Submitted To AECOM Canada Ltd.
189 Wyld Street Suite 103, North Bay, Ontario P1B 1Z2
On Behalf of the Ontario Ministry of Transportation

Highway 535 Rehabilitation
Approach Fill Settlement – Nepewassi River Bridge
Site No. 46-130, TWP. of Dunnet
GWP 5573-04-00

Highway 535
From 20.2 km north of Highway 17;
Including Highway 17/Highway 535(Hagar) Intersection;
and OVR to 0.01 km north of Roy Lumber Co.
District of Sudbury

FINAL FOUNDATION INVESTIGATION REPORT

Date: December, 2011
Ref. Nº: 11/04/11046-F4 R2

Geocres No. 41I-278

LVM | MERLEX

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1.0 INTRODUCTION

LVM | MERLEX has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation to provide information for the rectification of ongoing approach fill settlement at the Nepewassi River Bridge (Site No. 46-130) as well as for the design of a roadway protection system. The Nepewassi River Bridge is located on Highway 535, some 3.5 km south of Hwy 17, in the Township of Dunnet.

The foundation investigation location was specified by the MTO in the RFP/TPM documentation Agreement No. 5010-E-0015. The terms of reference for the scope of work are outlined in LVM | MERLEX's proposal P-10-169, dated December 2010. The purpose of this investigation was to determine the subsurface conditions in the area of the bridge approaches. LVM | MERLEX investigated the foundation areas by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2.0 SITE DESCRIPTION

The foundation investigation at the bridge approaches is located between Stations 18+843 and 18+928, Township of Dunnet (Site No. 46-130). The topography at the site is a low wide valley in which the Nepewassi River meanders in a west to east direction. The river valley is some 300 m in width, at the bridge site, with outcropping bedrock defining the south and north valley walls. The low flood plain area, adjacent to the river, supports bulrushes/grasses and low shrub vegetation. As the grade rises up the valley walls, to the north and south, mature deciduous and coniferous trees are present. Developed lands, to the north and south of the bridge site, support farming activities. The approaches, for the 1998 detour bridge, are still partially present to the west of the alignment. The existing highway embankment, at the two lane bridge structure, currently supports two undivided lanes of highway, running in a north south direction. The road

centerline elevation ranges from 207.8 m, at the south abutment, to 208.9 m at the north abutment. The existing bridge, at this location, is a three span steel plate girder bridge with concrete deck, supported on steel H piles driven to practical refusal. The river water level at the time of investigation was at elevation 202.5 m

The existing bridge is the third structure that has been built on this horizontal alignment. It is understood that the original structure, prior to 1951, was a timber structure on timber pile bents. A second, 11 span, timber trestle type structure on new timber pile bents was constructed in 1951. The existing 3 span bridge was constructed in 1999 under Contract No. 98-215. During design of the present bridge (in 1995) the MTO had reported that the timber trestle structure was in poor condition and that it had undergone considerable settlement at the abutments. The timber structure was described on Sheet 45 of Contract Drawing No.83-227 as having a 52.5 m span.

The vertical alignment, at the existing structure, was adjusted upward from 1.0 to 1.8 m at the south and north abutments respectively under the 1998 contract. It is unknown if the vertical alignment was altered at the time of the 1951 construction.

2.1 Site Physiography and Surficial Geology

This project is located in the Geomorphic Sub-province known as the North Shore - Sudbury Ridges and Pockets. The topography on this section of Highway 535 is generally rolling. There are frequent exposed bedrock ridges. At many locations, significant layers of earth overlay the bedrock. Organic terrain was also observed. Within the project area overburden consists primarily of silty clay, overlying silts and sands. The grade drops some 25 m into the valley where the Nepawassi Bridge is located.

Bedrock in the area, as indicated on OGS Map 2506, is of the Late to Middle Precambrian Era. At the location of this foundation investigation, the bedrock comprises of biotite gneiss.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out between June 14th and June 21st, 2011, during which time four (4) sampled boreholes were advanced in the area of the approach slabs at the Nepewassi Bridge. A deep borehole and dynamic cone penetration test was advanced through the existing approach slabs, a short distance back from the rear of both the south and north abutments (Borehole Nos. LVM-2 and LVM-3, respectively). In addition two borings were advanced a short distance beyond the ends of both the south and north approach slabs (Borehole Nos. LVM-1 and LVM-4, respectively).

The field investigation was carried out using a CME drilling rig equipped with hollow stem augers, standard augers, N size coring and casing, and all routine geotechnical sampling equipment. Soil samples were obtained at the borehole locations at regular intervals of depth using the standard 50 mm O.D. split spoon sampler advanced in accordance with the Standard Penetration Test (SPT) procedures (ASTM D-1586). The SPT method involves advancing a 50 mm O.D. split spoon sampler with the force of a 63.5 kg hammer freely dropping 760 mm mounted in a trip (automatic) hammer. The number of blows per 300 mm penetration was recorded as the “N” value. At the boreholes, a Dynamic Cone Penetration Test (DCPT) was carried out to give a continuous plot of the soil resistance with depth. When cohesive deposits were encountered, the in-situ strength was measured using an “N” size field vane, vane collar, and calibrated torque meter. Relatively undisturbed samples of the cohesive deposits were retrieved using a 73 mm O.D. thin walled sampler in accordance with ASTM D-1587. All

samples taken during this investigation were stored in labeled airtight containers for transport to our North Bay laboratory for visual examination and select laboratory testing.

Groundwater conditions in the open boreholes were observed during the advancement of and immediately following completion of the individual boreholes. Peizometers were installed in Borehole No. LVM-3 to monitor groundwater conditions, in the lower clay stratum and upper fills. All open boreholes were backfilled upon completion with compacted auger cuttings and bentonite backfill. At Borehole No. LVM-3 bentonite combined with filter sand packs and bentonite pellets were employed to filter and isolate the piezometers. At the boreholes through the embankment, the upper portion of the hole, where necessary, was backfilled with an asphalt cold patch to seal the existing asphalt surface. The field work for this investigation was under the full time direction of a senior member of our engineering staff, who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transport to our North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in our laboratory. Laboratory testing of select samples included routine testing for natural moisture content determination and particle size analysis as well as Atterberg Limits testing. Detailed consolidation testing on four samples was carried out at a MTO approved high capacity soil testing laboratory (Golder Associates, Mississauga). The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix B), with a summary of results presented on the laboratory sheets in Appendix C (Figures Nos. L-1 to L-9).

The location of the individual boreholes were determined in the field using highway chainage (established by others) and offset relative to highway centerline. The MTO co-ordinates,

northing and easting, were then established for the boring locations. Elevations contained in this report are referenced to a geodetic datum.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Record of Borehole Logs (Appendix B) and on Figure No. 2 (Appendix C). Please note that stratigraphic delineation presented on the borehole logs and soil strata plot are the results of non-continuous sampling, response to drilling progress, the results of SPT and Dynamic Cone Penetration Test (DCPT) plus field observations. Typically such boundaries represent transitions from one zone to another and are not an exact demarcation of specific geological unit. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location, and are shown on the drawings for illustration purposes only.

4.1 Background Data

Following award of this project LVM | MERLEX was supplied with a copy of a 1995 Foundation Investigation and Design Report carried out for construction of the existing bridge, under Contract No. 98-215. This earlier investigation, by Shaheen and Peaker Limited (S&P), revealed an extensive deposit of soft clay up to 20 m in depth, (south abutment), underlain by cohesionless silts and fine sands to sands and gravels overlying bedrock, which was encountered at depths varying from 45 to 27 m, (south and north abutment respectively). Groundwater, in the lower aquifer, was under an artesian condition, which indicated an elevated hydraulic gradient of 1 to 2 m above the water level in the river. This factual data consisted of six (6) sampled boreholes advanced by Shaheen and Peaker in 1995 and numbered D-1 to D-6 inclusive. In addition, the 1995 report contained the borehole logs of a single borehole advanced

by the MTO in 1992 and two boreholes (Borehole Nos. 1A and 2A) advanced by Morton and Partners Ltd in 1981. For completeness the location of these previous borings are shown on the LVM | MERLEX Borehole Location Plan (in grey scale) and copies of the Borehole logs, and factual laboratory data have been included in Appendix D.

4.2 Nepewassi River Bridge – Site No. 46-130

A plan and profile showing the borehole locations and stratigraphic sequences is shown on Figure No. 2, Appendix C. During the course of this exploration program, four (4) sampled boreholes were put down at this site, with Borehole Nos. LVM-1 and LVM-4 advanced through the existing embankment to the south and north of the 10 m long approach slabs, respectively, for the purpose of obtaining information for possible design of a roadway protection system. Borehole Nos. LVM-2 and LVM-3 were advanced through the approach slab at the south and north abutments, respectively, to address the ongoing settlement of the approach embankments. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. LVM-1 to LVM-4 inclusive were recorded at elevations 207.7, 207.8, 208.9, and 209.1 m, respectively.

This study was undertaken to define the characteristics of the deep clay stratum and, as such, the depth of borehole was limited to 25 m. For completeness the stratigraphic column has been supplemented with previous data which is shown on the stratigraphic profile and plan in grey scale.

The following is a description of the subsurface conditions encountered in the boreholes advanced by LVM | MERLEX during the 2011 investigation.

4.2.1 Pavement Structure

At the boreholes advanced beyond the approach slab a surficial pavement structure consisting of 200 and 275 mm of asphalt and 175 and 250 mm of crushed gravel was encountered at Borehole Nos. LVM-1 and LVM-4, respectively. At the two borings, advanced through the approach slab a short distance behind the rear of the abutments, a surficial pavement structure consisting of 240 and 200 mm asphalt and 280 and 350 mm concrete approach slab was encountered at Borehole Nos. LVM - 2 and LVM-3, respectively. At these two boreholes a void of 125 to 130 mm was encountered below the approach slab

4.2.2 Embankment - Lightweight Fill

At each borehole, underlying the above described surficial pavement structures, a deposit of granular fill was penetrated. The original contract drawings (Contract No. 98-215) indicate that lightweight fill was to be used to re-construct the upper part of the approach embankments and identifies this material as 3/8 structural coarse lightweight blast furnace slag (LBFS) fill. The encountered deposit consisted of brown to reddish brown medium to fine sand size particles trace silt size particles. The natural moisture content measured from samples of the LBFS fill was in the order of 5 to 20%. Gradation analyses were carried out on twelve (12) samples of this deposit, the results of which indicated 0 to 2% gravel size particles, 93 to 97% sand size particles, and 2 to 5% silt and clay size particles (Figure Nos. L-1a and L-1b, Appendix C). Based on mass/volume measurements taken on retrieved samples of the lightweight fill deposit, the unit weight of the in place fill was estimated to be on average 15.5 kN/m^3. At Station 18+843, a bulk sample of the lightweight fill material was retrieved to allow a Standard Proctor Dry Density (SPDD) Test to be undertaken. This testing, as per ASTM D-698 returned a SPDD value of 1580 kg/m^3 at an optimum moisture content of 20.5%. Gradation analysis was carried out on the sample used for the SPDD test, before and after testing. This data is shown on

Figure No. L-2, Appendix C. Based on SPT 'N' values of 16 to 81 (average 39) blows per 300 mm penetration, the compactness of this deposit was described as compact to very dense, generally dense. This deposit was encountered to depths of 3.7 and 4.3 m below ground surface at Borehole Nos. LVM-2 and LVM-3, respectively (elevations 204.1 and 204.6 m, respectively). A geotextile was encountered at a 4.3 m depth at Borehole No. LVM-3 at the transition from the lightweight fill to the original embankment fill materials.

Initially auger refusal was encountered at the surface of the lower fill deposit, at depths of 3.3 and 4.5 m below grade at Borehole Nos. LVM-1 and LVM-4, respectively (elevations 204.4 and 204.6 m, respectively). At Borehole No. LVM-1 two additional attempts were made, with both standard and hollow stem augers, to penetrate below the refusal depth, however, refusal was met on cobble/boulder size rock obstructions at a 3.1 m depth. These additional borings were within a horizontal distance of 1 m of the original boring. At the location of Borehole No. LVM-4 initial auger refusal was met at a 4.5 m depth, however, a second boring within 1 m of the original, penetrated the cobble/boulder size rock obstruction to allow advance of Borehole No. LVM-4a to a 16.1 m depth (elevation 193.0). DCPT refusal was encountered in this deposit at depths of 3.0, 3.7, 4.3 and 0.2 m below grade at Borehole Nos. LVM-1 to LVM-4, respectively (elevations 204.7, 204.1, 204.6 and 208.9 m, respectively). This refusal was interpreted to be due to obstructions in the underlying original embankment fill material, at approximately the interface between the upper LBFS fill and the original embankment fill, at all locations except at Borehole No. LVM-3 and at the dynamic cone penetration test at Borehole No. LVM-4.

4.2.3 Embankment – Fill

Underlying the LBFS fill, at Borehole Nos. LVM-2 and LVM-4a, a deposit of embankment fill consisting of sands and gravels with frequent cobble and boulder size rock was penetrated. Core drilling using an N size diamond core bits was required in this deposit to penetrate the cobble/boulder size rock obstructions at Borehole No. LVM-2. The natural moisture content measured on the limited samples obtained from the granular portion of this deposit obtained using the SPT method was in the order of 6 to 8%. This deposit was encountered to a depth of 10.6 m below grade (elevation 197.2 m), at Borehole No. LVM-2 and to a 5.3 m depth (elevation 203.8 m) at Borehole No. LVM-4a. Although not sampled (cored) at Borehole No. LVM-1, it is anticipated that auger refusal, which was encountered at a depth of 3.3 m, was due to the presence of cobble/boulder size rock in this embankment fill.

4.2.4 Silty Clay

Underlying the LBFS fill at Borehole No. LVM-3 (north abutment), and underlying the fill at Borehole No. LVM-4a, a deposit of black to dark grey silty clay trace sand trace organics and trace asphalt was penetrated. At Borehole No. LVM-3 this deposit contained a sand and gravel layer, approximately 150 mm thick, at a depth of 5.5 m (elevation 203.5 m). The natural moisture content measured on samples of this deposit was in the order of 4 to 24%. Atterberg Limits testing was carried out on two (2) samples of the cohesive portion of this deposit, the results of which indicated a Liquid Limit in the order of 28 to 32% and a Plastic Limit in the order of 20 to 22%. Based on the results of Atterberg Limits testing, this deposit was classified under USCS as silty clay of low plasticity (CL) (Figure No. L-3, Appendix C). Based on SPT ‘N’ values of 8 to 11 blows per 300 mm penetration the consistency of this deposit was described as stiff to very stiff. This deposit was encountered to depths of 8.8 and 9.1 m below grade at Borehole Nos. LVM-3 and LVM-4a, respectively (elevations 200.1 and 200.0 m, respectively).

4.2.5 Clay

Underlying the original embankment fill, at Borehole No. LVM-2, and underlying the silty clay at Borehole Nos. LVM-3 and LVM-4a, a deposit of grey clay was penetrated. The natural moisture content measured on samples of this deposit was in the order of 38 to 70%. Atterberg Limits testing was carried out on twelve (12) samples of this deposit, the results of which indicated a Liquid Limit in the order of 39% to 66% and a Plastic Limit in the order of 18 to 25%. Based on the results of Atterberg Limits testing, this deposit was classified under USCS as clay of high to medium plasticity (CH to CI) (Figure No. L-4, Appendix C). Based in-situ shear strength testing, returning values of 24 to 60 kPa, the consistency of this deposit was described as firm to stiff (Figure No. L-5, Appendix D). The sensitivity of the clay deposit is defined as the ratio of the in-situ shear strength over that of the remolded shear strength of the material. Based on the results, as obtained from in-situ field vane tests, the sensitivity of this clay deposit ranged from 2 to 6, indicating a low sensitivity. This deposit was encountered to a depth of 21.6 m below grade at Borehole No. LVM-3 (elevation 187.3 m). Sampling was terminated in this deposit at a depth of 25.0 m below grade at Borehole No. LVM-2 (elevation 182.8 m) and 15.5 m depth at Borehole No. LVM-4a (elevation 193.0 m).

Four (4) one-dimensional oedometer (consolidation) tests were carried out on samples of the clay deposit (Borehole Nos. LVM-2 Sample 11 (12.5 m depth), LVM-2 Sample 15 (18.6 m depth), LVM-2 Sample 17 (21.8 m depth), and LVM-3 Sample 16 (18.6 m depth)). The preconsolidation pressure was estimated (using the Casagrande method) to be in the order of 130 to 160 kPa. The over-consolidation ratio, which is the ratio of the preconsolidation pressure to the existing effective overburden pressure, was in the order of 0.81 to 1.23. Based on the results of the oedometer (consolidation) tests, vane shear strength data, and the relationship of the moisture content to liquid limit, this deposit is considered to be underconsolidated to just

slightly overconsolidated, relative to the existing overburden pressure. The sample taken from the higher elevation of 195.5 m, has been described as being slightly overconsolidated. Results from the consolidation tests are shown on enclosed Figure Nos. L-6 to L-9 (Appendix C).

4.2.6 Silty Sand

Underlying the clay, at Borehole No. LVM- 3, a deposit of grey silty sand trace gravel trace clay was penetrated. Auger refusal was encountered on a boulder in this deposit at a depth of 21.9 m below grade (elevation 187.0 m).

4.2.7 Compilation of Information From Previous Investigations

Following award of this assignment MTO supplied LVM | MERLEX with a copy of the Foundation Investigation and Design Report, as produced in 1995 by Shaheen and Peaker Limited (S&P), for the construction of the existing bridge, constructed under Contract No. 98-215. This data, as outlined previously, indicated that the extensive clay deposit was underlain by cohesionless deposits of silts and sand over bedrock. The bedrock was encountered at depths varying from 45 to 27 m, (south and north abutment respectively). Groundwater, in the lower aquifer, was under an artesian condition, which indicated a hydraulic gradient of 1 to 2 m higher than river water level. Information from this previous work has been used to supplement the lower portion of the stratigraphic column and has been generally confirmed by LVM | MERLEX where our borings have been advanced at a similar location.

4.3 Groundwater Conditions

It was known from the onset of this investigation, based on historical site data, that an artesian condition was present in the cohesionless deposits underlying the extensive clay stratum. A peizometer was installed in Borehole No. LVM-3 at an elevation of 194.0 m, which was approximately mid height of the clay deposit. The intent of this piezometer was to measure the pore water pressure in the clay stratum. This piezometer returned a stabilized water level reading at elevation 204.1 m, which is some 1.6 m above the river water level measured at elevation 202.5 m, at the time of this investigation. In the 1995 investigation the water level was measured at 202.5 m whereas on Contract Drawing No. 83-227 the river water level was shown at 202.11 m .The river water level directly reflects the groundwater level in the fill deposits along the adjacent riverbanks and approach embankments. The groundwater levels will fluctuate seasonally. The 1995 report indicates that the river water level had increased 0.3 to 0.4 m by the end of the field work.

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MTO Designate

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Regional Manager

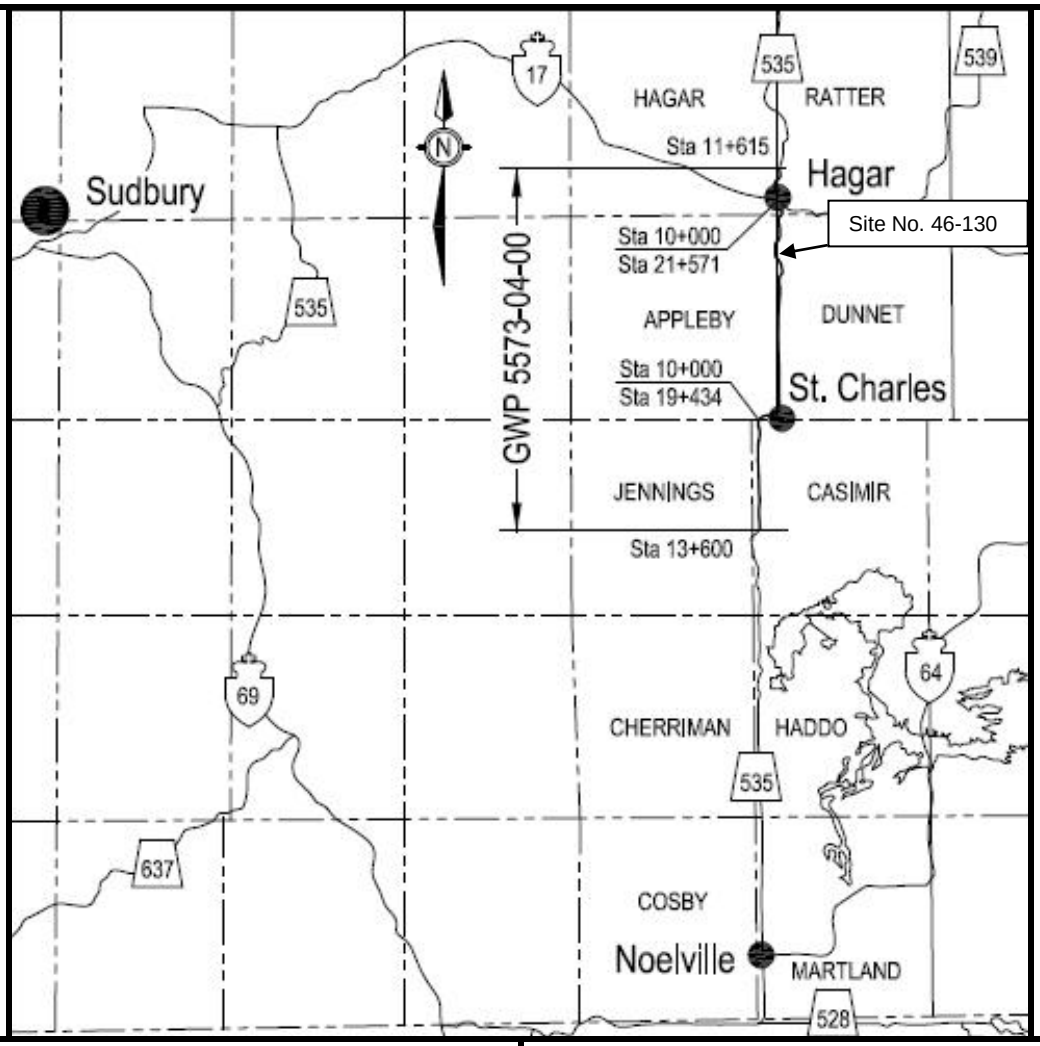
Appendix A Key Plan

Figure No. 1: Key Plan

KEY PLAN

Figure No. 1

NOT TO SCALE



FINAL
FOUNDATON INVESTIGATION REPORT
GWP 5573-04-00
Highway 535
From 20.2 km North of
Highway 64, Northerly to Highway 17:
Including Highway 17/Highway 535 (Hagar)
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Ref. No.: 11/04/11046-F4 R2 December, 2011

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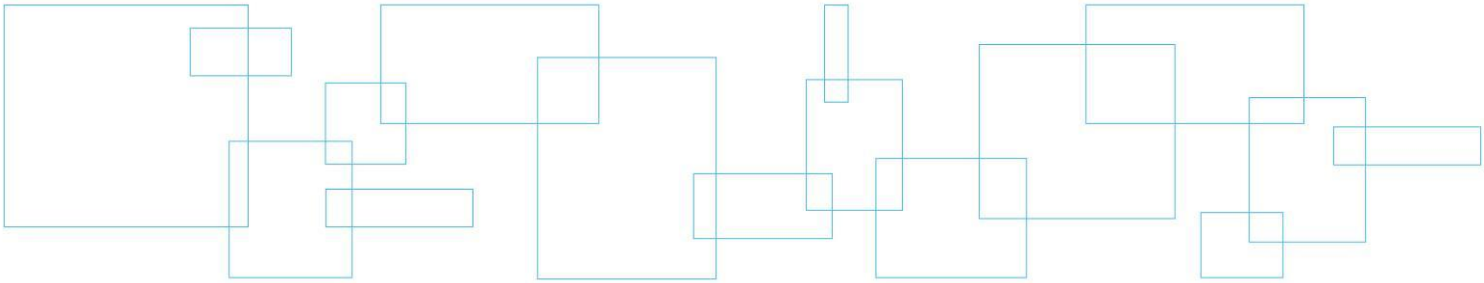
Appendix B Abbreviations
Record of Borehole Sheets

Enclosure No. 1: List of Abbreviations and Symbols
Enclosure Nos. 2 to 6: Record of Borehole Sheets



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LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

1. ABBREVIATIONS

AS Auger Sample
CS Chunk Sample
DS Denison type sample
FS Foil Sample
NP Non Plastic
PH Sampler advanced by hydraulic pressure
PM Sampler advanced by manual pressure
RC Rock core with size & percentage of recovery
SS Split Spoon
ST Slotted Tube
TO Thin-walled, open
TP Thin-walled, piston
WS Wash Sample

2. PENETRATION RESISTANCE/"N"

Dynamic Cone Penetration Test (DCPT):

A continuous profile showing the number of blows for each 300 mm of penetration of a 50 mm diameter 60° cone attached to AW rod driven by a 63 kg hammer falling 760 mm.

Plotted as —•—•—•—•

Standard Penetration Test (SPT) or "N" Values

The number of blows of a 63 kg hammer falling 760 mm required to advance a 50 mm O.D. drive open sampler 300 mm.

3. SOIL DESCRIPTION

a) *Cohesionless Soils:*

"N" (blows/0.3 m)	*Relative Density*
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

3. SOIL DESCRIPTION (Cont'd)

b) *Cohesive Soils:*

Undrained Shear Strength (kPa)	*Consistency*
Less than 12	very soft
12 to 25	soft
25 to 50	firm
50 to 100	stiff
100 to 200	very stiff
over 200	hard

c) *Method of Determination of Undrained Shear Strength of Cohesive Soils:*

+ 3.2 - Field Vane test in borehole. The number denotes the sensitivity to remoulding.

D - Laboratory Vane Test

¨ - Compression test in laboratory

For a saturated cohesive soil the undrained shear strength is taken as one-half of the undrained compressive strength.

4. TERMINOLOGY

Terminology used for describing soil strata is based on the proportion of individual particle sizes present in the samples (please note that, with the exception of those samples subject to a grain-size analysis, all samples were classified visually and the accuracy of visual examination is not sufficient to determine exact grain sizing):

Trace, or occasional	Less than 10%
Some	10 to 20%
With	20 to 30%
Adjective (i.e. silty or sandy)	30 to 40%
And (i.e. sand and gravel)	40 to 60%

5. LABORATORY TESTS

P Standard Proctor Test
A Atterberg Limit Test
GS Grain Size Analysis
H Hydrometer Analysis
C Consolidation

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

SAMPLE DESCRIPTION NOTES:

1. **FILL:** The term fill is used to designate all man-made deposits of natural soil and/or waste materials. The reader is cautioned that fill materials can be very heterogeneous in nature and variable in depth, density and degree of compaction. Fill materials can be expected to contain organics, waste materials, construction materials, shot rock, rip-rap, and/or larger obstructions such as boulders, concrete foundations, slabs, abandoned tanks, etc.; none of which may have been encountered in the borehole. The description of the material penetrated in the borehole therefore may not be applicable as a general description of the fill material on the site as boreholes cannot accurately define the nature of fill material. During the boring and sampling process, retrieved samples may have certain characteristics that identify them as 'fill'. Fill materials (or possible fill materials) will be designated on the Borehole Logs. If fill material is identified on the site, it is highly recommended that testpits be put down to delineate the nature of the fill material. However, even through the use of testpits defining the true nature and composition of the fill material cannot be guaranteed. Fill deposits often contain pockets or seams of organics, organically contaminated soils or other deleterious material that can cause settlement or result in the production of methane gas. It should be noted that the origins and history of fill material is frequently very vague or non-existent. Often fill material may be contaminated beyond environmental guidelines and the material will have to be disposed of at a designated site (i.e. registered landfill). Unless requested or stated otherwise in this report, fill material on this site has not been tested for contaminants however, environmental testing of the fill material can be carried out at your request. Detection of underground storage tanks cannot be determined with conventional geotechnical procedures.

2. **TILL:** The term till indicates a material that is an unstratified, glacial deposit, heterogeneous in nature and, as such, may consist of mixtures and pockets of clay, silt, sand, gravel, cobbles and/or boulders. These heterogeneous deposits originate from a geological process associated with glaciation. It must be noted that due to the highly heterogeneous nature of till deposits, the description of the deposit on the borehole log may only be applicable to a very limited area and therefore, caution must be exercised when dealing with a till deposit. When excavating in till, contractors may encounter cobbles/boulders or possibly bedrock even if they are not indicated on the borehole logs. It must be appreciated that conventional geotechnical sampling equipment does not identify the nature or size of any obstruction.

3. **BEDROCK:** Auger refusal may be due to the presence of bedrock, but possibly could also be due to the presence of very dense underlying deposits, boulders or other large obstructions. Auger refusal is defined as the point at which an auger can no longer be practically advanced. It must be appreciated that conventional geotechnical sampling equipment does not differentiate between nature and size of obstructions that prevent further penetration of the boring below grade. Bedrock indicated on the borehole logs will be labeled 'possibly' or 'probable' etc. based on the response of the boring and sampling equipment, surrounding topography, etc. Bedrock can be proven at individual borehole locations, at your request, by diamond core drilling operations or, possibly, by testpits. It must also be appreciated that bedrock surfaces can be, and most times are, very erratic in nature (i.e. sheer drops, isolated rock knobs, etc.) and caution must be used when interpreting subsurface conditions between boreholes. A bedrock profile can be more accurately estimated, at the clients' request, through a series of closely positioned unsampled auger probes combined with core drilling.

4. **GROUNDWATER:** Although the groundwater table may have been encountered during this investigation and the elevation noted in the report and/or on the record of boreholes, it must be appreciated that the elevation of the groundwater table will fluctuate based upon seasonal conditions, localized changes, erratic changes in the underlying soil profile between boreholes, underlying soil layers with highly variable permeabilities, etc. These conditions may affect the design and type and nature of dewatering procedures. Cave-in levels recorded in borings give a general indication of the groundwater level in cohesionless soils however, it must be noted that cave-in levels may also be due to the relative density of the deposit, drilling operations etc.

ENCLOSURE NO.:2 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. LVM-1

REFERENCE 11/04/11046-F4 R2 DATUM Geodetic LOCATION N5331504.4 E372595.0 - Dunnet Township - Nepewassi River Bridge ORIGINATED BY JL

PROJECT GWP 5573-04-00, Highway 535 - Site No. 46-130 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) June 20, 2011 DATE (Completed) June 20, 2011 TIME 5:00:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
207.7	Asphalt Surface										
0.0	± 200 mm Asphalt ± 175 mm Crushed Gravel		1	AS	N/A		207				
	FILL - brown to reddish brown lightweight blast furnace slag fill		2	SS	47			Augered to a ± 1.2 m depth			0 97 (3)
	(dense/compact)		3	SS	41		206				
			4	SS	22		205				
204.7											
204.4	DCPT Refusal		5	SS	49/200mm						0 96 (4)
3.3	Auger Refusal Cobble/boulder size rock End of Borehole										
	See Comments										

COMMENTS

Two additional borings (LVM-1a and LVM-1b) were advanced at Station 18+850, 2.0 m Rt of CL and Station 18+851, 1.8 m Rt of CL. Refusal was encountered at both borings at a depth of 3.1 m.

The stratification lines represent approximate boundaries. The transition may be gradual.

+ ³, × ³ : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 6/20/11 5:00:00 PM	DRY	2.9
2)	-	-
3)	-	-

MEL-GEO 11046 - BH LOGS - NEPEWASSI RIVER BRIDGE.GPJ MEL-GEO.GDT 12/8/11

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ENCLOSURE NO.:3 (Pg. 1 of 2)

METRIC

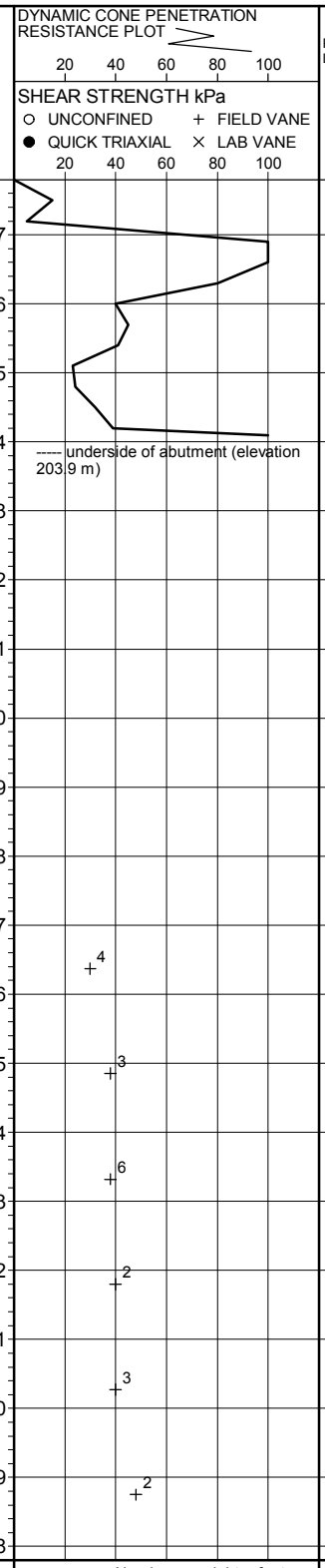
RECORD OF BOREHOLE NO. LVM-2

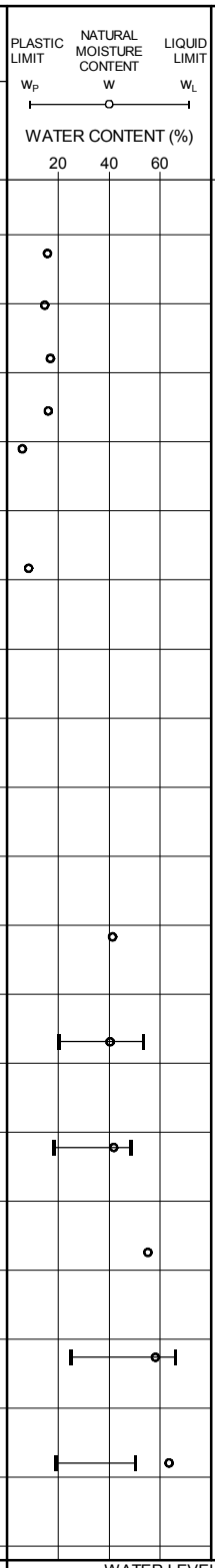
REFERENCE 11/04/11046-F4 R2 DATUM Geodetic LOCATION N5331508.1 E372600.4 - Dunnet Township - Nepewassi River Bridge ORIGINATED BY AT

PROJECT GWP 5573-04-00, Highway 535 - Site No. 46-130 BOREHOLE TYPE Track Mounted CME 55 - Hollow Stem Augers & N Casing COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) June 16, 2011 DATE (Completed) June 16, 2011 TIME 5:20:00 PM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS
207.8	Asphalt Surface					
0.0	± 240 mm Asphalt ± 280 mm Concrete ± 125 mm Void					
	FILL - brown to reddish brown lightweight blast furnace slag fill		1	SS	85	
			2	SS	26	
	(very dense/compact)		3	SS	16	
			4	SS	19	
204.1						
3.7	DCPT Refusal		5	SS	89/175 mm	
	FILL - sands and gravels					
	frequent cobble/boulder size rock pieces in granular matrix		6	RC	N/A	
			7	SS	12	
	core through 150 mm piece of rock at 4.6 m depth		8	SS	2	
	core through bloulder size rocks from 7.6 to 9 m recovered 325 mm core		9	RC	N/A	
198.2						
9.6	CLAY - grey silty clay					
	(medium to high plasticity)					
	(firm)		10	SS	WH	
			11	TO	WH	
			12	SS	WH	
			13	TO	WH	
			14	SS	WH	
			15	TO	WH	
	Continued Next Page					





UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
	0 96 (4)
	0 96 (4)
	0 95 (5)
	0 97 (3)
17.9	Consolidation Test
16.6	Consolidation Test

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

$\circ^{3\%}$ STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 6/16/11 6:05:00 PM	DRY	4.6
2)	-	-
3)	-	-

MEL-GEO 11046 - BH LOGS - NEPEWASSI RIVER BRIDGE.GPJ MEL-GEO.GDT 12/8/11

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ENCLOSURE NO.:3 (Pg. 2 of 2)

METRIC

RECORD OF BOREHOLE NO. LVM-2

REFERENCE 11/04/11046-F4 R2 DATUM Geodetic LOCATION N5331508.1 E372600.4 - Dunnet Township - Nepewassi River Bridge ORIGINATED BY AT

PROJECT GWP 5573-04-00, Highway 535 - Site No. 46-130 BOREHOLE TYPE Track Mounted CME 55 - Hollow Stem Augers & N Casing COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) June 16, 2011 DATE (Completed) June 16, 2011 TIME 5:20:00 PM CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa / WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100 — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE — PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L — 20 40 60	γ kN/m^3	GR SA (SI CL)
	Continued from Previous Page									
	CLAY - grey silty clay		16	SS	WH					
	(medium to high plasticity)						187	3		
	(firm)		17	TO	WH		186	2	16.4	Consolidation Test
							185			
							184			
182.8			18	SS	WH		183			
25.0	End of Sampling End of Borehole									

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METRIC

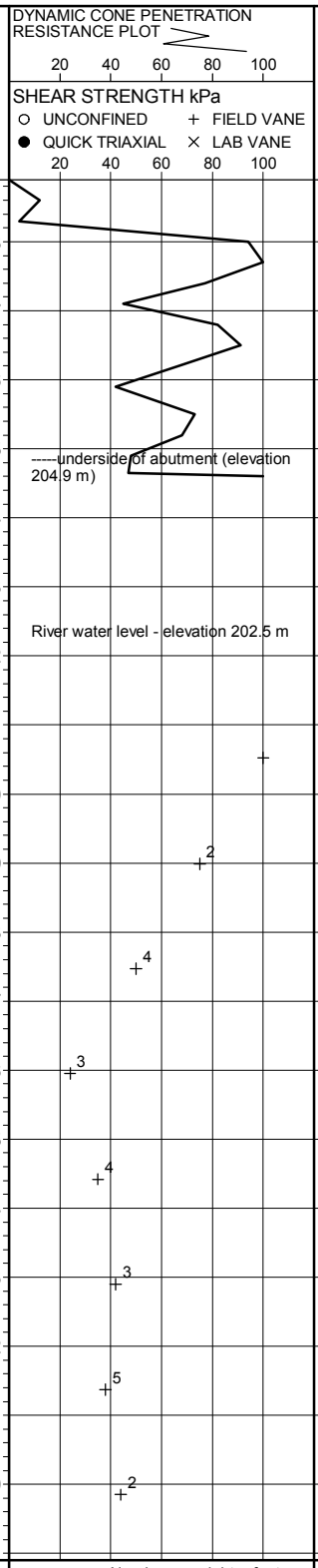
RECORD OF BOREHOLE NO. LVM-3

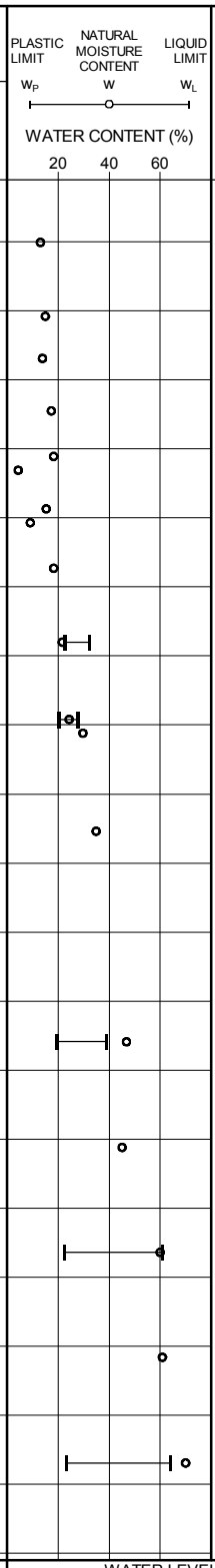
REFERENCE 11/04/11046-F4 R2 DATUM Geodetic LOCATION N5331525.3 E372618.2 - Dunnet Township - Nepewassi River Bridge ORIGINATED BY AT

PROJECT GWP 5573-04-00, Highway 535 - Site No. 46-130 BOREHOLE TYPE Track Mounted CME 55 - Hollow Stem Augers & N Casing COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) June 14, 2011 DATE (Completed) June 15, 2011 TIME 4:20:00 AM CHECKED BY MAM

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS
208.9	Asphalt Surface					
0.0	± 200 mm Asphalt ± 350 mm Concrete ± 130 mm Void FILL - brown to reddish brown lightweight blast furnace slag fill (very dense/ compact)		1	SS	81	
			2	SS	22	
			3	SS	33	
			4	SS	45	
204.6			5	SS	33	
4.3	DCPT Refusal Geotextile at 4.3 m depth SILTY CLAY - grey to black silty clay trace sand trace organics trace asphalt sand and gravel layer 150 mm thick at 5.5 m depth (very stiff)		6	SS	11	
			7	SS	7	
			8	SS	8	
			9	SS	6	
200.1						
8.8	CLAY - grey silty clay and clay (high/medium plasticity) (stiff/very stiff)		10	SS	4	
			11	TO	WH	
	(firm)		12	SS	WH	
			13	SS	WH	
	(stiff)		14	TO	WH	
			15	SS	WH	
			16	TO	WH	
	Continued Next Page					





UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
	2 93 (5)
	1 97 (2)
	1 96 (3)
	0 96 (4)
15.9	Consolidation Test

COMMENTS

Water levels shown on log refer to the 15 m deep piezometer (i.e. tip ay elevation 194 m). Water levels in the 4.7 m deep well was measured at 4.5 m depth on June 20, and was dry on August 16, 2011.

The stratification lines represent approximate boundaries. The transition may be gradual.

+ 3, × 3 : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 8/16/11	4.8	-
2)	-	-
3)	-	-

MEL-GEO 11046 - BH LOGS - NEPEWASSI RIVER BRIDGE.GPJ MEL-GEO.GDT 12/8/11

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ENCLOSURE NO.:4 (Pg. 2 of 2)

METRIC

RECORD OF BOREHOLE NO. LVM-3

REFERENCE 11/04/11046-F4 R2 DATUM Geodetic LOCATION N5331525.3 E372618.2 - Dunnet Township - Nepewassi River Bridge ORIGINATED BY AT

PROJECT GWP 5573-04-00, Highway 535 - Site No. 46-130 BOREHOLE TYPE Track Mounted CME 55 - Hollow Stem Augers & N Casing COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) June 14, 2011 DATE (Completed) June 15, 2011 TIME 4:20:00 AM CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						GR SA (SI CL)
	Continued from Previous Page										
	CLAY - grey silty clay and clay (high/medium plasticity)		17	SS	WH			+ 4			
187.3							188				
187.0	SILTY SAND - grey silty sand trace gravel trace clay		18	TO	WH				○		
21.9	Auger Refusal End of Borehole						187				

MEL-GEO 11046 - BH LOGS - NEPEWASSI RIVER BRIDGE.GPJ MEL-GEO.GDT 12/8/11

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ENCLOSURE NO.:5 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. LVM-4

REFERENCE 11/04/11046-F4 R2 DATUM Geodetic LOCATION N5331529.3 E372624.0 - Dunnet Township - Nepewassi River Bridge ORIGINATED BY JL

PROJECT GWP 5573-04-00, Highway 535 - Site No. 46-130 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started) June 21, 2011 DATE (Completed) June 21, 2011 TIME 9:10:00 AM CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	w_P w w_L WATER CONTENT (%)	γ kN/m³	GR SA (SI CL)
209.1	Asphalt Surface							20 40 60 80 100	20 40 60		
0.0	± 275 mm Asphalt ± 250 mm Crushed Gravel FILL - brown to reddish brown lightweight blast furnace slag fill (compact/very dense)		1	AS	N/A		208				
			2	SS	50/ 125 mm						
			3	SS	44		207				0 97 (3)
			4	SS	29		206				
			5	SS	39						
			6	SS	58		205				0 96 (4)
204.6											
4.5	Auger Refusal End of Borehole See Borehole No. LVM-4a										

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1)	-	-
2)	-	-
3)	-	-

MEL-GEO 11046 - BH LOGS - NEPEWASSI RIVER BRIDGE.GPJ MEL-GEO.GDT 12/8/11

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ENCLOSURE NO.:6 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. LVM-4a

REFERENCE 11/04/11046-F4 R2 DATUM Geodetic LOCATION N5331529.3 E372624.0 - Dunnet Township - Nepewassi River Bridge ORIGINATED BY JL

PROJECT GWP 5573-04-00, Highway 535 - Site No. 46-130 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) September 8, 2011 TIME CHECKED BY MAM

DATE (Completed) September 8, 2011

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
209.1	Asphalt Surface						
0.0	± 225 mm Asphalt FILL - brown to reddish brown lightweight blast furnace slag fill based on auger cuttings						208
204.8							207
4.3	FILL - sands and gravels some silt frequent cobble/boulder size rock pieces in granular matrix		1	SS	50/100mm		206
203.8							205
5.3	SILTY CLAY - dark grey silty clay trace organics trace sand (very stiff)		2	SS	9		204
			3	SS	9		203
			4	SS	8		202
200.0							201
9.1	CLAY - grey clay sand w/ silt seam at 9.2 m (firm)		5	SS	7		200
			6	SS	PM		199
			7	SS	PM		198
			8	SS	PM		197
			9	SS	PM		196
193.0							195
16.1	End of Sampling End of Borehole						194
							193

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
20 40 60

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA (SI CL)

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+ 3, × 3 : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1)	-	-
2)	-	-
3)	-	-

MEL-GEO 11046 - BH LOGS - NEPEWASSI RIVER BRIDGE.GPJ MEL-GEO.GDT 12/8/11

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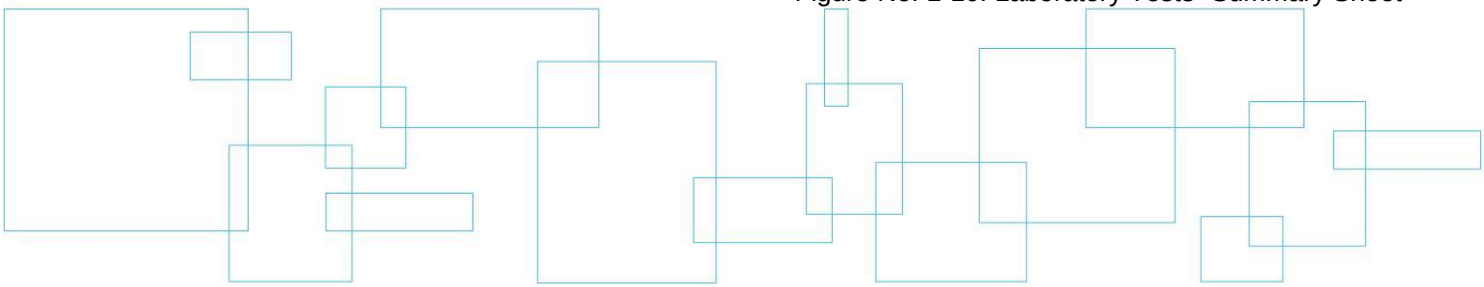
Appendix C Borehole Location Plan Labwork

Figure No. 2: Borehole Location and Soil Strata
Figure Nos. L-1a, L-1b and L-2: Grain Size Analysis Graph
Figure Nos. L-3 and L-4: Plasticity Chart
Figure No. L-5: In-Situ Shear Strengths vs. Elevation
Figure Nos. L-6a to L9c: Consolidation Test Results and Summary
Figure No. L-10: Laboratory Tests- Summary Sheet



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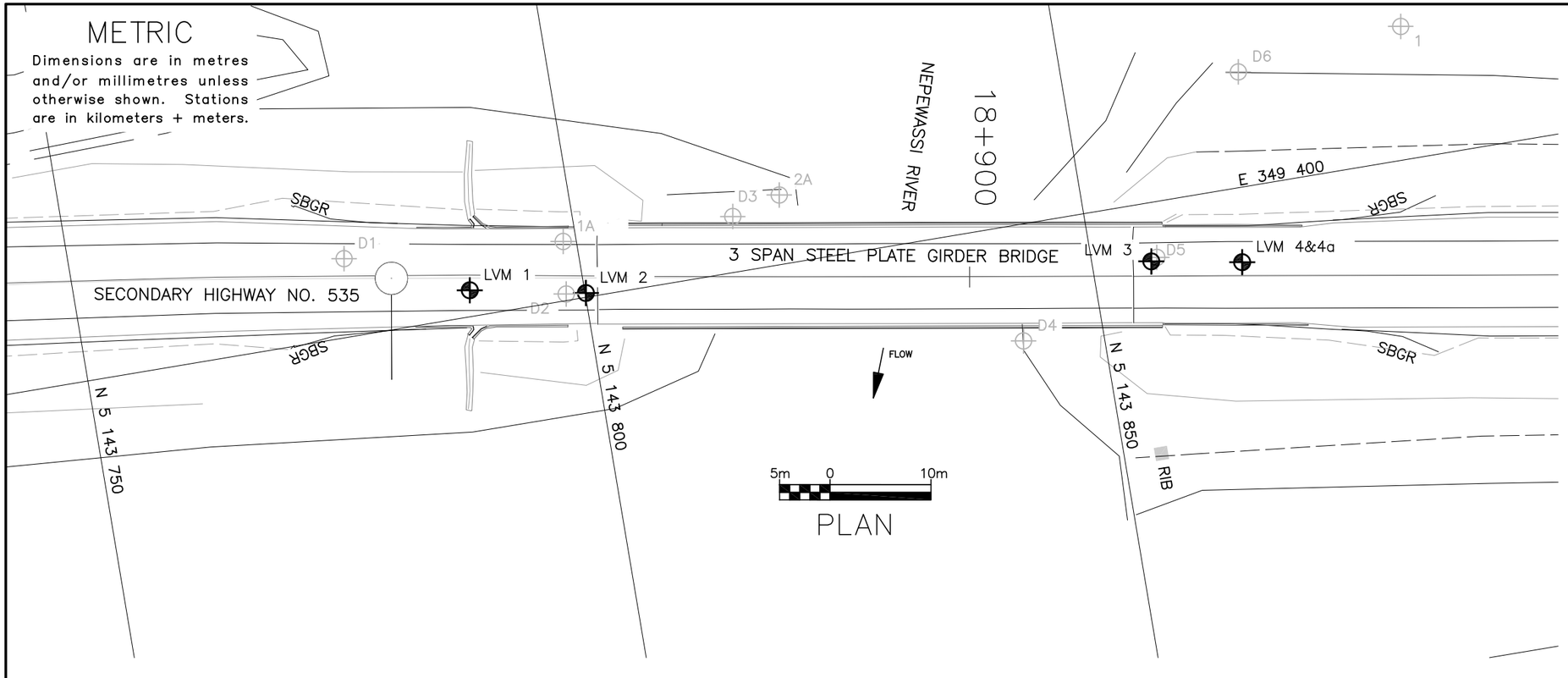
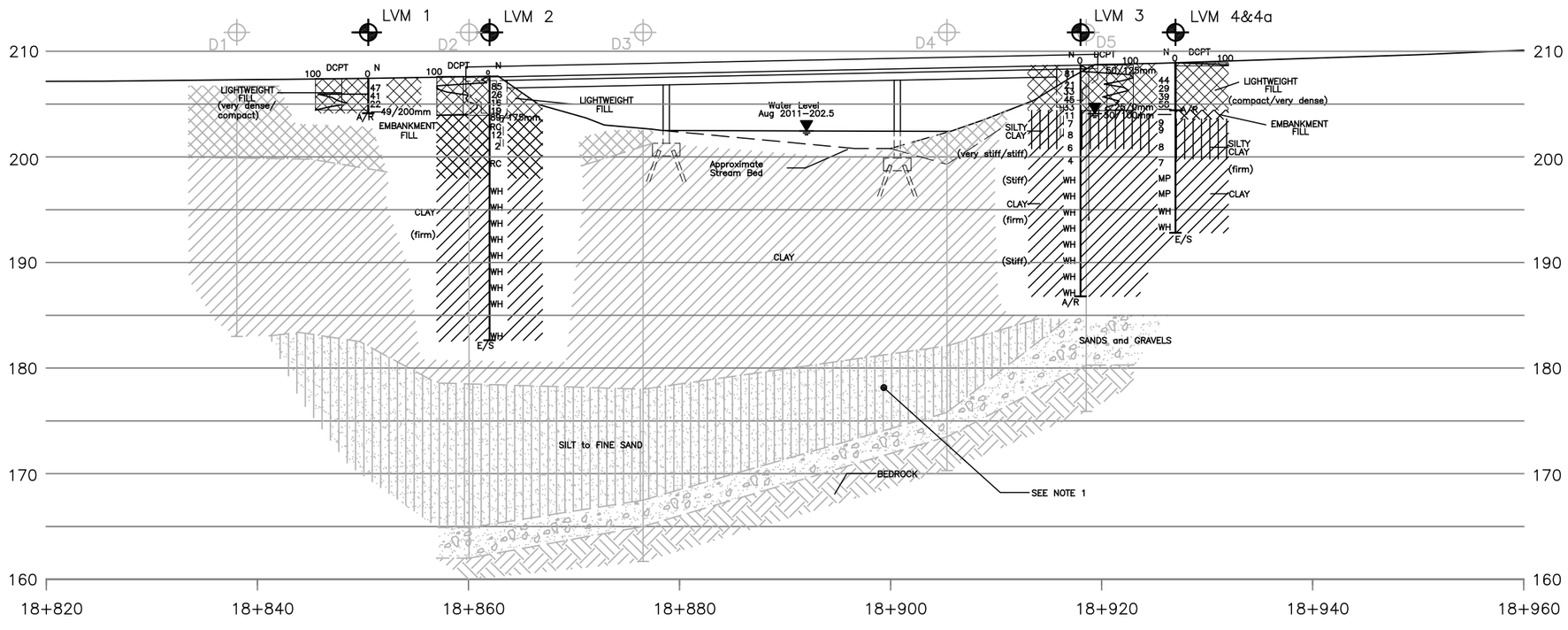
METRIC

Dimensions are in metres and/or millimetres unless otherwise shown. Stations are in kilometers + meters.



PLAN



PROFILE

SITE No	46–130
WP No	5573–04–00
GEOCRES No	41I–278

N

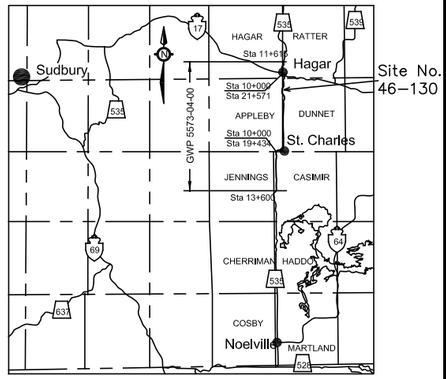
HWY NO. 535 – Township of Dunnet

Nepewassi River Bridge – Site No. 46–130 Approach Fill Settlement

BOREHOLE LOCATIONS & SOIL STRATA

Figure 2

L|V|M | MERLEX



KEY PLAN – NOT TO SCALE

LEGEND

- LVM Borehole
- Boreholes by Others
- "N" Blows/0.3 m (Std Pen Test, 475 J/blow)
- DCPT Blows/0.3 m (60° Cone, 475 J/blow)
- Water Level at Time of Investigation
- A/R Auger Refusal at Elevation
- E/S End of Sampling

Borehole No.	Elev.	O/S	Station	Co-ordinates Northerly	Co-ordinates Easterly
Borehole No. LVM1	207.7	1.2m Rt	18+851	5143789	349398
Borehole No. LVM2	207.8	1.5m Rt	18+862	5143800	349400
Borehole No. LVM3	208.9	1.5m Lt	18+918	5143856	349406
Borehole No. LVM4	209.1	1.1m Lt	18+927	5143865	349408
Borehole No. LVM4a	209.1	1.1m Lt	18+928	5143866	349408

NOTE 1:

Borehole Nos. D1, D2, D3, D4, D5, D6, 1A, 2A and 1 (in greyscale) were advanced under three previous investigations by others. Reproduced for general information and completeness of stratigraphy.

NOTE 2:

The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design purposes only.

REVISIONS	DATE	BY	DESCRIPTION
	Oct 2011	MCM	Final

HWY No. 535 – Dunnet Twp – Nepewassi River Bridge			REF: 11046
SUBM'D			SITE 46–130
DRAWN RG	CHK MAM	DATE June 2011	FIG 2

Reference No.: 11/04/11046-F4 R2
Date: December 2011

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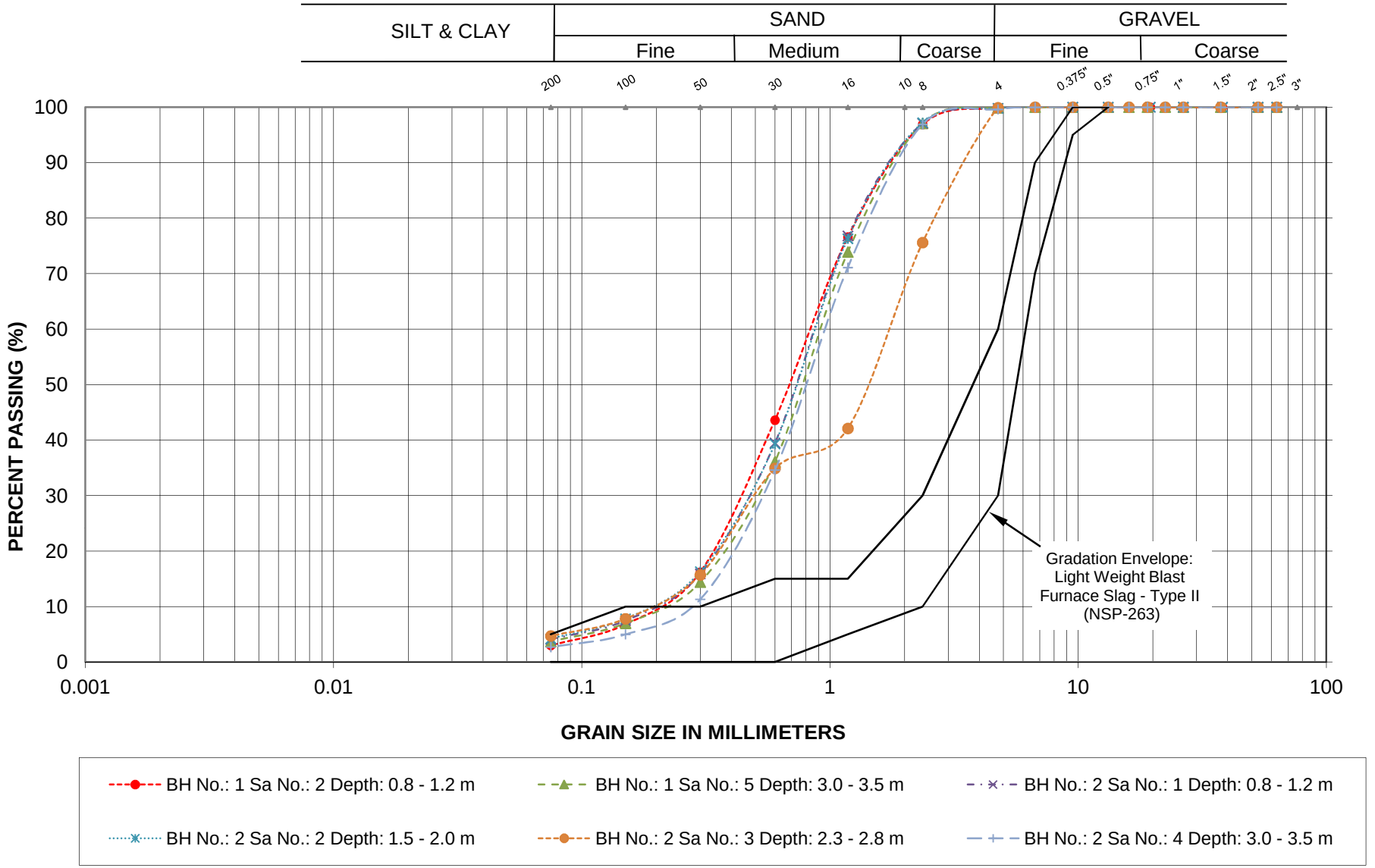
GRAIN SIZE ANALYSIS



PROJECT: Hwy 535 - Nepewassi Bridge
LOCATION: Site No. 46-130

LBFS FILL

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FIGURE L-1a

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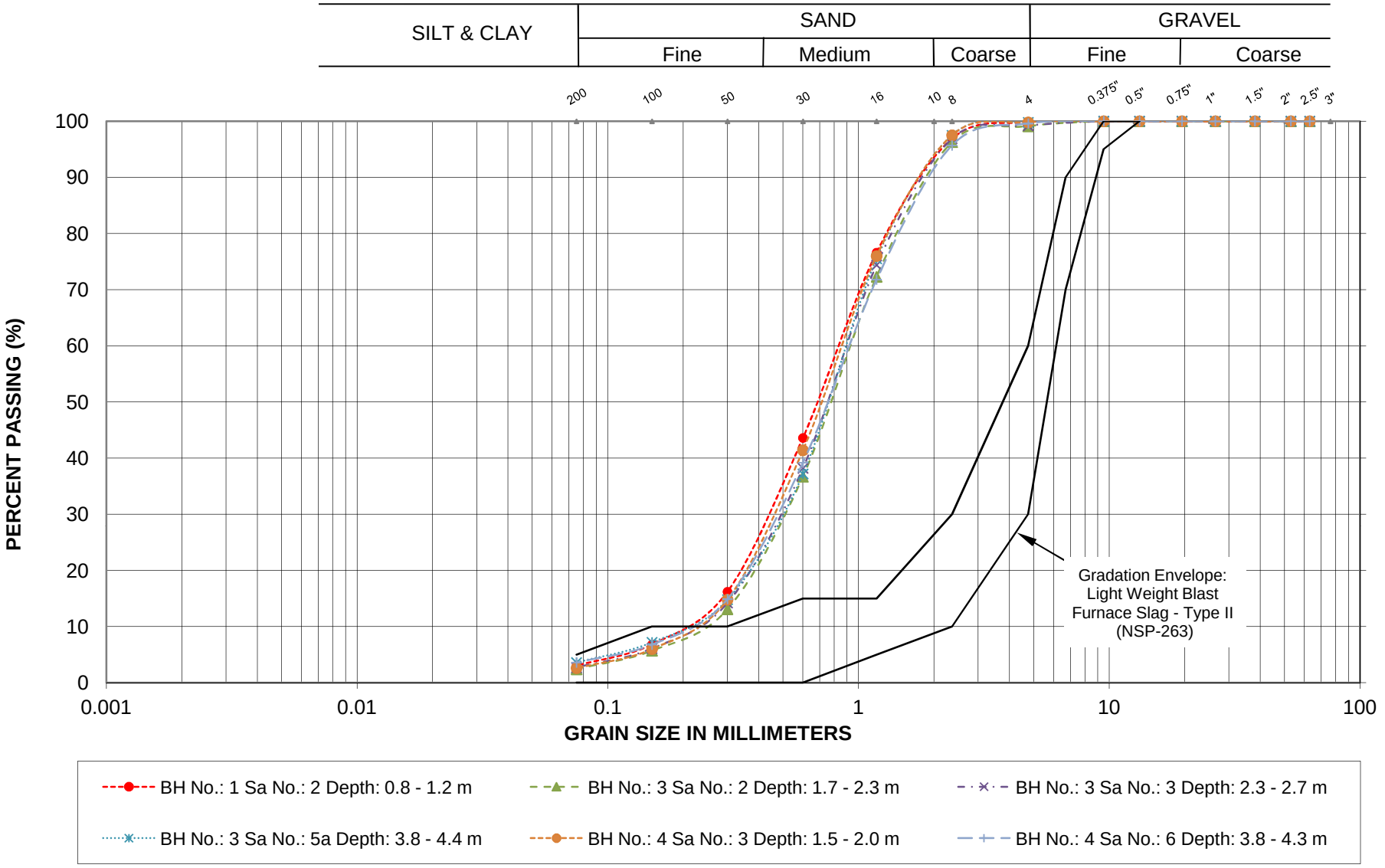
GRAIN SIZE ANALYSIS



LBFS FILL

PROJECT: Hwy 535 - Nepewassi Bridge
LOCATION: Site No. 46-130

LVM | MERLEX

FIGURE L-1b

Reference No.: 11/04/11046-F4 R2
Date: December 2011

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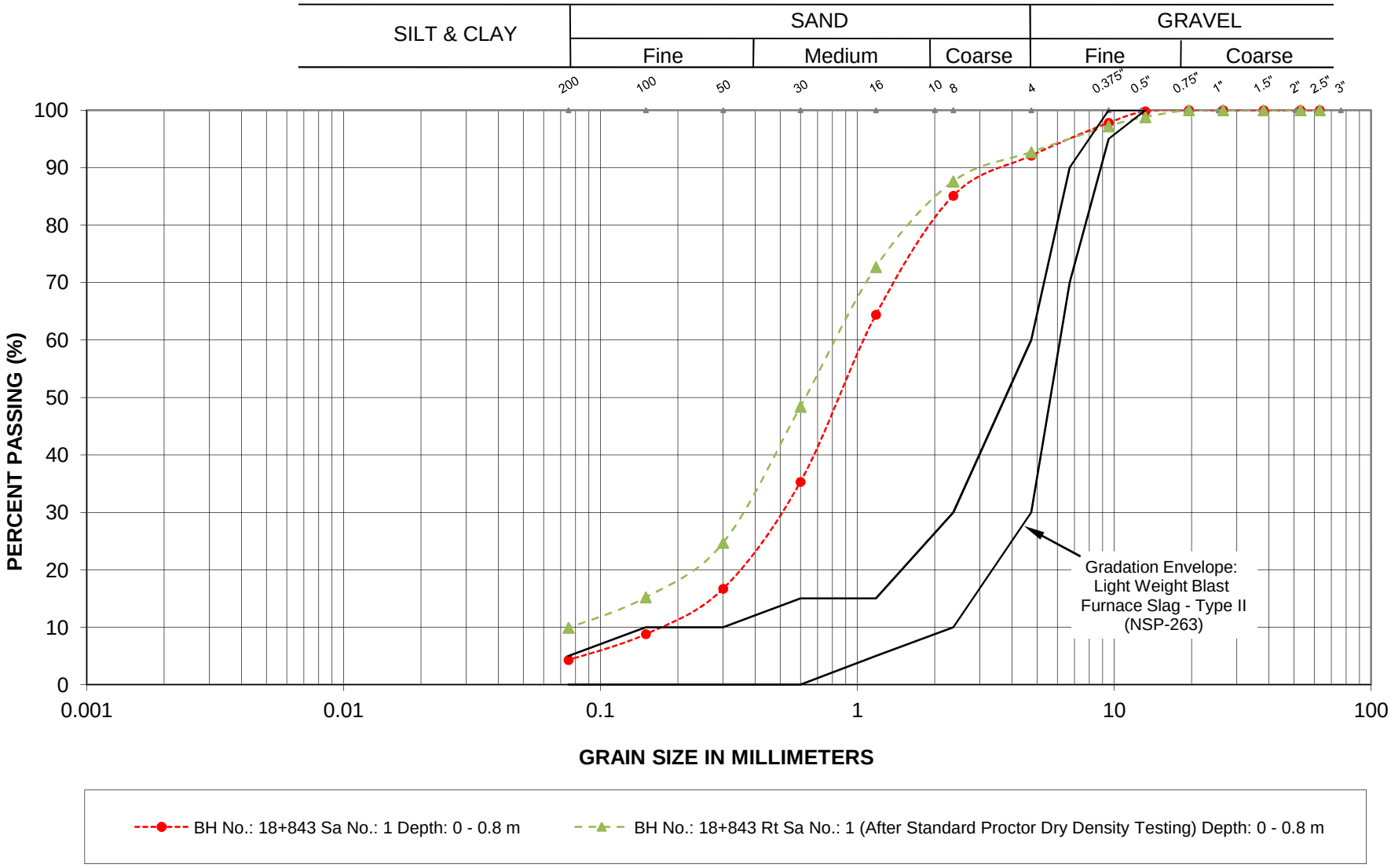
GRAIN SIZE ANALYSIS



LBFS Fill
Before and After SPDD Test
Standard Proctor Density 1580kg/m^3
Optimum Moisture 20.5%
LVM | MERLEX

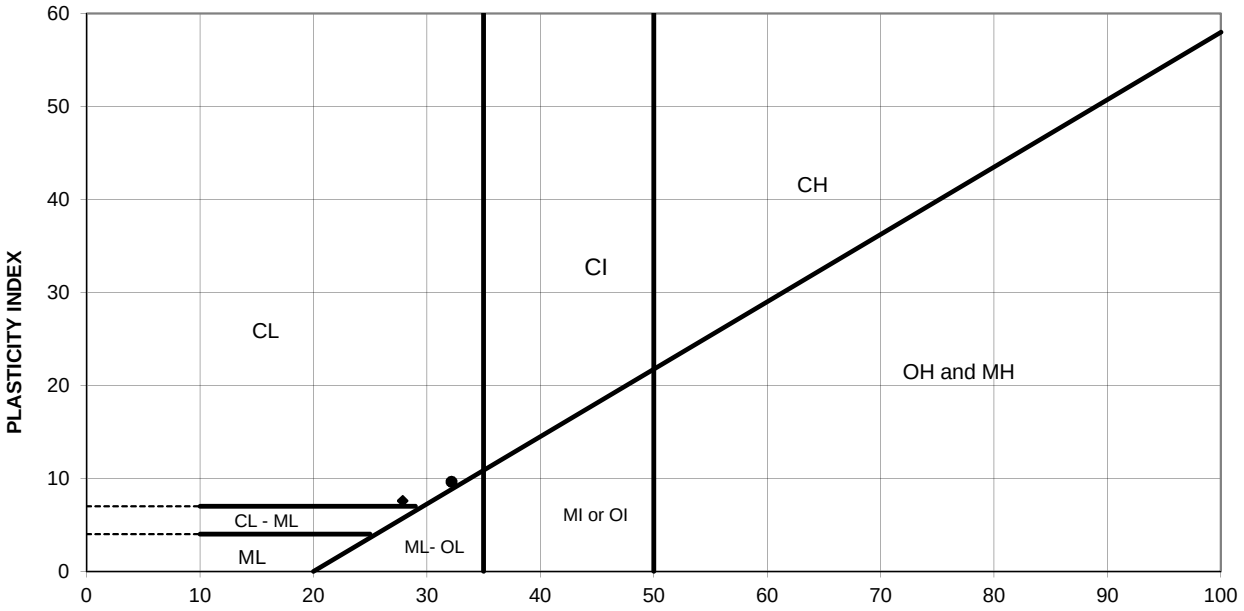
PROJECT: Hwy 535 - Nepewassi Bridge
LOCATION: Site No. 46-130

FIGURE L-2

ATTERBERG LIMITS TEST RESULTS

FIGURE L-3

ATTERBERG INDICES



SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	3	8	6.1	202.8	32.2	22.5	9.7	21.6
◆	3	9a	7.6	201.3	27.8	20.2	7.6	24.3

Date: Dec-11
Project: Hwy 535 - Site 46-130
G.W.P: 5573-04-00

Prep'd: AT
Chkd: RG
Ref. No.: 11/04/11046-F4 R2

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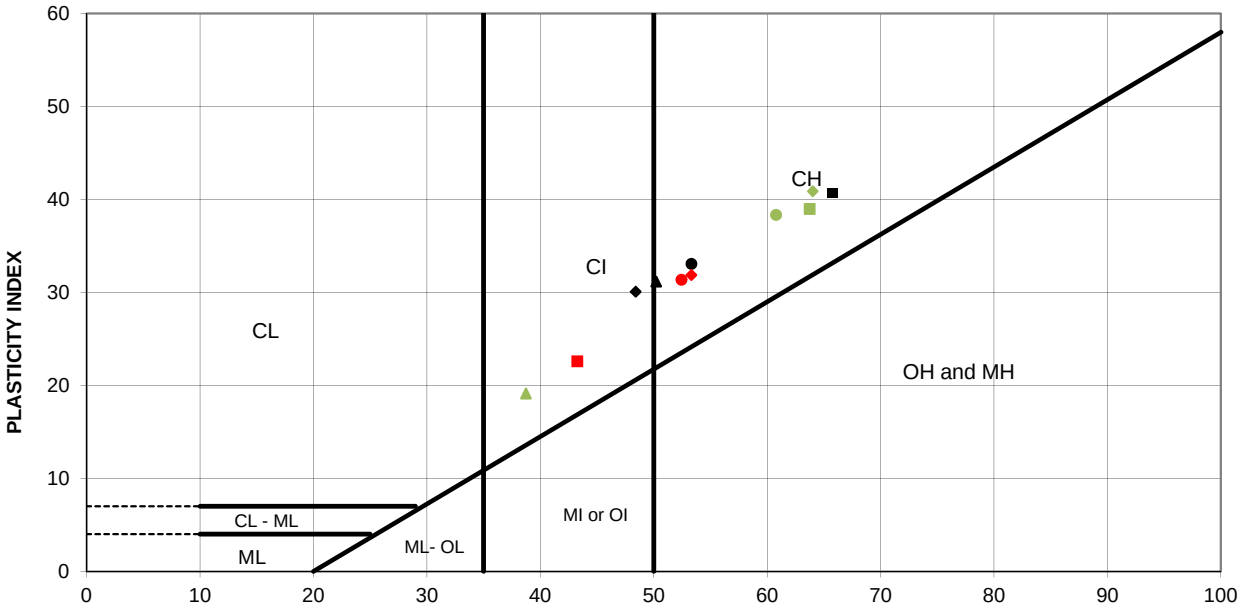
ATTERBERG LIMITS TEST RESULTS	FIGURE L-4

ATTERBERG INDICES



SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	2	11	12.2	195.6	53.3	20.2	33.1	40.3
◆	2	12	13.7	194.1	48.4	18.3	30.1	41.8
■	2	14	16.8	191.0	65.8	25.1	40.7	58.1
▲	2	15	18.3	189.5	50.2	19.0	31.2	63.5
●	2	16	19.8	188.0	52.4	21.0	31.4	55.4
◆	2	17	21.3	186.5	53.3	21.4	31.9	60.6
■	2	18	24.4	183.4	43.2	20.6	22.6	38.4
▲	3	12	12.2	196.7	38.7	19.6	19.2	46.8
●	3	14	15.2	193.7	60.8	22.4	38.4	59.9
◆	3	16	18.3	190.6	64.0	23.1	40.9	69.9
■	3	17	19.8	189.1	63.7	24.7	39.0	62.6

Date: Dec-11
Project: Hwy 535 - Site 46-130
G.W.P: 5573-04-00

Prep'd: AT
Chkd: RG
Ref. No.: 11/04/11046-F4 R2

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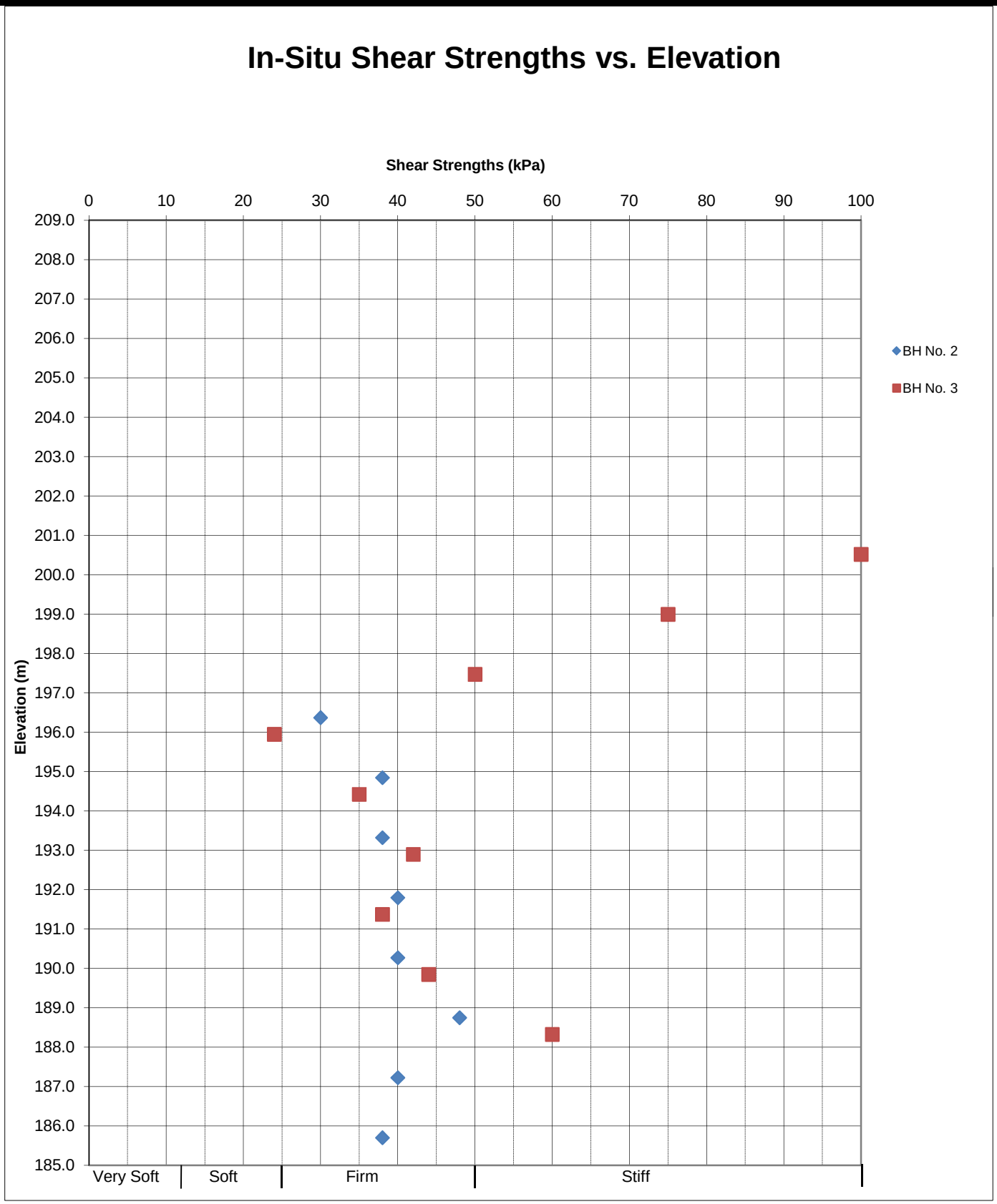
IN-SITU SHEAR STRENGTHS	Figure No. L-5



Date: December 2011
Project: 11/04/11046-F4 R2
Location: Site No. 46-130

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Checked:MAM

CONSOLIDATION TEST SUMMARY

FIGURE L-6a

SAMPLE IDENTIFICATION

Project Number	11-1183-0039	Sample Number	11
Borehole Number	2	Sample Depth, m	12.2

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	10		
Date Started	6/24/2011		
Date Completed	7/08/2011		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m^3	17.92
Sample Diameter, cm	6.30	Dry Unit Weight, kN/m^3	12.69
Area, cm^2	31.18	Specific Gravity, measured	2.75
Volume, cm^3	79.14	Solids Height, cm	1.195
Water Content, %	41.20	Volume of Solids, cm^3	37.25
Wet Mass, g	144.65	Volume of Voids, cm^3	41.89
Dry Mass, g	102.44	Degree of Saturation, %	100.8

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	c_v cm^2/s	m_v m^2/kN	k cm/s
0.00	2.538	1.125	2.538				
5.03	2.525	1.114	2.532	1	1.36E+00	1.00E-03	1.34E-04
9.03	2.522	1.111	2.524	83	1.63E-02	2.96E-04	4.71E-07
20.02	2.515	1.106	2.519	235	5.72E-03	2.47E-04	1.39E-07
40.46	2.502	1.094	2.509	485	2.75E-03	2.60E-04	7.01E-08
79.83	2.475	1.072	2.488	485	2.71E-03	2.68E-04	7.11E-08
160.23	2.420	1.026	2.448	576	2.20E-03	2.69E-04	5.81E-08
315.19	2.240	0.875	2.330	2907	3.96E-04	4.59E-04	1.78E-08
629.29	2.077	0.739	2.158	1500	6.58E-04	2.04E-04	1.32E-08
1259.30	1.950	0.632	2.014	853	1.01E-03	7.97E-05	7.87E-09
2470.11	1.841	0.541	1.895	628	1.21E-03	3.54E-05	4.21E-09
1259.30	1.845	0.544	1.843				
315.19	1.883	0.576	1.864				
79.83	1.932	0.617	1.908				
20.02	1.976	0.654	1.954				
5.03	2.014	0.686	1.995				

Note:

k calculated using cv based on t_{90} values.

Specimen swelled under 5kPa

Specimen taken 12cm from the bottom of the tube

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.01	Unit Weight, kN/m^3	20.40
Sample Diameter, cm	6.30	Dry Unit Weight, kN/m^3	16.00
Area, cm^2	31.18	Specific Gravity, measured	2.75
Volume, cm^3	62.80	Solids Height, cm	1.195
Water Content, %	27.54	Volume of Solids, cm^3	37.25
Wet Mass, g	130.65	Volume of Voids, cm^3	25.55
Dry Mass, g	102.44		

Prepared By: LFG

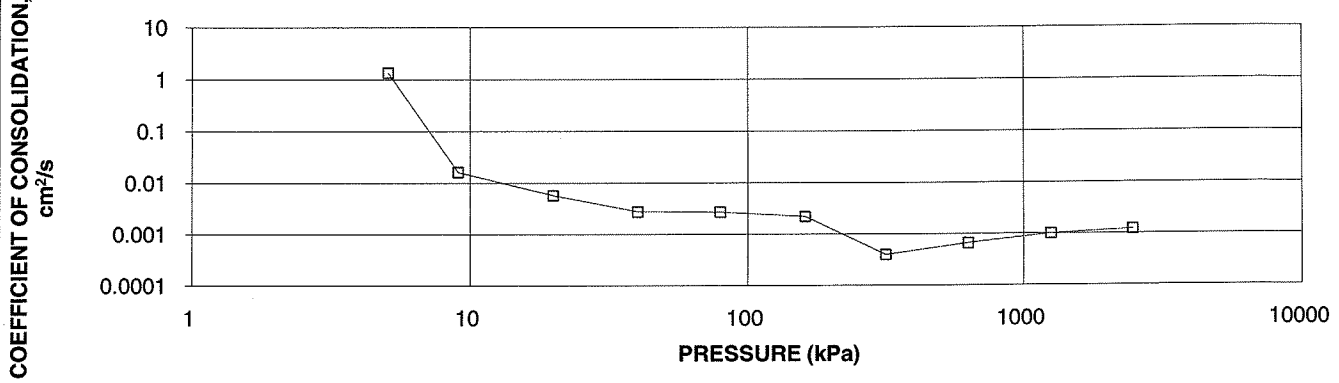
Golder Associates

Checked By:

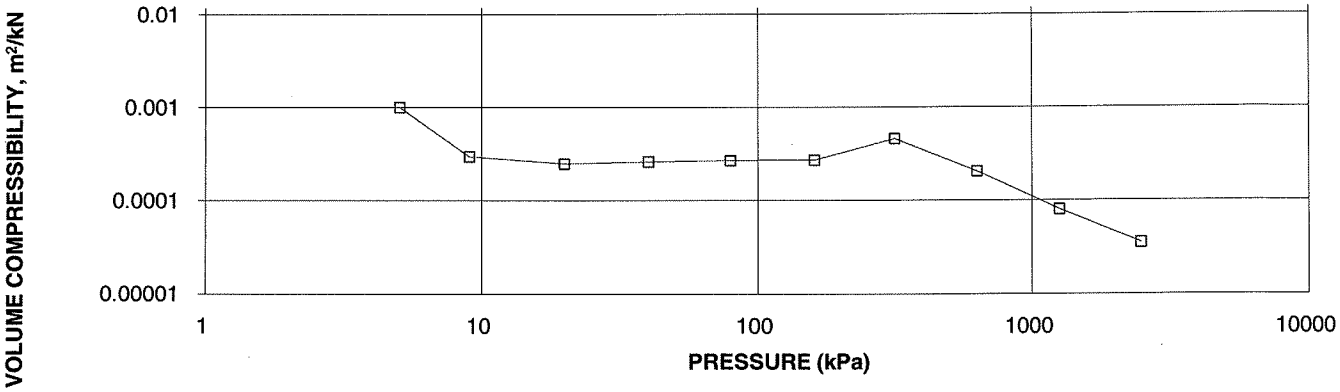
CONSOLIDATION TEST SUMMARY

FIGURE L-6b

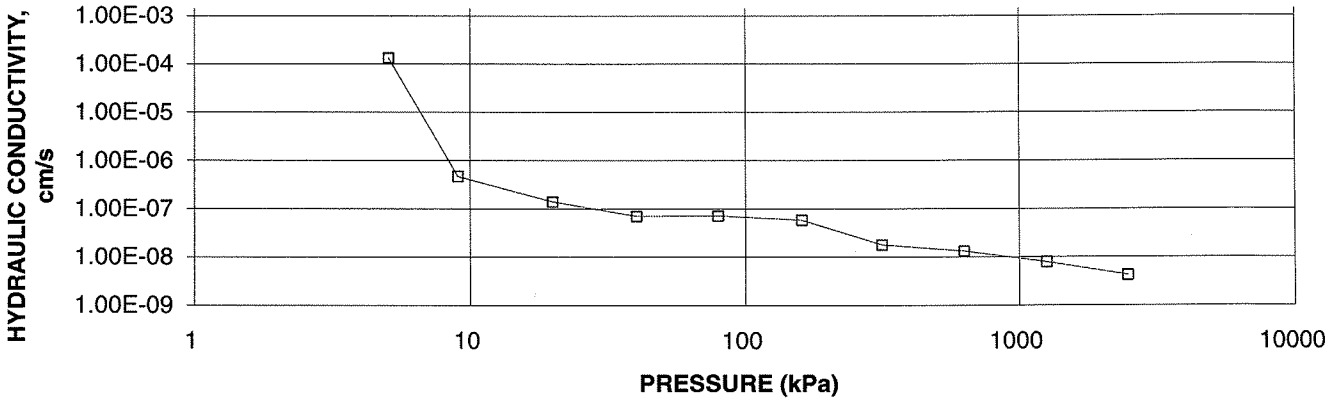
CONSOLIDATION TEST
C_V cm²/s VS PRESSURE (kPa)
BH 2 SA 11



CONSOLIDATION TEST
M_V m²/kN vs PRESSURE (kPa)
BH 2 SA 11



CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs PRESSURE
BH 2 SA 11



Project No. 11-1183-0039
Prepared By: LFG

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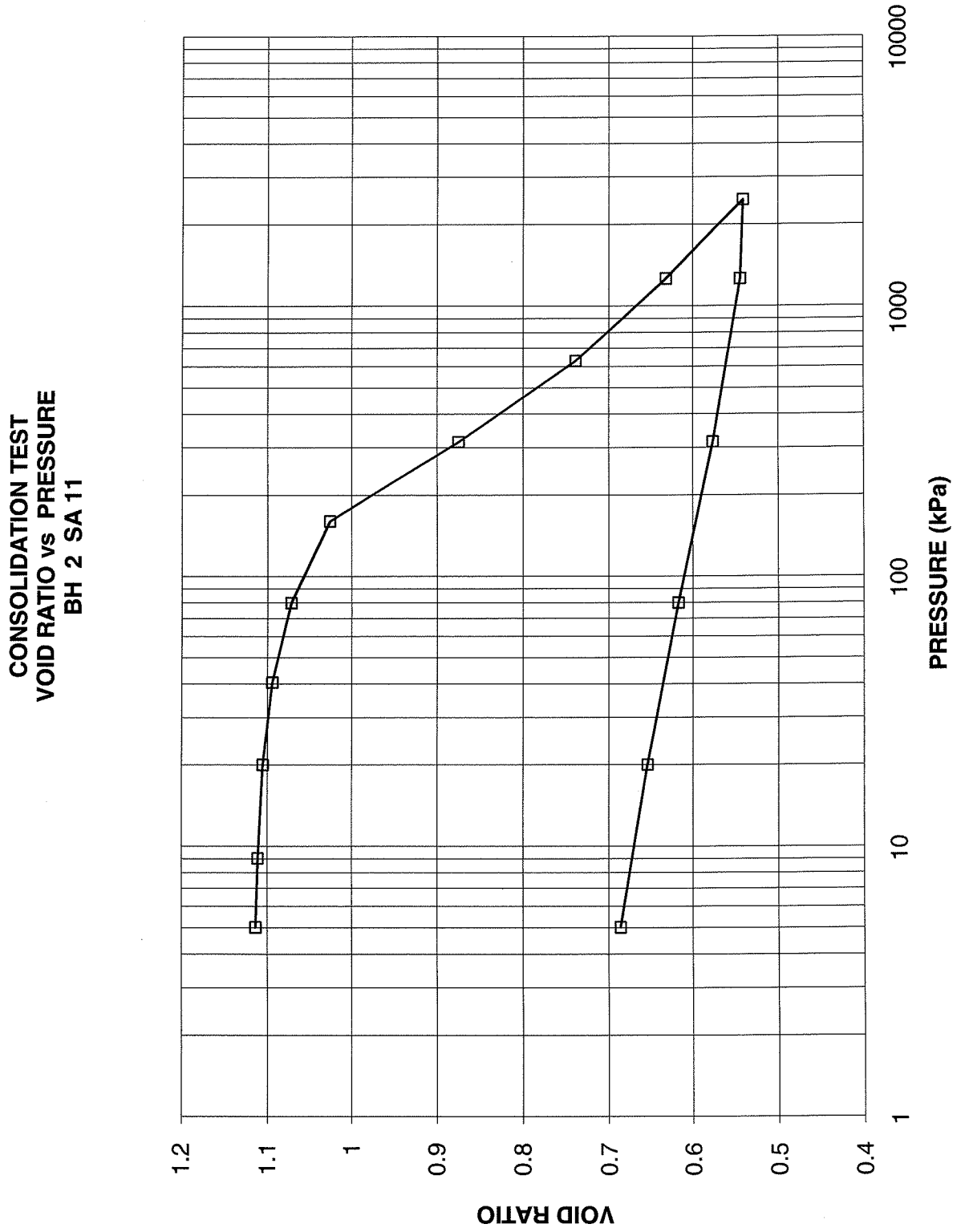
CONSOLIDATION TEST
VOID RATIO VS LOG PRESSURE

FIGURE L-6c



Project No. 11-1183-0039

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CONSOLIDATION TEST SUMMARY

FIGURE L-7a

SAMPLE IDENTIFICATION

Project Number	11-1183-0039	Sample Number	15
Borehole Number	2	Sample Depth, m	18.3

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	5		
Date Started	7/01/2011		
Date Completed	7/17/2011		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m^3	16.59
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m^3	10.87
Area, cm^2	31.55	Specific Gravity, measured	2.69
Volume, cm^3	80.07	Solids Height, cm	1.045
Water Content, %	52.71	Volume of Solids, cm^3	32.99
Wet Mass, g	135.50	Volume of Voids, cm^3	47.09
Dry Mass, g	88.73	Degree of Saturation, %	99.3

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	c_v cm^2/s	m_v m^2/kN	k cm/s
0.00	2.538	1.428	2.538				
4.98	2.538	1.427	2.538	2	6.83E-01	7.91E-06	5.29E-07
10.00	2.534	1.424	2.536	208	6.55E-03	3.14E-04	2.02E-07
19.96	2.529	1.419	2.531	652	2.08E-03	2.02E-04	4.12E-08
39.99	2.507	1.398	2.518	591	2.27E-03	4.33E-04	9.64E-08
80.00	2.473	1.365	2.490	620	2.12E-03	3.36E-04	6.98E-08
159.80	2.389	1.285	2.431	1500	8.35E-04	4.14E-04	3.39E-08
313.28	2.170	1.075	2.279	2746	4.01E-04	5.62E-04	2.21E-08
621.99	1.986	0.899	2.078	1771	5.17E-04	2.35E-04	1.19E-08
1242.10	1.843	0.763	1.914	1017	7.64E-04	9.09E-05	6.81E-09
2484.23	1.714	0.639	1.778	709	9.45E-04	4.09E-05	3.79E-09
1242.10	1.726	0.651	1.720				
313.28	1.770	0.693	1.748				
80.00	1.840	0.760	1.805				
19.96	1.904	0.821	1.872				
4.99	1.960	0.875	1.932				

Note:
k calculated using cv based on t_{90} values.
Specimen swelled under 10kPa
Specimen taken 12cm from the bottom of the tube

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.96	Unit Weight, kN/m^3	18.92
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m^3	14.07
Area, cm^2	31.55	Specific Gravity, measured	2.69
Volume, cm^3	61.83	Solids Height, cm	1.045
Water Content, %	34.45	Volume of Solids, cm^3	32.99
Wet Mass, g	119.30	Volume of Voids, cm^3	28.85
Dry Mass, g	88.73		

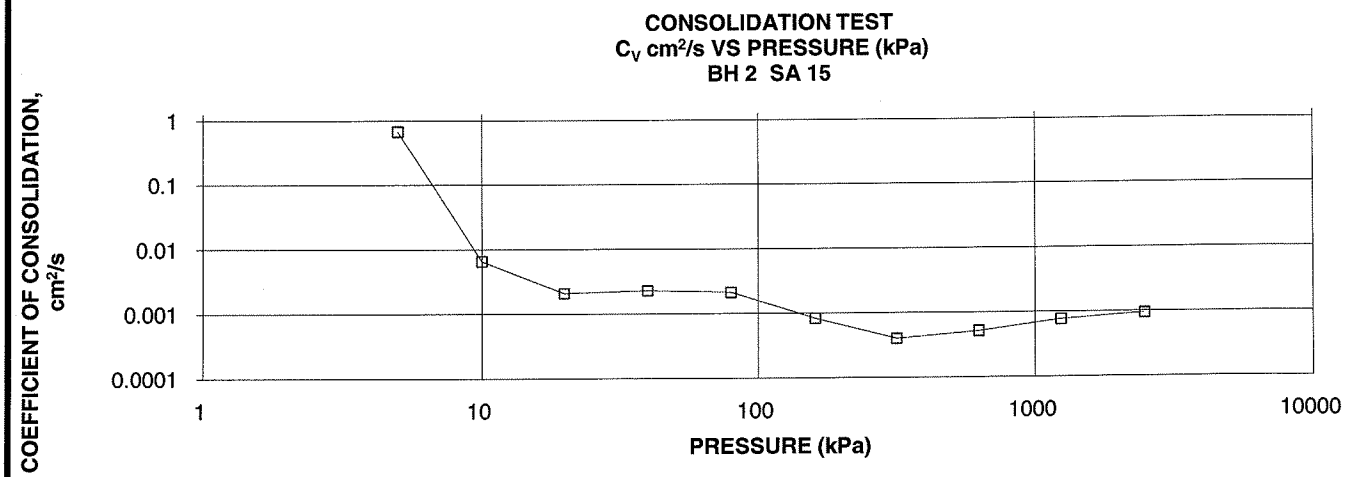
Prepared By: LFG

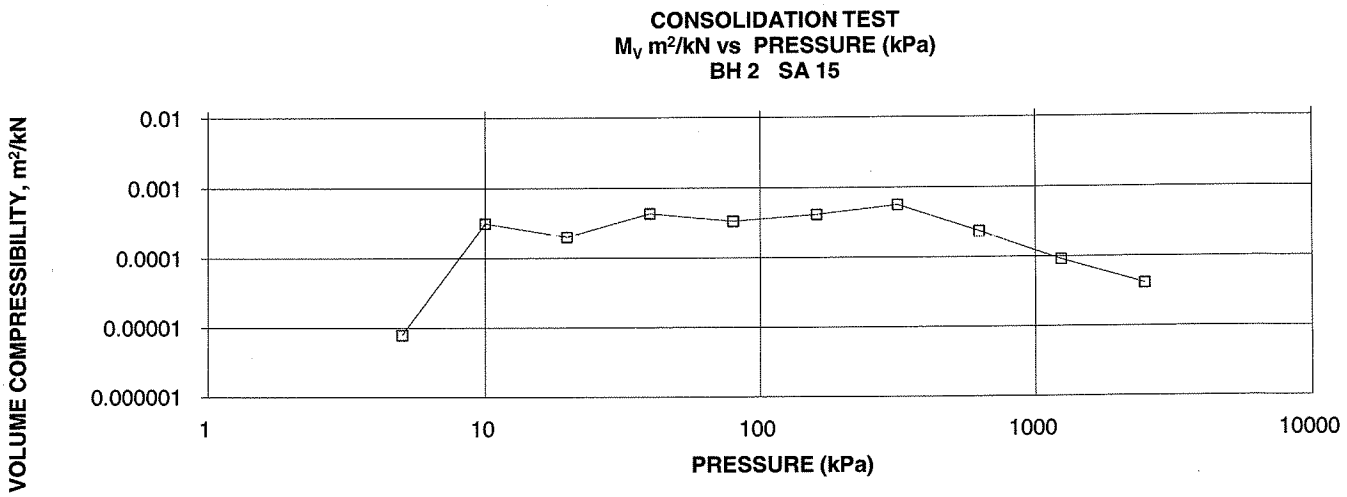
Golder Associates

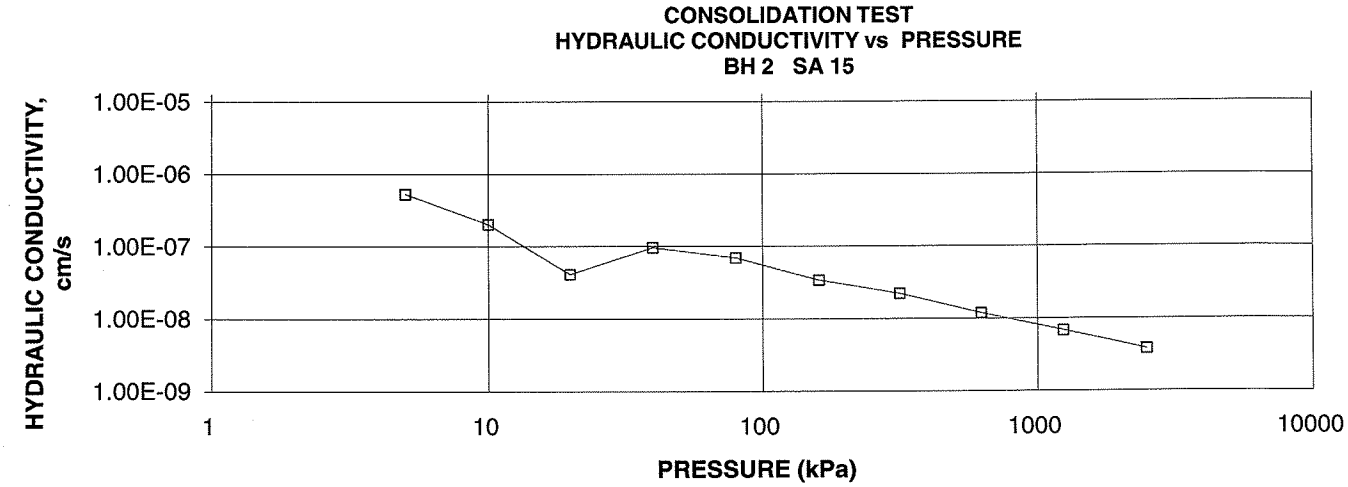
Checked By:

CONSOLIDATION TEST SUMMARY

FIGURE L-7b







Project No. 11-1183-0039
Prepared By: LFG

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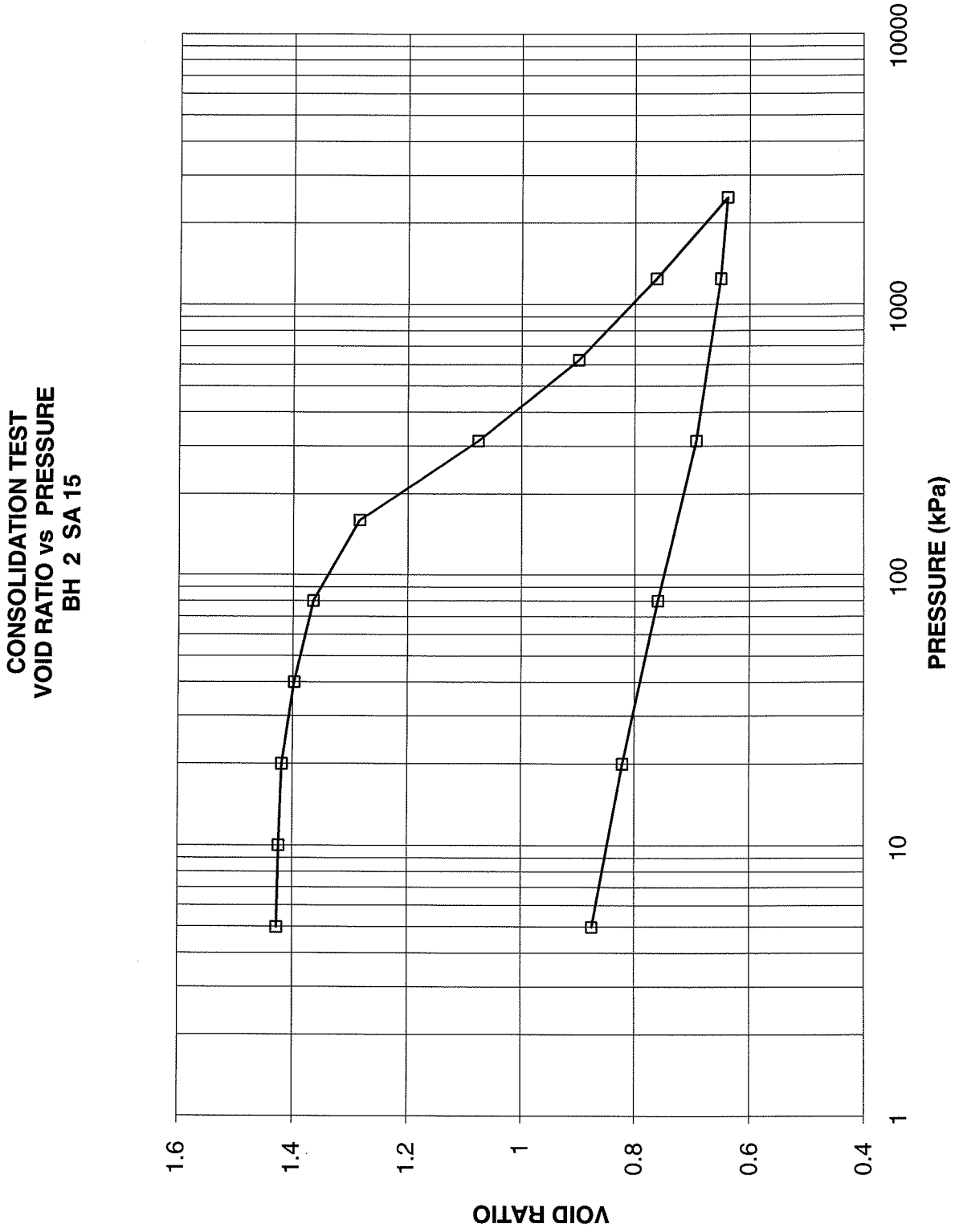
CONSOLIDATION TEST
VOID RATIO VS LOG PRESSURE

FIGURE L-7c



Project No. 11-1183-0039

Prepared By: LFG

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CONSOLIDATION TEST SUMMARY

FIGURE L-8a

SAMPLE IDENTIFICATION

Project Number	11-1183-0039	Sample Number	17
Borehole Number	2	Sample Depth, m	21.3

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	12		
Date Started	6/24/2011		
Date Completed	7/07/2011		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.55	Unit Weight, kN/m^3	16.37
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m^3	10.31
Area, cm^2	31.58	Specific Gravity, measured	2.76
Volume, cm^3	80.46	Solids Height, cm	0.970
Water Content, %	58.86	Volume of Solids, cm^3	30.64
Wet Mass, g	134.33	Volume of Voids, cm^3	49.83
Dry Mass, g	84.56	Degree of Saturation, %	99.9

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	c_v cm^2/s	m_v m^2/kN	k cm/s
0.00	2.548	1.626	2.548				
5.01	2.549	1.627	2.548	1	1.38E+00	-7.05E-05	-9.51E-06
9.84	2.549	1.627	2.549	4	3.44E-01	2.44E-05	8.22E-07
20.52	2.541	1.619	2.545	305	4.50E-03	2.98E-04	1.31E-07
39.98	2.521	1.598	2.531	652	2.08E-03	3.97E-04	8.11E-08
80.00	2.485	1.562	2.503	1116	1.19E-03	3.48E-04	4.06E-08
156.44	2.389	1.462	2.437	1744	7.22E-04	4.94E-04	3.50E-08
314.93	2.097	1.161	2.243	2469	4.32E-04	7.24E-04	3.06E-08
624.36	1.932	0.991	2.014	1500	5.74E-04	2.09E-04	1.17E-08
1246.31	1.796	0.851	1.864	923	7.98E-04	8.61E-05	6.73E-09
2438.45	1.680	0.732	1.738	667	9.60E-04	3.81E-05	3.58E-09
1246.31	1.688	0.739	1.684				
314.93	1.739	0.792	1.713				
79.37	1.800	0.855	1.769				
20.52	1.849	0.906	1.824				
5.01	1.894	0.952	1.871				

Note:
k calculated using cv based on t_{90} values.
Specimen swelled under 10kPa
Specimen taken 10cm from bottom

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

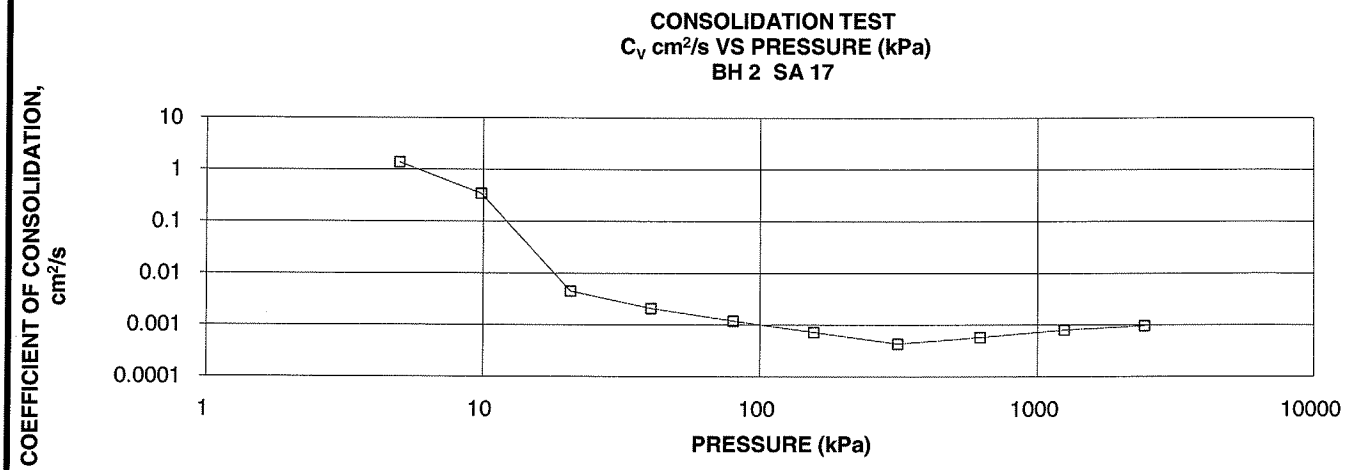
Sample Height, cm	1.89	Unit Weight, kN/m^3	18.77
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m^3	13.87
Area, cm^2	31.58	Specific Gravity, measured	2.76
Volume, cm^3	59.80	Solids Height, cm	0.970
Water Content, %	35.35	Volume of Solids, cm^3	30.64
Wet Mass, g	114.45	Volume of Voids, cm^3	29.16
Dry Mass, g	84.56		

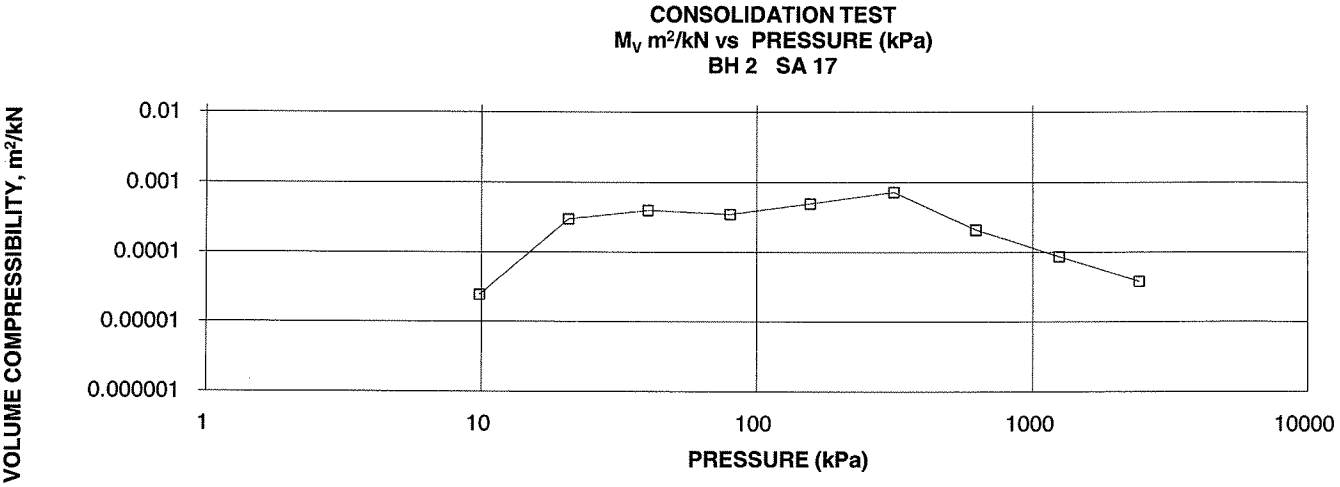
Prepared By: LFG

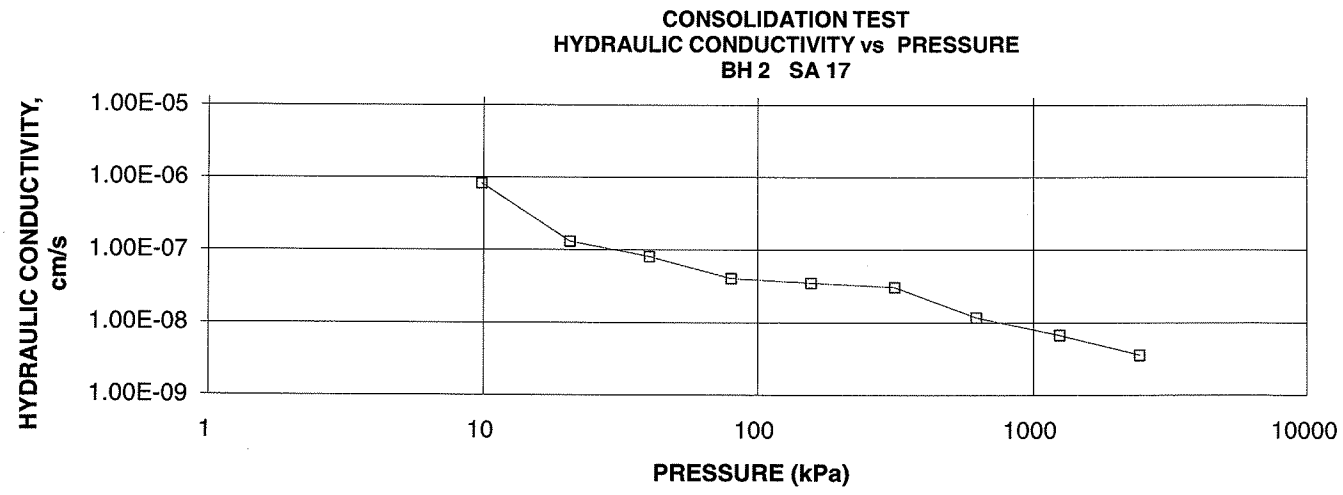
Golder Associates

Checked By:

CONSOLIDATION TEST SUMMARY	FIGURE L-8b







Project No. 11-1183-0039
Prepared By: LFG

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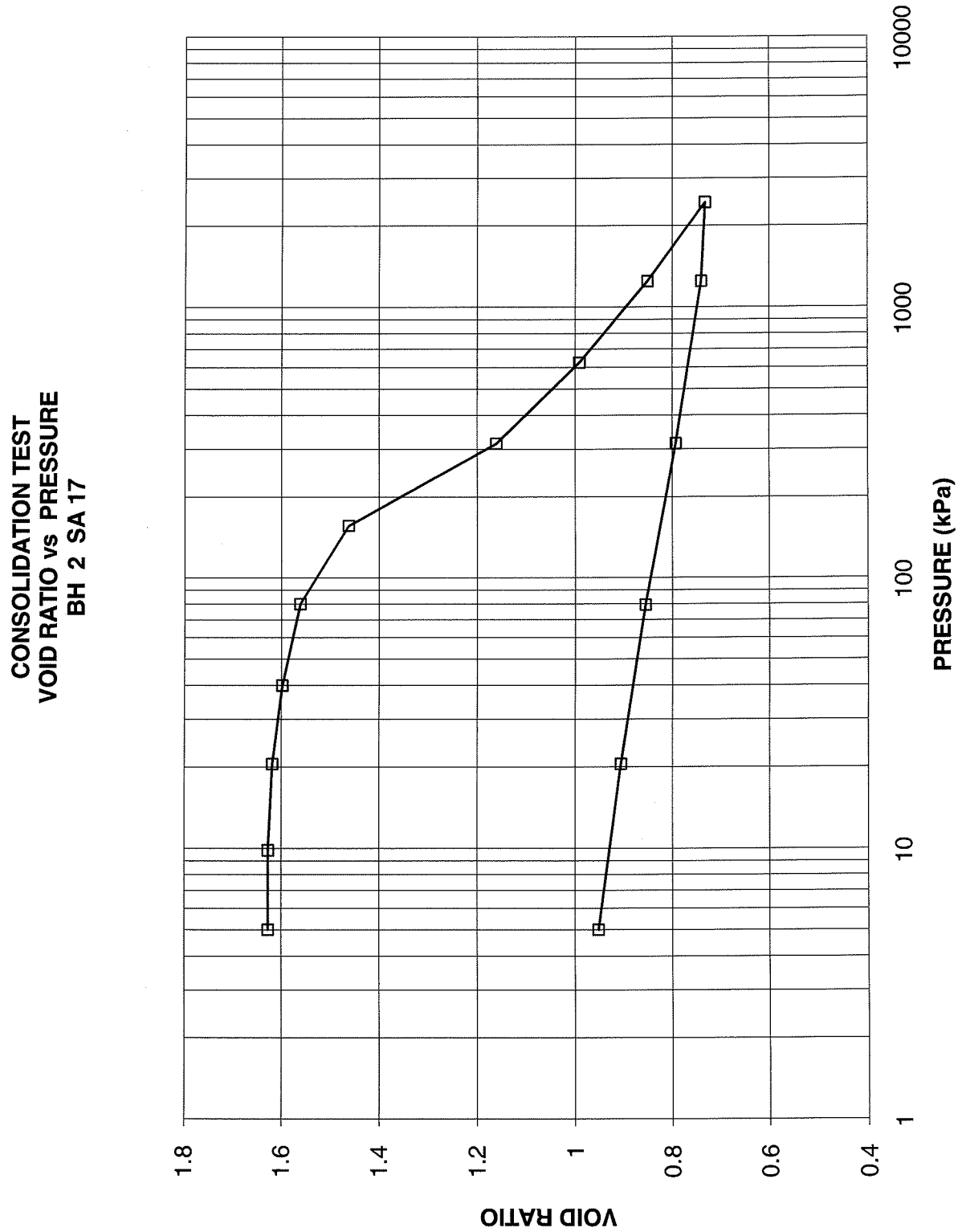
CONSOLIDATION TEST
VOID RATIO VS LOG PRESSURE

FIGURE L-8c



Project No. 11-1183-0039

Prepared By: LFG

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CONSOLIDATION TEST SUMMARY

FIGURE L-9a

SAMPLE IDENTIFICATION

Project Number	11-1183-0039	Sample Number	16
Borehole Number	3	Sample Depth, m	18.3

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	9		
Date Started	6/24/2011		
Date Completed	7/05/2011		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m^3	15.92
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	9.83
Area, cm^2	31.47	Specific Gravity, measured	2.77
Volume, cm^3	59.79	Solids Height, cm	0.688
Water Content, %	61.86	Volume of Solids, cm^3	21.65
Wet Mass, g	97.05	Volume of Voids, cm^3	38.15
Dry Mass, g	59.96	Degree of Saturation, %	97.2

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	c_v cm^2/s	m_v m^2/kN	k cm/s
0.00	1.900	1.762	1.900				
4.96	1.900	1.762	1.900	1	7.65E-01	0.00E+00	0.00E+00
9.94	1.903	1.767	1.902	3	2.56E-01	-3.17E-04	-7.94E-06
19.42	1.897	1.758	1.900	167	4.58E-03	3.33E-04	1.50E-07
40.00	1.888	1.745	1.893	239	3.18E-03	2.30E-04	7.17E-08
79.47	1.863	1.708	1.876	279	2.67E-03	3.33E-04	8.73E-08
160.63	1.757	1.554	1.810	1500	4.63E-04	6.87E-04	3.12E-08
312.72	1.553	1.258	1.655	2192	2.65E-04	7.06E-04	1.83E-08
628.31	1.401	1.037	1.477	1301	3.55E-04	2.53E-04	8.82E-09
1250.77	1.286	0.870	1.344	667	5.74E-04	9.72E-05	5.47E-09
2444.12	1.186	0.724	1.236	305	1.06E-03	4.41E-05	4.59E-09
1250.77	1.199	0.744	1.193				
312.72	1.241	0.805	1.220				
79.74	1.298	0.886	1.269				
21.11	1.341	0.950	1.319				
4.96	1.375	0.999	1.358				

Note:
k calculated using cv based on t_{90} values.
Specimen swelled under 10kPa
Specimen taken 12cm from the bottom of the tube

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.38	Unit Weight, kN/m^3	18.55
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	13.59
Area, cm^2	31.47	Specific Gravity, measured	2.77
Volume, cm^3	43.27	Solids Height, cm	0.688
Water Content, %	36.47	Volume of Solids, cm^3	21.65
Wet Mass, g	81.83	Volume of Voids, cm^3	21.63
Dry Mass, g	59.96		

Prepared By: LFG

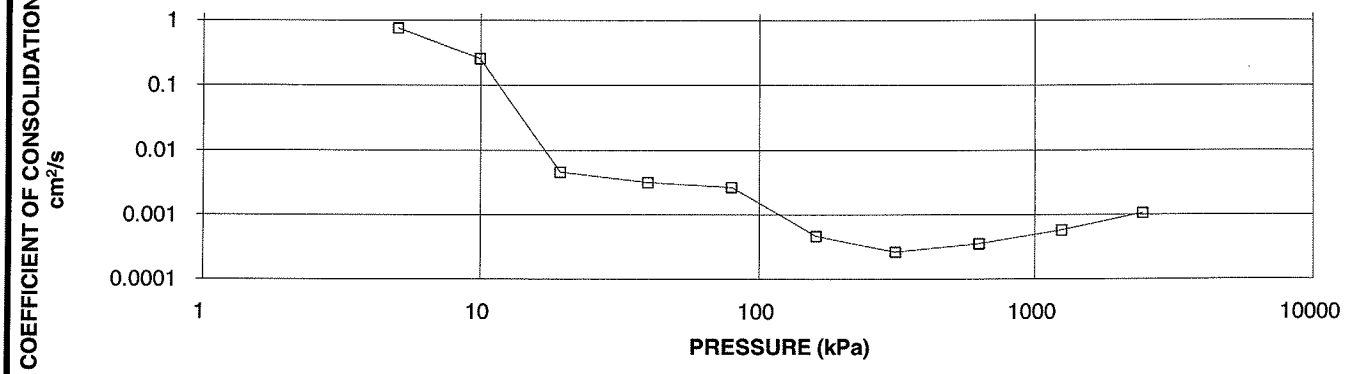
Golder Associates

Checked By:

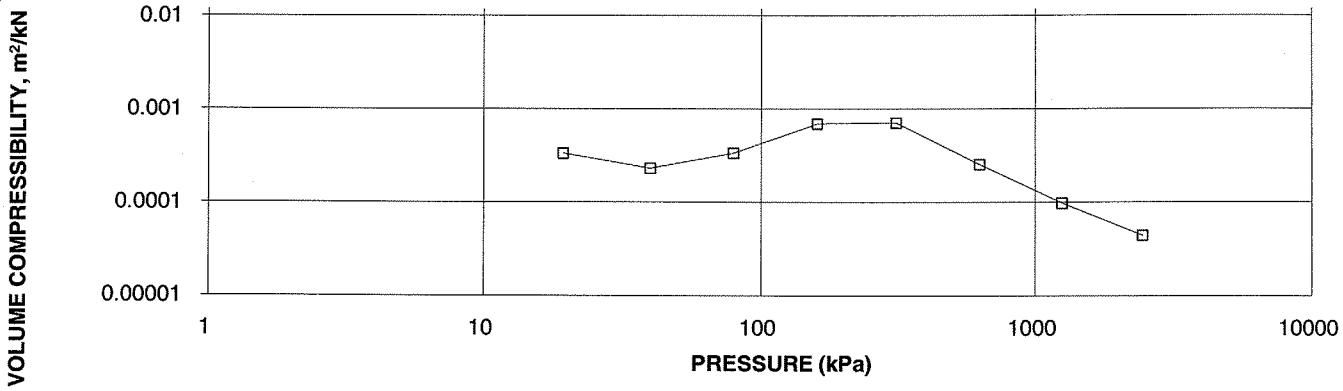
CONSOLIDATION TEST SUMMARY

FIGURE L-9b

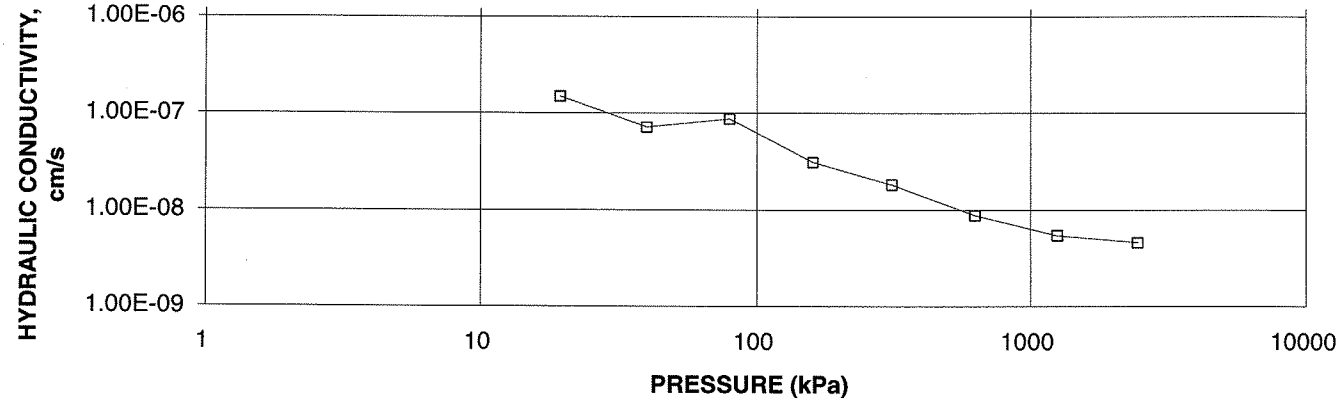
CONSOLIDATION TEST
C_V cm²/s VS PRESSURE (kPa)
BH 3 SA 16



CONSOLIDATION TEST
M_V m²/kN vs PRESSURE (kPa)
BH 3 SA 16



CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs PRESSURE
BH 3 SA 16



Project No. 11-1183-0039
Prepared By: LFG

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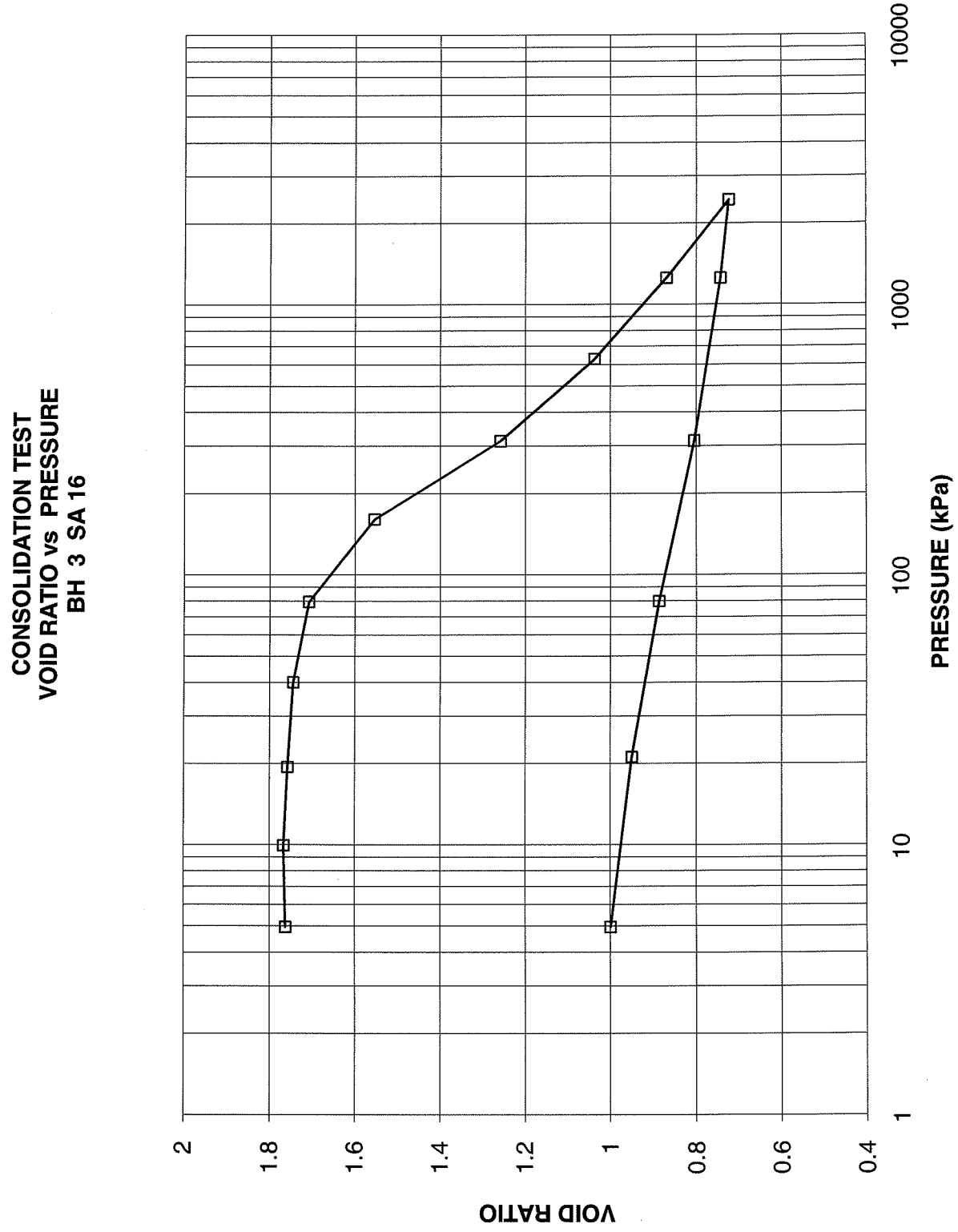
CONSOLIDATION TEST
VOID RATIO VS LOG PRESSURE

FIGURE L-9c



Project No. 11-1183-0039

Prepared By: LFG

Golder Associates

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Laboratory Tests - Summary Sheet

Borehole No.	Sample No.	Depth	Particle Size Analysis				NMC	Atterberg Limits			SPT 'N'	USCS	Unit Weight (kN/m3)	Remarks
			Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)		LL (%)	PL (%)	IP (%)				
1	1	0.0					7.0				N/A			
	2	0.8		97.0	3.0		13.3				47	SP		
	3	1.5					15.4				41			
	4	2.3					20.2				22			
	5a	3.0		96.0	4.0		18.8				49/200mm	SP		
	5b	3.0					8.2				49/200mm			
2	1	0.8		96.0	4.0		15.8				85	SP	13.0	Field unit weight Estimate
	2	1.5		96.0	4.0		14.7				26	SP	14.6	Field unit weight Estimate
	3	2.3		95.0	5.0		16.9				16	SP	13.8	Field unit weight Estimate
	4	3.0		97.0	3.0		16.1				19	SP	14.6	Field unit weight Estimate
	5	3.8					5.9				89/175mm			
	6	4.6									N/A			NQ Core - 25% Recovery
	7	5.3					8.4				12			
	8	6.4									2			<1" Recovery
	9	7.6									N/A			NQ Core - 13% Recovery
	10	10.7					41.3				WH			
	11	12.2					40.3	53.3	20.2	33.1	WH	CH	17.9	Consolidation
	12	13.7					41.8	48.4	18.3	30.1	WH			
	13	15.2					55.2				WH			
	14	16.8					58.1	65.8	25.1	40.7	WH	CH		
	15	18.3					63.5	50.2	19.0	31.2	WH	CH	16.6	Consolidation
	16	19.8					55.4	52.4	21.0	31.4	WH	CH		
	17	21.3					60.6	53.3	21.4	31.9	WH	CH	16.4	Consolidation
	18	24.4					38.8	43.2	20.6	22.6	WH	CI		
3	1	0.6	2.0	93.0	5.0		13.1				81	SP	19.0	Field unit weight Estimate
	2	1.7	1.0	97.0	2.0		14.9				22	SP	11.5	Field unit weight Estimate
	3	2.3	1.0	96.0	3.0		13.8				33	SP	13.8	Field unit weight Estimate

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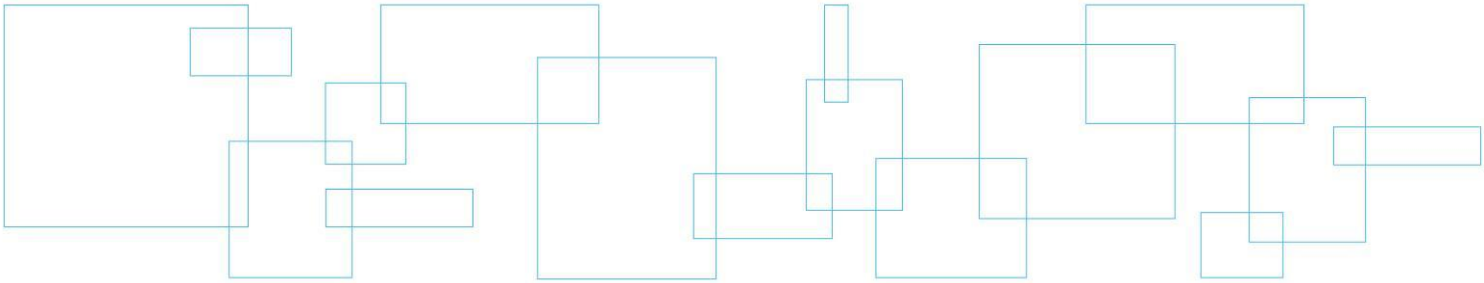
Laboratory Tests - Summary Sheet

Borehole No.	Sample No.	Depth	Particle Size Analysis				NMC	Atterberg Limits			SPT 'N'	USCS	Unit Weight (kN/m3)	Remarks
			Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)		LL (%)	PL (%)	IP (%)				
	4	3.0					17.3				45		15.5	Field unit weight Estimate
	5a	3.8	0.0	96.0	4.0		18.2				33	SP	17.1	Field unit weight Estimate
	5b	3.8					4.3				33			
	6a	4.6					15.3				11			
	6b	4.6					9.1				11			
	7	5.3					18.2				7			
	8	6.1					21.6	32.2	22.5	9.7	8	CL		
	9a	7.6					24.3	27.8	20.2	7.6	6	CL		
	9b	7.6					29.7				6			
	10	9.1					34.9				4			
	11	10.7									WH			
	12	12.2					46.8	38.7	19.6	19.2	WH	CI		
	13	13.7					45.1				WH			
	14	15.2					59.9	60.8	22.4	38.4	WH	CH		
	15	16.8					60.8				WH			
	16	18.3					69.9	64.0	23.1	40.9	WH	CH	15.9	Consolidation
	17	19.8					62.6	63.5	24.7	38.8	WH	CH		
	18	21.3					29.8				WH			
4	1	0.0					4.9				N/A			
	2	0.8					8.9				50/125mm			
	3	1.5		97.0	3.0		12.9				44	SP		
	4	2.3					13.6				29			
	5	3.0					18.6				39			
	6	3.8		96.0	4.0		16.6				58	SP		

Appendix D Boreholes by Others

Borehole Logs by Others



RECORD OF BOREHOLE No D1 — 1 OF 1 — METRIC

W.P. 128-88-01 LOCATION Station 18+816.3, 1.9 m left of centreline ORIGINATED BY S.C.

DIST 54 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 11.01.95 & 11.02.95 CHECKED BY K.P.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS
206.7	Ground Surface					
0.0	~ 40 mm of asphalt over; Fill: sand and coarse gravel					
204.0						
2.7	Fill: rock fill with sand and gravel, rock sizes at least to 0.3 m					
199.9						
6.8	Clayey Silt: soft, with organics		1	SS	5	
198.8						
8.0	Silty Clay to Clay: soft to stiff, grey, laminated, fissured		2	TW	PM	
			3	SS	1	
	sand and gravel layer					
193.3						
13.4	Silty Clay: contains sand seams and gravel sizes, soft to firm, laminated, fissured		4	TW	PM	
			5	SS	1	
			6	TW	PM	
183.0			7	SS	1	
23.7	End of Borehole Stabilized water level measured one day after completion of drilling. Standpipe slotted from 22.9 m to 19.8 m, sealed from 17.4 m to 16.5 m.					

ELEVATION SCALE: 206, 205, 204, 203, 202, 201, 200, 199, 198, 197, 196, 195, 194, 193, 192, 191, 190, 189, 188, 187, 186, 185, 184, 183

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
$\frac{}{10}$

RECORD OF BOREHOLE No D2 1 OF 3 METRIC

W.P. 128-88-01 LOCATION Station 18+838.7, 1.6 m right of centreline ORIGINATED BY S.C.

DIST 54 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 11.03.95 & 11.04.95 CHECKED BY K.P.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
206.8	Ground Surface										
0.0	Fill: mostly sand and gravel, compact, wet below 5 m, some organics at 6 m, some blast rock should be anticipated		1	SS	5		206				
			2	SS	18		205				
198.9							204				
8.0	Silt: clayey, with some sand, loose, grey, wet		3	SS	5		203				
							202				
194.0			4	TW	PM		201				
12.8	Silty Clay: becoming clayey silt or silt at depth, soft to firm, fissured, laminated, grey		5	SS	1		200				
							199				
			6	TW	PM		198			14.5	
							197				
			7	SS	0		196				
							195				
			8	TW	PM		194			15.7	0 0 27 73
							193				
			9	SS	16		192				
178.8							191				
28.0	Silt: changing to fine sand, some boulders near base of this horizon, compact to very dense						190				
							189				
							188			17.3	
							187				
							186				
							185				
							184				
							183				
							182				
							181				
							180				
							179				
							178				
							177				

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No D2 2 OF 3 METRIC

W.P. 128-88-01 LOCATION Station 18+838.7, 1.6 m right of centreline ORIGINATED BY S.C.

DIST 54 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 11.03.95 & 11.04.95 CHECKED BY K.P.

ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued										
	Silt: changing to fine sand, some boulders near base of this horizon, compact to very dense		10	SS	27		176		○		0 0 92 8
							175				
							174				
			11	SS	20		173				
							172				
							171				
			12	SS	26		170		○		
							169				
							168				
			13	SS	78		167				
164.9							166				
41.9	Boulders and broken rock, poor recovery, some sand						165				
							164				
162.0							163				
44.8	Bedrock: Biotite Gneiss, vertically jointed, highly broken (see attached core log for detailed description)						162				
							161				
							160				
158.2							159				
48.6	End of Borehole Water rose (artesian) to 0.5 m above ground level when drilling at 30.5 m depth Stabilized water level measured one day after completion of drilling. Standpipe slotted from 43.0 m to 40.0 m, sealed from 7.6 m to 6.4 m.										

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

CORE LOG OF BOREHOLE D2

S & P

Project : WP 128-88-01
Location : Station 18+838.7, 1.6 m right of centreline
Started : November 4, 1995
Completed : November 5, 1995
Inclination: Vertical Azimuth: Vertical
Sheet 3 of 3
Datum: Geodetic

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
28				178.80 28.00												
30																
32																
34																
36																
38																
40		**Refer to Page 1 of Borehole D2 for soil description**														
42	CORE	Boulders and Broken Rock: argillite and gneiss		164.90 41.90	1	0.07	grey 100									
44	CORE				2	0.12	100									
		Clayey Silt Till layer at 44.6 m		161.98 44.82												
46	NQ Core Barrel CORE CORE CORE CORE	**Biotite Gneiss:** medium grained, biotite-quartz-feldspar, brown to grey, moderately to slightly weathered, friable in upper levels, medium to high strength			3 4 5	0.05 0.03 0.07	grey-rd.brown 100 100 100						3 sets of joints, flat, dipping and vertical joint surfaces are rough planar to rough undulating sandy along joints in Run 3 where gneiss is friable occasional healed joints			
48	CORE				6 7	0.11 0.04	milky-brown 100 100									
		End of Borehole		158.18 48.62												
50																
52																

COREL0G C1100 03/08/96

Groundwater Elevations

Shallow/Single Installation
Water Level (date)

Deep/Dual Installation
Water Level (date)

Logged : H.Lohse
Checked : H.Lohse

RECORD OF BOREHOLE No D3 1 OF 3 METRIC

W.P. 128-88-01 LOCATION Station 18+855.5, 5.5 m left of centerline ORIGINATED BY R.O.

DIST 54 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 10.06.95 & 10.11.95 CHECKED BY K.P.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
202.6	Ground Surface						
0.0 / 201.0	Fill: clay, silt, some sand						
1.5	Silty Clay to Clay: soft to firm, grey, laminated structure, fissured, with gravel sizes		1	SS	2		
			2	SS	1		
			3	TW	PM	16.4	0 5 41 54
			4	SS	0		
			5	TW	PM	15.0	0 5 41 54
			6	SS	1	14.5	
			7	TW	PM	15.3	
190.0			8	SS	1	14.5	
12.5	Silty Clay: with sand and gravel seams		9	TW	PM		0 4 23 73
186.7			10	SS	1	15.7	
15.8	Silty Clay to Clay: soft to firm, grey, laminated, fissured, gravel sizes		11	TW	PM	16.2	0 2 43 55
			12	SS	0		
178.0	Silt and Sand rose in casing						
24.5	Silt: layered with sand, some clay, compact, grey		13	SS	6		
			14	SS	20		0 2 81 17
172.5							

GROUND WATER CONDITIONS

ELEVATION SCALE: 202, 201, 200, 199, 198, 197, 196, 195, 194, 193, 192, 191, 190, 189, 188, 187, 186, 185, 184, 183, 182, 181, 180, 179, 178, 177, 176, 175, 174, 173

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No D3 2 OF 3 METRIC

W.P. 128-88-01 LOCATION Station 18+855.5, 5.5 m left of centerline ORIGINATED BY R.O.

DIST 54 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 10.06.95 & 10.11.95 CHECKED BY K.P.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued										
30.0	Silty Sand to Sandy Silt: fine, compact to dense		15	SS	25		172		○		
							171				
							170				
			16	SS	34		169		○		
167.5							168				
35.0	Cobbles, Boulders and Sand: possible broken bedrock						167				
			17	SS	31		166				
165.0			18	SS	60/0.1		165				
37.5	Bedrock: Biotite Gneiss (see attached core log for detailed description)						164				
							163				
161.7							162				
40.8	End of Borehole Stabilized water levels measured in #1 and #2 seven days after completion of drilling. Standpipe #1 slotted from 40.8 m to 39.3 m, sealed from 39.2 m to 37.0 m. Standpipe #2 slotted from 33.5 m to 30.5 m, sealed from 23.9 m to 23.3 m, artesian water level at +1.5 m. Standpipe #3 slotted from 15.3 m to 13.7 m, sealed from 1.4 m to surface, water level 10.3 m below grade upon completion. Water Level Records Piez No./Tip Depth/Water Level 1/40.8 m/+1.4 m 2/33.5 m/+1.5 m 3/15.2 m/-10.3 m on completion										

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

CORE LOG OF BOREHOLE D3

S & P

Project : WP 128-88-01
Location : Station 18+855.5, 5.5 m left of centerline
Started : October 11, 1995
Completed : October 11, 1995

Inclination: Vertical Azimuth: Vertical

Datum: Geodetic

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN
F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED
SM-SMOOTH R-ROUGH ST-STEPPED PL-PLANAR
FL-FLEXURED UE-UNEVEN W-WAVY C-CURVED

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATRATION RATE (m/min)	COLOUR % RETURN FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
28																
30				172.50 30.00												
32																
34				167.50 35.00												
36		**Refer to page 2 of Borehole D3 for soil description**		164.95												
38	NQ Core Barrel CORE	**Biotite Gneiss:** medium grained, biotite-quartz-feldspar, grey with occasional brown seams, unweathered, high to very high strength		37.55	1	0.12	grey 100						3 sets of joints, flat, dipping and vertical			
40	CORE CORE				2 3	0.1 0.1	grey 100 grey 100						surfaces are rough planar			
		End of Borehole		161.66 40.84												
42																
44																
46																
48																
50																
52																

Groundwater Elevations

Shallow/Single Installation
Water Level (date)

Deep/Dual Installation
Water Level (date)

Logged : H. Lohse
Checked : H. Lohse

CORELOG C1100 03/08/98

RECORD OF BOREHOLE No D4 — 1 OF 3 — METRIC

W.P. 128-88-01 LOCATION Station 18+883.5, 6.4 m right of centrline ORIGINATED BY R.O.

DIST 54 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 10.04.95 & 10.05.95 CHECKED BY K.P.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
202.3	Ground Surface										
0.0 / 200.8	Fill: sand and blast rock										
1.5 / 199.3	Fill: sand and organics		1	SS	3						
			2	SS	1					14.7	
3.0	Silty Clay to Clay: soft to firm, grey, laminated, fissured, gravel sizes, trace sand		3	TW	PM					14.5	
			4	SS	1						0 2 33 66
			5	TW	PM					14.3	
			6	SS	1						
			7	TW	PM					14.6	0 2 47 52
			8	SS	1					14.6	
			9	TW	PM					15.0	
			10	TW	PM					15.3	
187.3											
15.0 / 186.3	Gravel and Cobbles: some sand and clay		11	SS	2					15.3	
16.0	Silty Clay to Silt: soft to firm, grey, some gravel sizes, probable seams of sand and gravel		12	TW	PM					14.5	
			13	SS	8						
182.1			14	TW	PM					17.2	0 1 64 35
20.2	Silt, Sand, Gravel and Clay: artesian conditions										
			15	SS	10						0 4 84 13
175.8			16	SS	59						
26.5 / 173.5	Cobbles, Boulders and Gravel: broken bedrock?										
28.8	Bedrock: Biotite Gneiss		17	SS	60/ 0.0						

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No D4 2 OF 3 METRIC

W.P. 128-88-01 LOCATION Station 18+883.5, 6.4 m right of centrline ORIGINATED BY R.O.

DIST 54 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 10.04.95 & 10.05.95 CHECKED BY K.P.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued										
170.3	Bedrock: Biotite Gneiss (see attached core log for detailed description)						172 171				
32.0	End of Borehole Stabilized water levels measured 5 days after completion of drilling. Standpipe #1 slotted from 32.0 m to 29.0 m, sealed from 23.7 m to 23.0 m, artesian water level at +1.8 m. Standpipe #2 slotted from 23.0 m to 22.6 m, sealed from 22.6 m to 21.3 m, artesian water level +1.8										

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$15 \oplus \frac{20}{10} 5$ (%) STRAIN AT FAILURE

CORE LOG OF BOREHOLE D4

S & P

Project : WP 128-88-01
Location : Station 18+883.5, 6.4 m right of centrline
Started : October 4, 1995
Completed : October 5, 1995

Sheet 3 of 3
Inclination: Vertical Azimuth: Vertical Datum: Geodetic

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN
F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED
SM-SMOOTH R-ROUGH ST-STEPPED PL-PLANAR
FL-FLEXURED UE-UNEVEN W-WAVY C-CURVED

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR / % RETURN	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
28		**Refer to Page 1 of Borehole D4 for soil description**		173.50													
30	NQ Core Barrel CORE CORE	**Biotite Gneiss:** medium grained, biotite-quartz-feldspar, banded, grey to brown, occasional pegmatite layers consisting of quartz and feldspar, unweathered, high strength to very high strength		28.80	1	0.14	grey 100							3 sets of joints, flat, dipping and vertical some joints are partly healed joint surfaces are rough planar			
					2	0.07	grey 100										
32					3	0.17	grey 100										
		End of Borehole		170.32 31.98													
34																	
36																	
38																	
40																	
42																	
44																	
46																	
48																	
50																	
52																	

Groundwater Elevations

Shallow/Single Installation
Water Level (date)

Deep/Dual Installation
Water Level (date)

Logged : H.Lohse
Checked : H.Lohse

CORELOG C1100 03/09/96

RECORD OF BOREHOLE No D5&D5A 1 OF 3 METRIC

W.P. 128-88-01 LOCATION Station 18+898.8, 1.9 m left of centreline ORIGINATED BY R.O.

DIST 54 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 10.30.95 & 11.06.95 CHECKED BY K.P.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
207.1	Ground Surface						207				
0.0	~40 mm asphalt over; Fill: sand and gravel over rock fill with some sand and gravel		1	AS			206				
			2	SS	22		205				
202.1			3	SS	32		204		○		
5.0	Sand: fine with silt, some organics		4	SS	18		203				
199.2							202		○		
8.0	Clay: silty, soft to firm, stratified, fissured		5	TW	PM		201		○		
							200				
							199				
							198	3			0 0 35 65
	sand seams and layers		6	SS	1		197				
							196	3	○		
							195				
	Clay: silty, soft to firm, stratified, fissured		7	TW	PM		194				
							193	5			
							192	3		15.6	
	layer of boulders at least 0.3 m diameter		8	SS	50/0.03m		191				
							190				
			9	SS	22		189				
185.6	End of Borehole 5, moved 4 m east						188		○		
21.5	Boulders, Sand, Gravel		10	SS	26		187				
				CORE			186		○		
				CORE			185				
			11	SS	90/0.25m		184				
179.7							183				
27.4	Bedrock: Biotite Gneiss (see attached core log for detailed description)						182				
							181				
							180				
				CORE			179				
							178				

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No D5&D5A 2 OF 3 METRIC

W.P. 128-88-01 LOCATION Station 18+898.8, 1.9 m left of centreline ORIGINATED BY R.O.

DIST 54 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 10.30.95 & 11.06.95 CHECKED BY K.P.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued										
175.5	Bedrock: Biotite Gneiss			CORE			177 / 176				
31.6	End of Borehole 5A Stabilized water levels measured upon completion of drilling. Standpipe slotted from 22.9 m to 19.8 m, sealed from 17.4 m to 16.5 m.										

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

CORE LOG OF BOREHOLE D5A

S & P

Project : WP 128-88-01
Location : Station 18+898.8, 1.9 m left of centreline
Started : October 31, 1995
Completed : November 6, 1995
Inclination: Vertical Azimuth: Vertical
Sheet 3 of 3
Datum: Geodetic

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN
F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED
SM-SMOOTH R-ROUGH ST-STEPPED PL-PLANAR
FL-FLEXURED UE-UNEVEN W-WAVY C-CURVED

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA Dip wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
22	NQ Core Barrel CORE			185.60 21.50	1											
					2											
24																
26		Refer to page 1 of Borehole D5&D5A for soil description		179.70 27.40												
28	NQ Core Barrel CORE	**Biotite Gneiss:** medium grained, biotite-quartz-feldspar, brown to grey, unweathered, high to very high strength			3	0.11	beige 100						3 set of joints, flat, dipping and vertical join surfaces are rough planar some healed joints and partial 2 mm wide open joints in Run 4			
30	NQ Core Barrel CORE				4	0.48	beige 100									
		End of Borehole		175.48 31.62												
32																
34																
36																
38																
40																

Groundwater Elevations

Shallow/Single Installation
Water Level (date)

Deep/Dual Installation
Water Level (date)

Logged : H.Lohse
Checked : H.Lohse

CORELOG C1100 03/09/96

RECORD OF BOREHOLE No D6 1 OF 1 METRIC

W.P. 128-88-01 LOCATION Station 18+905.0, 20.3 m left of centrline ORIGINATED BY R.O.

DIST 54 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 10.02.95 & 10.03.95 CHECKED BY K.P.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
202.7	Ground Surface										
0.0	Clay to Silty Clay: sand layers, organics, brown/grey, stiff		1	SS	3					19.3	
			2	SS	6					19.0	
			2A	TW	PM					19.0	
199.7			3	SS	10					17.9	
3.0	Silty Clay to Clay: soft to firm with some gravel sizes, fissured, laminated structure		4	SS	2						
			5	SS	1						
			6	SS	1						
195.2			6A	TW	PM					14.8	
7.5	Silty Clay: silt, sand and gravel layers, also with cobbles and boulders, soft or loose		7	SS	27						
			8	SS	1						
			9	TW	PM					14.9	
			10	SS	1						
			11	SS	60/0.04 m			CONE B			
			12	TW	PM			CONE A		18.0	
			13	SS	60/0.05 m						
184.0			14	SS	60/0.1 m						
18.7	End of Borehole Stabilized water level measured nine days after completion of drilling. Standpipe slotted from 15.8 m to 9.8 m, sealed from 4.0 m to 3.4 m.										

+^{3}, ×^{3}: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No D6

1 OF 1

METRIC

W.P. 128-88-00 LOCATION Station 18+905.5, 20.7 m west of centreline ORIGINATED BY R.O.

DIST 13 HWY 535 BOREHOLE TYPE Hollow Stem Augers COMPILED BY B.B.

DATUM Geodetic DATE 10.02.95 & 10.03.95 CHECKED BY K.P.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
202.7									
0.0	**Clay to Silty Clay:** sand layers, organics, brown/grey, stiff		1	SS	3			19.3	
			2	SS	6			19.0	
			2A	TW				19.0	
199.7			3	SS	10			17.9	
3.0	**Silty Clay to Clay:** soft to firm with some gravel sizes, fissured, laminated structure		4	SS	2				
			5	SS	1				
			6	SS	1				
196.2			6A	TW				14.8	
7.5	**Silty Clay:** silt, sand and gravel layers, also with cobbles and boulders, soft or loose		7	SS	27				
			8	SS	1				
			9	TW				14.9	
			10	SS	1				
			11	SS	60/0.04 m				
			12	TW				18.0	
			13	SS	60/0.05 m				
184.0			14	SS	60/0.1 m				
18.7	End of Borehole Stabilized water level measured nine days after completion of drilling. Standpipe slotted from 15.8 m to 9.8 m, sealed from 4.0 m to 3.4 m.								

DYNAMIC CONE PENETRATION RESISTANCE PLOT — 20 40 60 80 100

SHEAR STRENGTH kPa — ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE — 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) — 20 40 60

Cone B

Cone A

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 1 — 1 OF 1 — METRIC

W.P. 128-88-01 LOCATION Sta 18+920.6 Lt 24.7 m ORIGINATED BY DK

DIST 64 HWY 535 BOREHOLE TYPE Hollow Stem Auger, Cone COMPILED BY DK

DATUM Geodetic DATE 92 03 06 CHECKED BY BI

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS
204.5	Ground Surface					
0.0 / 203.4	Clayey Silt, Some Sand Occasional Organic Inclusions Brown, (Possible Fill)		1	SS	8	
1.1	Clayey Silt, Layered Occasional Rootlets Light Grey and Brown		2	SS	18	
201.5	Stiff to Very Stiff		3	SS	8	
3.0	Silty Clay to Clay		4	SS	0	▼*
	Firm		5	TW	PH	
	Grey					
	Some Gravel		6	SS	3	
			7	SS	1	
191.7			8	TW	PH	
12.8	Silty Sand		9	SS	0	
190.2	Grey, Very Loose					
14.3	End of Borehole Probable Bedrock					

* Water level in the borehole one hour after completion

Reproduced from W.P 50-78-02

ELEVATION SCALE: 204, 202, 200, 198, 196, 194, 192

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE; 10 20 30 40 50

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	0 0 (100)
16.8	
16.0	0 0 (100)

+3, ×5 Numbers refer to 20 15 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 1A

METRIC

W.P. 128-88-01 LOCATION Sta 18+838.4 Lt 3.6 m ORIGINATED BY

DIST 54 HWY 535 BOREHOLE TYPE NW Casing, Tricone, Washboring, Cone Test COMPILED BY

DATUM Geodetic DATE 81-09-10, 11, 12 and 13 CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
206.5								
0.0	Sand and gravel, Compact Granular "B" fill Brown		1	SS	-			32 65 3
204.1			2	SS	32			
2.4	Rockfill. Red and grey		3	SS	27			
199.2								
7.3	Clay, stiff Green and grey		4	SS	9			
197.9								
8.9	Clay, silty, trace of sand and gravel Firm Grey		5	SS	7		87%	Organic
			6	TW	PH			
			7	TW	PH			
			8	TW	PH		18.0	8 53 39
			9	SS	<1			
			10	SS	<1			
			11	TW	PH			
187.6	End of sampline		12	SS	1			
19.2	Start cone test							
	Probably clay							
182.4								
24.4	Probably granular material. Compact							

ELEVATION SCALE: 205, 203, 201, 199, 197, 195, 193, 191, 189, 187, 185, 183, 181, 179, 177

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE
20 40 60 80 100

PLASTIC LIMIT W_p NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L
WATER CONTENT (%) 20 40 60

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 15 10 STRAIN AT FAILURE (%)

EXTRACTED FROM BRIDGE INVESTIGATION REPORT BY
MORTON & PARTNERS LIMITED, OCTOBER 1981 **

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 1A (continued)

METRIC

W.P. 128-88-01 LOCATION Sta 18+838.4 Lt 3.6 m ORIGINATED BY

DIST 54 HWY 535 BOREHOLE TYPE NW Casing, Tricone, Washboring, Cone Test COMPILED BY

DATUM Geodetic DATE 81-09-10, 11, 12 and 13 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT Wp — NATURAL MOISTURE CONTENT W — LIQUID LIMIT Wl / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
177.0 29.8	Probably granular materials. Compact to dense, changing to very dense at ± elev. 168.4						177 175 173 171 169 167				
166.0 30.8	End of cone test										

Reproduced from W.P. 50-78-02

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2A

METRIC

W.P. 128-88-01 LOCATION Sta 18+860.0 Lt 8.2 m ORIGINATED BY

DIST 54 HWY 535 HOLE TYPE Wash Boring COMPILED BY

DATUM Geodetic DATE 81-09-13, 14 and 15 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT Wp — NATURAL MOISTURE CONTENT W — LIQUID LIMIT Wl / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
205.0										
0.0	Rockfill to 0.5 m Sand, silty, clayey, Wood pieces		1	SS	2					
201.2										
1.8	Clay Firm Green and grey		2	SS	7		201			
			3	SS	1		199			111% 97%
198.7										
4.3	Clay, silty, trace of sand and gravel. Soft to firm. Grey		4	SS	1		197			
			5	TW	PH					
			6	TW	PH		195			16.0
			7	TW	PH		193			
			8	SS	<1					
			9	SS	<1		191			81%
			10	TW	PH		189			
			11	TW	PH		187			
			12	SS	<1					
			13	SS	<1		185			
	Washed only below elev. 154.3						183			
178.6							181			
26.4	End of Borehole						179			

Reproduced from W.P. 50-78-02

GR 2 SA 50 SI 48 CL

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 (%) STRAIN AT FAILURE / 10