							
287.2	End of Borehole		8	SS	6		7	286							
5.8	Groundwater in open bore on completion: 1.5m  Cave on completion: 2.3m  DCPT conducted from 5.8m to 9.1m						8	285							
283.9							9	284							
9.1	End of DCPT														

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

# RECORD OF BOREHOLE No U13



1 OF 2

G.W.P. 81-99-00 LOCATION 4972546 N. 365422 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 10 August 2001 - 10 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE				"N" VALUES	SHEAR STRENGTH kPa					
293.4	0.3m TOPSOIL		1	SS	14									
			2	SS	22									
			3	SS	19									
	SAND, trace to some, Silt, trace Gravel, occasional Gravelly Sand zones grey. compact to dense, wet		4	SS	14									
			5	SS	22									
			6	SS	20									
			7	SS	31									
			8	SS	29									
			9	SS	24									
			10	SS	35									
285.2	End of Borehole Auger refusal													
8.2	Groundwater in open bore on completion: 1.4m  Cave on completion: 2.4m  DCPT conducted from 8.2m to 16.6m													

Continued Next Page

+ 3, X 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No U13

amec

2 OF 2

G.W.P. 81-99-00 LOCATION 4972546 N, 365422 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 10 August 2001 - 10 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	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 <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
276.8 16.6	End of DCPT						281 13 280 14 279 15 278 16 277							

# RECORD OF BOREHOLE No U14



1 OF 1

G.W.P. 81-99-00 LOCATION 4972532 N. 365438 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 9 August 2001 - 9 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
293.0	0.2m TOPSOIL		1	SS	6											
0.0	trace rootlets															
			2	SS	7		1	292								
			3	SS	10		2	291							17 79 (4)	
			4	SS	9											
							3	290								
			5	SS	12											
	SAND, some to with Gravel, trace Silt, Occasional Gravelly Sand zones brown to grey, loose to compact wet		6	SS	25		4	289							23 74 (3)	
			7	SS	22		5	288								
			8	SS	22											
							6	287								
			9	SS	18											
							7	286								
			10	SS	14		8	285								
			11	SS	22											
							9	284								
			12	SS	53											
283.4																
9.6	End of Borehole															
	Groundwater in open bore on completion: 2.3m															
	Cave on completion: 3.8m															

+ 3 X 3 Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE



# RECORD OF BOREHOLE No U15

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4972614 N, 365466 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 9 August 2001 - 9 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		w <sub>p</sub>	w	w <sub>L</sub>			
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
292.5									20 40 60 80 100						GR SA SI CL	
0.0	0.45m PEAT		1	SS	17											
	SAND, with Peat, trace Wood fragments, dark brown to black, loose, wet		2	SS	9											
291.1																
1.4	PEAT		3	SS	11											
290.7																
1.8	SAND, some Silt, trace Clay, Gravel, brown, compact, wet		4	SS	14											
			5	SS	10											
			6	SS	10											
288.2	End of Borehole															
4.3	Groundwater in open bore on completion: 1.7m  Cave on completion: 2.1m  DCPT couducted from 4.3m to 11.5m															
281.0																
11.5	End of DCPT															

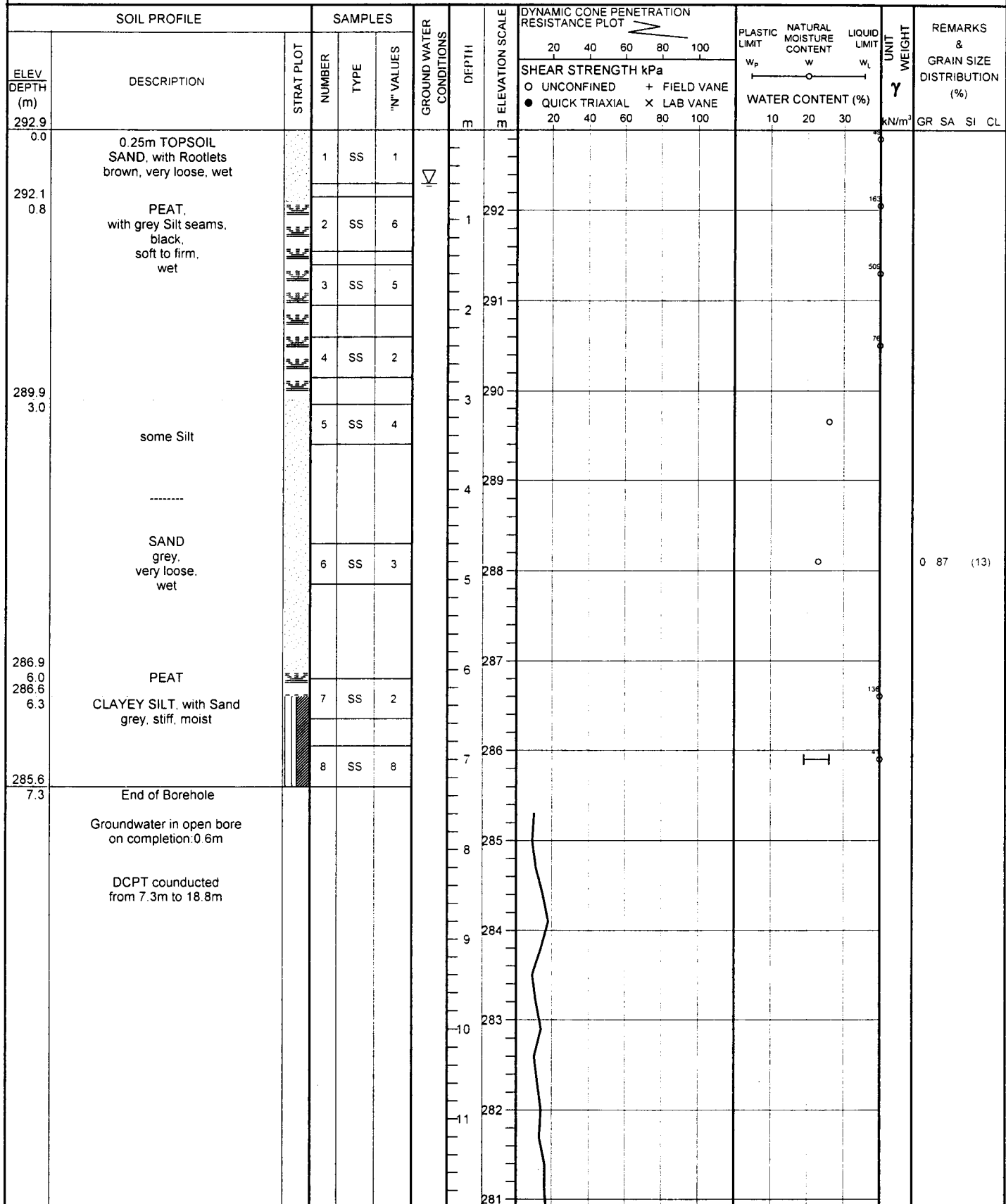
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No U16



1 OF 2

G.W.P. 81-99-00 LOCATION 4972637 N, 365448 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 9 August 2001 - 9 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868



Continued Next Page

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

# RECORD OF BOREHOLE No U16



2 OF 2

G.W.P. 81-99-00 LOCATION 4972637 N, 365448 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 9 August 2001 - 9 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
									20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60 80 100					
							280								
							279								
							278								
							277								
							276								
							275								
274.1	End of DCPT														
18.8															

# RECORD OF BOREHOLE No U17



1 OF 1

G.W.P. 81-99-00 LOCATION 4972657 N, 365483 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 9 August 2001 - 9 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
293.2									20 40 60 80 100	20 40 60 80 100					
0.0	0.3m TOPSOIL		1	SS	7	▽	293								
	SAND, with Rootlets, wood fragments, brown, loose to compact, wet		2	SS	11		1								
291.8	PEAT						292								
1.4			3	SS	20										
291.4	SAND, brown, wet						2								
1.8	SILTY CLAY, grey, very stiff, moist		4	SS	18		291								
291.1															
2.1															
290.3	SAND, trace Silt, Gravel, grey, compact, wet		5	SS	17		290								
2.9															
288.9			6	SS	20		4								
4.3	End of Borehole						289								
	Groundwater in open bore on completion: 1.5m														
	Cave on completion: 2.0m														

+ 3 x 3. Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No U18

G.W.P. 81-99-00 LOCATION 4972692 N, 365464 E ORIGINATED BY JF  
 DIST 52 HWY 35 BOREHOLE TYPE Hollow Stem Augring COMPILED BY NNK  
 DATUM Geodetic DATE 9 August 2001 - 9 August 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
295.1 0.0	0.3m TOPSOIL		1	SS	4			295							
	SAND, with Peat, Wood fragments, brown, very loose, wet														
293.7 1.4	PEAT		2	SS	4		1	294							
293.3 1.8			3	SS	16										
	SAND, some Gravel, trace Silt, brown, compact to very dense, wet		4	SS	23		2	293							
			5	SS	57		3	292							
291.5 3.6	CLAYEY SILT, grey, hard, damp		6	SS	50/13		4	291							
291.0 4.2	End of Borehole														
	Groundwater in open bore on completion: 1.5m														
	Cave on completion: 2.0m														

# RECORD OF BOREHOLE No V1



1 OF 1

G.W.P. 81-99-00 LOCATION 4973238 N, 366613 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 30 November 2000 - 30 November 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100					
300.1																		
0.0	PEAT, trace Decayed Wood, trace Silt, black, very soft, wet		1	SS	0			300										
299.4																		
0.8	SAND, trace Gravel, Silt loose to compact, wet		2	SS	7			299										3 88 9 0
			3	SS	13			298										
	brown		4	SS	20			297										
	grey		5	SS	25			297										8 85 7 0
296.4																		
3.8	End of Borehole																	
	Water level in open bore on completion: 0.2 m																	

# RECORD OF BOREHOLE No V2



1 OF 1

G.W.P. 81-99-00 LOCATION 4973264 N, 365506 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Continuous Sampling COMPILED BY NNK  
 DATUM Geodetic DATE 30 November 2000 - 1 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100		
300.1															
0.0	PEAT, black, very soft, wet		1	SS	0			300							
			2	SS	1			1							
298.6			3	SS	2			299							
1.5	SAND, with Peat, black, very loose, wet														
298.3															
1.8	SAND AND GRAVEL, brown, loose, wet		4	SS	7			2							
297.8								298							
2.3	SANDY SILT, some Gravel, trace Clay		5	SS	10										11 34 47 8
297.3															
2.8	grey, compact, wet		6	SS	37			3							9 82 (9)
296.7								297							
3.5	SAND, trace Gravel, Silt, grey, dense, wet														
	End of Borehole														
	Sampler Bouncing on Possible Bedrock or boulder														
	Water level in open Bore on completion : ground surface														

+ 3 x 3

Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No V3

amec

1 OF 1

G.W.P. 81-99-00 LOCATION 4973250 N, 365499 E ORIGINATED BY NNK  
 DIST 52 HWY 35 BOREHOLE TYPE Hand Augering COMPILED BY NNK  
 DATUM Geodetic DATE 19 December 2000 - 19 December 2000 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100					
303.8	120mm ASPHALTIC CONCRETE																	
0.0																		
303.3	SAND(FILL), with Gravel, brown, damp																	
0.5	End of Borehole																	
	Auger Refusal on probable Rockfill							303										



# RECORD OF BOREHOLE No W1



W.P. 81-99-00	LOCATION 4964714 N, 362582 E	1 OF 1	ORIGINATED BY ISH
DIST 52 HWY 35	BOREHOLE TYPE Hand Augering	COMPILED BY ISH/NNK	
DATUM Geodetic	DATE 30 July 2001 - 30 July 2001	CHECKED BY AD	
PROJECT Highway 35 Widening		JOB NO. TT20868	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV. DEPTH (m)	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)			
									○ UNCONFINED	+ FIELD VANE							● QUICK TRIAXIAL	x LAB VANE	
283.3									20	40	60	80	100						
0.0 283.0 0.3	0.3 m TOPSOIL						283												
	reddish brown, SILTY SAND some Gravel, occasional Cobbles						1												
	damp						282												
281.7																			
1.6	End of Borehole																		
	Auger Refusal on Possible Bedrock / Rockfill																		
	Ground water in open bore on completion: None																		

# RECORD OF BOREHOLE No W2

1 OF 1


W.P. 81-99-00 LOCATION 4964723 N. 362601 E ORIGINATED BY ISH  
 DIST 52 HWY 35 BOREHOLE TYPE Hand Augering COMPILED BY ISH/NNK  
 DATUM Geodetic DATE 30 July 2001 - 30 July 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
285.5															
285.3	0.25 m TOPSOIL														
0.3	reddish brown. SILTY SAND trace Gravel														
	with Gravel and Cobbles														
	damp		1	AS	-		1								
283.8	End of Borehole														
1.7	Auger Refusal on Possible Bedrock / Rock Fill														
	Ground water in open bore on completion: None														

# RECORD OF BOREHOLE No W4

1 OF 1

W.P. 81-99-00 LOCATION 4964732 N. 362622 E ORIGINATED BY ISH  
 DIST 52 HWY 35 BOREHOLE TYPE Hand Augering COMPILED BY ISH/NNK  
 DATUM Geodetic DATE 30 July 2001 - 30 July 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
290.2									20 40 60 80 100						GR SA SI CL
290.0	0.25m TOPSOIL						290								
289.3	reddish brown SILTY SAND with Gravel														
289.7															
0.5	brown FINE SAND with Gravel and Cobbles						1								
288.7	End of Borehole														
1.5	Auger Refusal on Possible Rock Fill														
	Ground water in open bore on completion: None														

# RECORD OF BOREHOLE No W5



1 OF 1

W.P. 81-99-00 LOCATION 4964709 N. 362602 E ORIGINATED BY ISH  
 DIST 52 HWY 35 BOREHOLE TYPE Hand Drilling COMPILED BY ISH/NNK  
 DATUM Geodetic DATE 30 July 2001 - 30 July 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
281.7														
280.9	0.2m TOPSOIL		1	SS	11									
0.2	reddish brown.													
	SAND,		2	SS	26									
	some Gravel, Silt													
	damp													
	compact													
	very dense		3	SS	50/8									
280.0														
1.8	End of Borehole													
	Auger Refusal on													
	Possible Bedrock													
	Ground water in open bore													
	on completion: None													

+ 3 × 3. Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No W6



1 OF 1

G.W.P. 81-99-00 LOCATION 4964701 N. 362602 E ORIGINATED BY ISH  
 DIST 52 HWY 35 BOREHOLE TYPE Hand Drilling COMPILED BY ISH/NNK  
 DATUM Geodetic DATE 30 July 2001 - 30 July 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20 40 60 80 100	20 40 60 80 100					
278.9 0.0															
278.4 0.5	PEAT. with Sand		1	SS	2										
	brown. SAND fine. trace Gravel. Silt		2	SS	13		1	278							
	compact	wet	3	SS	20										
276.6 2.3	very dense		4	SS	50/13		2	277							6 80 14 0
	End of Borehole														
	Refusal on Possible Bedrock														
	Groundwater in open bore on completion: at surface														

# RECORD OF BOREHOLE No W7



1 OF 1

W.P. 81-99-00 LOCATION 4964759 N 362589 E ORIGINATED BY ISH  
 DIST 52 HWY 35 BOREHOLE TYPE Hand Augering COMPILED BY ISH/NNK  
 DATUM Geodetic DATE 30 July 2001 - 30 July 2001 CHECKED BY AD  
 PROJECT Highway 35 Widening JOB NO. TT20868

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE									
296.0							20 40 60 80 100						
295.8							20 40 60 80 100						
295.6	0.2 m TOPSOIL		1	AS	-		20 40 60 80 100						
0.4	brown SILTY SAND trace Rootlets End of Borehole												
	Auger Refusal on Possible Bedrock												
	Ground water in open bore on completion: None												

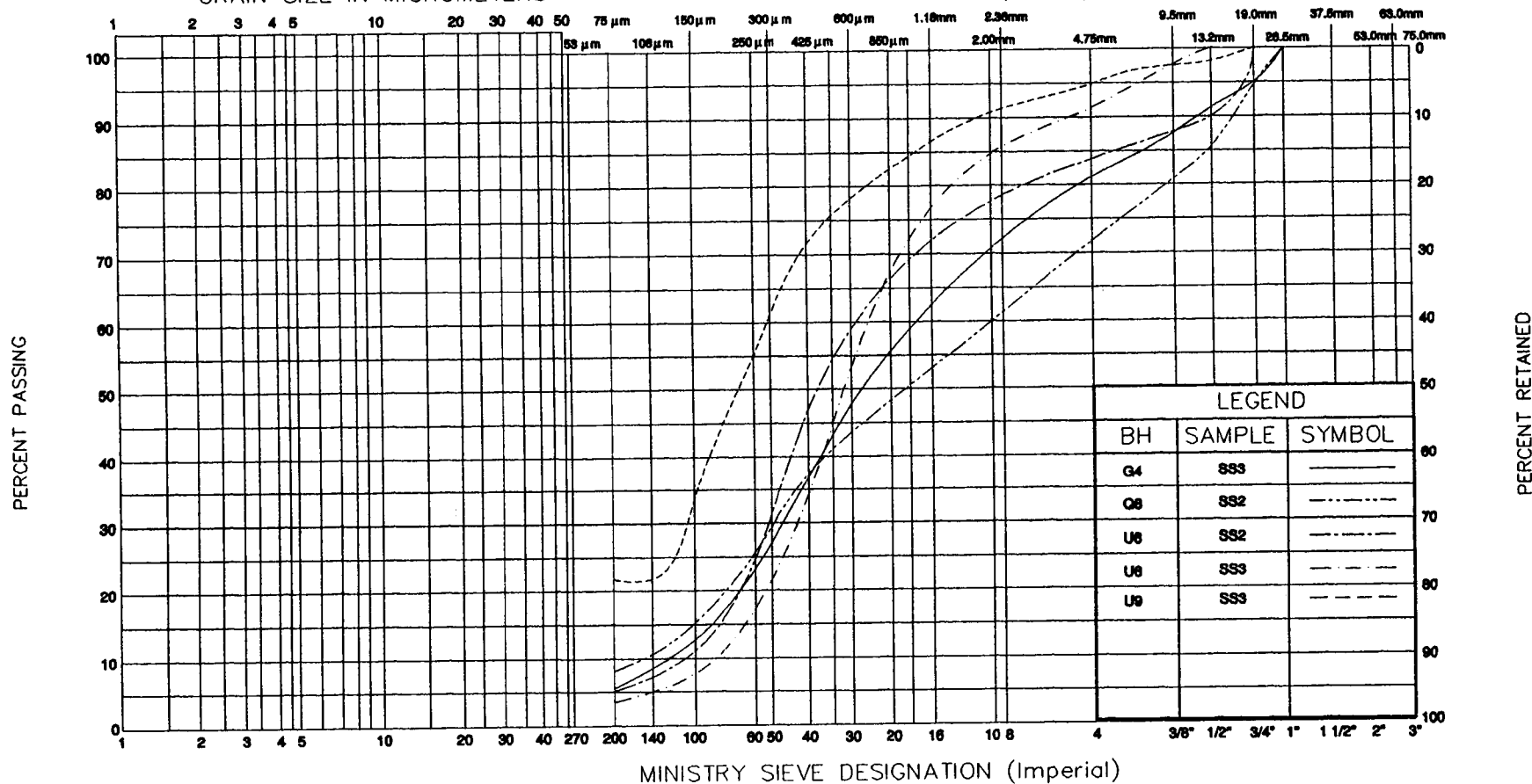
APPENDIX D  
LABORATORY TEST RESULTS

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	FINE	MEDIUM	COARSE	FINE	COARSE

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



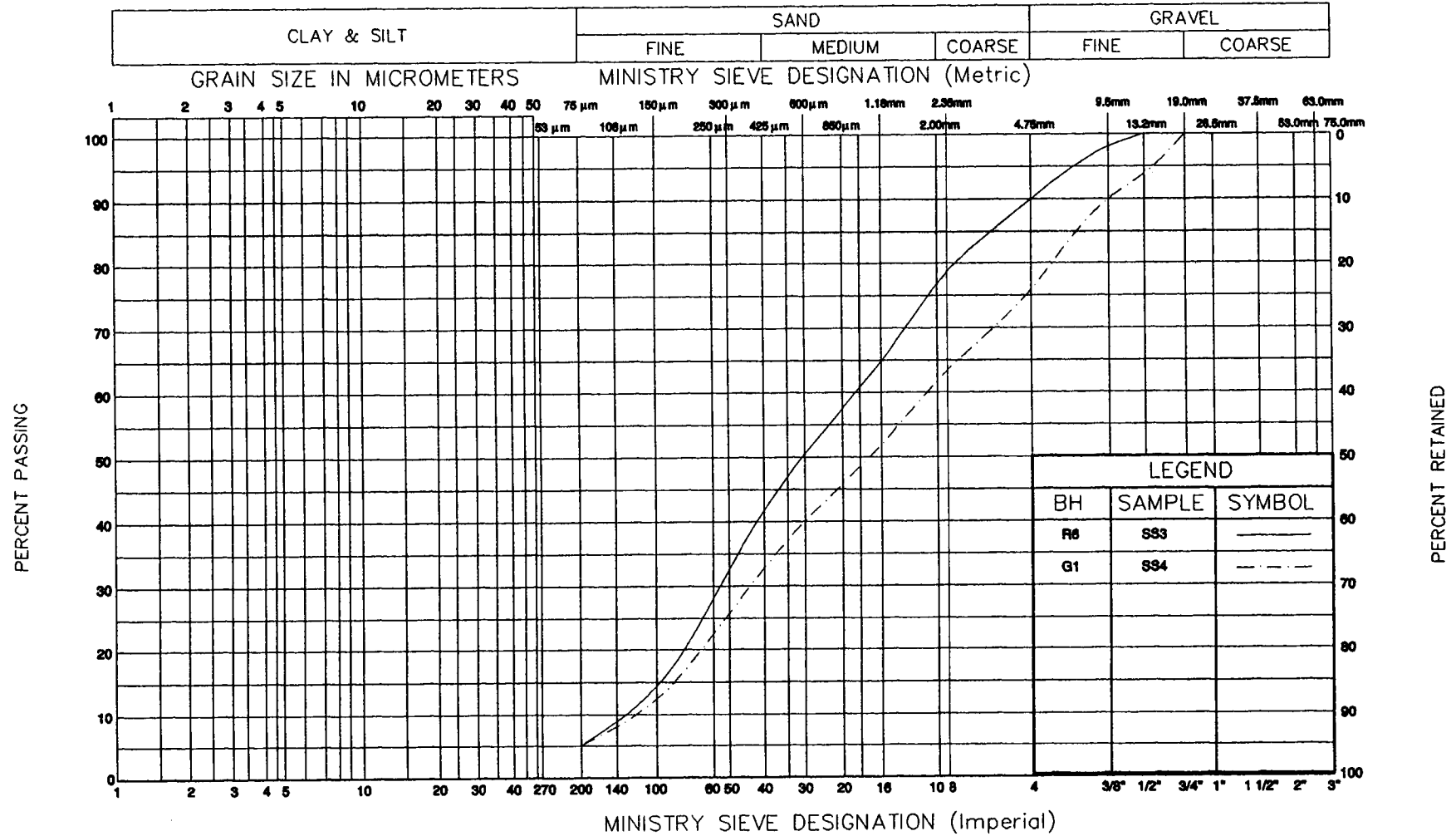
**amec**

GRAIN SIZE DISTRIBUTION  
SAND (FILL) some to with Gravel trace Silt

HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 1



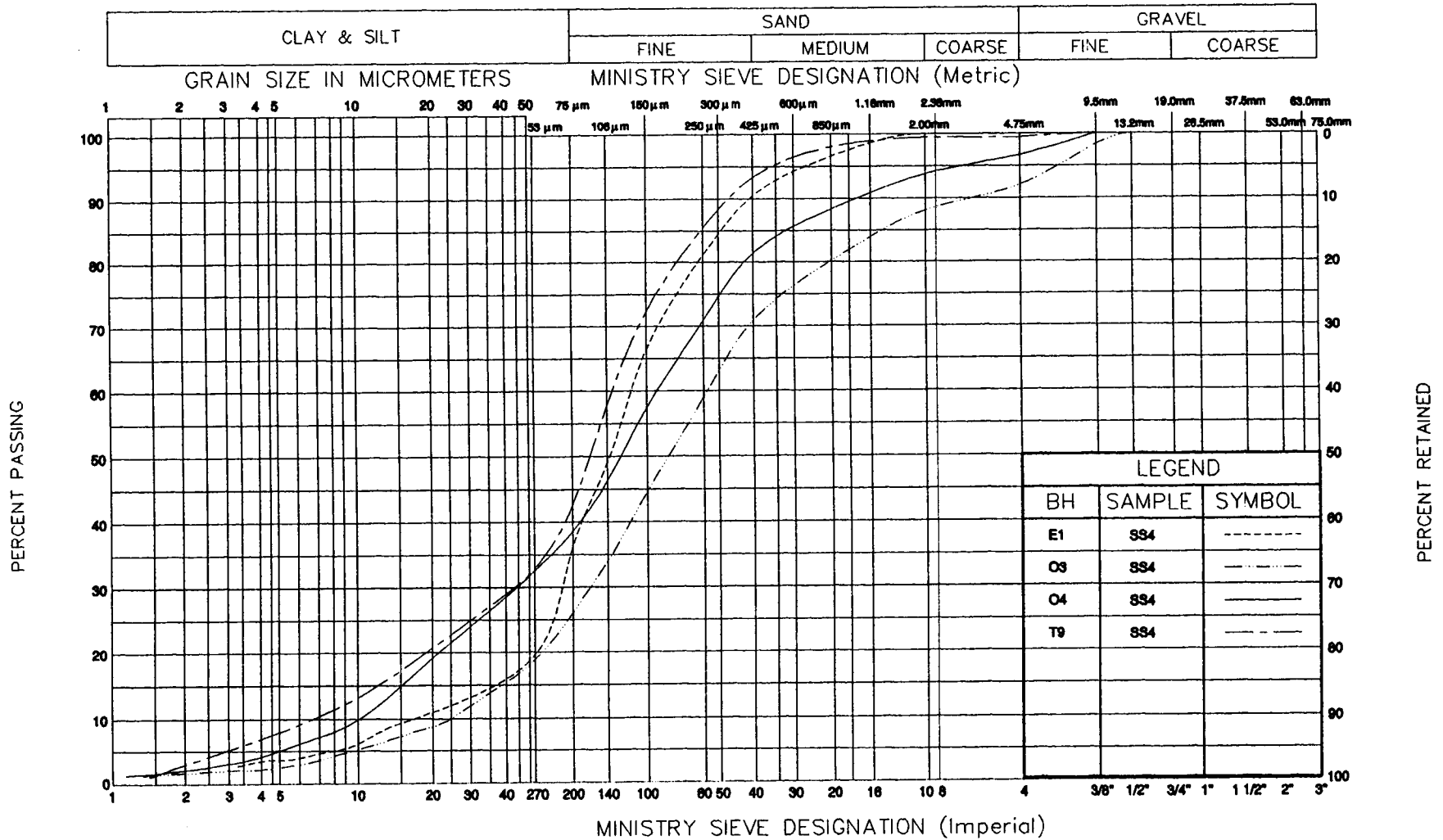
# UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION  
SAND with Organics some Gravel trace Silt

HWY 35 WIDENING
G.W.P 81-99-00
FIG. No 2

# UNIFIED SOIL CLASSIFICATION SYSTEM

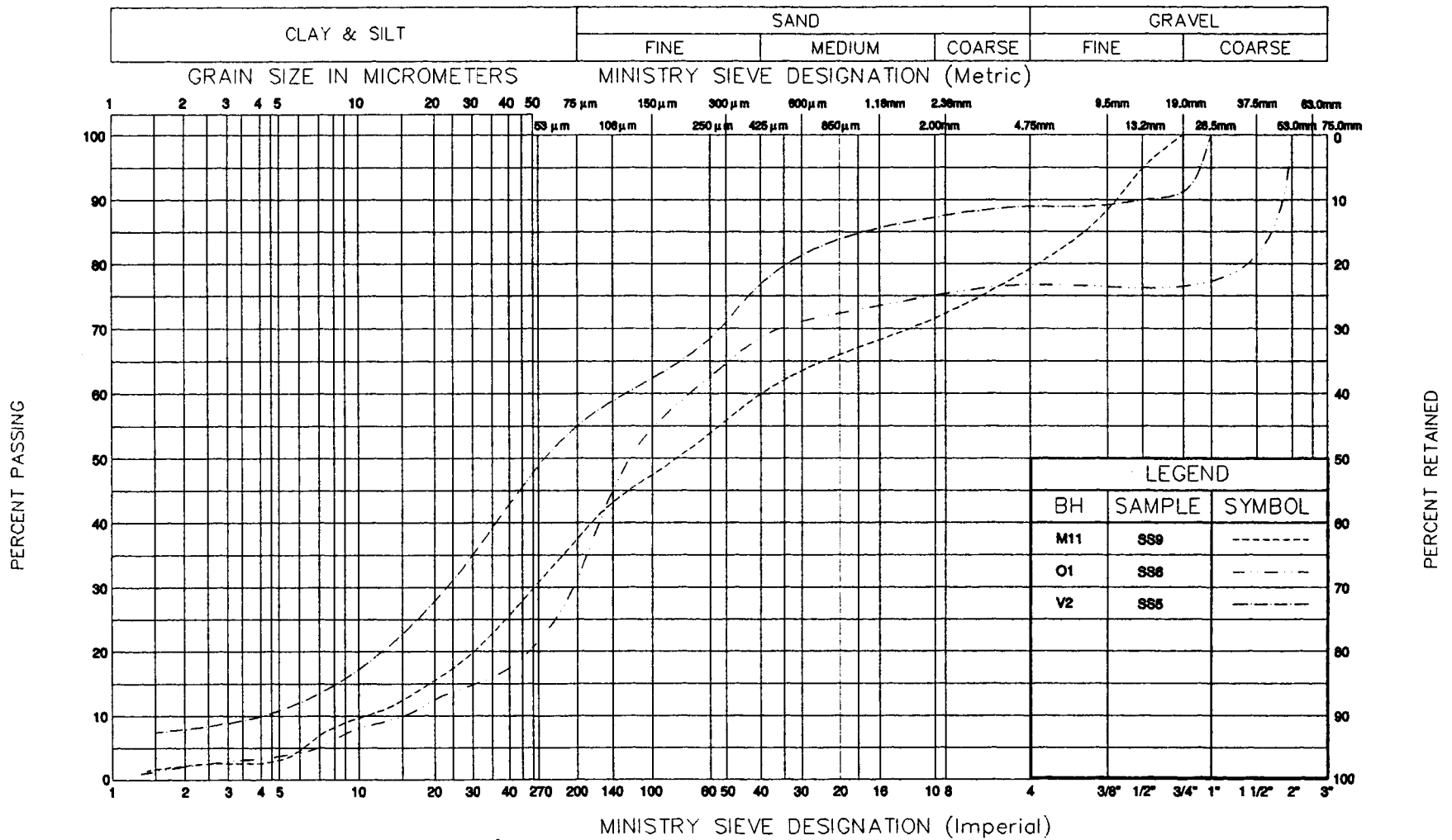


**amec**

GRAIN SIZE DISTRIBUTION  
SILTY SAND trace Gravel

HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 3

# UNIFIED SOIL CLASSIFICATION SYSTEM



**amec**

GRAIN SIZE DISTRIBUTION  
SANDY SILT some to with Gravel, trace Clay

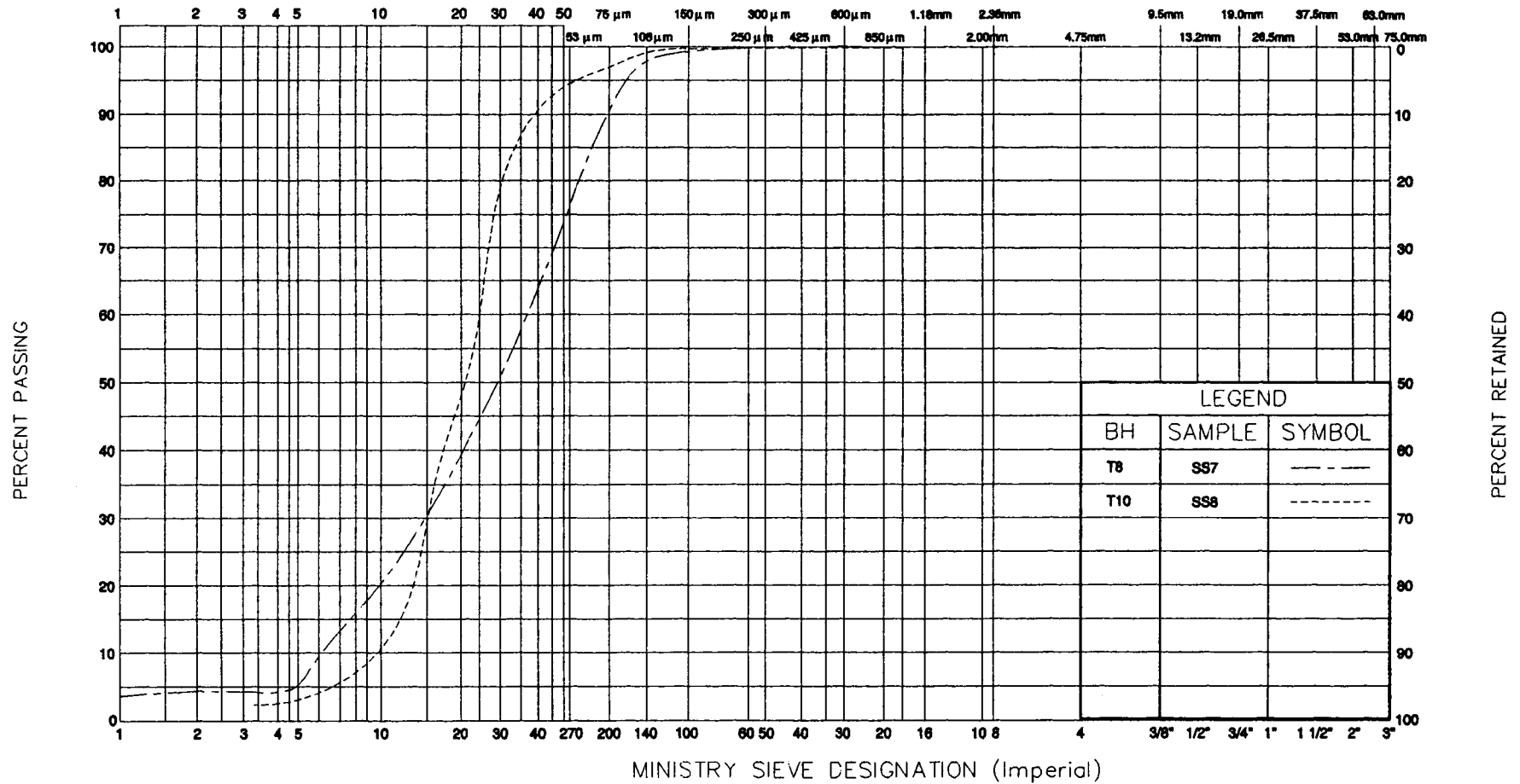
HWY 35 WIDENING
G.W.P 81-99-00
FIG. No 4

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	FINE	MEDIUM	COARSE	FINE	COARSE

GRAIN SIZE IN MICROMETERS

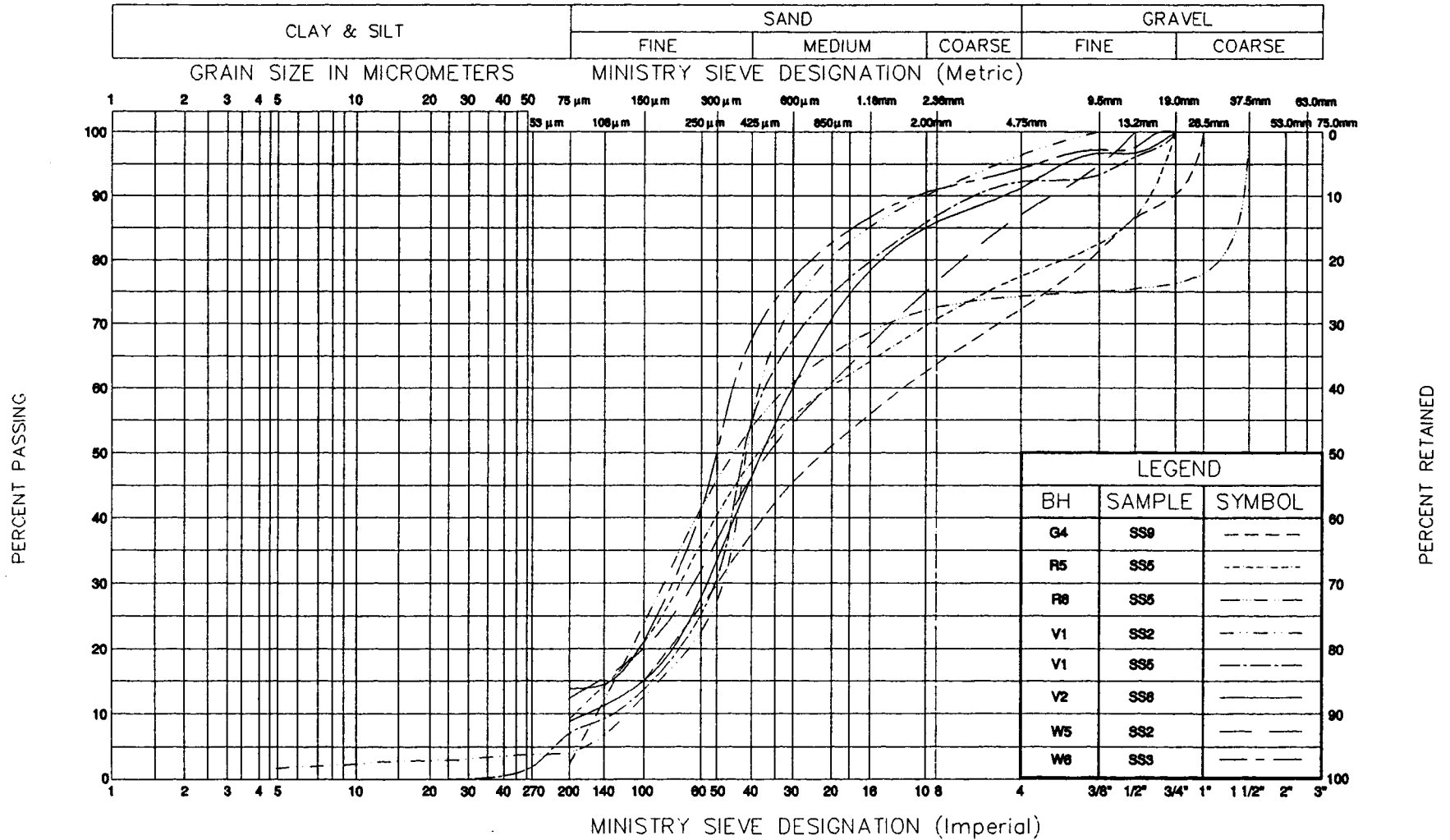
MINISTRY SIEVE DESIGNATION (Metric)



GRAIN SIZE DISTRIBUTION  
SILT, trace Sand, trace Clay

HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 5

# UNIFIED SOIL CLASSIFICATION SYSTEM



amec

GRAIN SIZE DISTRIBUTION  
SAND trace to with Gravel, trace Silt

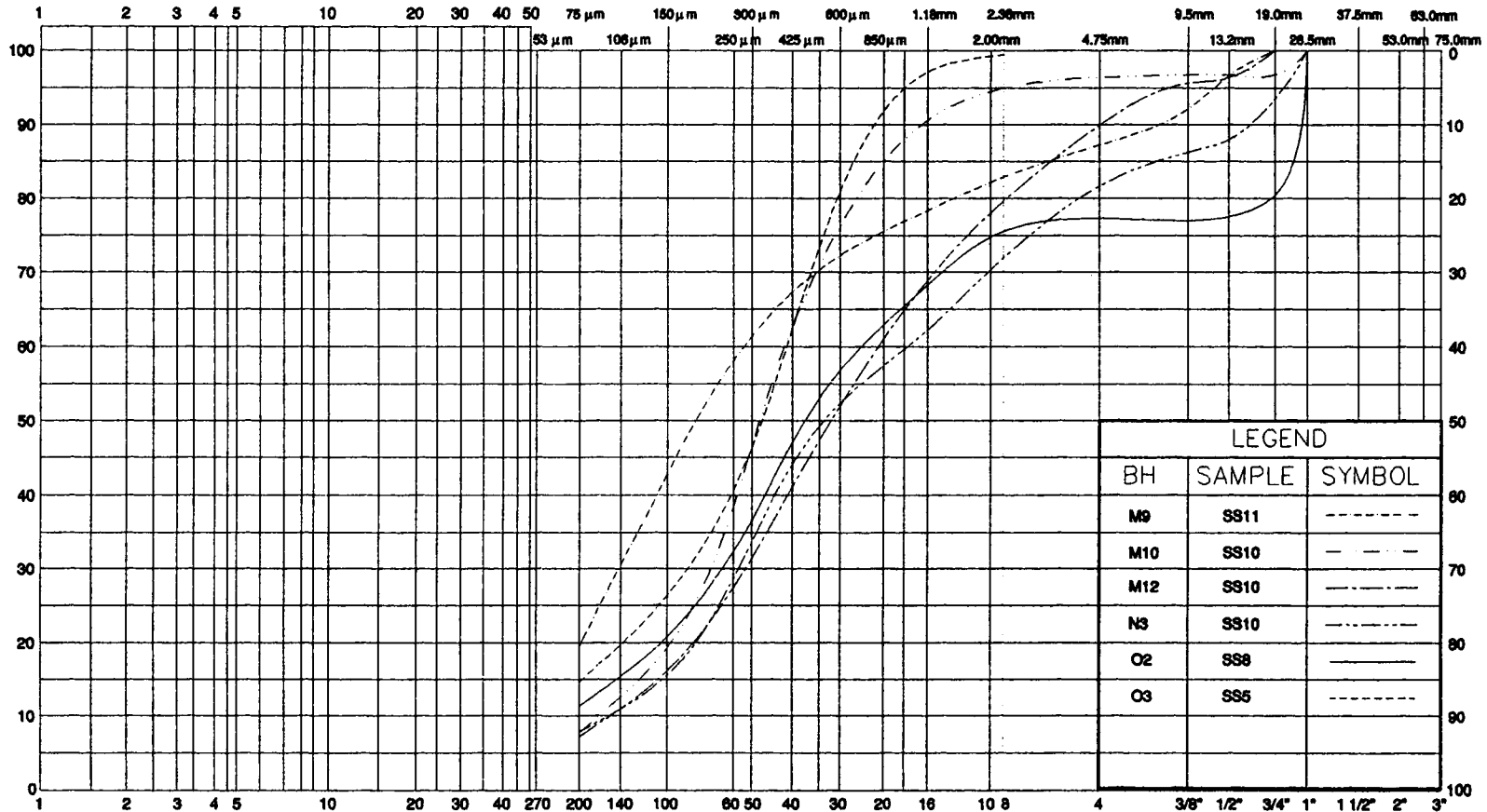
HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 6

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT					SAND			GRAVEL	
					FINE	MEDIUM	COARSE	FINE	COARSE

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



MINISTRY SIEVE DESIGNATION (Imperial)

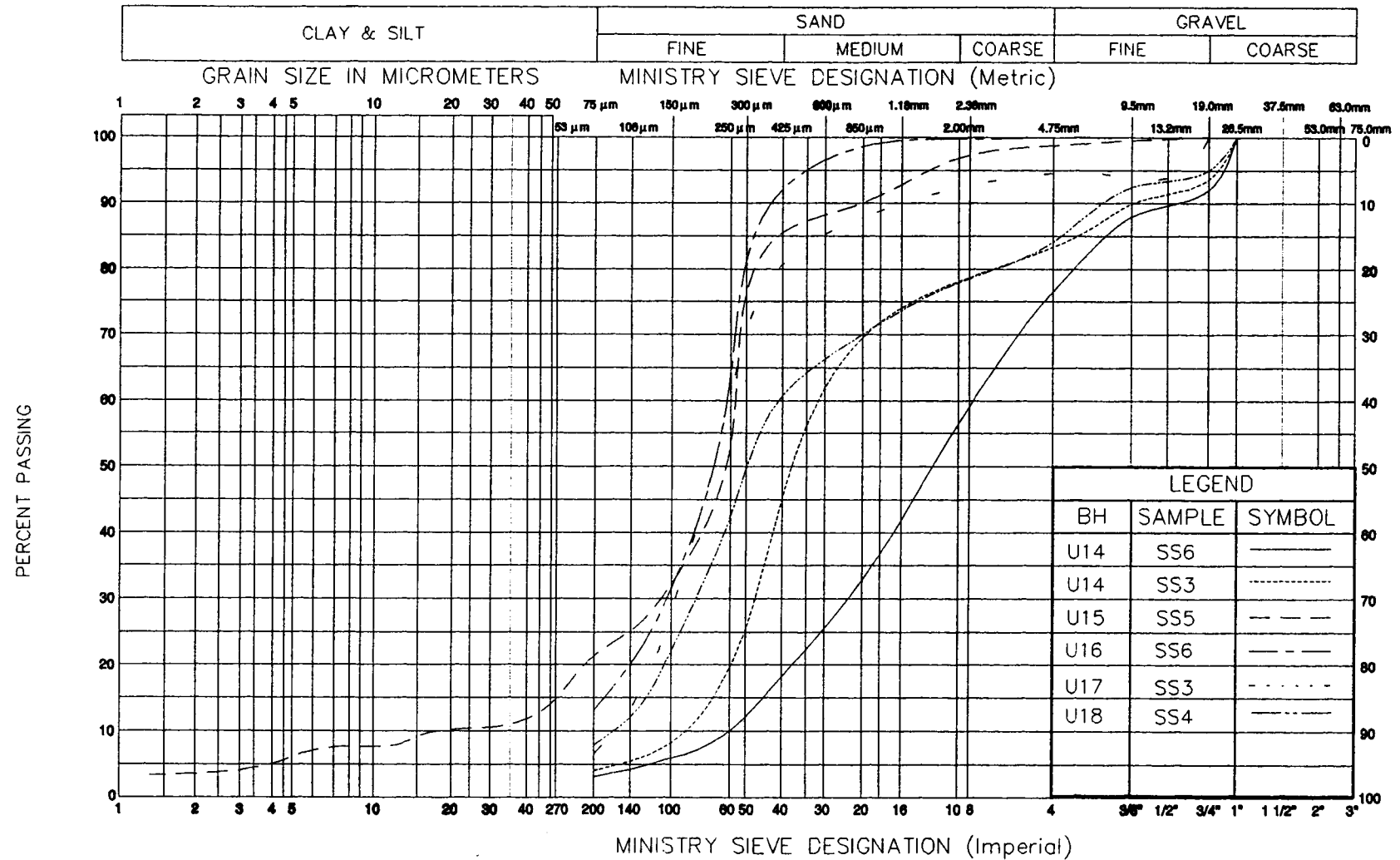
**amec**

GRAIN SIZE DISTRIBUTION  
SAND, trace to with Gravel, trace to with Silt

HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 7



# UNIFIED SOIL CLASSIFICATION SYSTEM



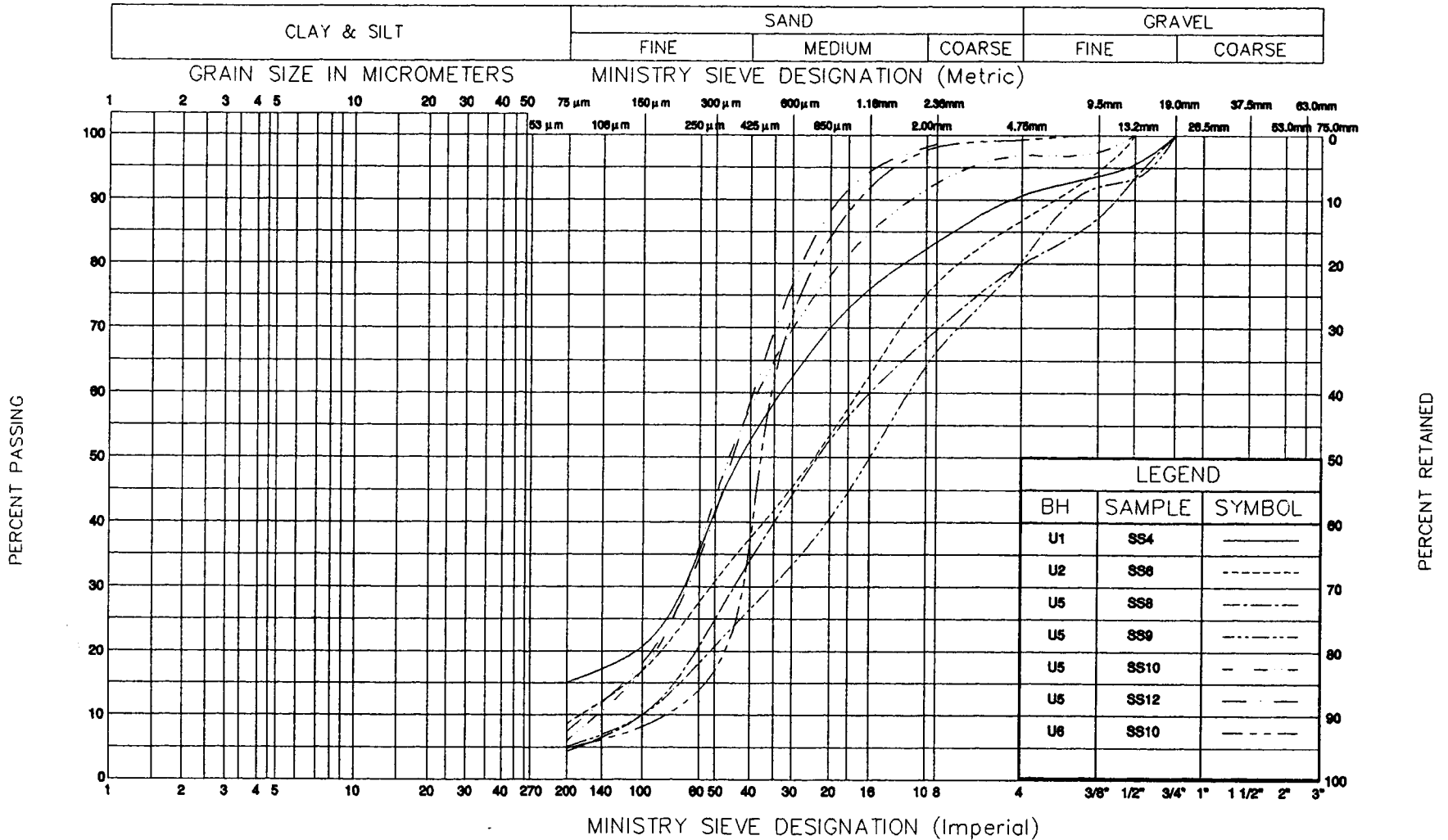
amec

GRAIN SIZE DISTRIBUTION  
SAND  
Trace to with Silt, Gravel

HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No. 9a



# UNIFIED SOIL CLASSIFICATION SYSTEM



amec

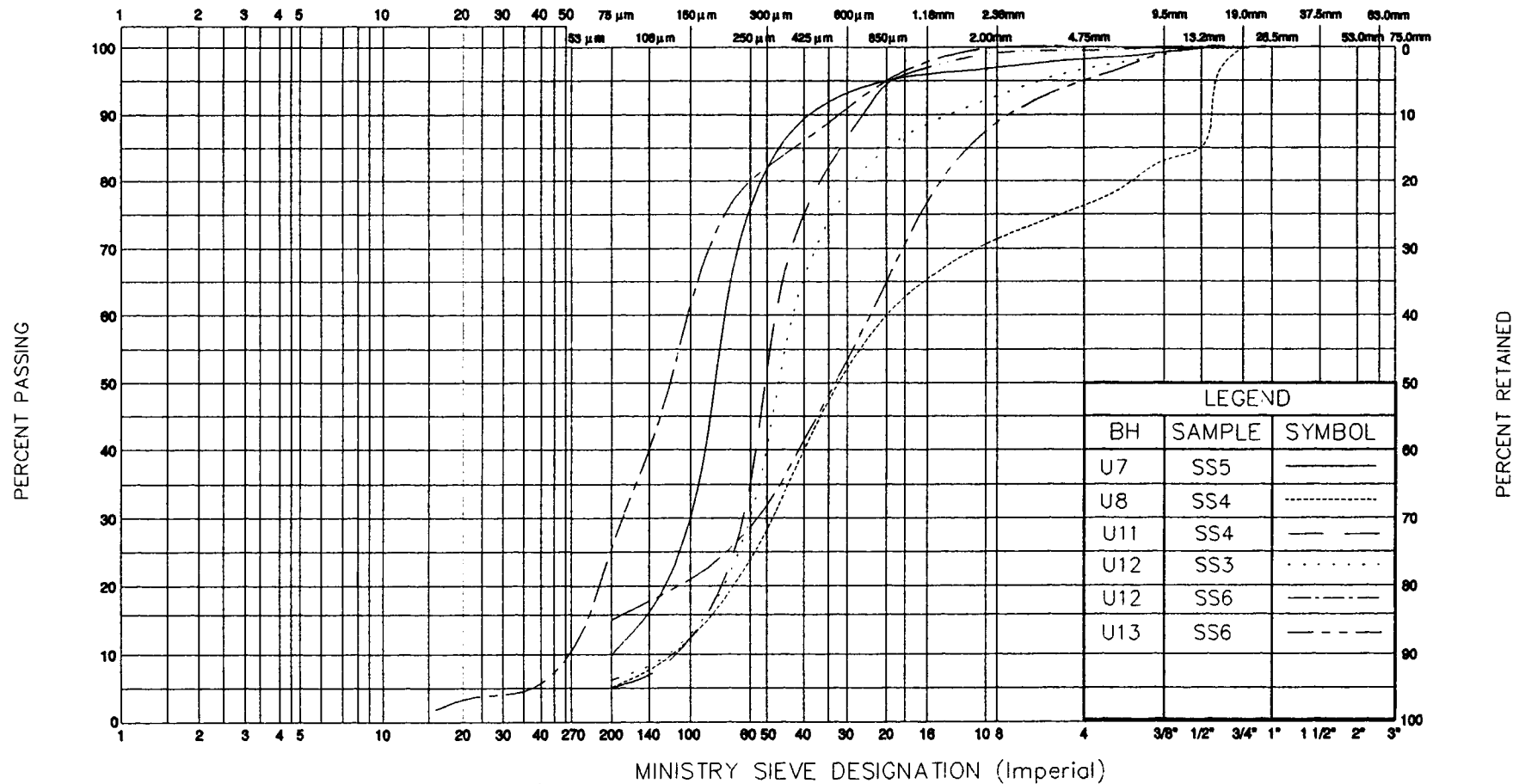
GRAIN SIZE DISTRIBUTION  
SAND, trace to some Gravel, trace to some Silt

HW 35 WIDENING  
G.W.P 81-99-00  
FIG. No 9b

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT					SAND			GRAVEL	
					FINE	MEDIUM	COARSE	FINE	COARSE

GRAIN SIZE IN MICROMETERS      MINISTRY SIEVE DESIGNATION (Metric)



**amec**

GRAIN SIZE DISTRIBUTION  
SAND  
Trace to with Silt, Gravel

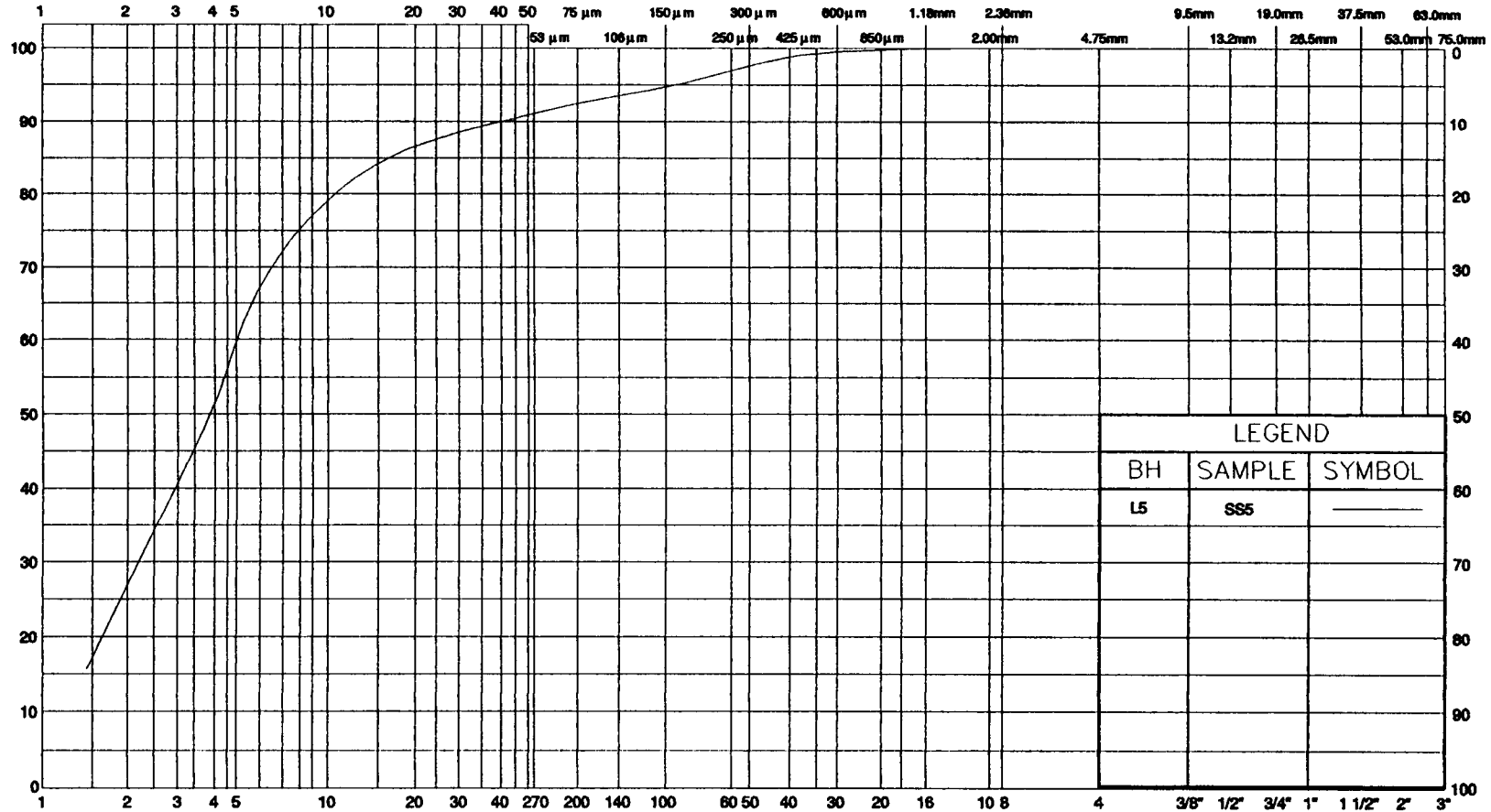
HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No. 9c

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT				SAND			GRAVEL	
				FINE	MEDIUM	COARSE	FINE	COARSE

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



PERCENT PASSING

PERCENT RETAINED

## LEGEND

BH	SAMPLE	SYMBOL
L5	SS5	—

MINISTRY SIEVE DESIGNATION (Imperial)

amec

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT (GLACIAL TILL) trace Sand

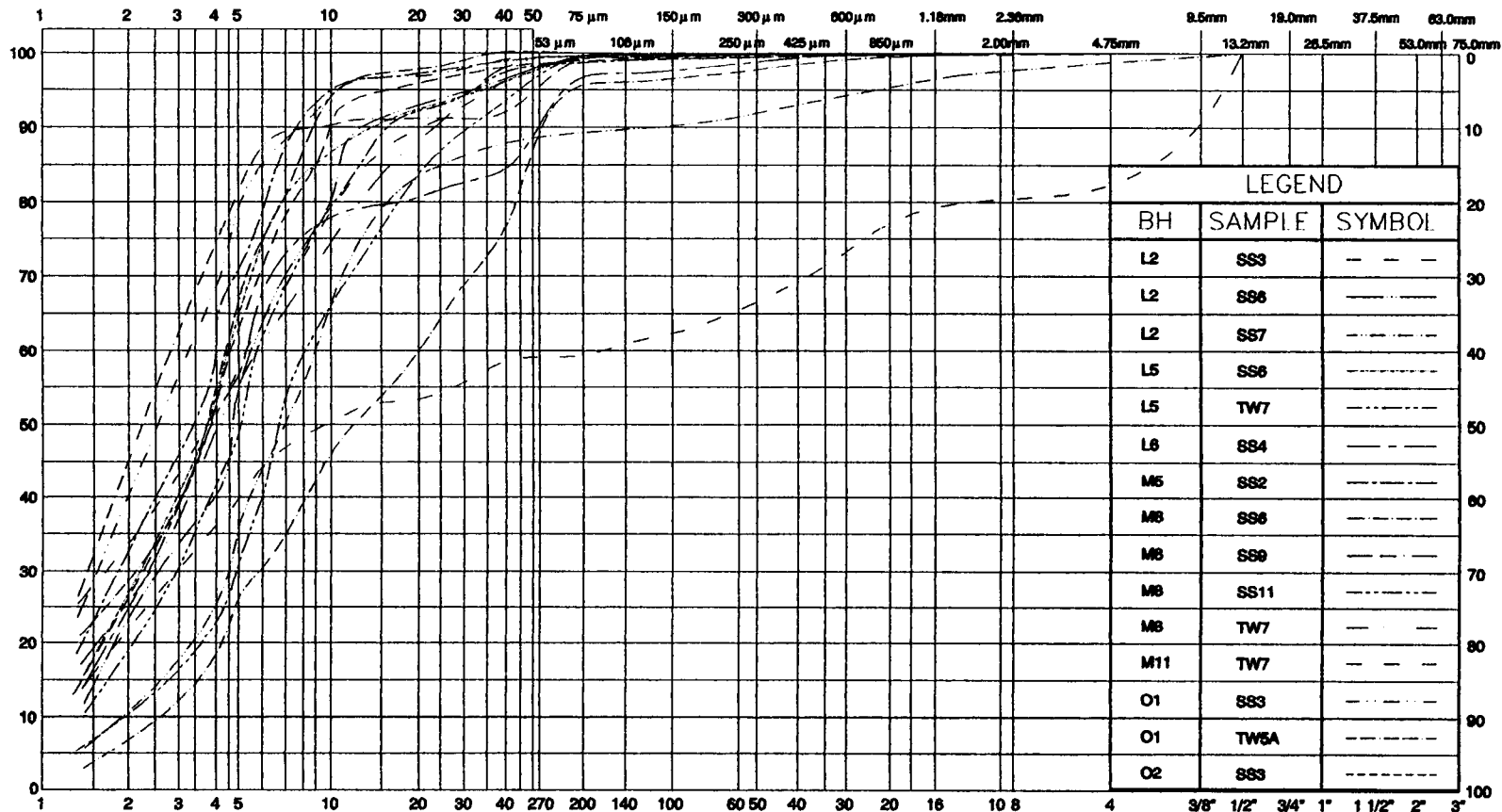
HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 10

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	FINE	MEDIUM	COARSE	FINE	COARSE

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



MINISTRY SIEVE DESIGNATION (Imperial)

amec

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT TO SILTY CLAY, varved

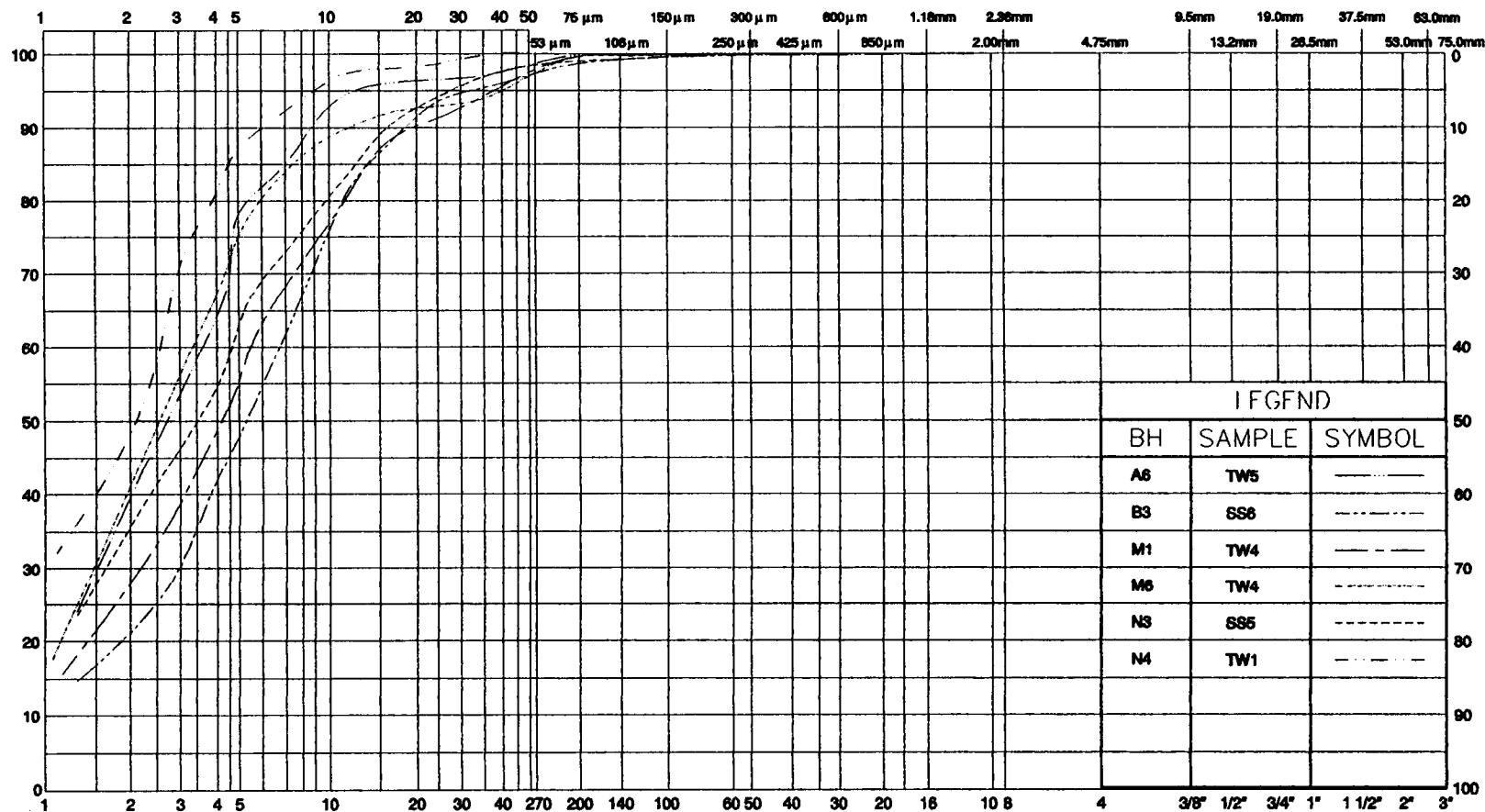
HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 11a

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	FINE	MEDIUM	COARSE	FINE	COARSE

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



MINISTRY SIEVE DESIGNATION (Imperial)

PERCENT RETAINED

amec

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT TO SILTY CLAY, varved

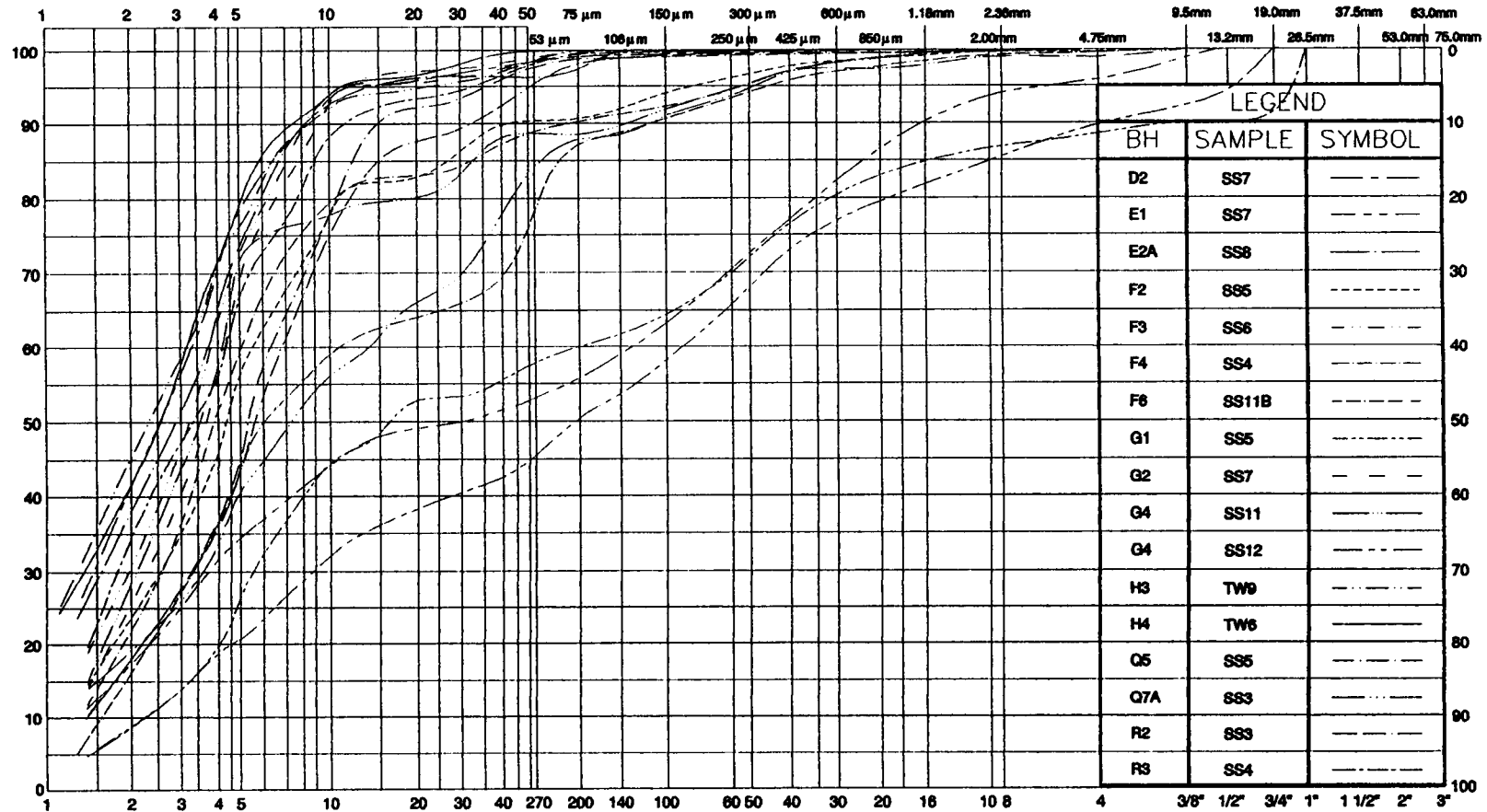
HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 11b

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	FINE	MEDIUM	COARSE	FINE	COARSE

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



MINISTRY SIEVE DESIGNATION (Imperial)

amec

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT

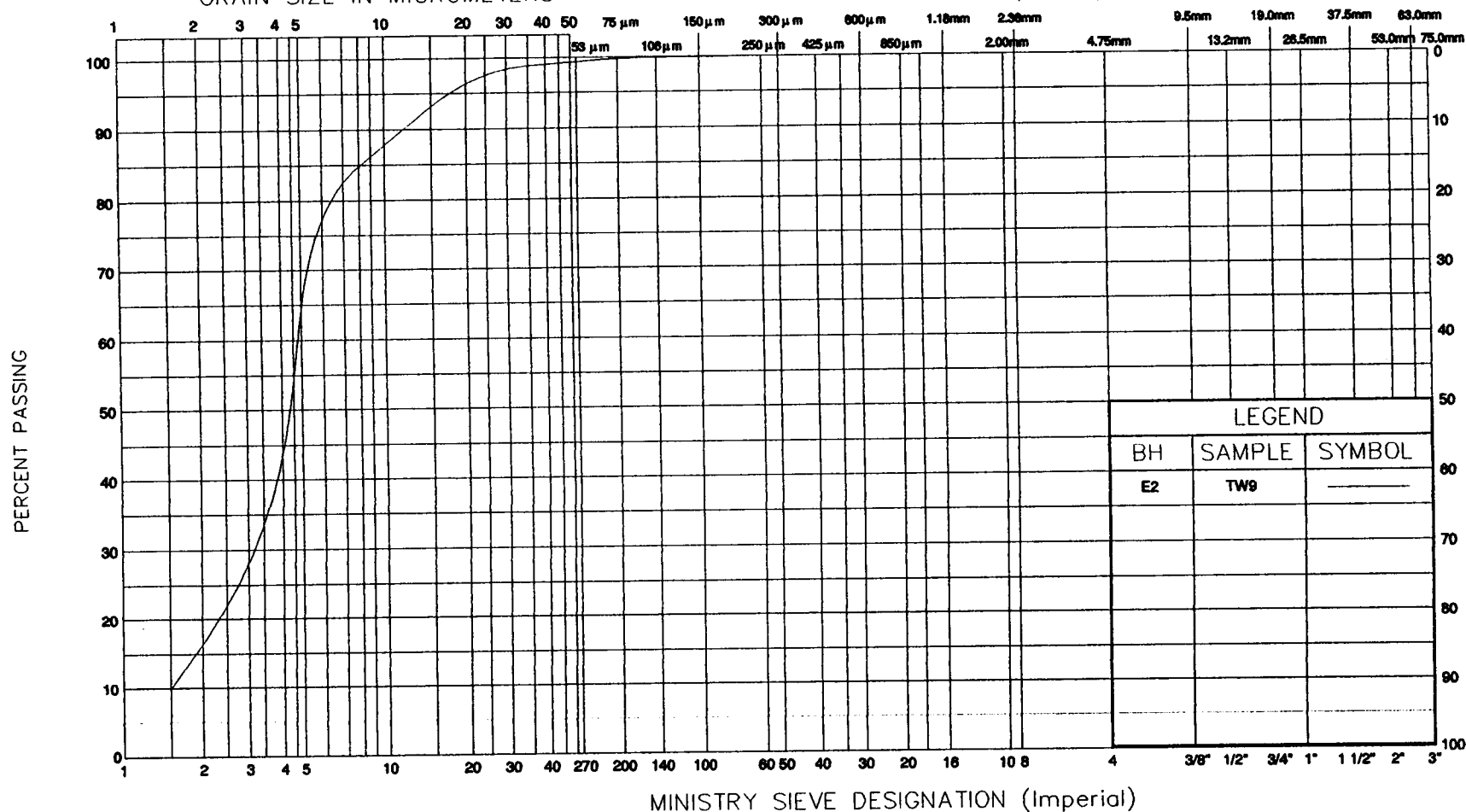
HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 12a

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	FINE	MEDIUM	COARSE	FINE	COARSE

GRAIN SIZE IN MICROMETERS

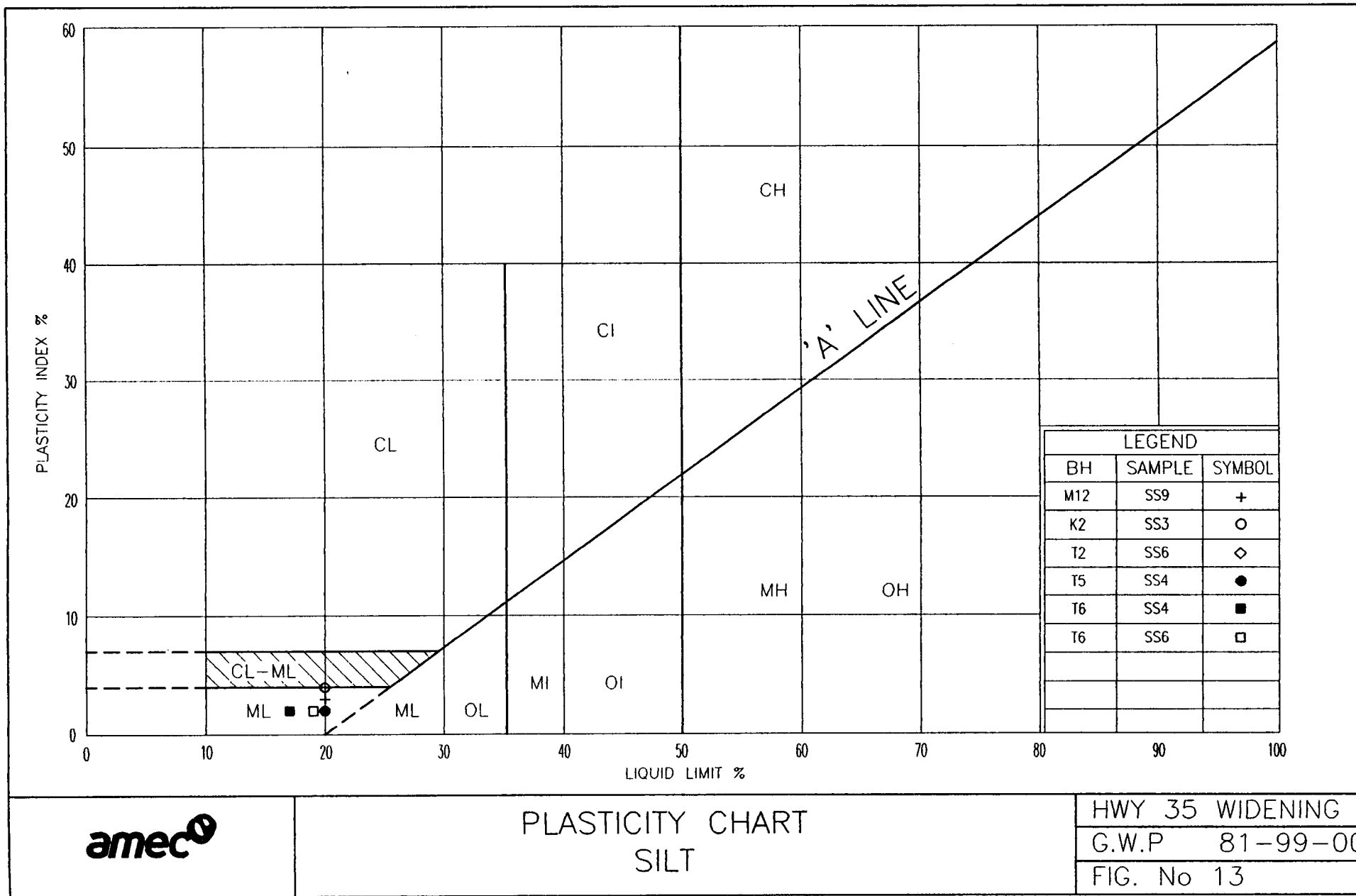
MINISTRY SIEVE DESIGNATION (Metric)



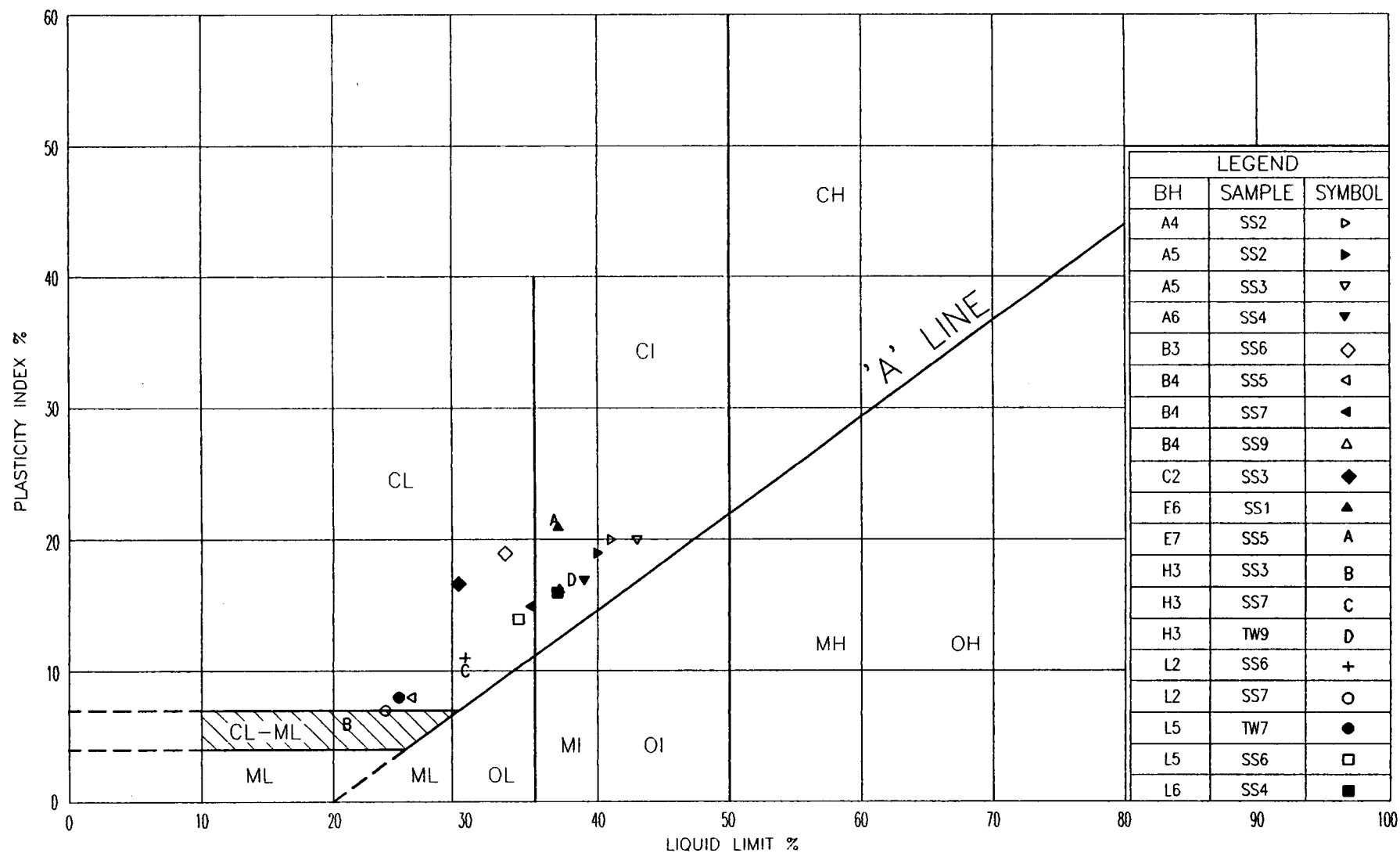
**amec**

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT

HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 12b



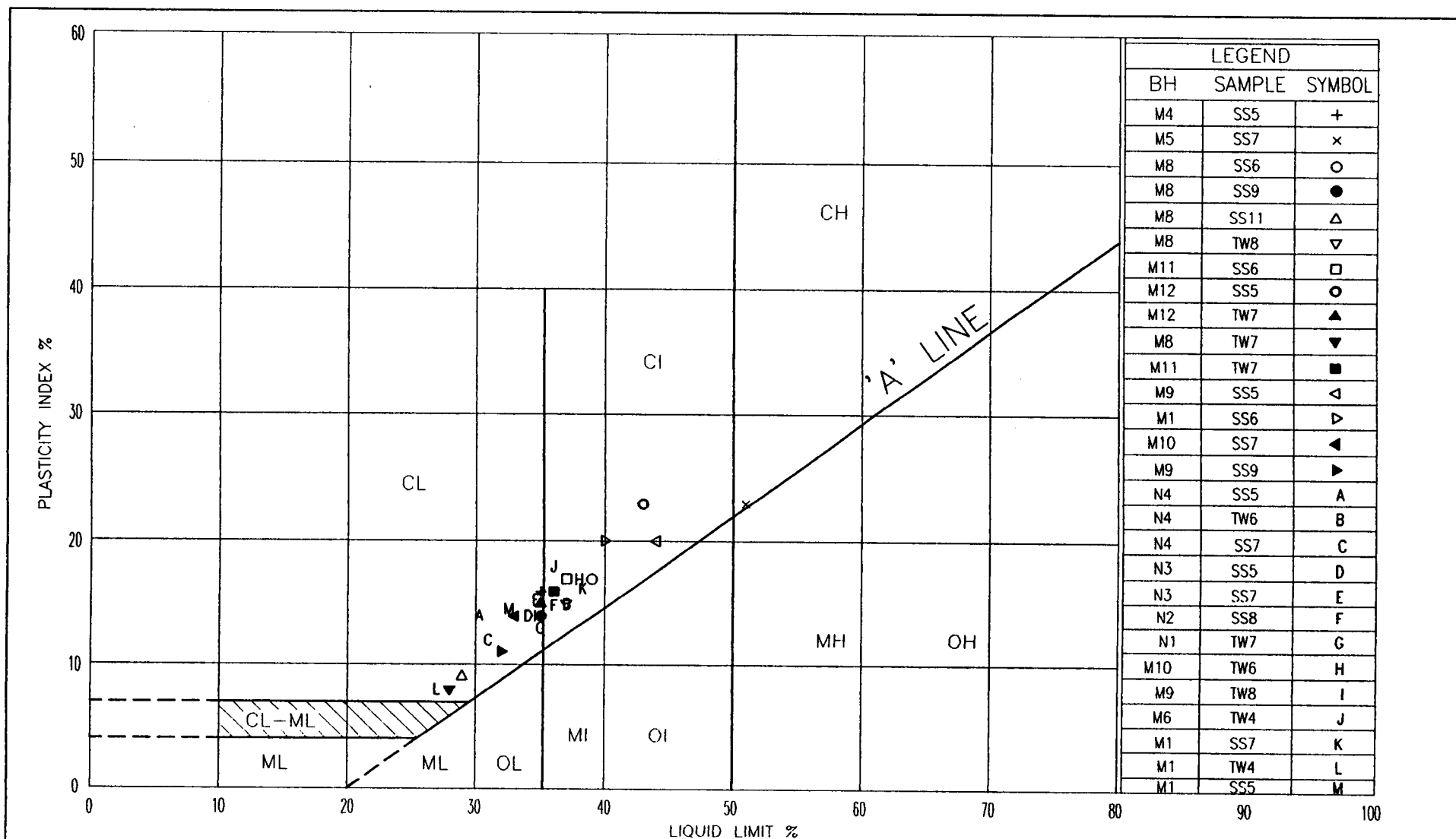




**amec**

# PLASTICITY CHART CLAYEY SILT varved to SILTY CLAY

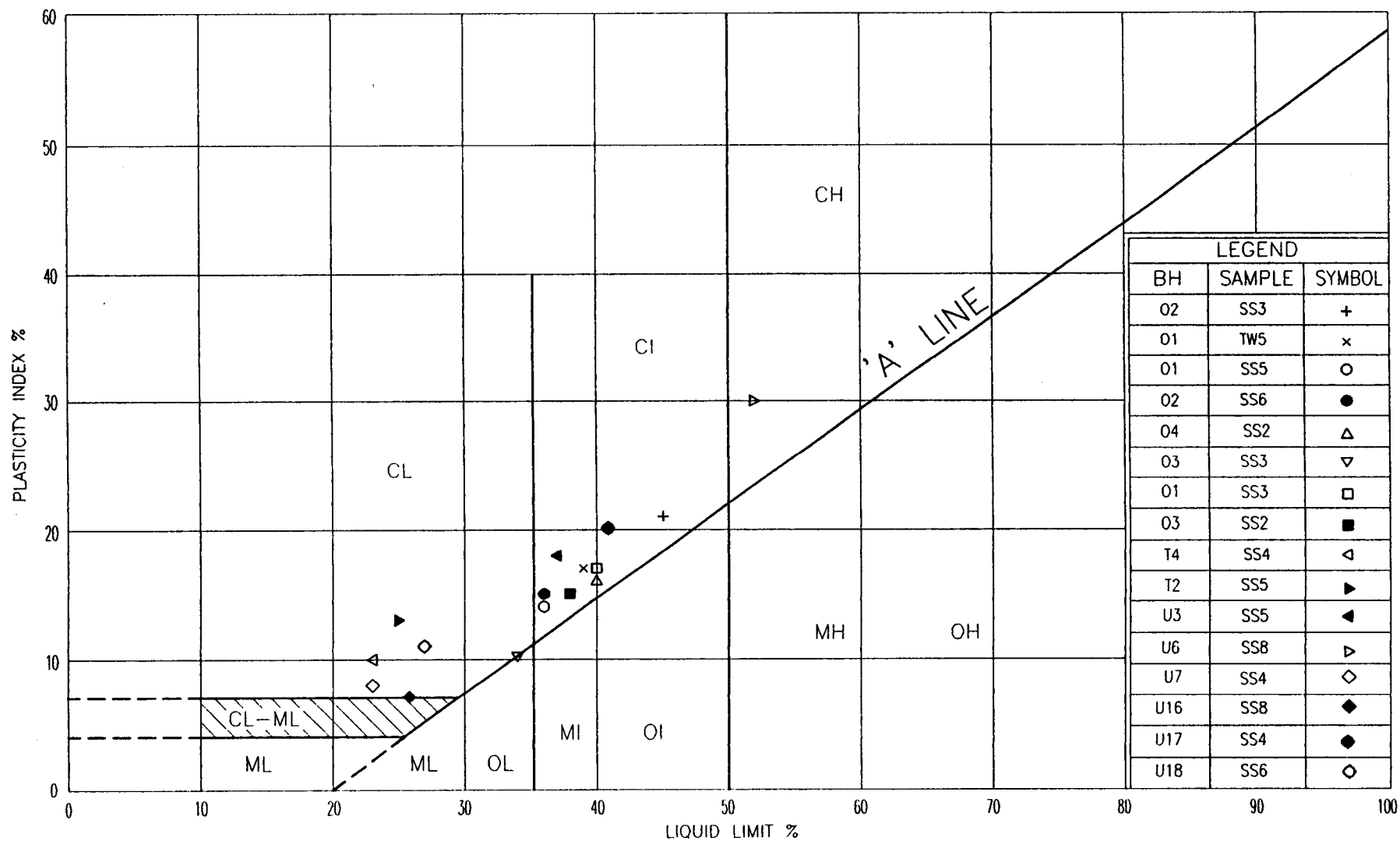
HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 14



amec<sup>®</sup>

PLASTICITY CHART  
CLAYEY SILT to SILTY CLAY to CLAY  
varved to massive

HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 15

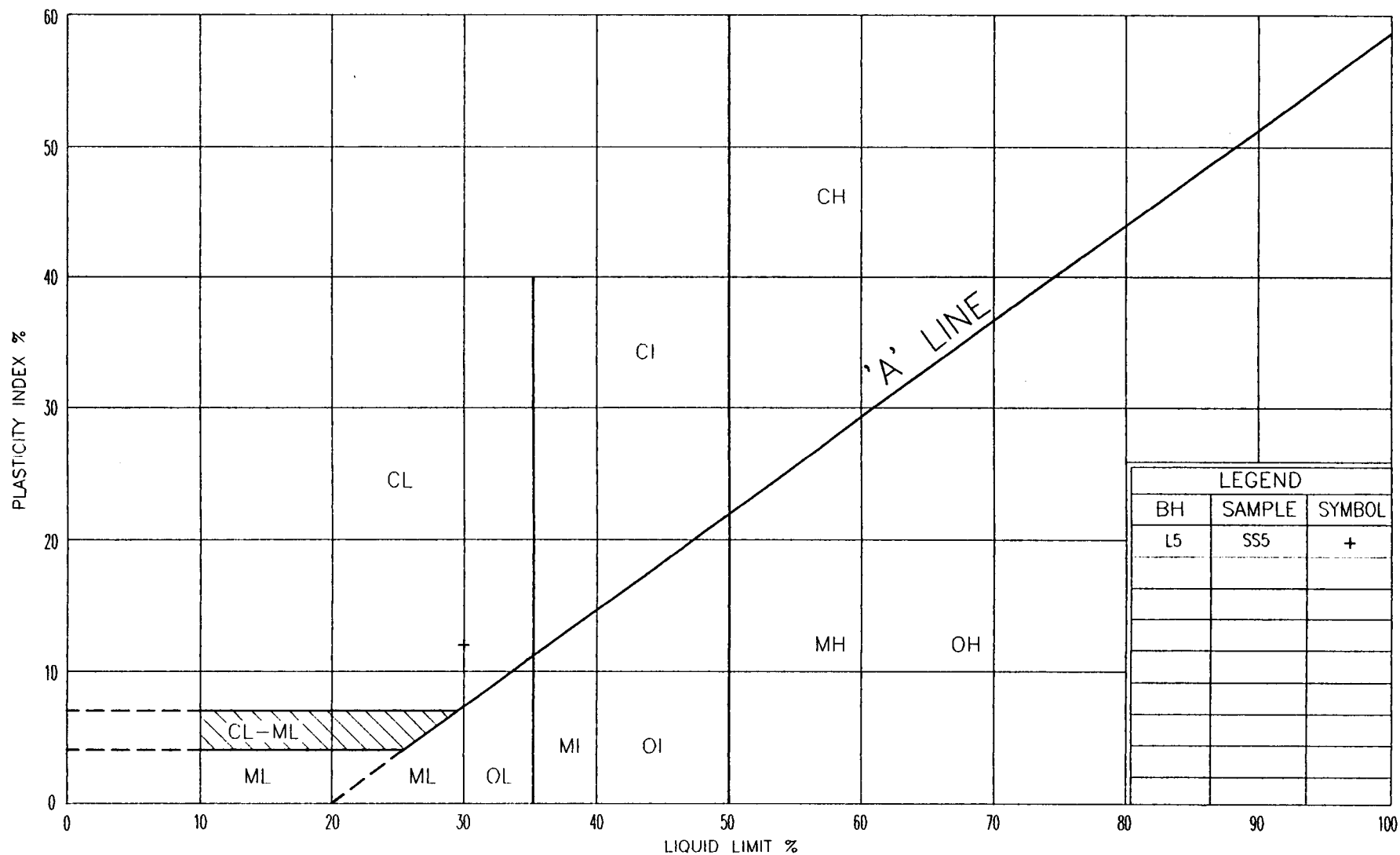


**amec**

PLASTICITY CHART  
CLAYEY SILT to SILTY CLAY varved to massive

HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No. 16





**amec**

PLASTICITY CHART  
CLAYEY SILT (GLACIAL TILL)  
trace Sand

HWY 35 WIDENING  
G.W.P 81-99-00  
FIG. No 18

Project: Hwy 35

Job#: TT20868

Date: 03-Jan-01

BH#:-E2

Sa#: TW6

Depth(m): 8.76

Ring # : A Ring Height (in) = 0.757 Wt of dry filter paper (g) = 0.64

Wet soil + Ring Wt (g) = 192.6 Wt of ring (g) = 76.62

Wet soil + Wet Paper + Ring (g) = 191.07 Wet Paper (g) = 1.85

Dry Soil + Dry Paper + Ring (g) = 163.45 Ring Dia (in) = 2.495

Initial moisture Content (%) = 34.563 Final moisture Content (%) = 30.642

Area of Ring (in<sup>2</sup>) = 4.889 Initial Volume (in<sup>3</sup>) = 3.7011Initial Bulk Density (kg/m<sup>3</sup>) = 1912 Initial Dry Density (kg/m<sup>3</sup>) = 1421

Specific Gravity of Soil = 2.767 Equiv. Thick. of solids (mm) = 9.875

Final gauge reading for Load 1 = 0.2512 Gauge reading for last Loading = 0.0000

Trial #	1	2	3	4	5	6	7
Load (tsf)	0	0.03125	0.0625	0.125	0.25	0.50	1.0
Gauge Reading (in)	0.2512	0.2491	0.24715	0.2443	0.24015	0.23345	0.2248
(H-Hs) mm	9.353	9.299	9.250	9.177	9.072	8.902	8.682
Voids ratio	0.947	0.942	0.937	0.929	0.919	0.901	0.879
t90 (min)		7.84	7.84	3.42	2.56	1.21	2.25
Cv (ft <sup>2</sup> /day)		0.155	0.154	0.350	0.463	0.966	0.509
k' (tsf)		11.265	12.098	16.512	22.593	27.834	42.731
Mv (ft <sup>2</sup> / ton)		0.0888	0.0827	0.0606	0.0443	0.0359	0.0234

Trial #	8	9	10	11	12	13	14
Load (tsf)	2.0	4.0	8.0	2.0		0.5	0.5
Gauge Reading (in)	0.2104	0.1944	0.1757	0.1818		0.1901	
(H-Hs) mm	8.315	7.909	7.434	7.588		7.801	
Voids ratio	0.842	0.801	0.753	0.768		0.790	
t90 (min)	1.44	1.56	2.25				
Cv (ft <sup>2</sup> /day)	0.770	0.680	0.450				
k' (tsf)	50.561	89.519	149.765	670.279		123.512	
Mv (ft <sup>2</sup> / ton)	0.0198	0.0112	0.0067	0.0015		0.0081	

Trial #	15	16
Load (tsf)	0.125	
Gauge Reading (in)	0.19560	
(H-Hs) mm	7.940	
Voids ratio	0.804	
t90 (min)		
Cv (ft <sup>2</sup> /day)		
k' (tsf)	0.466	
Mv (ft <sup>2</sup> / ton)	2.1442	

Project: Hwy 35

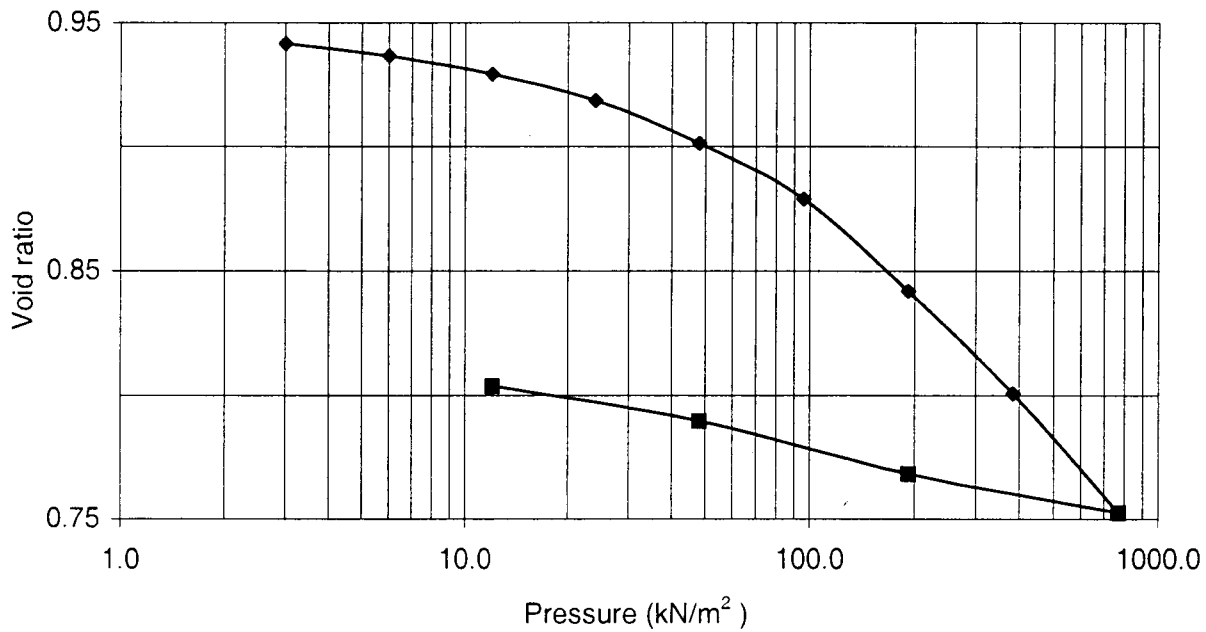
Job#: TT20868

Date: January 3, 2001

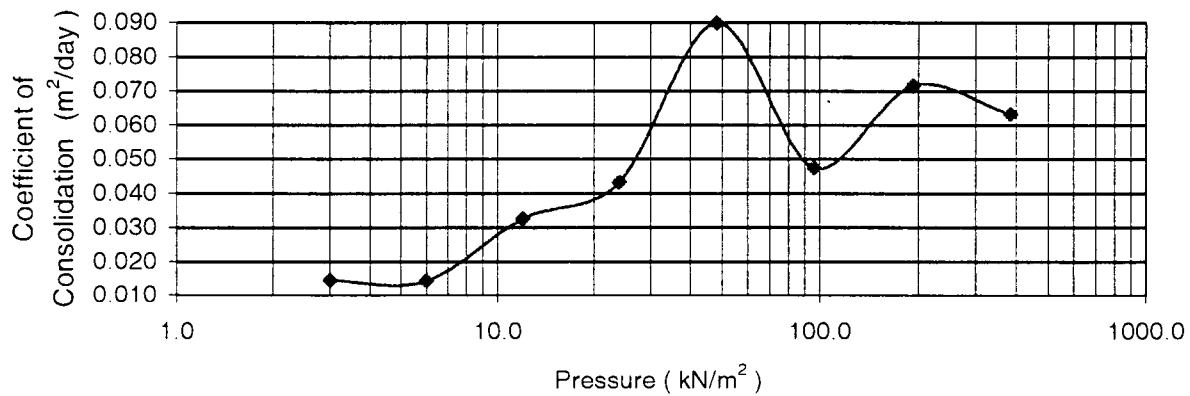
BH#:-E2 Sa#: TW6

Depth(m): 8.76

Void Ratio Vs Pressure



Coefficient of Consolidation Vs Pressure



Project: Hwy 35

Job#: TT20868

Date: 03-Jan-01

BH#:-H4

Sa#: TW6

Depth(m): 4.27

Ring #: A Ring Height (in) = 0.757 Wt of dry filter paper (g) = 0.63

Wet soil + Ring Wt (g) = 189.26 Wt of ring (g) = 76.62

Wet soil + Wet Paper + Ring (g) = 189.52 Wet Paper (g) = 1.72

Dry Soil + Dry Paper + Ring (g) = 158.24 Ring Dia (in) = 2.495

Initial moisture Content (%) = 39.079 Final moisture Content (%) = 37.276

Area of Ring (in<sup>2</sup>) = 4.889 Initial Volume (in<sup>3</sup>) = 3.7011Initial Bulk Density (kg/m<sup>3</sup>) = 1857 Initial Dry Density (kg/m<sup>3</sup>) = 1335

Specific Gravity of Soil = 2.768 Eqiv. Thick. of solids (mm) = 9.276

Final gauge reading for Load 1 = 0.2613 Gauge reading for last Loading = 0.0000

Trial #	1	2	3	4	5	6	7
Load (tsf)	0	0.0625	0.125	0.25	0.50	1.0	2.0
Gauge Reading (in)	0.2613	0.25962	0.258	0.25515	0.25085	0.24532	0.2363
(H-Hs) mm	9.952	9.910	9.869	9.797	9.688	9.547	9.318
Voids ratio	1.073	1.068	1.064	1.056	1.044	1.029	1.005
t90 (min)		8.12	3.06	1.82	2.40	2.89	1.82
Cv (ft <sup>2</sup> /day)		0.149	0.394	0.658	0.495	0.406	0.631
k' (tsf)		29.026	29.142	33.059	43.657	67.505	82.159
Mv (ft <sup>2</sup> / ton)		0.0345	0.0343	0.0302	0.0229	0.0148	0.0122

Trial #	8	9	10	11	12	13	14
Load (tsf)	4.0	8.0	16.0	2.0		0.5	0.5
Gauge Reading (in)	0.2193	0.1925		0.2005		0.2102	
(H-Hs) mm	8.886	8.204		8.407		8.655	
Voids ratio	0.958	0.884		0.906		0.933	
t90 (min)	2.25	1.56					
Cv (ft <sup>2</sup> /day)	0.493	0.668					
k' (tsf)	86.124	106.525		516.150		107.108	
Mv (ft <sup>2</sup> / ton)	0.0116	0.0094		0.0019		0.0093	

Trial #	15	16
Load (tsf)	0.125	
Gauge Reading (in)	0.21920	
(H-Hs) mm	8.884	
Voids ratio	0.958	
t90 (min)		
Cv (ft <sup>2</sup> /day)		
k' (tsf)	0.392	
Mv (ft <sup>2</sup> / ton)	2.5538	



Project: Hwy 35

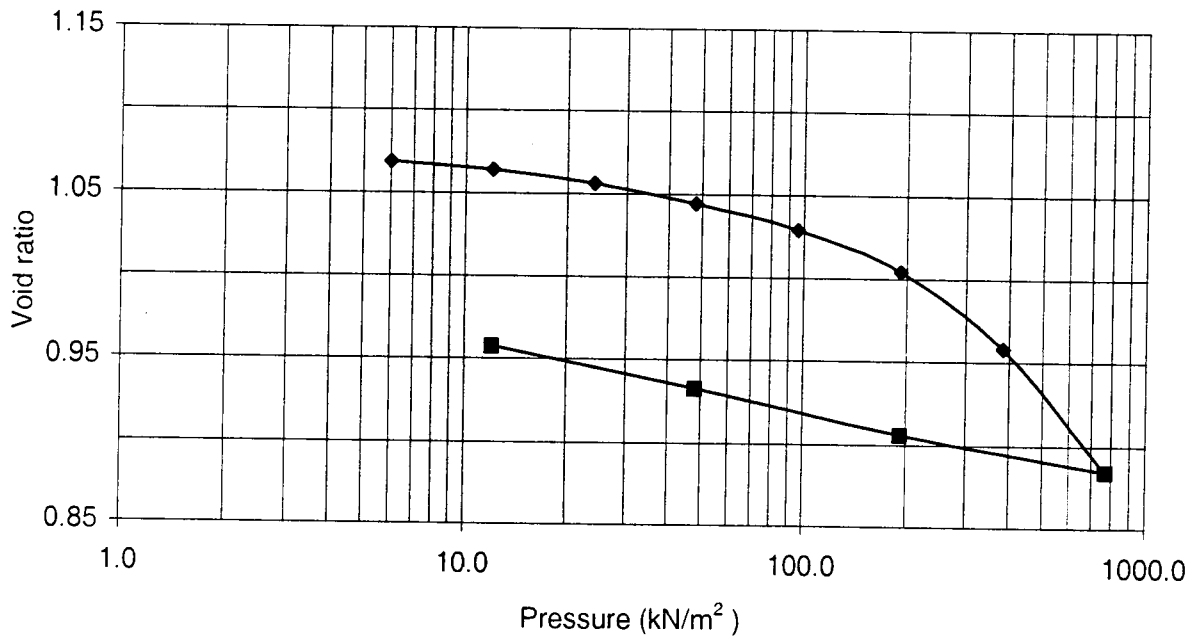
Job#: TT20868

Date: January 3, 2001

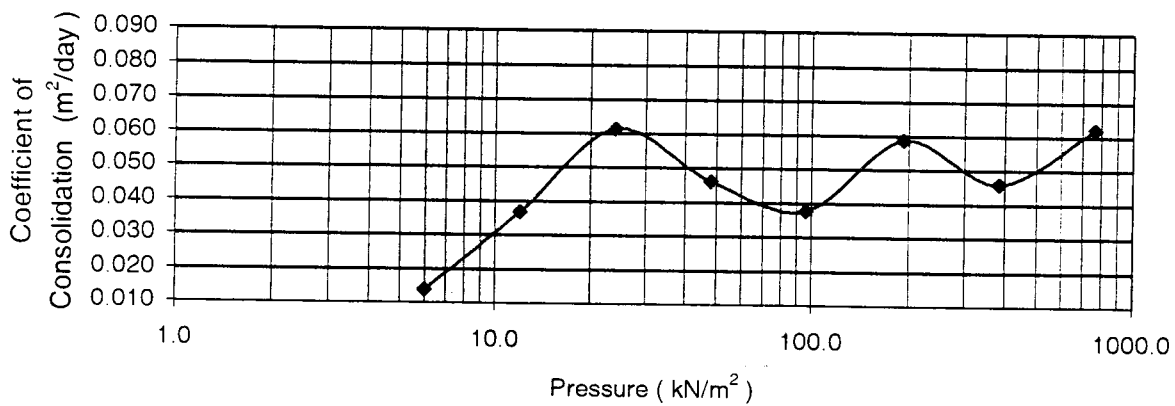
BH#:-H4 Sa#: TW6

Depth(m): 4.27

Void Ratio Vs Pressure



Coefficient of Consolidation Vs Pressure



Project: Hwy 35

Job#: TT20868

BH#:- L5 - Sa#: TW7

Date: 02-Jan-01

BH#:- L5

Sa#: TW7

Depth(m): 4.72

Ring #: 1 Ring Height (in) = 0.71 Wt of dry filter paper (g) = 0.35

Wet soil + Ring Wt (g) = 124.71 Wt of ring (g) = 59.08

Wet soil + Wet Paper + Ring (g) = 123.89 Wet Paper (g) = 1.19

Dry Soil + Dry Paper + Ring (g) = 110.76 Ring Dia (in) = 1.900

Initial moisture Content (%) = 27.859 Final moisture Content (%) = 23.943

Area of Ring (in<sup>2</sup>) = 2.835 Initial Volume (in<sup>3</sup>) = 2.0131

Initial Bulk Density (kg/m<sup>3</sup>) = 1990 Initial Dry Density (kg/m<sup>3</sup>) = 1556

Specific Gravity of Soil = 2.734 Equiv. Thick. of solids (mm) = 10.264

Final gauge reading for Load 1 = 0.2597 Gauge reading for last Loading = 0.1428

Trial #	1	2	3	4	5	6	7
Load (tsf)	0	0.0625	0.125	0.25	0.5	1.0	2.0
Gauge Reading (in)	0.2597	0.2542	0.2520	0.2485	0.2445	0.2394	0.2315
(H-Hs) mm	7.770	7.630	7.575	7.486	7.384	7.253	7.054
Voids ratio	0.757	0.743	0.738	0.729	0.719	0.707	0.687
t <sub>90</sub> (min)		16.00	4.00	4.41	3.80	4.00	3.61
Cv (ft <sup>2</sup> /day)		0.066	0.262	0.236	0.271	0.254	0.276
k' (tsf)		8.068	20.014	25.082	43.675	67.456	87.854
Mv (ft <sup>2</sup> / ton)		0.1239	0.0496	0.0394	0.0225	0.0145	0.0111

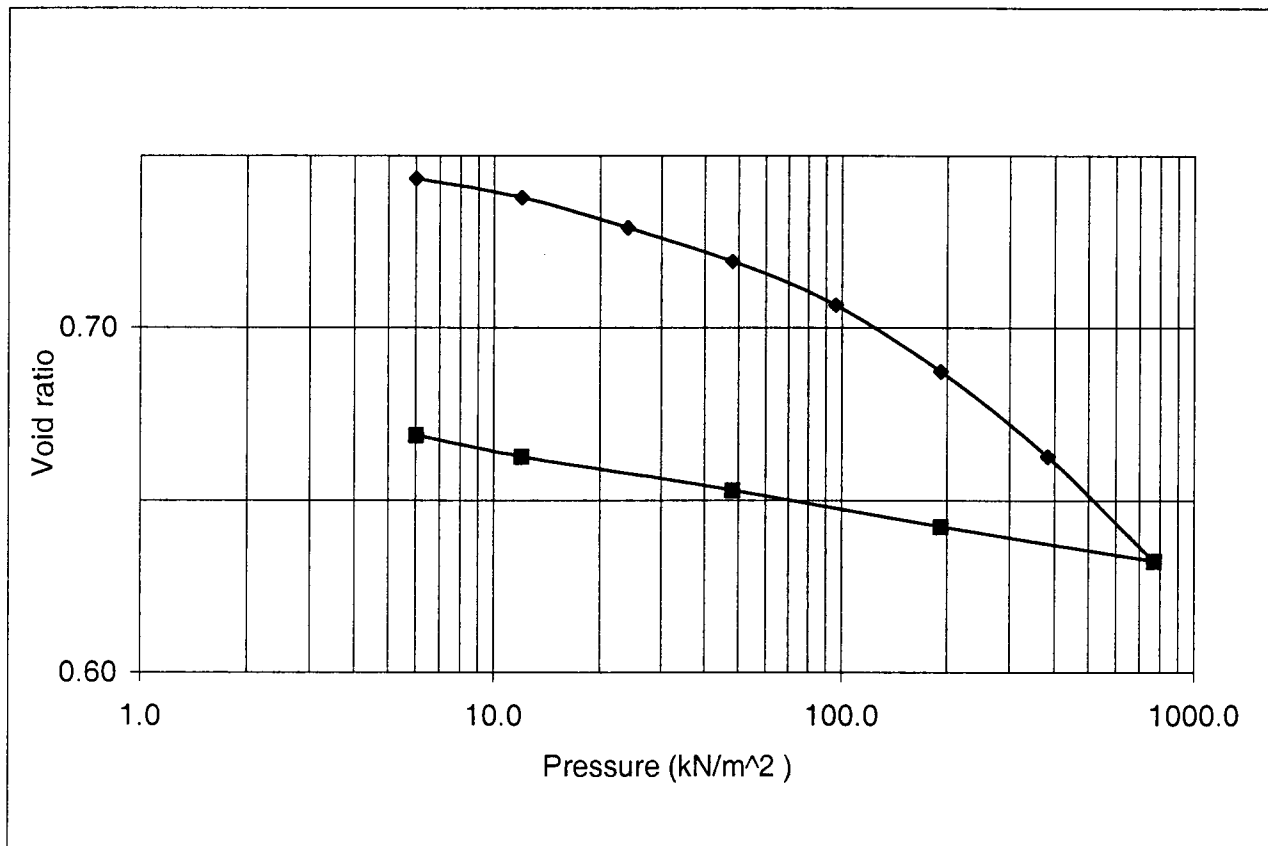
Trial #	8	9	10	11	12	13	14
Load (tsf)	4.0	8.0	4.0	2.0	1.0	0.5	0.3
Gauge Reading (in)	0.2216	0.2093		0.2134		0.2176	
(H-Hs) mm	6.802	6.490		6.594		6.701	
Voids ratio	0.663	0.632		0.642		0.653	
t <sub>90</sub> (min)	4.41	3.80					
Cv (ft <sup>2</sup> /day)	0.220	0.247					
k' (tsf)	137.737	218.504		965.268		237.036	
Mv (ft <sup>2</sup> / ton)	0.0070	0.0043		0.0010		0.0039	

Trial #	15	16
Load (tsf)	0.13	0.0625
Gauge Reading (in)	0.2216	0.2241
(H-Hs) mm	6.802	6.866
Voids ratio	0.663	0.669
t <sub>90</sub> (min)		
Cv (ft <sup>2</sup> /day)		
k' (tsf)	62.616	16.798
Mv (ft <sup>2</sup> / ton)	0.0150	0.0563

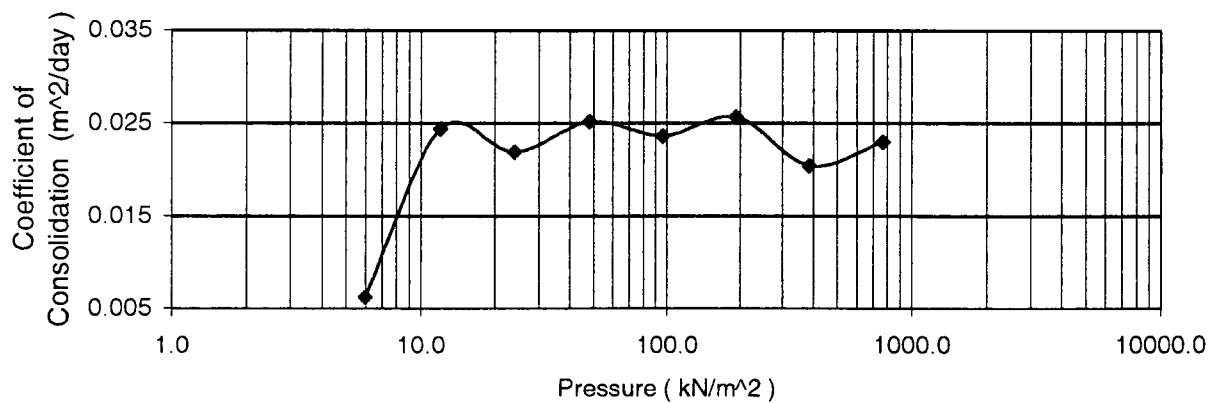
Project: Hwy 35  
Date: 02-Jan-01

BH#:- L5  
BH#:- L5 - Sa#: TW7  
Sa#: TW7

Job#: TT20868  
Depth(m): 4.72



Coefficient of Consolidation Vs Pressure



Project: Hwy 35

Job#: TT20868

Date: 20-Dec-00

BH#:-M8

Sa#: TW8

Depth(m): 5.56

Ring #: A Ring Height (in) = 0.757 Wt of dry filter paper (g) = 0.62

Wet soil + Ring Wt (g) = 191.75 Wt of ring (g) = 76.62

Wet soil + Wet Paper + Ring (g) = 187.52 Wet Paper (g) = 1.94

Dry Soil + Dry Paper + Ring (g) = 162.97 Ring Dia (in) = 2.495

Initial moisture Content (%) = 34.294 Final moisture Content (%) = 27.097

Area of Ring (in<sup>2</sup>) = 4.889 Initial Volume (in<sup>3</sup>) = 3.7011Initial Bulk Density (kg/m<sup>3</sup>) = 1898 Initial Dry Density (kg/m<sup>3</sup>) = 1414

Specific Gravity of Soil = 2.793 Eqiv. Thick. of solids (mm) = 9.731

Final gauge reading for Load 1 = 0.2562 Gauge reading for last Loading = 0.1786

Trial #	1	2	3	4	5	6	7
Load (tsf)	0	0.0125	0.0625	0.125	0.25	0.5	1.0
Gauge Reading (in)	0.2562	0.2382	0.2332	0.22735	0.2193	0.2124	0.20145
(H-Hs) mm	9.497	9.039	8.912	8.764	8.559	8.384	8.106
Voids ratio	0.976	0.929	0.916	0.901	0.880	0.862	0.833
t <sub>90</sub> (min)		7.84	3.42	2.25	2.25	1.69	2.89
Cv (ft <sup>2</sup> /day)		0.151	0.336	0.504	0.494	0.644	0.367
k' (tsf)		0.526	7.390	7.842	11.307	26.091	32.566
Mv (ft <sup>2</sup> / ton)		1.9022	0.1353	0.1275	0.0884	0.0383	0.0307

Trial #	8	9	10	11	12	13	14
Load (tsf)	2.0	4.0	8.0		2.0		0.5
Gauge Reading (in)	0.1902	0.1763	0.1581		0.1632		0.1702
(H-Hs) mm	7.820	7.467	7.005		7.134		7.311
Voids ratio	0.804	0.767	0.720		0.733		0.751
t <sub>90</sub> (min)	2.72	2.56	3.24				
Cv (ft <sup>2</sup> /day)	0.378	0.387	0.292				
k' (tsf)	62.422	99.424	148.813		775.176		143.309
Mv (ft <sup>2</sup> / ton)	0.0160	0.0101	0.0067		0.0013		0.0070

Trial #	15	16
Load (tsf)	0.125	0.063
Gauge Reading (in)	0.17505	0.17855
(H-Hs) mm	7.435	7.524
Voids ratio	0.764	0.773
t <sub>90</sub> (min)		
Cv (ft <sup>2</sup> /day)		
k' (tsf)	51.348	12.069
Mv (ft <sup>2</sup> / ton)	0.0195	0.0829

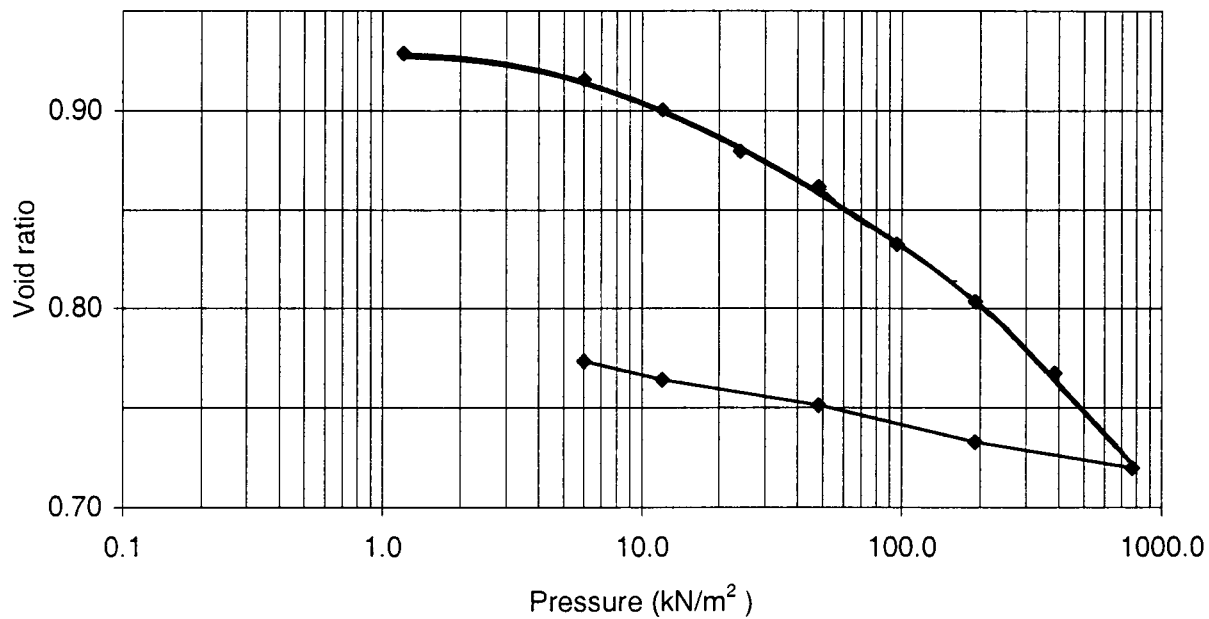
Project: Hwy 35

Job#: TT20868

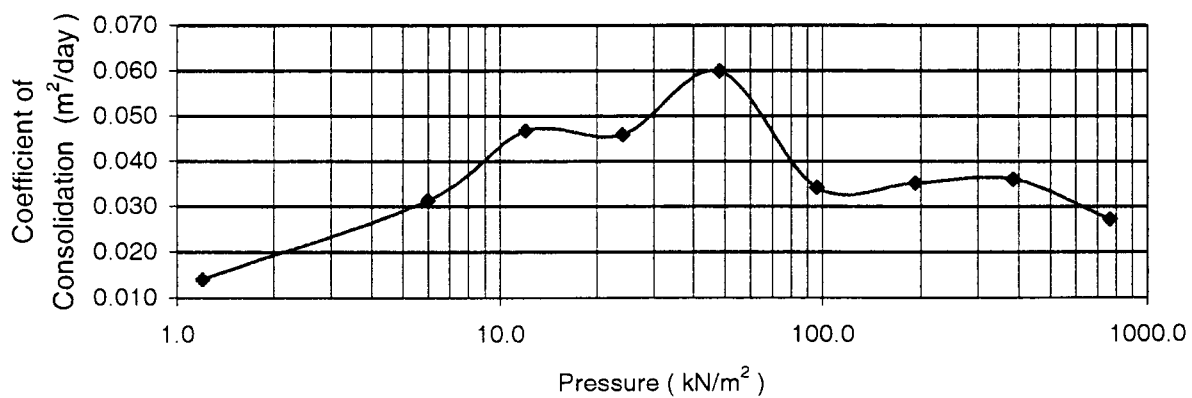
Date: December 20, 2000 BH#:-M8 Sa#: TW8

Depth(m): 5.56

Void Ratio Vs Pressure



Coefficient of Consolidation Vs Pressure



Project: Hwy 35

Job#: TT20868

Date: 12-Feb-01

BH#:- M6

Sa#: TW4

Depth(m): 2.7

Ring # : B Ring Height (in) = 0.753 Wt of dry filter paper (g) = 0.65  
 Wet soil + Ring Wt (g) = 187.23 Wt of ring (g) = 76.57  
 Wet soil + Wet Paper + Ring (g) = 183.15 Wet Paper (g) = 1.78  
 Dry Soil + Dry Paper + Ring (g) = 150.94 Ring Dia (in) = 2.495  
 Initial moisture Content (%) = 50.109 Final moisture Content (%) = 42.160  
 Area of Ring (in<sup>2</sup>) = 4.889 Initial Volume (in<sup>3</sup>) = 3.6815  
 Initial Bulk Density (kg/m<sup>3</sup>) = 1834 Initial Dry Density (kg/m<sup>3</sup>) = 1222  
 Specific Gravity of Soil = 2.777 Equiv. Thick. of solids (mm) = 8.416  
 Final gauge reading for Load 1 = 0.2586 Gauge reading for last Loading = 0.0000

Trial #	1	2	3	4	5	6	7
Load (tsf)	0	0.0625	0.125	0.25	0.5	1.0	2.0
Gauge Reading (in)	0.2586	0.25225	0.2464	0.2393	0.2284	0.214	0.19725
(H-Hs) mm	10.710	10.549	10.400	10.220	9.943	9.577	9.152
Voids ratio	1.273	1.253	1.236	1.214	1.181	1.138	1.087
t90 (min)		2.25	4.84	1.69	1.56	1.56	1.44
Cv (ft <sup>2</sup> /day)		0.530	0.242	0.682	0.720	0.695	0.721
k' (tsf)		7.411	7.977	13.042	16.828	25.097	42.293
Mv (ft <sup>2</sup> / ton)		0.1349	0.1254	0.0767	0.0594	0.0398	0.0236

Trial #	8	9	10	11	12	13	14
Load (tsf)	4.0	8.0	16.0	32.0	16.0	8.0	4.0
Gauge Reading (in)	0.1798	0.1578					
(H-Hs) mm	8.707	8.150					
Voids ratio	1.035	0.968					
t90 (min)	1.44	2.25					
Cv (ft <sup>2</sup> /day)	0.687	0.414					
k' (tsf)	79.046	122.852					
Mv (ft <sup>2</sup> / ton)	0.0127	0.0081					

Trial #	15	16	16	16	17	18
Load (tsf)	2.00	1.000	0.500	0.250	0.125	0.063
Gauge Reading (in)	0.1642		0.1718		0.1808	
(H-Hs) mm	8.312		8.504		8.734	
Voids ratio	0.988		1.010		1.038	
t90 (min)						
Cv (ft <sup>2</sup> /day)						
k' (tsf)	611.437		130.848		27.603	
Mv (ft <sup>2</sup> / ton)	0.0016		0.0076		0.0362	

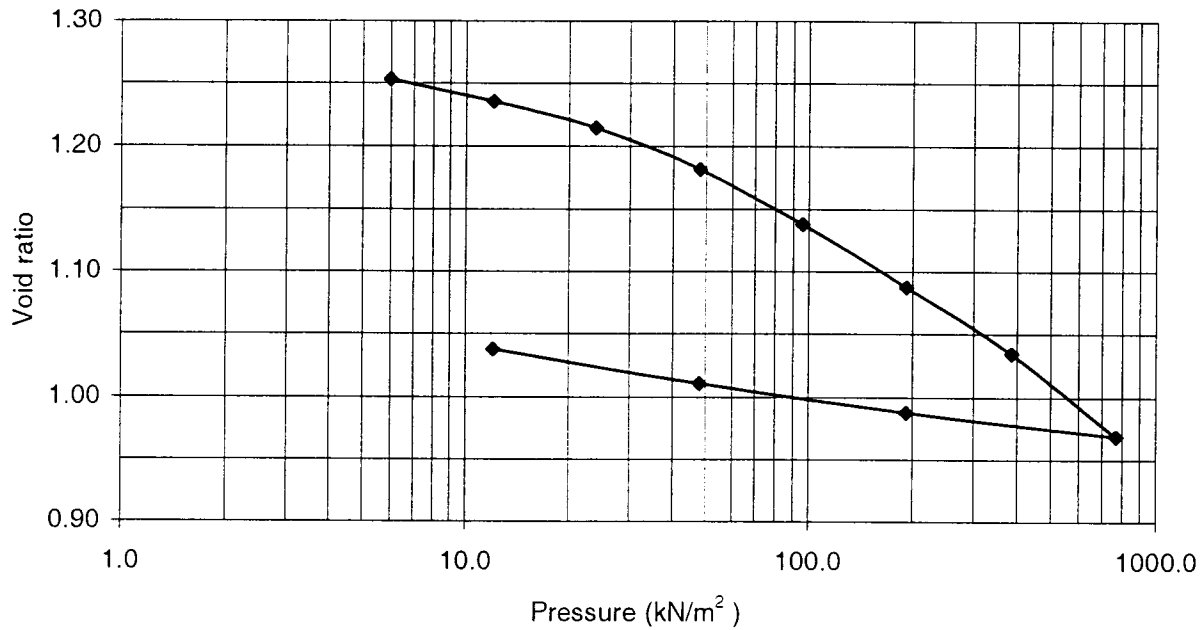
Project: Hwy 35

Job#: TT20868

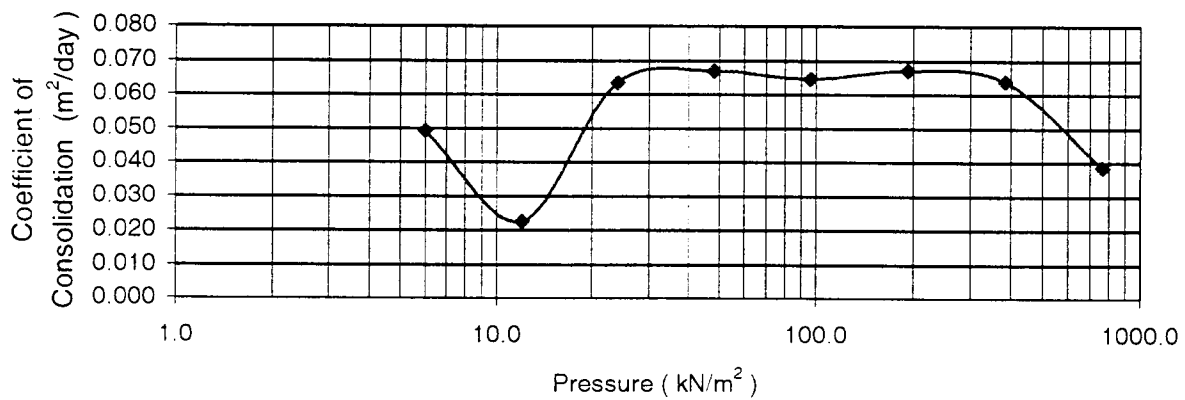
Date: February 12, 2001 BH#:- M6 Sa#: TW4

Depth(m): 2.74

Void Ratio Vs Pressure



Coefficient of Consolidation Vs Pressure



Project: Hwy 35

Job#: TT20868

Date: 03-Jan-01

BH#:-M11

Sa#: TW7

Depth(m): 5.56

Ring #: A Ring Height (in) = 0.757 Wt of dry filter paper (g) = 0.63

Wet soil + Ring Wt (g) = 190.31 Wt of ring (g) = 76.62

Wet soil + Wet Paper + Ring (g) = 188.68 Wet Paper (g) = 1.90

Dry Soil + Dry Paper + Ring (g) = 160.19 Ring Dia (in) = 2.495

Initial moisture Content (%) = 37.075 Final moisture Content (%) = 32.819

Area of Ring (in<sup>2</sup>) = 4.889 Initial Volume (in<sup>3</sup>) = 3.7011

Initial Bulk Density (kg/m<sup>3</sup>) = 1875 Initial Dry Density (kg/m<sup>3</sup>) = 1368

Specific Gravity of Soil = 2.767 Equiv. Thick. of solids (mm) = 9.503

Final gauge reading for Load 1 = 0.2537 Gauge reading for last Loading = 0.1937

Trial #	1	2	3	4	5	6	7
Load (tsf)	0	0.0625	0.125	0.25	0.50	1.0	2.0
Gauge Reading (in)	0.2537	0.25105	0.2484	0.2446	0.2389	0.22925	0.211
(H-Hs) mm	9.725	9.658	9.590	9.494	9.349	9.104	8.640
Voids ratio	1.023	1.016	1.009	0.999	0.984	0.958	0.909
t <sub>90</sub> (min)		1.96	2.25	2.25	2.10	3.80	2.89
Cv (ft <sup>2</sup> /day)		0.618	0.534	0.530	0.560	0.303	0.384
k' (tsf)		17.854	17.791	24.727	32.803	38.456	40.140
Mv (ft <sup>2</sup> / ton)		0.0560	0.0562	0.0404	0.0305	0.0260	0.0249

Trial #	8	9	10	11	12	13	14
Load (tsf)	4.0	8.0	16.0	2.0		0.5	0.5
Gauge Reading (in)	0.1899	0.1665		0.1731		0.1814	
(H-Hs) mm	8.103	7.510		7.676		7.888	
Voids ratio	0.853	0.790		0.808		0.830	
t <sub>90</sub> (min)	1.96	3.24					
Cv (ft <sup>2</sup> /day)	0.536	0.304					
k' (tsf)	67.546	118.741		613.557		121.500	
Mv (ft <sup>2</sup> / ton)	0.0148	0.0084		0.0016		0.0082	

Trial #	15	16
Load (tsf)	0.125	0.063
Gauge Reading (in)	0.18940	0.19370
(H-Hs) mm	8.092	8.201
Voids ratio	0.851	0.863
t <sub>90</sub> (min)		
Cv (ft <sup>2</sup> /day)		
k' (tsf)	0.440	10.068
Mv (ft <sup>2</sup> / ton)	2.2707	0.0993



Project: Hwy 35

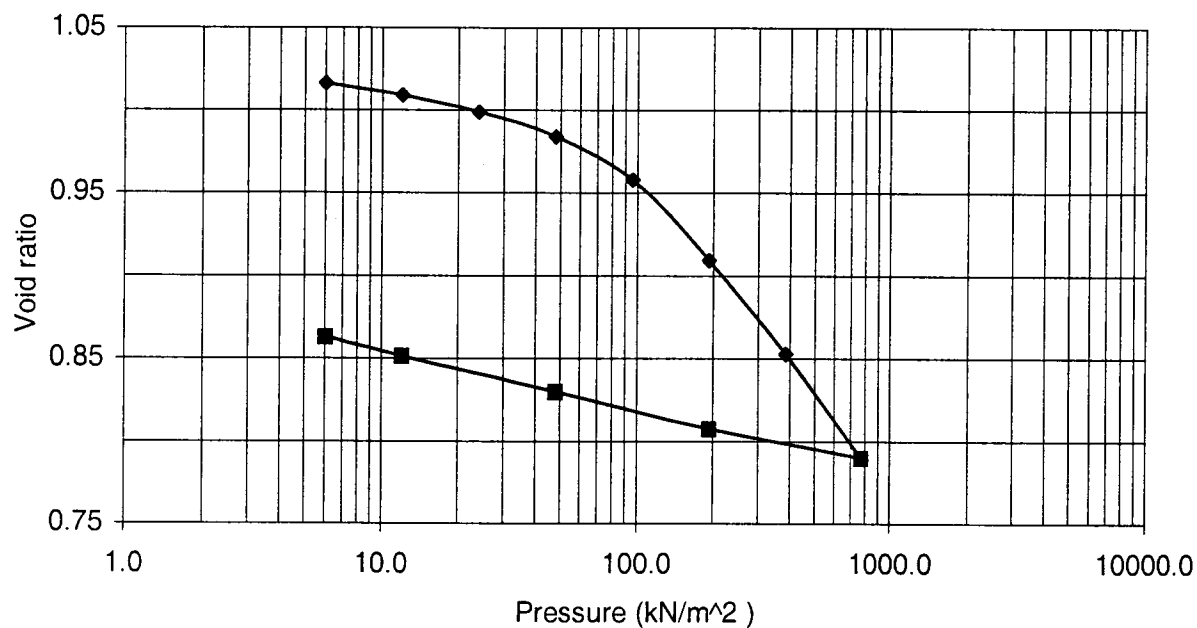
Job#: TT20868

Date: January 3, 2001

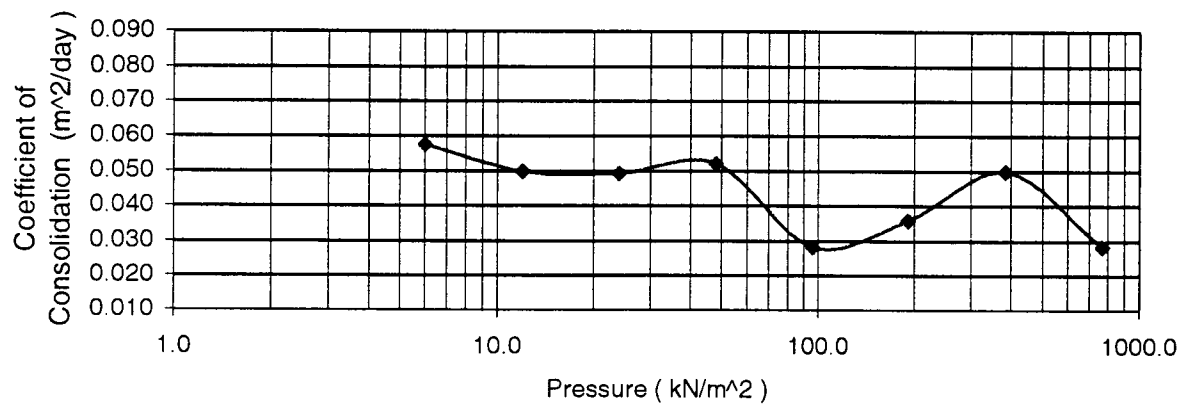
Sa#: TW7  
BH#:-M11

Depth(m): 5.56

### Voids Ratio Vs Pressure



### Coefficient of Consolidation Vs Pressure



Project: Hwy 35

Job#: TT20868

Date: 12-Feb-01

BH#:- N4

Sa#: TW6

Depth(m): 4.8

Ring #: B Ring Height (in) = 0.753 Wt of dry filter paper (g) = 0.65  
 Wet soil + Ring Wt (g) = 183.91 Wt of ring (g) = 76.57  
 Wet soil + Wet Paper + Ring (g) = 179.28 Wet Paper (g) = 1.86  
 Dry Soil + Dry Paper + Ring (g) = 151.16 Ring Dia (in) = 2.495  
 Initial moisture Content (%) = 45.172 Final moisture Content (%) = 36.394  
 Area of Ring (in<sup>2</sup>) = 4.889 Initial Volume (in<sup>3</sup>) = 3.6815  
 Initial Bulk Density (kg/m<sup>3</sup>) = 1779 Initial Dry Density (kg/m<sup>3</sup>) = 1226  
 Specific Gravity of Soil = 2.777 Equiv. Thick. of solids (mm) = 8.441  
 Final gauge reading for Load 1 = 0.2670 Gauge reading for last Loading = 0.0000

Trial #	1	2	3	4	5	6	7
Load (tsf)	0	0.031	0.0625	0.125	0.25	0.5	1.0
Gauge Reading (in)	0.2670	0.2582	0.2532	0.2458	0.237	0.2238	0.2096
(H-Hs) mm	10.685	10.461	10.334	10.147	9.923	9.588	9.227
Voids ratio	1.266	1.239	1.224	1.202	1.176	1.136	1.093
t <sub>90</sub> (min)		6.50	5.76	5.76	2.89	1.96	1.96
Cv (ft <sup>2</sup> /day)		0.183	0.202	0.199	0.388	0.555	0.534
k' (tsf)		2.653	4.688	6.243	10.395	13.693	24.993
Mv (ft <sup>2</sup> / ton)		0.3770	0.2133	0.1602	0.0962	0.0730	0.0400

Trial #	8	9	10	11	12	13	14
Load (tsf)	2.0	4.0	8.0	32.0	16.0	8.0	4.0
Gauge Reading (in)	0.1913	0.1733	0.1527				
(H-Hs) mm	8.762	8.304	7.782				
Voids ratio	1.038	0.984	0.922				
t <sub>90</sub> (min)	0.72	1.00	0.64				
Cv (ft <sup>2</sup> /day)	1.383	0.947	1.395				
k' (tsf)	38.011	75.047	128.321				
Mv (ft <sup>2</sup> / ton)	0.0263	0.0133	0.0078				

Trial #	15	16	16	16	17	18
Load (tsf)	2.00	1.000	0.500	0.250	0.125	0.063
Gauge Reading (in)	0.1598		0.1690		0.175	
(H-Hs) mm	7.961		8.196		8.348	
Voids ratio	0.943		0.971		0.989	
t <sub>90</sub> (min)						
Cv (ft <sup>2</sup> /day)						
k' (tsf)	543.574		104.716		40.937	
Mv (ft <sup>2</sup> / ton)	0.0018		0.0095		0.0244	

Project: Hwy 35

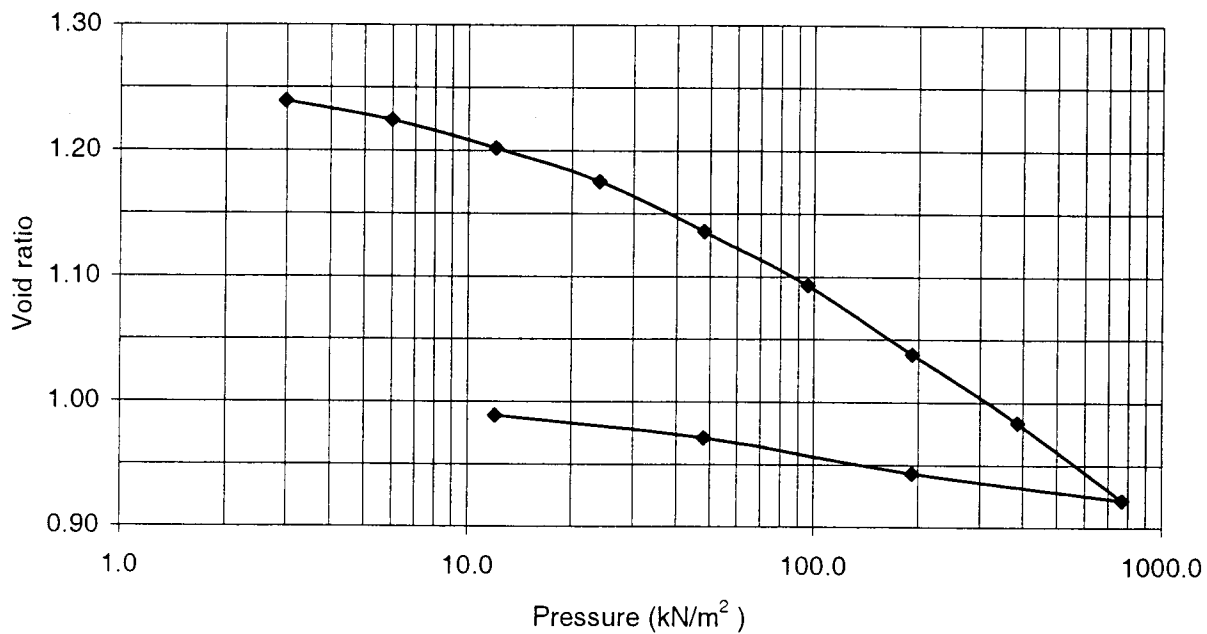
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Date: February 12, 2001

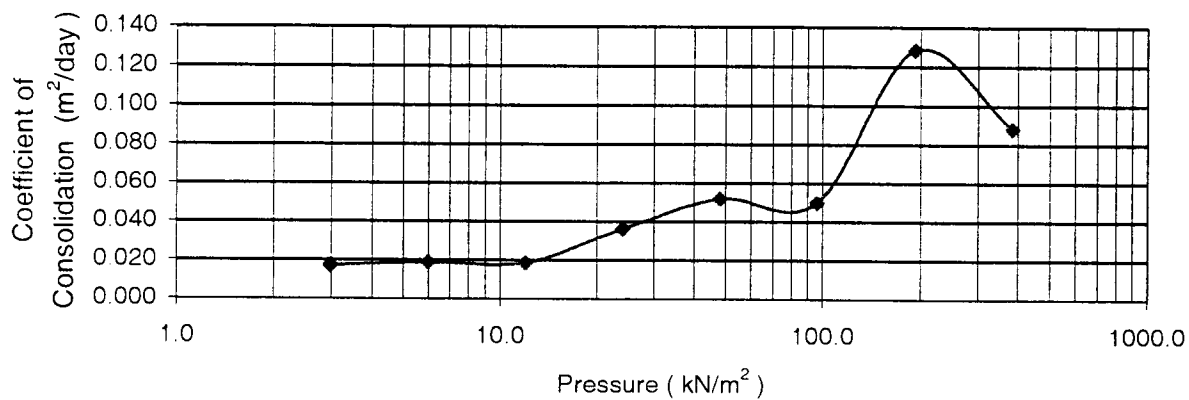
BH#:- N4 Sa#: TW6

Depth(m): 4.80

Void Ratio Vs Pressure



Coefficient of Consolidation Vs Pressure



Project: Hwy 35

Job#: TT20868

Date: 20-Dec-00

BH#:- 01

Sa#: TW\_5A

Depth(m): 3.3

Ring #: B Ring Height (in) = 0.753 Wt of dry filter paper (g) = 0.66

Wet soil + Ring Wt (g) = 191.89 Wt of ring (g) = 76.56

Wet soil + Wet Paper + Ring (g) = 191.82 Wet Paper (g) = 1.98

Dry Soil + Dry Paper + Ring (g) = 162.82 Ring Dia (in) = 2.495

Initial moisture Content (%) = 34.731 Final moisture Content (%) = 32.336

Area of Ring (in<sup>2</sup>) = 4.889 Initial Volume (in<sup>3</sup>) = 3.6815Initial Bulk Density (kg/m<sup>3</sup>) = 1912 Initial Dry Density (kg/m<sup>3</sup>) = 1419

Specific Gravity of Soil = 2.79 Eqiv. Thick. of solids (mm) = 9.727

Final gauge reading for Load 1 = 0.2550 Gauge reading for last Loading = 0.2025

Trial #	1	2	3	4	5	6	7
Load (tsf)	0	0.0625	0.125	0.25	0.5	1.0	2.0
Gauge Reading (in)	0.2550	0.25365	0.2526	0.2511	0.2483	0.24455	0.2383
(H-Hs) mm	9.399	9.365	9.338	9.300	9.229	9.134	8.975
Voids ratio	0.966	0.963	0.960	0.956	0.949	0.939	0.923
t <sub>90</sub> (min)		9.00	10.24	5.29	4.41	3.61	2.89
Cv (ft <sup>2</sup> /day)		0.133	0.117	0.225	0.269	0.325	0.401
k' (tsf)		34.861	44.741	62.550	66.884	99.507	118.808
Mv (ft <sup>2</sup> / ton)		0.0287	0.0224	0.0160	0.0150	0.0100	0.0084

Trial #	8	9	10	11	12	13	14
Load (tsf)	4.0	8.0	16.0		4.0		1.0
Gauge Reading (in)	0.2277	0.2033	0.1673		0.1756		0.1847
(H-Hs) mm	8.705	8.086	7.172		7.383		7.612
Voids ratio	0.895	0.831	0.737		0.759		0.783
t <sub>90</sub> (min)	3.61	6.25	3.80				
Cv (ft <sup>2</sup> /day)	0.314	0.173	0.260				
k' (tsf)	138.272	119.203	155.844		961.880		223.293
Mv (ft <sup>2</sup> / ton)	0.0072	0.0084	0.0064		0.0010		0.0045

Trial #	15	16	16	16
Load (tsf)		0.250		0.063
Gauge Reading (in)		0.1929		0.2025
(H-Hs) mm		7.822		8.066
Voids ratio		0.804		0.829
t <sub>90</sub> (min)				
Cv (ft <sup>2</sup> /day)				
k' (tsf)		62.059		13.494
Mv (ft <sup>2</sup> / ton)		0.0161		0.0741

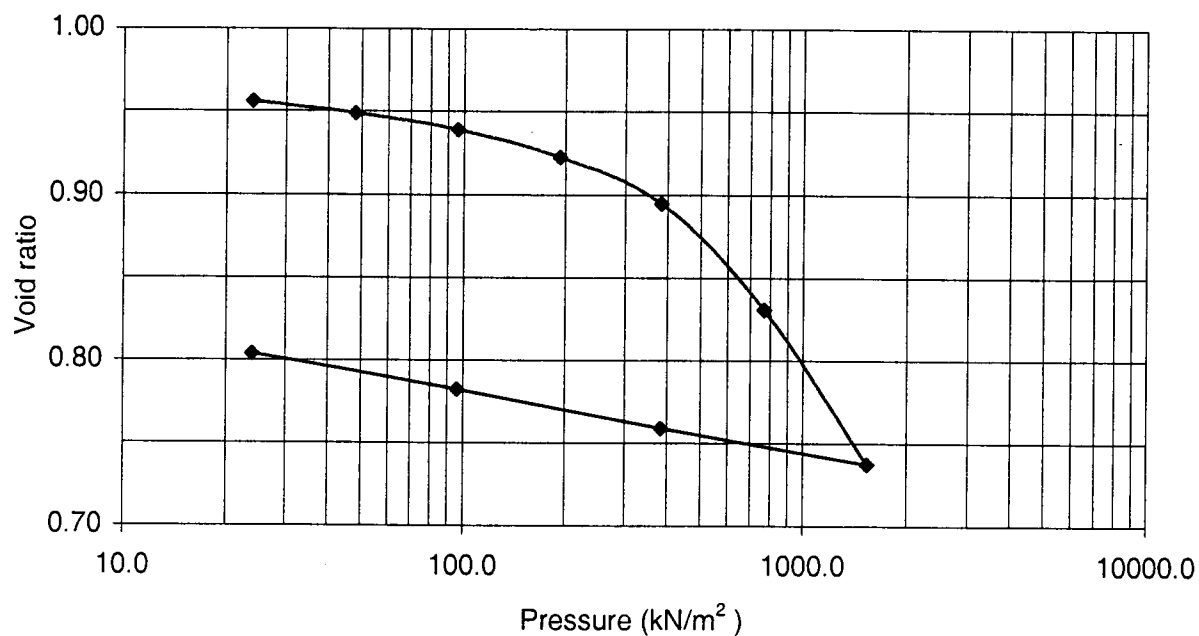
Project: Hwy 35

Job#: TT20868

Date: December 20, 2000 BH#:- O1 Sa#: TW\_5A

Depth(m): 3.28

Void Ratio Vs Pressure



Coefficient of Consolidation Vs Pressure

