



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
SEVEN MILE BRIDGE REPLACEMENT
HIGHWAY 11
DISTRICT OF RAINY RIVER, ONTARIO**

G.W.P. 6048-08-00, Site No. 45-76

Geocres Number: 52C-28

Report to

**McCormick Rankin
A Member of MMM Group**

Thurber Engineering Ltd.
2010 Winston Park Drive, Suite 103
Oakville, Ontario
L6H 5R7
Phone: (905) 829 8666
Fax: (905) 829 1166

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the location of the Seven Mile Bridge carrying Highway 11 over a section of Rainy Lake approximately 10 km northeast of Fort Frances, in the District of Rainy River, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin, under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0011.

In the preparation of this report and in addition to the boreholes drilled under the current assignment, reference has been made to information on subsurface conditions and original bridge construction contained in previous reports. The titles of the previous reports are listed as follows:

- Soil Conditions and Engineering Study, Seven Mile Bridge Structure, Highway 120 Alignment, Rainy Lake Causeway, Fort Frances, Ontario, Geocres No. 52C-6, prepared by Geocon Ltd., dated June 15, 1960. (Reference 1).
- Report on Repairs to Seven Mile Bridge, Rainy Lake Causeway, Fort Frances, Ontario, prepared by Fenco, dated December 15, 1961. (Reference 2).

2 SITE DESCRIPTION

The Seven Mile Bridge is located on Highway 11 approximately 10 km northeast of Fort Frances in the District of Rainy River, Ontario. The bridge is part of the causeway crossing Rainy Lake.



The existing bridge is a nine-span structure with a total length of approximately 42.0 m and width of 10.7 m. The structure consists of a wood and concrete deck supported on timber pile bents supplemented by steel H-piles at the abutments and adjacent bents. The span lengths between pile bents are 3.7 m for the end spans adjacent to the abutments and 4.9 m for the remaining spans. Each pile bent consists of six timber piles spaced at 1.7 m, plus the supplemental H-piles.

The bridge approach embankments comprise a causeway constructed by end-dumping of fill in the lake channel. The embankments are approximately 4 m high. Rock protection is visible above the water level on the embankment slopes. A railway causeway and bridge run parallel to the Highway 11 causeway, approximately 30 m to the east.

Photographs in Appendix D show the general nature of the site.

The site lies within a boundary zone between the Wabigoon and Quetico Subprovinces of the Superior Structural Province. The region is characterized by gneissic domes and granitoid intrusions with metavolcanic and metasedimentary rocks occupying the margins. The bedrock is mantled by glaciolacustrine clays and sand and gravel deposits.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out during the period of October 15 to 20, 2011 and consisted of drilling and sampling six boreholes (numbered SMB-01 to SMB-06) through the highway embankment at the abutments and approaches.

Boreholes SMB-02 to SMB-05 were drilled adjacent to the existing abutments and terminated at depths ranging from 11.2 m to 21.9 m (Elev. 319.1 to 329.8). Boreholes were not drilled through the existing bridge, in order to avoid damaging the existing concrete and wood bridge deck. Drill rig access under the bridge was not practical.

Bedrock was proved in Boreholes SMB-02 and SMB-05 by NQ size diamond coring advanced 3.1 m and 3.8 m into bedrock. Boreholes SMB-03 and SMB-04 were terminated upon auger refusal on probable bedrock. A Dynamic Cone Penetration Test (DCPT) was conducted adjacent to each borehole to supplement the data.

Boreholes SMB-01 and SMB-06 were drilled through the approach embankments. Borehole SMB-01 was terminated upon auger refusal on probable bedrock at 11.2 m (Elev. 329.8) and Borehole SMB-06 was terminated in the fill layer at 10.5 m depth (Elev. 330.6).

The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix E.

The borehole locations were marked in the field and utility clearances were obtained prior to drilling.

The drilling was carried out using a CME 75 truck-mounted drill rig. Hollow stem augers and wash boring methods with NW-casing were used to advance the boreholes. Samples were obtained

at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). NQ coring methods were used to recover core samples from the bedrock.

The drilling and sampling operations were supervised on a full time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil and rock samples for transport to Thurber's laboratory for further examination and testing.

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Two standpipe piezometers consisting of 19 mm PVC pipe with slotted screen and enclosed in filter sand were installed at this site to permit longer term groundwater level monitoring. The piezometers were subsequently decommissioned in general accordance with MOE Regulation 903. Boreholes without piezometers were backfilled in general accordance with Regulation 903. The installation and completion details of the boreholes and piezometers are summarized in Table 3.1.

Table 3.1 – Borehole and Piezometer Completion Details

Location	Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
East Approach	SMB-01	None installed	Borehole backfilled with bentonite to 1.5 m, auger cuttings to 0.15 m, then asphalt to surface.
East Abutment	SMB-02	13.9 /327.1	Sand from 13.9 to 10.9 m, bentonite from 10.9 m to 0.9 m, then sand and gravel to surface.
	SMB-03	None installed	Borehole backfilled with bentonite to 1.5 m, auger cuttings to 0.15 m, then asphalt to surface.
West Abutment	SMB-04	None installed	Borehole backfilled with bentonite to 1.5 m, auger cuttings to 0.15 m, then asphalt to surface.
	SMB-05	21.9 /319.1	Sand from 21.9 m to 17.9 m, bentonite from 17.9 m to 1.5 m, sand from 1.5 m to 0.15 m, then asphalt to surface.
West Approach	SMB-06	None installed	Borehole backfilled with bentonite to 1.5 m, auger cuttings to 0.15 m, then asphalt to surface.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing where appropriate. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

Point load tests were carried out on selected samples of intact bedrock to assist in evaluation of the compressive strength of the bedrock. The results of point load tests on the rock core samples are presented on the Record of Borehole sheets in Appendix A.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. Stratigraphic profiles and cross-sections are presented on the “Borehole Locations and Soil Strata” drawings in Appendix E. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond borehole locations.

In general terms, the stratigraphy encountered at this site consists of a pavement structure overlying sand and gravel embankment fill, underlain by discontinuous deposits of silty clay and sand and silt till, overlying bedrock. The fill contained rock fill locally in the west approach.

More detailed descriptions of the individual strata are presented below.

5.1 Pavement Structure

All boreholes were drilled through the pavement structure on Highway 11 and encountered a surficial 90 to 100 mm thick layer of asphalt. Granular fill was encountered below the asphalt.

5.2 Sand and Gravel Fill

Sand and gravel embankment fill was encountered in all boreholes drilled during the current investigation. In Boreholes SMB-01 to SMB-05, the lower boundary of the sand and gravel fill was encountered at depths ranging from 7.1 to 15.0 m (Elev. 326.0 to 333.9), deeper at the west abutment. Borehole SMB-06 was terminated within the sand and gravel fill at 10.5 m depth (Elev. 330.6).

The sand and gravel fill contains trace to some silt and occasional cobbles and boulders. Boulder sizes of 250 to 350 mm, locally 1300 mm for one boulder in Borehole SMB-06, were noted during drilling. Coring was required to advance through the boulders in some cases.

SPT N-values recorded in the fill ranged from 3 to 92 blows per 0.3m of penetration, indicating a very loose to very dense relative density. Typically the N-values were in the order of 8 to 28 blows per 0.3 m, indicating a loose to compact condition. Values of 85 blows per 0.23 m to 100 blows per 0.05 m of penetration were obtained where cobbles and boulders were encountered in the fill.

Moisture contents of samples of the sand and gravel fill typically ranged from about 3% to 10% above the observed water level and 10% to 24% below the water level.

The results of grain size distribution analyses conducted on samples of the sand and gravel fill are presented on the Record of Borehole sheets and on Figures B1 to B3 of Appendix B. The results of the laboratory tests are summarized as follows:

Gravel %	23 to 88
Sand %	11 to 64
Silt and Clay %	1 to 13

5.3 Silty Clay

Native grey silty clay containing trace sand was encountered below the fill in Boreholes SMB-01 and SMB-03, at depths of 7.1 and 9.4 m (Elev. 333.9 and 331.6), respectively. The silty clay layer was 2.8 and 1.8 m thick. In Borehole SMB-01, the lower boundary of the clay was encountered at 9.9 m depth (Elev. 331.1). Borehole SMB-03 was terminated below the silty clay at 11.2 m depth (Elev. 329.8), upon auger refusal on probable bedrock.

In Borehole SMB-01, SPT N-values of 1 and 9 blows per 0.3 m of penetration were recorded in the silty clay, indicating a stiff to very soft consistency. An undrained shear strength of 96 kPa (stiff) was measured in this layer. An SPT N-value of 24 blows per 0.3 m of penetration was recorded in Borehole SMB-03, indicating a very stiff consistency.

The moisture contents of samples of the silty clay ranged from 45% to 76%.

Grain size distribution curves for samples of the silty clay are presented in Figure B4, Appendix B. The results are also summarized on the Record of Borehole sheets included in Appendix A. Atterberg Limits test results from one sample are plotted on Figure B6 of Appendix B. The results of the laboratory tests are summarized as follows:

Gravel %	0
Sand %	1 to 3
Silt %	35 to 47
Clay %	50 to 64
Liquid Limit	61
Plastic Limit	24

The above results show that the silty clay is generally of high plasticity with a group symbol of CH.

5.4 Sand and Silt Till

Grey sand and silt till containing trace to some gravel was contacted below the silty clay at 9.9 m depth (Elev. 331.1) in Borehole SMB-01 and below the fill at 15.0 and 14.0 m depth (Elev. 326.0 and 327.0) in Boreholes SMB-04 and SMB-05, respectively. The till graded to fine sand with some gravel in Borehole SMB-05. The thickness of the sand and silt till ranged from 1.1 to 4.1 m.

Boreholes SMB-01 and SMB-04 were terminated below the sand and silt till at 11.2 and 16.1 m depth (Elev. 329.8 and 324.9), upon auger refusal on probable bedrock. In

Borehole SMB-05, the lower boundary of the till was encountered on bedrock at 18.1 m depth (Elev. 322.9).

SPT N-values recorded in the sand and silt till ranged from 18 to 44 blows per 0.3 m of penetration, indicating a compact to dense relative density. An N-value of 100 blows per 0.075 m was obtained at the base of the till on bedrock in Borehole SMB-04.

The moisture contents of the till ranged from 11% to 36%.

The results of grain size distribution analyses conducted on two samples of the sand and silt till are presented on the Record of Borehole sheets and on Figure B5 of Appendix B. The results are summarized as follows:

	Sand and Silt	Sand
Gravel %	12	15
Sand %	35	79
Silt %	44	6
Clay %	9	

Till deposits inherently contain cobbles and boulders, and these should be anticipated during construction.

5.5 Bedrock and Refusal

The soils described above are underlain by bedrock consisting of grey monzodiorite. Bedrock was proved by coring in Boreholes SMB-02 and SMB-05. Boreholes SMB-01, SMB-03 and SMB-04 were terminated upon auger refusal on probable bedrock. Table 5.1 summarizes the depths and elevations to the top of bedrock and auger refusal encountered in the boreholes.

Table 5.1 – Depths and Elevations of Top of Bedrock and Auger Refusal

Foundation Unit	Borehole	Top of Bedrock/Auger Refusal on Probable Bedrock	
		Depth (m)	Elevation (m)
East Approach	SMB-01	11.2	329.8
East Abutment	SMB-02	11.0*	330.0
	SMB-03	11.2	329.8
West Abutment	SMB-04	16.1	324.9
	SMB-05	18.1*	322.9

*Bedrock proved by coring.

Total Core Recovery (TCR) in the bedrock was generally 100%. A recovery of 87% was obtained in the final run from Borehole SMB-02. The measured RQD of the rock cores ranged from 82% to 100%, indicating a good to excellent rock quality.

The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to 2 with one value of 5.

The unconfined compressive strength of the rock interpreted from point load tests conducted on the recovered rock cores ranged from 151 to 197 MPa, indicating a very strong rock. The interpreted unconfined compressive strengths are indicated on the Record of Borehole sheets in Appendix A.

5.6 Water Levels

Water levels in the boreholes were measured upon completion of drilling. Water was added into the boreholes during wash-boring and coring operations, and therefore the water levels may not have been stabilized. Standpipe piezometers were installed in Boreholes SMB-02 and SMB-05 to monitor water levels after completion of drilling. The water levels measured in the piezometers and open boreholes are summarized in Table 5.2.

Table 5.2 – Water Level Measurements

Foundation Unit	Borehole	Date	Water Level (m)		Comments
			Depth	Elevation	
East Approach	SMB-01	October 15, 2011	4.9	336.1	In open borehole
East Abutment	SMB-02	October 16, 2011	4.2	336.8	In piezometer
		October 20, 2011	3.9	337.1	
		October 27, 2011	4.3	336.7	
West Abutment	SMB-03	October 20, 2011	3.9	337.1	In open borehole
	SMB-04	October 17, 2011	4.5	336.5	In open borehole
	SMB-05	October 16, 2011	4.5	336.5	In piezometer
		October 20, 2011	4.0	337.0	
		October 27, 2011	4.0	337.0	
West Approach	SMB-06	October 18, 2011	3.8	337.3	In open borehole

The water level in the lake is indicated on the preliminary GA drawing provided by McCormick Rankin to be at Elev. 336.7 in February 2011.

The groundwater levels will be controlled by the water level in the lake. The recorded values are short-term readings and fluctuations of the lake and groundwater levels are to be expected. The groundwater level may also be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

5.7 Previous Investigation (Reference 1)

A foundation investigation was conducted at this site in 1960 (Reference 1) shortly following construction of the causeway, approach embankments and bridge. The field investigation consisted of nine boreholes drilled through the approach embankments and three probes drilled adjacent to the embankment toe. The borehole logs, laboratory test results, and Borehole Plan and Soil Stratigraphy drawing from the previous investigation are reproduced in Appendix C.

The approximate locations of the previous boreholes (BH-1 to BH-9) and probes (P10 to P12) are included on the Boreholes Locations and Soil Strata drawing in Appendix E. The previous information was used to supplement the current borehole data during preparation of the soil profiles and cross-sections presented on this drawing. It must be noted that earthworks were continued on site subsequent to drilling of the 1960 boreholes, and the current site stratigraphy may vary from that recorded in the previous boreholes.

In general, the subsurface conditions documented during the 1960 investigation are consistent with the conditions encountered during the current investigation, comprising the following:

- A 300 to 900 mm thick layer of rock fill was encountered surficially in Boreholes 1, 2, 3, 5 and 6.
- Loose to compact granular fill was encountered below the rock fill or surficially in all boreholes. The granular fill extended to depths of 1.2 to 11.9 m (Elev. 335.7 to 328.0).
- In Boreholes 7 to 9 drilled on the west approach, a 2.4 to 5.2 m thick layer of rock fill was encountered below the granular fill. The lower boundary of the rock fill was at depths of 4.9 to 11.6 m (Elev. 332.5 to 328.0).
- Native soft to firm, grey, varved silty clay was contacted below the granular fill and rock fill in Boreholes 2 to 9, as well as surficially in Probes 10 to 12. The thickness of the silty clay ranged from 0.3 m in Borehole 3 to 14.0 m in Probe 11. In general, the thickness of the clay increased towards the perimeter of the embankments, indicating that the clay had been largely, but incompletely, displaced during fill placement. The lower boundary of the clay layer varied between depths of 8.5 and 14.3 m (Elev. 329.9 and 324.2).
- Compact to dense, grey sandy till was encountered below the fill and silty clay in all boreholes and probes except Probe 10. The thickness of the sandy till layer ranged from 0.3 to 3.7 m.
- Bedrock or probable bedrock/boulders was contacted below the sandy till in Boreholes 1 to 4 and 6 to 8 at the following depths and elevations:

Table 5.3 – Depths and Elevations of Top of Bedrock (Previous Investigation)

Location	Borehole	Top of Bedrock/Auger Refusal	
		Depth (m)	Elevation (m)
East Approach	1	10.1*	330.6
	2	9.4*	328.9
	3	10.8	329.6
West Approach	4	16.8*	323.1
	6	13.4	325.1
	7	17.9	321.0
	8	15.4	322.0

*Bedrock proved by coring

- The water level observed in the boreholes during the investigation (March/April 1960) was at elevation 336.9.

The report also documents that the causeway and approach embankments were constructed by end-dumping of rock fill and granular material into the lake during November 1958 and March 1959. During construction, “several minor spreading-type failures” were reported, and lateral failures occurred on both sides of the south approach embankment.

Timber piles for bridge construction were driven during April and May 1959. Settlement and rotational movement of the two or three pile bents at each end of the bridge was observed shortly after pile installation. Consequently, steel H-piles were driven at the first two bents at each end of the bridge to supplement the timber piles.

6 MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. MMM Group Limited surveyed the borehole locations and provided the co-ordinates and the ground surface elevations.

Thurber obtained utility clearances for the borehole locations prior to drilling.

Eastern Ontario Diamond Drilling Ltd. from Hawkesbury, Ontario supplied a truck mounted CME 75 drill rig and conducted the drilling, sampling and in-situ testing operations.

The drilling and sampling operations were supervised in the field on a full time basis by Mr. Jason Mei of Thurber Engineering Ltd.

Routine laboratory testing was carried out by Thurber Engineering Ltd.

Overall planning and supervision of the field program was conducted by Mr. Mark Farrant, P. Eng.

Interpretation of the data and preparation of the report was carried out by Ms. R. Palomeque Reyna, P.Eng. and Mr. Murray Anderson, P. Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

Rocio Palomeque Reyna, P.Eng., M.Eng.
Geotechnical Engineer

Murray R. Anderson, P.Eng., M.Eng.
Senior Foundations Engineer

Report reviewed by:
P. K. Chatterji, P.Eng., Ph.D.
Review Principal



Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$


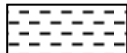



 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No SMB-01

1 OF 2

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 874.2 E 284 020.2 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2011.10.15 - 2011.10.15 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT			NATURAL MOISTURE CONTENT			LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p			w			w _L				GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
								20	40	60	80	100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SMB-01

2 OF 2

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 874.2 E 284 020.2 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2011.10.15 - 2011.10.15 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
								WATER CONTENT (%)								
							20	40	60	80	100		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
	Continued From Previous Page															
9.9	SAND and SILT , some gravel, trace clay Dense Grey Wet (TILL)		10	SS	44								○			12 35 44 9
329.8			11	SS	42								○			
11.2	END OF BOREHOLE AT 11.2m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 11.2m AND WATER LEVEL AT 4.9m. BOREHOLE BACKFILLED WITH BENTONITE FROM 11.2m TO 1.5m, AUGER CUTTINGS FROM 1.5m TO 0.15m, THEN ASPHALT TO SURFACE.															

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 8/30/13

RECORD OF BOREHOLE No SMB-02

2 OF 2

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 866.8 E 284 018.4 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE Hollow Stem Auger/NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.10.15 - 2011.10.16 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W			LIQUID LIMIT W _L
Continued From Previous Page								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%)		
330.0	SAND and GRAVEL , trace silt Very Dense Grey Wet (FILL) Cored through boulder (350mm) at 10.3m		9	SS	88/ 0.200	331						FI 2 2 0 1 1 1 1	RUN #1 TCR=100% SCR=86% RQD=100% UCS=197MPa (Average) RUN #2 TCR=100% SCR=100% RQD=100% UCS=197MPa (Average) RUN #3 TCR=87% SCR=87% RQD=87% UCS=166MPa (Average)
11.0	BEDROCK monzodiorite, grey, occasional vertical breaks		1	RUN		330							
	Sub-vertical fractures at 12.1m and 12.6m		2	RUN		329							
	Horizontal fracture at 12.5m and 12.9m					328							
326.9			3	RUN									
14.1	END OF BOREHOLE AT 14.1m. BOREHOLE OPEN TO 13.9m AND WATER LEVEL AT 4.1m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Oct. 16/11 4.2 336.8 Oct. 20/11 3.9 337.1 Oct. 27/11 4.3 336.7												

WATER LEVEL READINGS:
 DATE DEPTH (m) ELEV. (m)
 Oct. 16/11 4.2 336.8
 Oct. 20/11 3.9 337.1
 Oct. 27/11 4.3 336.7

RECORD OF BOREHOLE No SMB-03

1 OF 2

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 866.3 E 284 024.9 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2011.10.20 - 2011.10.20 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)						
								○ UNCONFINED + FIELD VANE	w _p w w _L							
								● QUICK TRIAXIAL × LAB VANE								
341.0							20 40 60 80 100						GR	SA	SI	CL
0.0	ASPHALT:(100mm)															
0.1	SAND and GRAVEL, trace silt, occasional cobbles Dense to Very Dense Brown Moist (FILL) Cobbles from 1.1m to 1.4m		1	SS	39											
			2	SS	50/ 0.075											46 46 8 (SI+CL)
			3	SS	37											
	Compact															
			4	SS	22											
			5	SS	16											
			6	SS	22											47 48 5 (SI+CL)
	Loose Wet															
	Compact		8	SS	13											
	Dense		9	SS	31											66 28 6 (SI+CL)
331.6																
9.4	Silty CLAY, trace sand Very Stiff Grey															

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SMB-03

2 OF 2

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 866.3 E 284 024.9 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2011.10.20 - 2011.10.20 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page													
	Silty CLAY , trace sand Very Stiff Grey		10	SS	24		331							0 3 47 50
329.8							330							
11.2	END OF BOREHOLE AT 11.2m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 9.4m AND WATER LEVEL AT 3.9m. BOREHOLE BACKFILLED WITH BENTONITE FROM 11.2m TO 1.5m, AUGER CUTTINGS FROM 1.5m TO 0.15m THEN ASPHALT TO SURFACE.													

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 8/30/13

METRIC

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No SMB-04

2 OF 2

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 820.4 E 284 010.1 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2011.10.16 - 2011.10.17 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
	Continued From Previous Page							20 40 60 80 100		W _p W W _L				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100		20 40 60				

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

RECORD OF BOREHOLE No SMB-05

1 OF 3

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 819.2 E 284 017.1 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE Hollow Stem Auger/NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.10.19 - 2011.10.19 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) W _p W W _L				
341.0																
0.0	ASPHALT:(100mm)															
0.1	SAND and GRAVEL, trace silt, occasional cobbles Very Dense to Compact Brown Moist (FILL)		1	SS	52											
			2	SS	15											
			3	SS	28											
	Loose to Compact		4	SS	9											
			5	SS	15										31 58 11 (SI+CL)	
			6	SS	12											
			7	SS	18											
	Grey Wet															
			8	SS	17										56 39 5 (SI+CL)	
			9	SS	12											

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15 10 5 0
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SMB-05

2 OF 3

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 819.2 E 284 017.1 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE Hollow Stem Auger/NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.10.19 - 2011.10.19 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _P W W _L	20 40 60	GR SA SI CL			
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%)				
								20 40 60 80 100		20 40 60				
	SAND and GRAVEL , trace silt, occasional cobbles and boulders Compact Gray Wet (FILL)		10	SS	29		331							
							330							
	Boulder (250mm) at 12.5m		11	SS	19		329							
	Dense		12	SS	49		328							
327.0							327							
14.0	SAND and SILT , trace to some gravel, trace clay Compact Grey Wet (TILL)		13	SS	18		326							
325.5							325							
15.5	SAND , some gravel, trace silt Compact Grey Wet (TILL)		14	SS	28		324							
							323							
322.9			15	SS	26		322							
18.1	BEDROCK monzodiorite, grey, occasional vertical breaks		1	RUN			323							
	Horizontal fractures at 18.4m and 18.5m						322							
	Sub-vertical fracture at 20.2m		2	RUN										

Continued Next Page

+ 3, × 3 : Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 8/30/13

RECORD OF BOREHOLE No SMB-05

3 OF 3

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 819.2 E 284 017.1 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE Hollow Stem Auger/NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.10.19 - 2011.10.19 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)				
							20	40	60	80	100	W _p	W	W _L			
	Continued From Previous Page																
	BEDROCK monzodiorite, grey, occasional vertical breaks Sub-vertical fracture at 20.6m, 20.8m and 21.6m		3	RUN													
319.1																	
21.9	END OF BOREHOLE AT 21.9m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Oct. 19/11 4.5 336.5 Oct. 20/11 4.0 337.0 Oct. 27/11 4.0 337.0																

RECORD OF BOREHOLE No SMB-06

1 OF 2

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 812.5 E 284 014.9 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2011.10.18 - 2011.10.18 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				w _p w w _L								
341.1								20	40	60	80	100					GR	SA	SI	CL
0.0	ASPHALT:(100mm)							20	40	60	80	100								
0.1	SAND and GRAVEL, trace silt, occasional cobbles and boulders Very Dense to Compact Brown Moist (FILL)		1	SS	82		341							○						
			2	SS	34									○						
							340													
			3	SS	13									○						
							339													
			4	SS	10									○						
							338							○						
			5	SS	17									○						
							337							○						
	Boulder (280mm) from 4.3m to 4.6m																			
			6	SS	69															
							336													
	Boulder (1300mm) at 5.0m																			
							335													
			7	SS	8		334													
	Loose to Compact Grey Wet																			
							333													
			8	SS	17									○						
							332													

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SMB-06

2 OF 2

METRIC

W.P. 6048-08-00 LOCATION Seven Mile Bridge N 5 391 812.5 E 284 014.9 ORIGINATED BY JM
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2011.10.18 - 2011.10.18 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
330.6	Continued From Previous Page		9	SS	28		331										
10.5	<p>SAND and GRAVEL, occasional cobbles Compact Grey Wet (FILL)</p> <p>END OF BOREHOLE AT 10.5m. BOREHOLE OPEN TO 10.5m AND WATER LEVEL AT 3.8m. BOREHOLE BACKFILLED WITH BENTONITE FROM 10.5m TO 1.5m, AUGER CUTTINGS FROM 1.5m TO 0.15m THEN ASPHALT TO SURFACE.</p>																

Appendix B

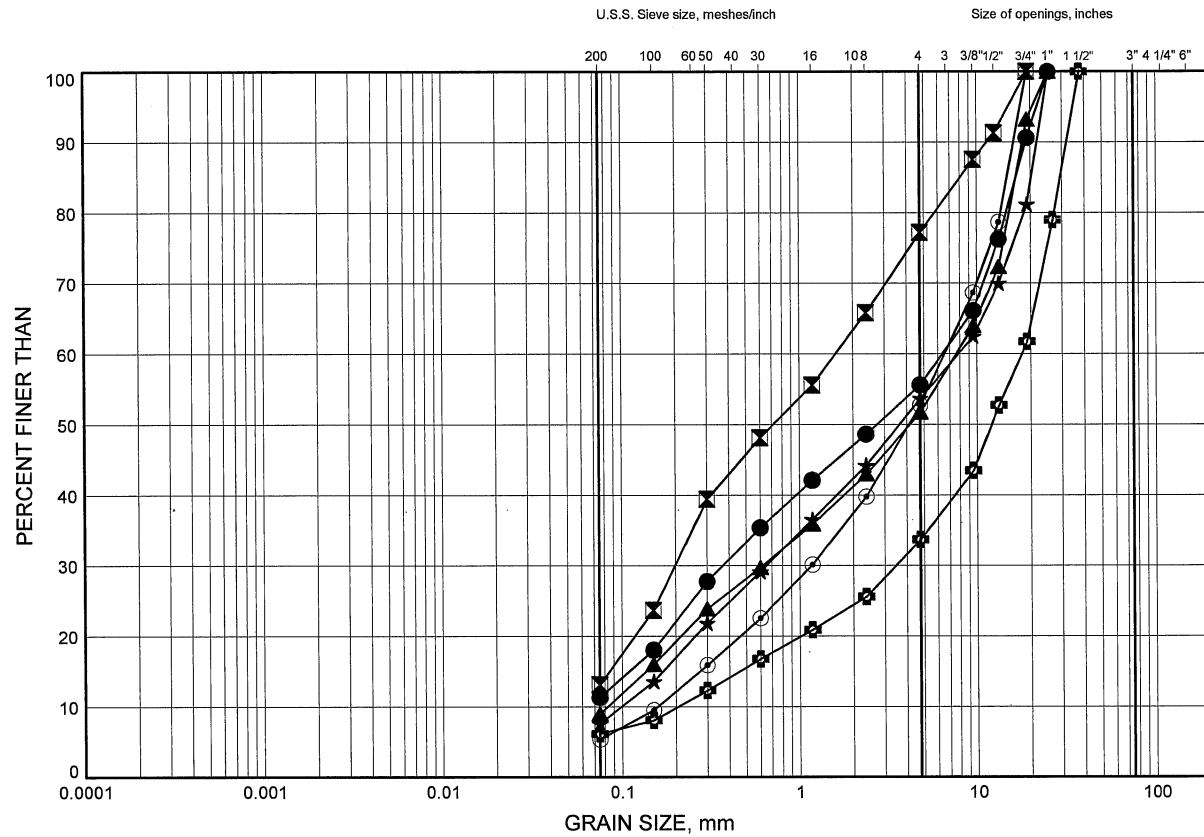
Laboratory Test Results

NWR 32 Rehabs

GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND & GRAVEL FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SMB-01	1.83	339.17
⊠	SMB-01	6.40	334.60
▲	SMB-02	8.69	332.31
★	SMB-03	1.07	339.93
⊙	SMB-03	4.11	336.89
⊕	SMB-03	8.69	332.31

Date May 2013
W.P. 6048-08-00



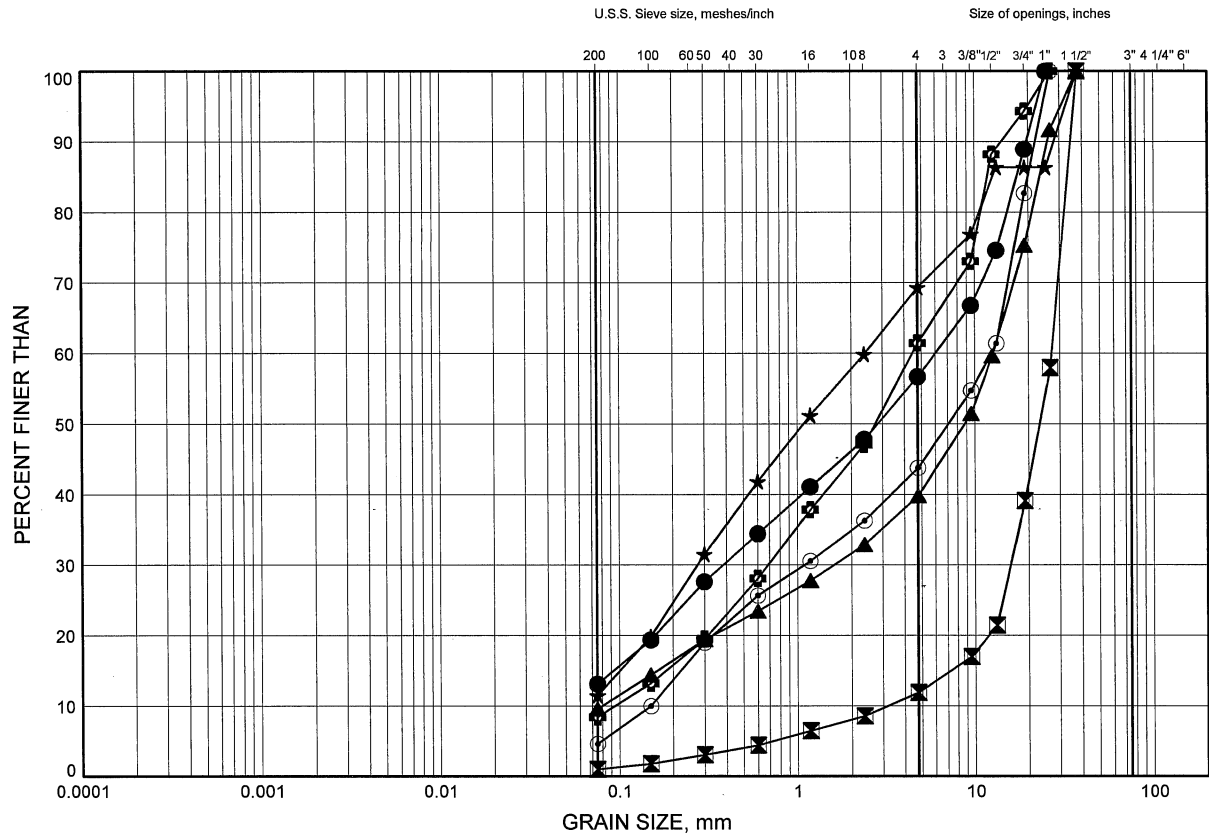
Prep'd AN
Chkd. RPR

NWR 32 Rehabs

GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND & GRAVEL FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SMB-04	2.59	338.41
⊠	SMB-04	5.64	335.36
▲	SMB-04	14.71	326.29
★	SMB-05	3.35	337.65
⊙	SMB-05	7.16	333.84
⊕	SMB-05	13.26	327.74

Date May 2013
W.P. 6048-08-00



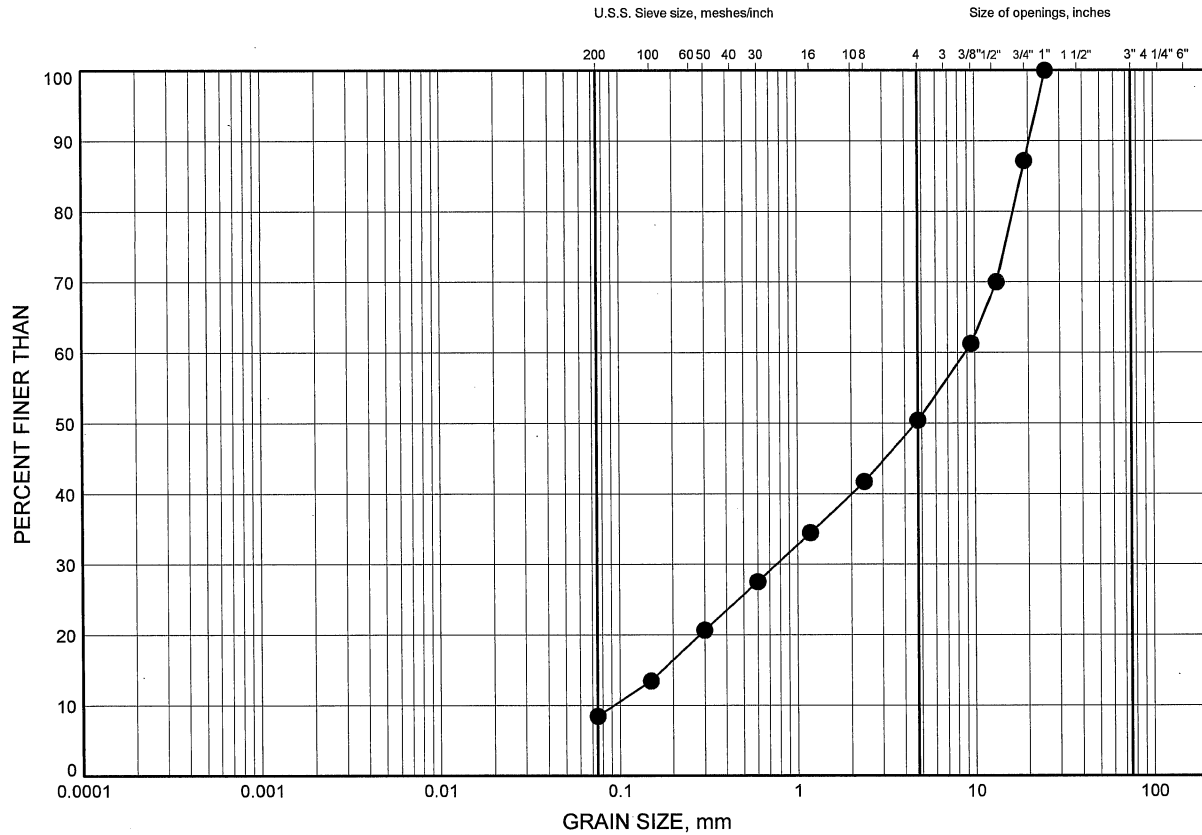
Prep'd AN
Chkd. RPR

GRAIN SIZE DISTRIBUTION - THURBER 1197.GPJ 5/2/13

NWR 32 Rehabs GRAIN SIZE DISTRIBUTION

FIGURE B3

SAND & GRAVEL FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SMB-06	1.83	339.27

GRAIN SIZE DISTRIBUTION - THURBER 1197.GPJ 5/2/13

Date May 2013
W.P. 6048-08-00



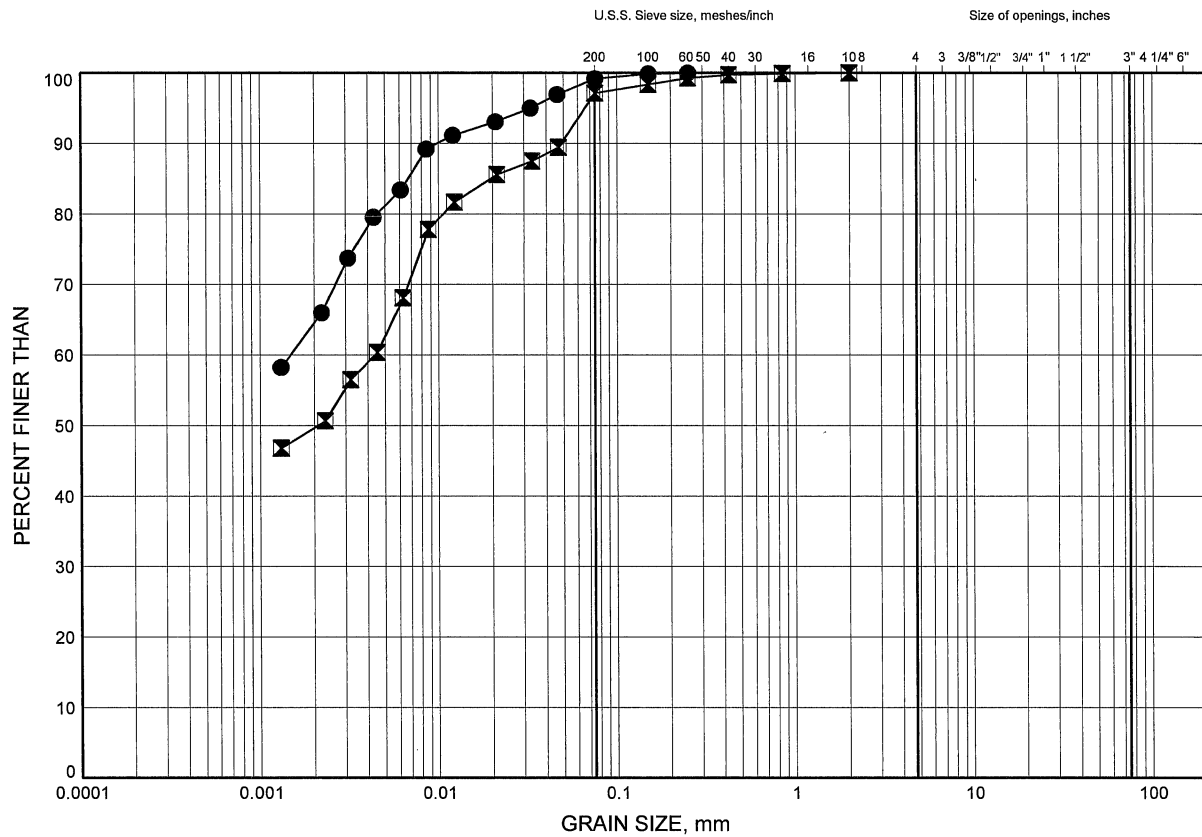
Prep'd AN
Chkd. RPR

NWR 32 Rehabs

GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY CLAY

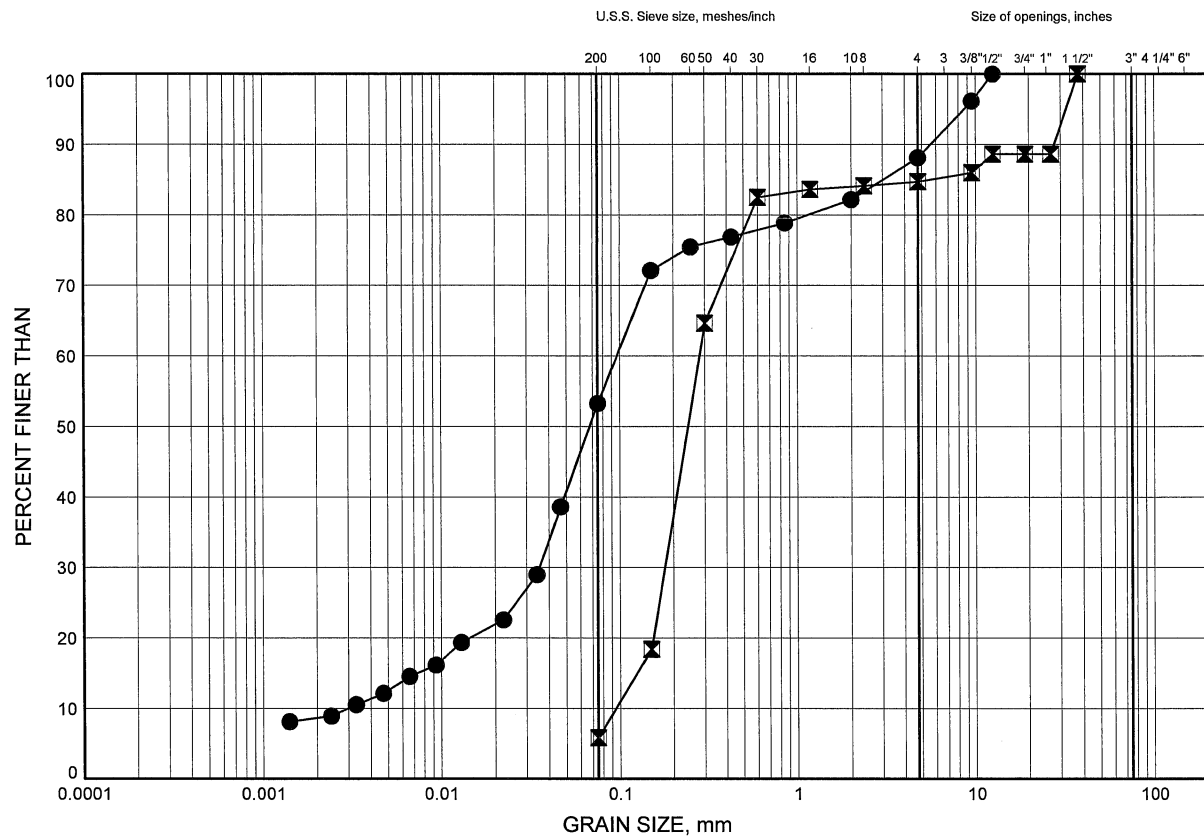


NWR 32 Rehabs

GRAIN SIZE DISTRIBUTION

FIGURE B5

SAND to SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SMB-01	10.21	330.79
⊠	SMB-05	16.31	324.69

Date August 2013
W.P. 6048-08-00

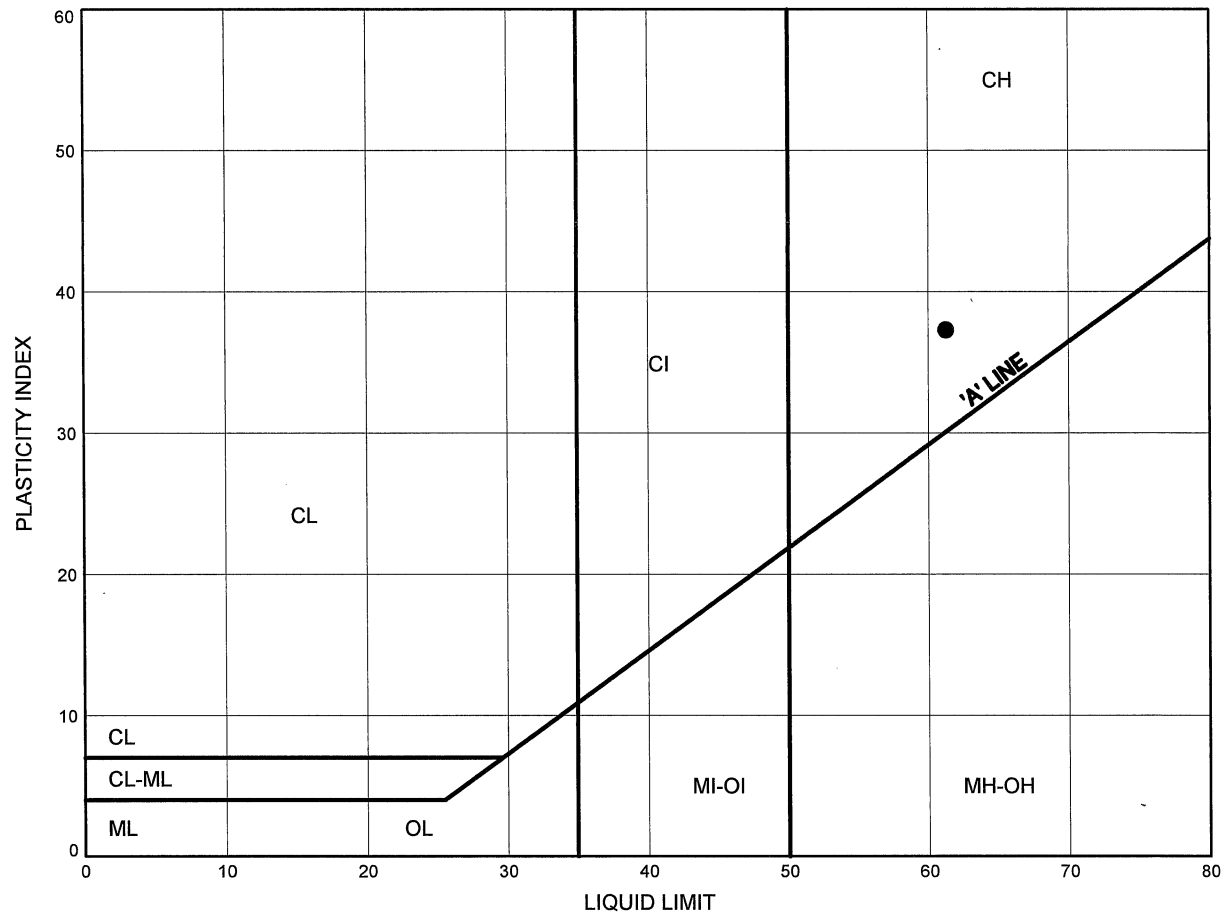


Prep'd AN
Chkd. RPR

NWR 32 Rehabs
ATTERBERG LIMITS TEST RESULTS

FIGURE B6

SILTY CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SMB-01	8.69	332.31

THURBALT 1197.GPJ 5/2/13

Date May 2013
W.P. 6048-08-00



Prep'd AN
Chkd. RPR

Appendix C

Record of Borehole Sheets and Soil Profile from Previous Investigation

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPENDIX I

CONTRACT 57054 BORING # 1 DATUM GEODETIC CASING BK
 BORING DATE FEB. 21, 1963 REPORT DATE MARCH 29, 1963 COMPILED BY MW EJA CHECKED BY JES
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. LBS. ENERGY)

SAMPLE CONDITION		SAMPLE TYPES		ABBREVIATIONS	
	DISTURBED	A.S. - AUGER SAMPLE	F.S. - FOIL SAMPLE	V. - IN-SITU VANE TEST	γ - WET UNIT WEIGHT
	FAIR	S.T. - SLOTTED TUBE	S.O. - SLEEVE-OPEN	M. - MECHANICAL ANALYSIS	K - PERMEABILITY
	GOOD	W.S. - WASHED SAMPLE	S.F. - SLEEVE-FOOT VALVE	U. - UNCONFINED COMPRESSION	C - CONSOLIDATION
	LOST	D.O. - DRIVE-OPEN	T.O. - THIN WALLED OPEN	Qc - TRIAXIAL CONSOLIDATED QUICK	
		D.F. - DRIVE-FOOT VALVE	R.C. - ROCK CORE	Q. - TRIAXIAL QUICK	WL - WATER LEVEL IN CASING
		C.S. - CHUNK SAMPLE		S. - TRIAXIAL SLOW	WT - WATER TABLE IN SOIL

SOIL PROFILE			SAMPLES			
LEV. EPTH	WATER CONDITIONS	DESCRIPTION	STRAT. PLOT	ELEVATION SCALE	OTHER TESTS	CONDITION TYPE NUMBER PENETRATION RESISTANCE BLOWS/FT.
117.8		GROUND LEVEL		1120		
110		ROCK FILL		1110		
108.8		LOOSE TO COMPACT BROWN GRANULAR FILL		1100		
108.8				1090		
108.8		GREY SANDY TILL		1080		
108.8		SOUND GREY SYENITE GNEISS BEDROCK		1070		
107.0				1060		
106.8				1050		
				1040		
				1030		
				1020		
				1010		
				1000		
				990		
				980		
				970		
				960		
				950		
				940		
				930		
				920		
				910		
				900		
				890		
				880		
				870		
				860		
				850		
				840		
				830		
				820		
				810		
				800		
				790		
				780		
				770		
				760		
				750		
				740		
				730		
				720		
				710		
				700		
				690		
				680		
				670		
				660		
				650		
				640		
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				420		
				410		
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				380		
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				270		
				260		
				250		
				240		
				230		
				220		
				210		
				200		
				190		
				180		
				170		
				160		
				150		
				140		
				130		
				120		
				110		
				100		
				90		
				80		
				70		
				60		
				50		
				40		
				30		
				20		
				10		
				0		

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPEX-I

CONTRACT 57084 BORING 2 DATUM GEODETIC CASING BX
 BORING DATE FEB 11 1960 REPORT DATE MARCH 25 1960 COMPILED BY M.W.E.J.A. CHECKED BY J.H.
 SAMPLER HAMMER WT 140 LBS DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. LBS ENERGY)

SAMPLE CONDITION

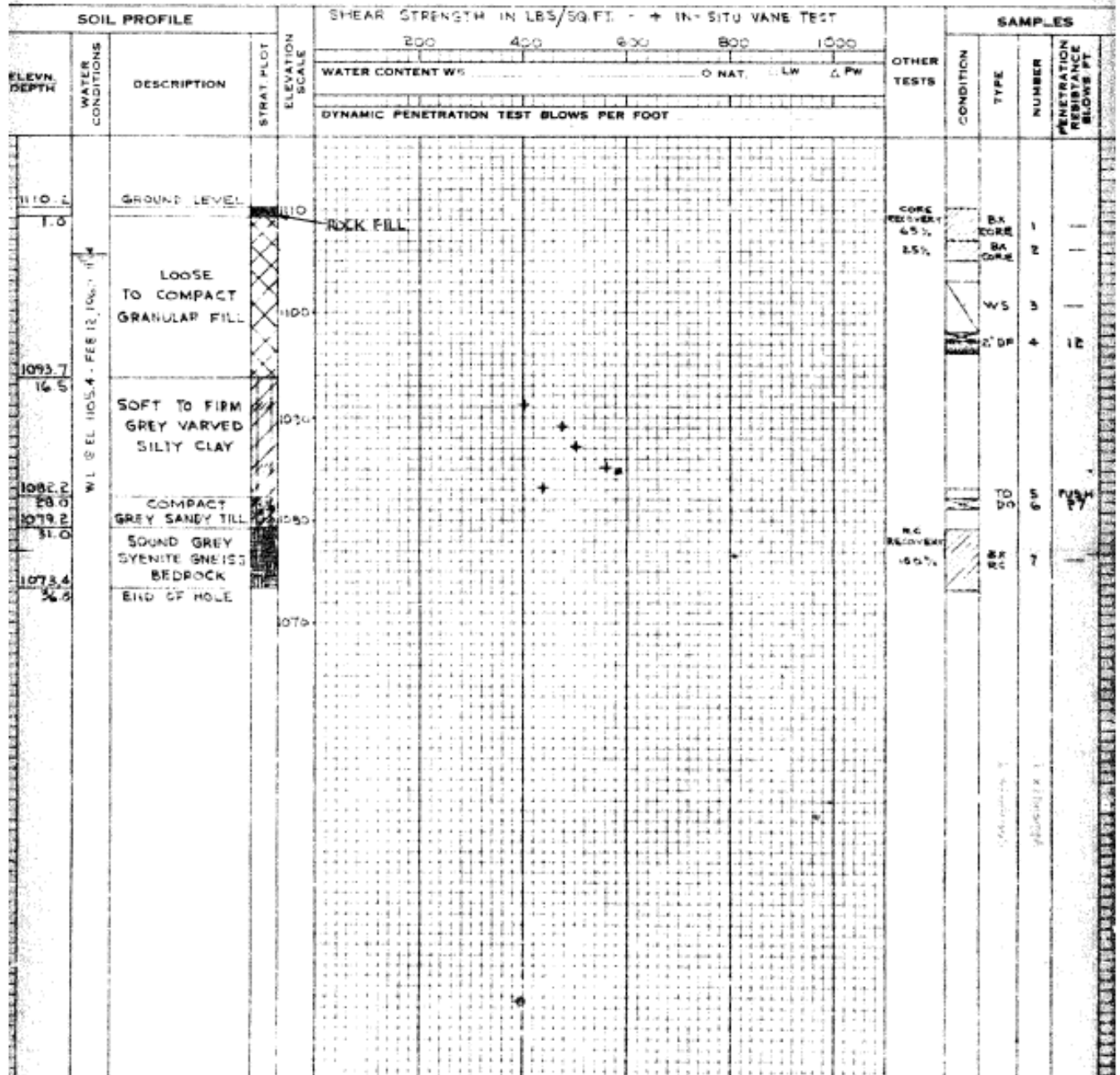
☐ DISTURBED
☐ FAIR
☐ GOOD
☐ LOST

SAMPLE TYPES

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE
 F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 1 - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL



APPENDIX I

SAMPLE CONDITION

SAMPLE TYPES

ABBREVIATIONS



DISTURBED
FAIR
GOOD
LOST

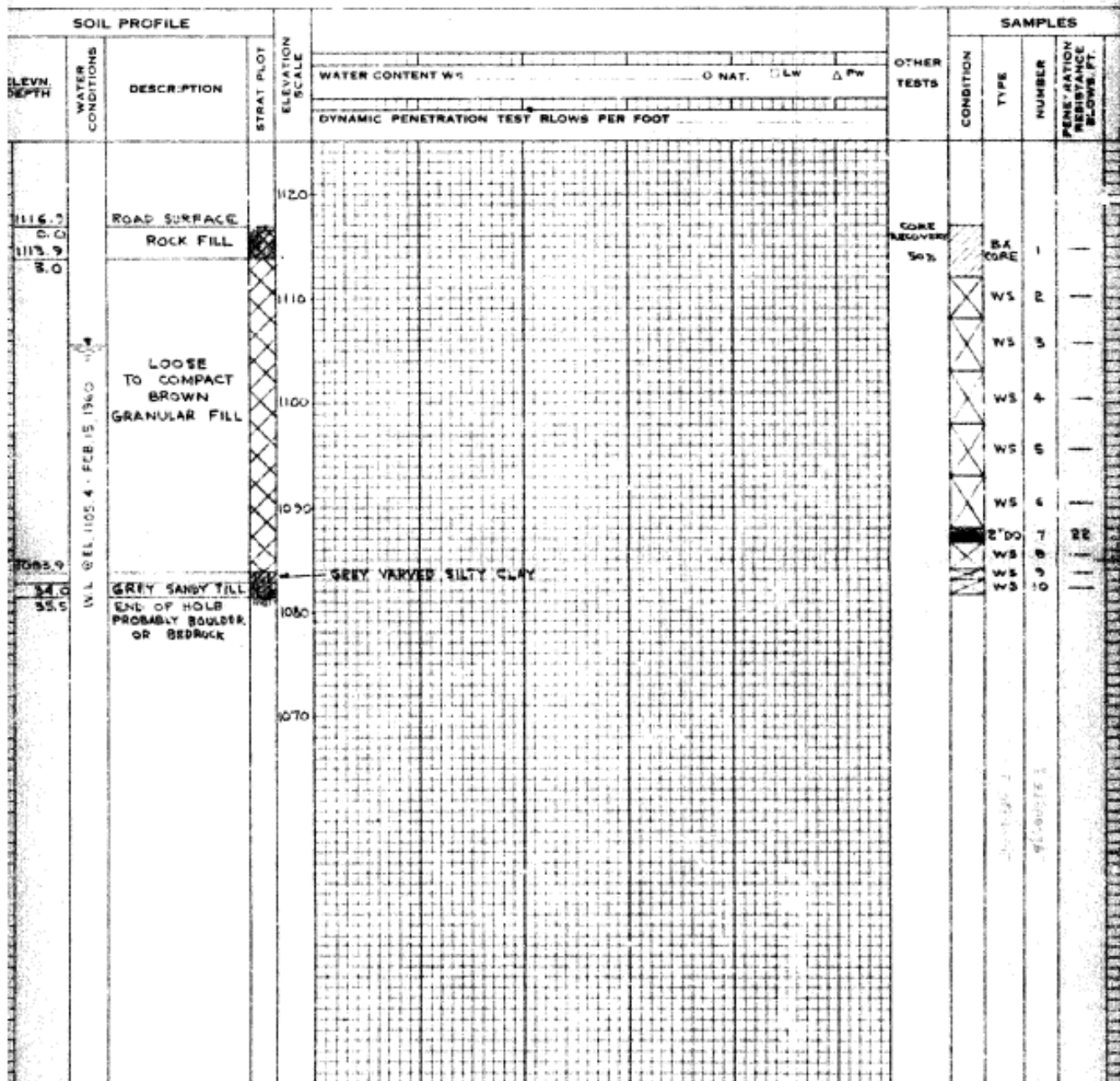
A.S. - AUGER SAMPLE
S.T. - SLOTTED TUBE
W.S. - WASHED SAMPLE
D.O. - DRIVE-OPEN
D.F. - DRIVE-FOOT VALVE
C.S. - CHUNK SAMPLE

F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

V - IN-SITU VANE TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
Qc - TRIAXIAL CONSOLIDATED QUICK
Q - TRIAXIAL QUICK
S - TRIAXIAL SLOW

γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION

WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPENDIX I

CONTRACT ST034 BORING # 4 DATUM GEODETIC CASING BX
 BORING DATE FEB. 17, 1960 REPORT DATE MARCH 25, 1960 COMPILED BY M. W. KJA CHECKED BY JK
 SAMPLER HAMMER WT. 140 LBS DROP 50 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. LBS. ENERGY)

SAMPLE CONDITION

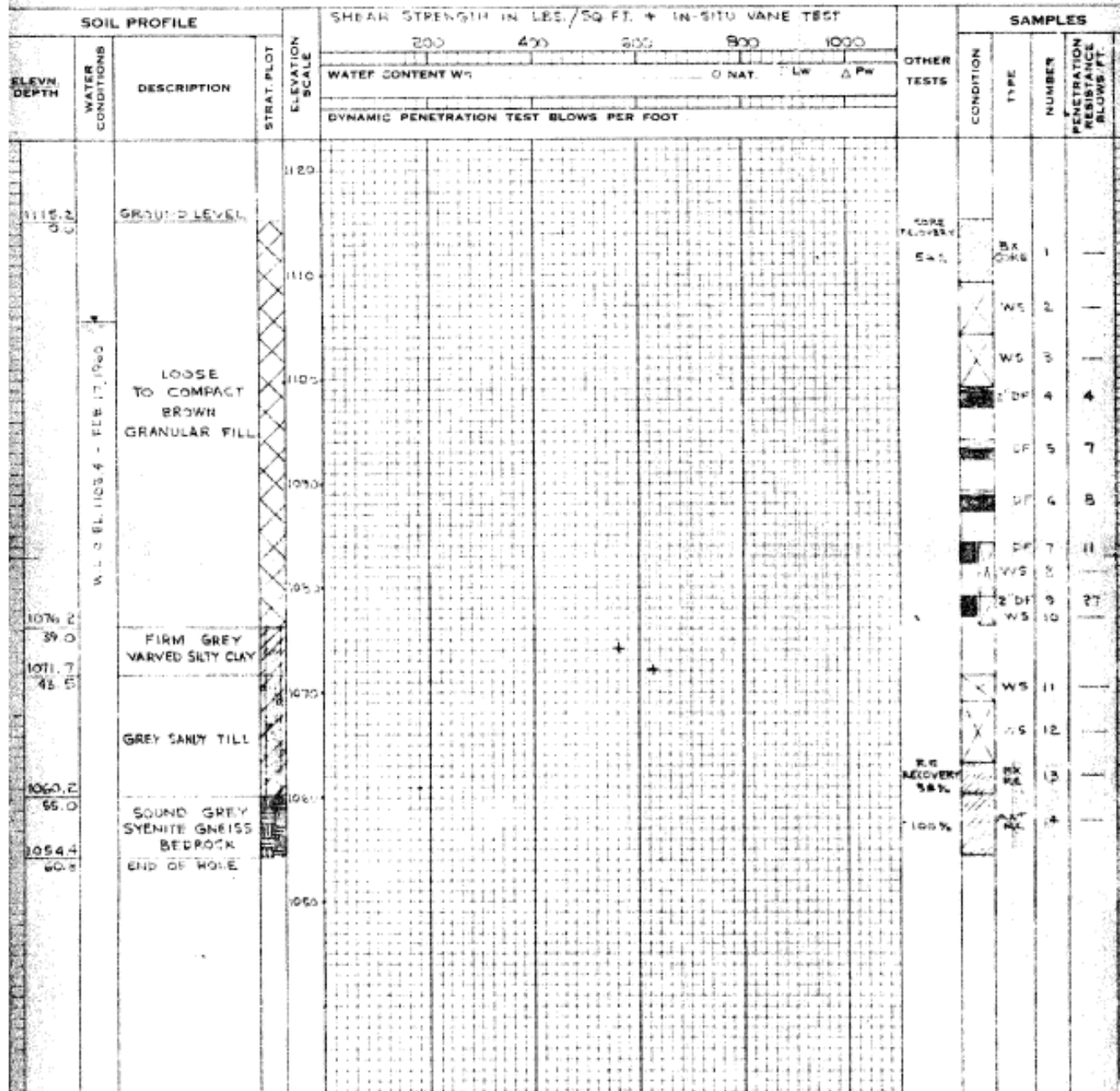
☐ DISTURBED
☐ FAIR
☐ GOOD
☐ LOST

SAMPLE TYPES

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE
 F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 Qc - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 VIL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPENDIX I

CONTRACT S7034 BORING 5 DATUM GEODETIC CASING BK
 BORING DATE FEB 20, 1960 REPORT DATE MARCH 29, 1960 COMPILED BY J.A. CHECKED BY J.A.
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION

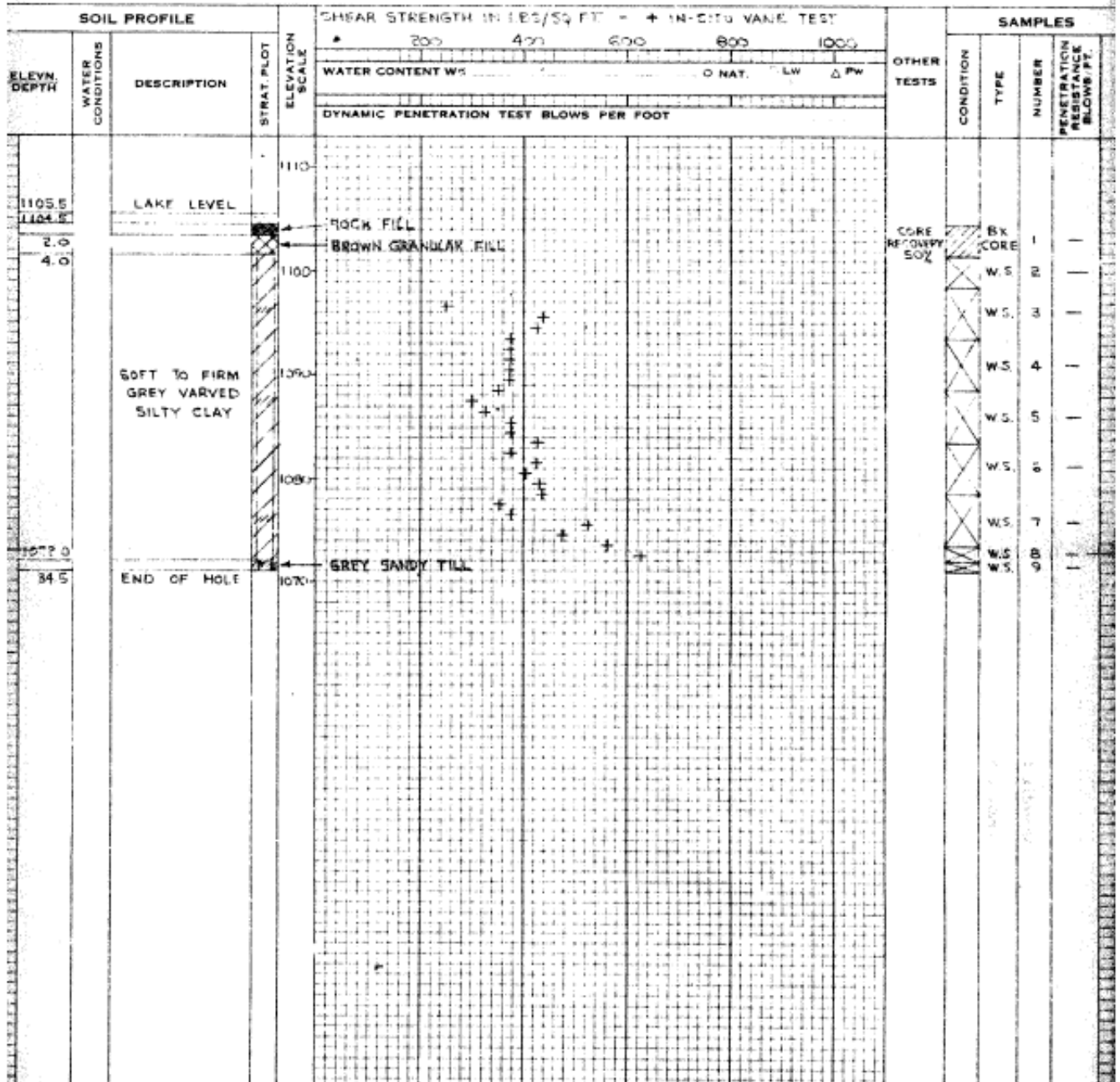
☐ DISTURBED
☐ FAIR
☐ GOOD
☐ LOST

SAMPLE TYPES

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUCK SAMPLE
 F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPENDIX I

CONTRACT 57034 BORING # 6 DATUM GEOD. TIC CASING Bx
 BORING DATE FEB 23, 1960 REPORT DATE MARCH 29, 1960 COMPILED BY J.A. CHECKED BY J.P.
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. LBS. ENERGY)

SAMPLE CONDITION

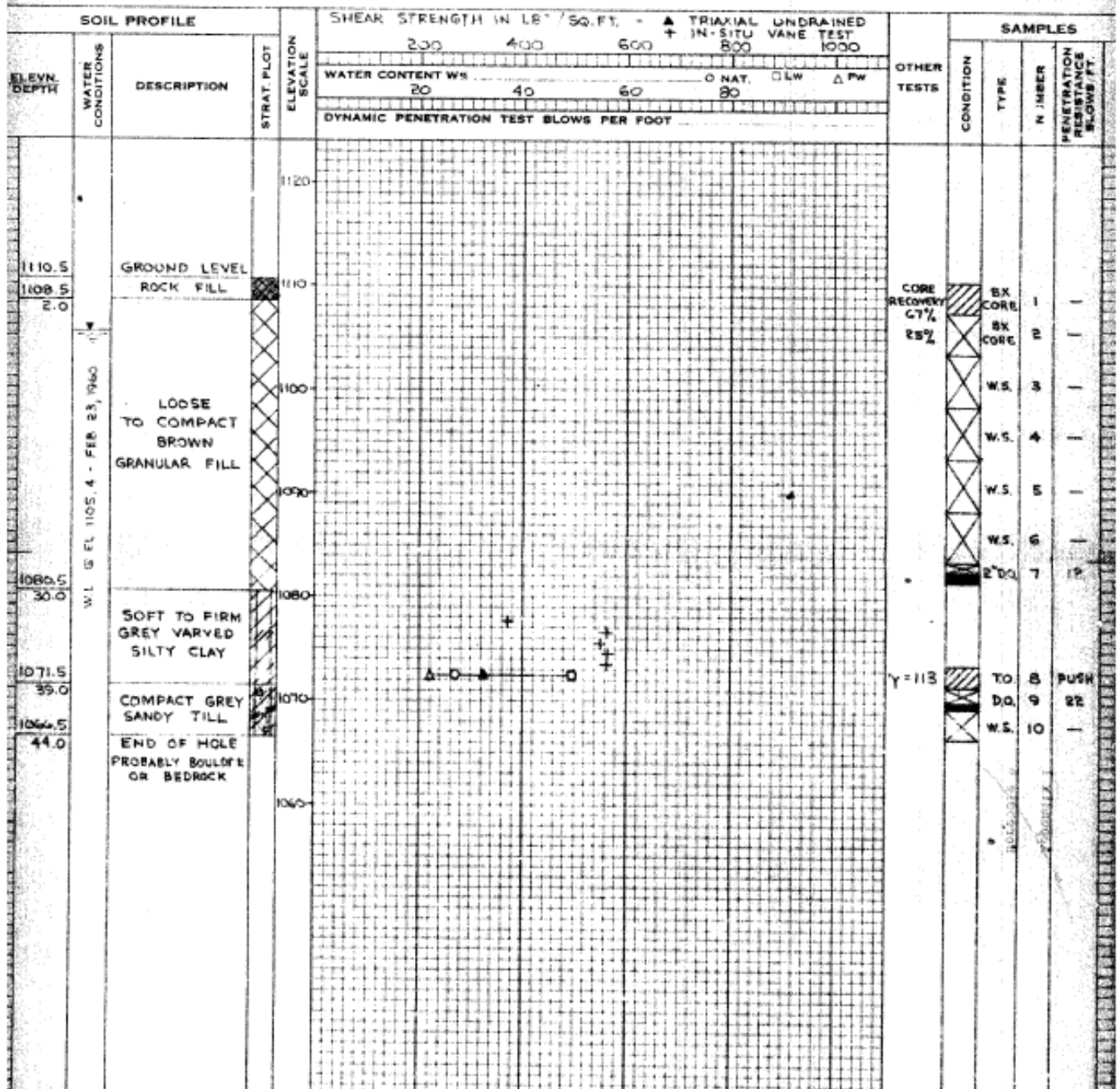
☐ DISTURBED
☐ FAIR
☐ GOOD
☐ LOST

SAMPLE TYPES

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE
 F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL



OFFICE REPORT ON SOIL EXPLORATION

APPENDIX I

SAMPLE CONDITION

SAMPLE TYPES

ABBREVIATIONS

	DISTURBED	FAIR	GOOD	LOST
1980	16	7	1	0
1981	10	10	1	0
1982	10	10	1	0
1983	10	10	1	0
1984	10	10	1	0
1985	10	10	1	0
1986	10	10	1	0
1987	10	10	1	0
1988	10	10	1	0
1989	10	10	1	0
1990	10	10	1	0
1991	10	10	1	0
1992	10	10	1	0
1993	10	10	1	0
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1995	10	10	1	0
1996	10	10	1	0
1997	10	10	1	0
1998	10	10	1	0
1999	10	10	1	0
2000	10	10	1	0
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2004	10	10	1	0
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2007	10	10	1	0
2008	10	10	1	0
2009	10	10	1	0
2010	10	10	1	0
2011	10	10	1	0
2012	10	10	1	0
2013	10	10	1	0
2014	10	10	1	0
2015	10	10	1	0
2016	10	10	1	0
2017	10	10	1	0
2018	10	10	1	0
2019	10	10	1	0
2020	10	10	1	0
2021	10	10	1	0
2022	10	10	1	0
2023	10	10	1	0
2024	10	10	1	0
2025	10	10	1	0
2026	10	10	1	0
2027	10	10	1	0
2028	10	10	1	0
2029	10	10	1	0
2030	10	10	1	0
2031	10	10	1	0
2032	10	10	1	0
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2042	10	10	1	0
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2052	10	10	1	0
2053	10	10	1	0
2054	10	10	1	0
2055	10	10	1	0
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2061	10	10	1	0
2062	10	10	1	0
2063	10	10	1	0
2064	10	10	1	0
2065	10	10	1	0
2066	10	10	1	0
2067	10	10	1	0
2068	10	10	1	0
2069	10	10	1	0
2070	10	10	1	0
2071	10	10	1	0
2072	10	10	1	0
2073	10	10	1	0
2074	10	10	1	0
2075	10	10	1	0
2076	10	10	1	0
2077	10	10	1	0
2078	10	10		

A.S. - AUGER SAMPLE
S.T. - SLOTTED TUBE
W.S. - WASHED SAMPLE
D.O. - DRIVE OPEN
D.F. - DRIVE-FOOT VALVE
C.S. - CHUNK SAMPLE

F.S. - FOIL SAMPLE
S.O. - SLEEVE-OPEN
S.F. - SLEEVE-FOOT VALVE
T.O. - THIN WALLED OPEN
R.C. - ROCK CORE

V - IN-SITU VANE TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
QC - TRIAXIAL CONSOLIDATED QUICK
Q - TRIAXIAL QUICK
S - TRIAXIAL SLOW

W - WET UNIT WEIGHT
K - PERMEABILITY
C - CONSOLIDATION

WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL

SOIL PROFILE				ELEVATION SCALE		WATER CONTENT W%		DYNAMIC PENETRATION TEST BLOWS PER FOOT		OTHER TESTS		SAMPLES			
ELEV. DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT PLOT									CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOW/FT.
1112.0 C.C.		GROUND LEVEL													
1093.0 80.0		BROWN GRANULAR FILL													
1076.0 38.0		ROCK FILL													
1065.0 50.0		GREY VARVED SILTY CLAY													
1053.0 63.0		END OF HOLE PROBABLY BOULDER OR BEDROCK													

ALABAMA HIGHWAY DEPARTMENT

MOBILE DISTRICT

PROJECT NO. 1-112-CV

DATE: 11-25-1962

Causeway

7

12'

15'

18'

21'

24'

27'

30'

33'

36'

39'

42'

45'

48'

51'

54'

57'

60'

63'

66'

69'

72'

75'

78'

81'

84'

87'

90'

93'

96'

99'

102'

105'

108'

111'

114'

117'

120'

123'

126'

129'

132'

135'

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168'

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228'

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258'

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297'

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309'

312'

315'

318'

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324'

327'

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339'

342'

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351'

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582'

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693'

696'

699'

702'

705'

708'

711'

714'

717'

720'

723'

726'

729'

732'

735'

738'

741'

744'

747'

750'

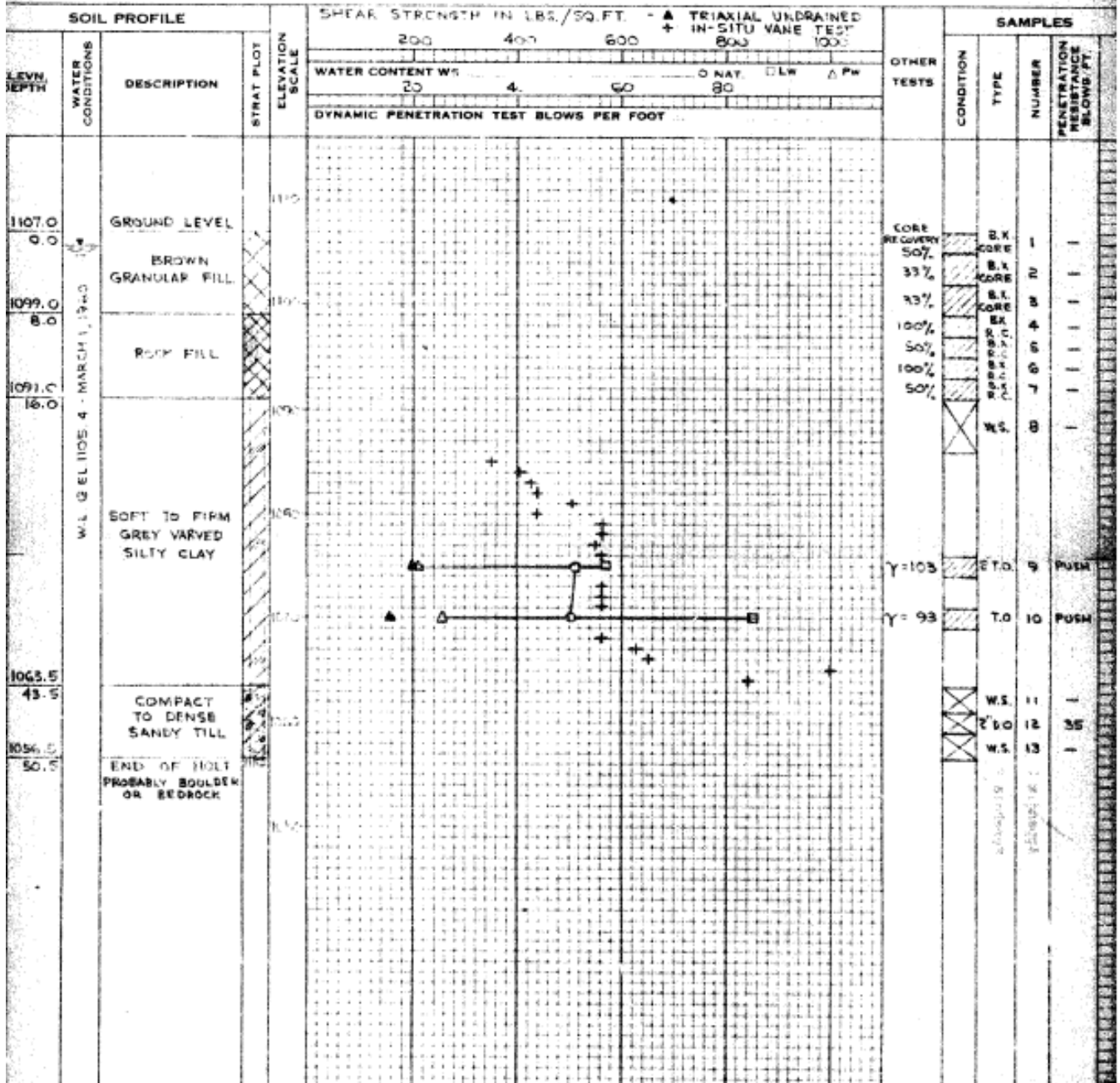
GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPENDIX L

CONTRACT 57034 BORING # B DATUM GEODETIC CASING EX
 BORING DATE MARCH 1, 1960 REPORT DATE MARCH 22, 1960 COMPILED BY J.A. CHECKED BY J.L.
 SAMPLER HAMMER WT. 140 LBS. DROP 20 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. - LBS. ENERGY)

SAMPLE CONDITION		SAMPLE TYPES		ABBREVIATIONS	
	DISTURBED	A.S. - AUGER SAMPLE	F.S. - FOIL SAMPLE	V - IN-SITU VANE TEST	γ - WET UNIT WEIGHT
	FAIR	S.T. - SLOTTED TUBE	G.O. - SLEEVE-OPEN	M - MECHANICAL ANALYSIS	K - PERMEABILITY
	GOOD	W.S. - WASHED SAMPLE	S.F. - SLEEVE-FOOT VALVE	U - UNCONFINED COMPRESSION	C - CONSOLIDATION
	LOST	D.O. - DRIVE-OPEN	T.O. - THIN WALLED OPEN	QC - TRIAXIAL CONSOLIDATED QUICK	WL - WATER LEVEL IN CASING
		D.F. - DRIVE-FOOT VALVE	R.C. - ROCK CORE	Q - TRIAXIAL QUICK	WT - WATER TABLE IN SOIL
		C.S. - CHUNK SAMPLE		S - TRIAXIAL SLOW	



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPENDIX I

CONTRACT 57024 BORING # 9 DATUM GEODETIC CASING BX
 BORING DATE MARCH 19, 1960 REPORT DATE MARCH 29, 1960 COMPILED BY J.A. CHECKED BY JH
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. - LBS. ENERGY)

SAMPLE CONDITION

☐ DISTURBED
☐ FAIR
☐ GOOD
☐ LOST

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

SAMPLE TYPES

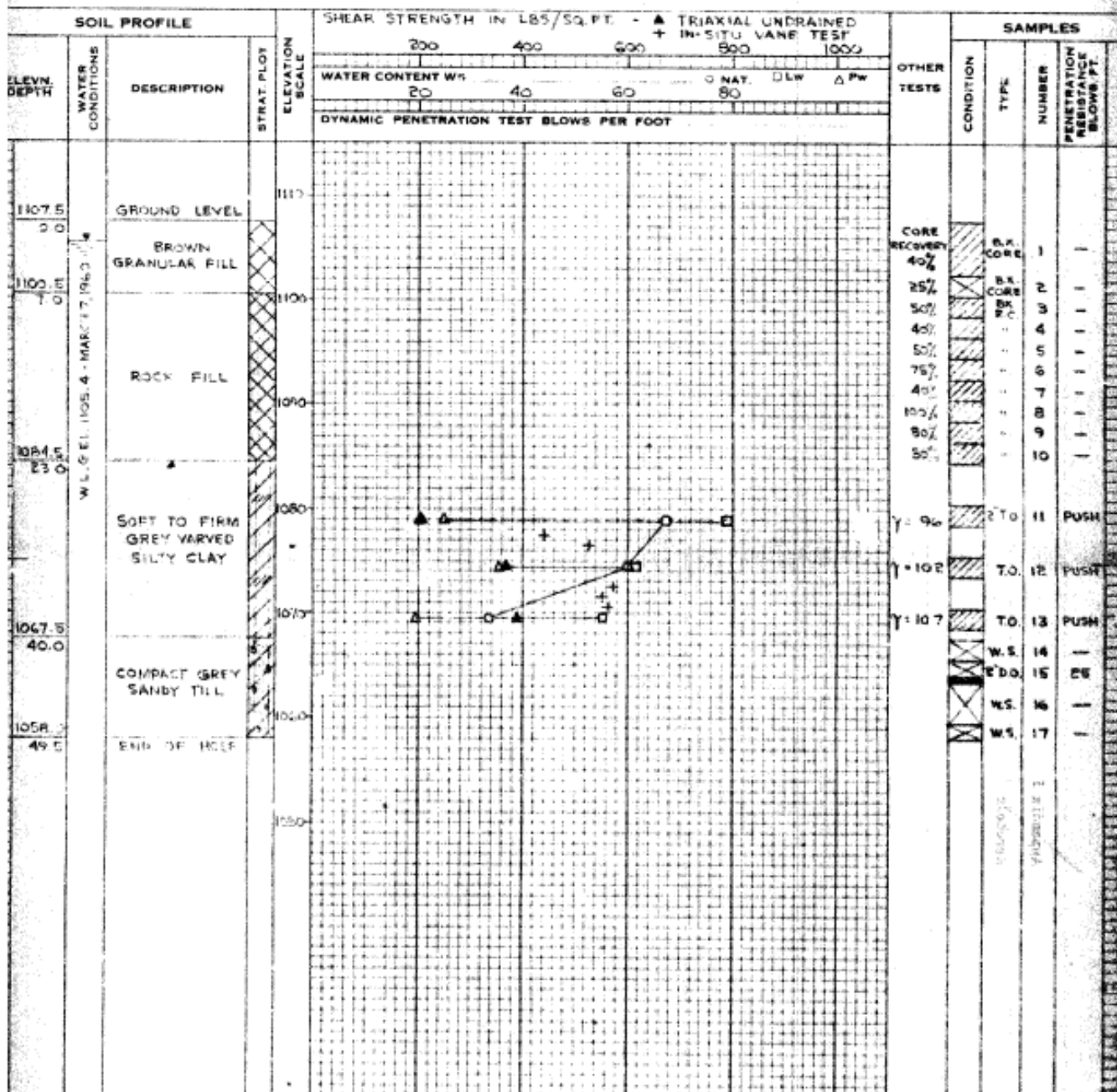
F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 Qc - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW

γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION

WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL



OFFICE REPORT ON SOIL EXPLORATION

SAMPLE CONDITION

SAMPLE TYPES

**DISTURBED
FAIR
GOOD
LOST**

A.S. - AUGER SAMPLE
S.T. - SLOTTED TUBE
W.S. - WASHED SAMPLE
D.O. - DRIVE-OPEN
D.F. - DRIVE-FOOT VALVE
C.S. - CHUNK SAMPLE

F.S. - FOIL SAMPLE
S.O. - SLEEVE-OPEN
S.P. - SLEEVE-FOOT VALVE
T.O. - THIN WALLED OPEN
R.C. - ROCK CORE

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW

ABBREVIATIONS

γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION

WL . WATER LEVEL IN CASING
WT . WATER TABLE IN SOIL

SOIL PROFILE

GENERAL INFORMATION				WATER CONTENT W:			OTHER TESTS			SAMPLES		
ELEVATION DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT PLOT ELEVATION SCALE	DYNAMIC PENETRATION TEST BLOWS PER FOOT			CONDITCN	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS FT.		
				C NAT	LW	Pw						
1105.4		ICE LEVEL										
1.0		LAKE BOTTOM										
1086.4		GREY SILTY CLAY										
19.0		END OF HOLE										
1113.0		GROUND LEVEL										
0.0		GREY SILTY CLAY										
1067.0		GREY SANDY TILL										
46.0		END OF HOLE										
1063.0												
50.0												

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 57034 PROBING 12 DATUM GEODETIC CASING
BORING DATE MARCH 8, 1960 REPORT DATE APRIL 4, 1960 COMPILED BY J.A. CHECKED BY JH
SAMPLER HAMMER WT. LBS. DROP INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. LBS. ENERGY)

SAMPLE CONDITION

SAMPLE TYPES

ABBREVIATIONS

☐ DISTURBED
☐ FAIR
☐ GOOD
☐ LOST

A.S. - AUGER SAMPLE
S.T. - SLOTTED TUBE
W.S. - WASHED SAMPLE
D.O. - DRIVE OPEN
D.F. - DRIVE-FOOT VALVE
C.S. - CHUNK SAMPLE

F.S. - FOIL SAMPLE
S.O. - SLEEVE-OPEN
S.F. - SLEEVE-FOOT VALVE
T.O. - THIN WALLED OPEN
R.C. - ROCK CORE

ABBREVIATION

N - IN-SITU VANE TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
QC - TRIAXIAL CONSOLIDATED QUICK
Q - TRIAXIAL QUICK
S - TRIAXIAL SLOW

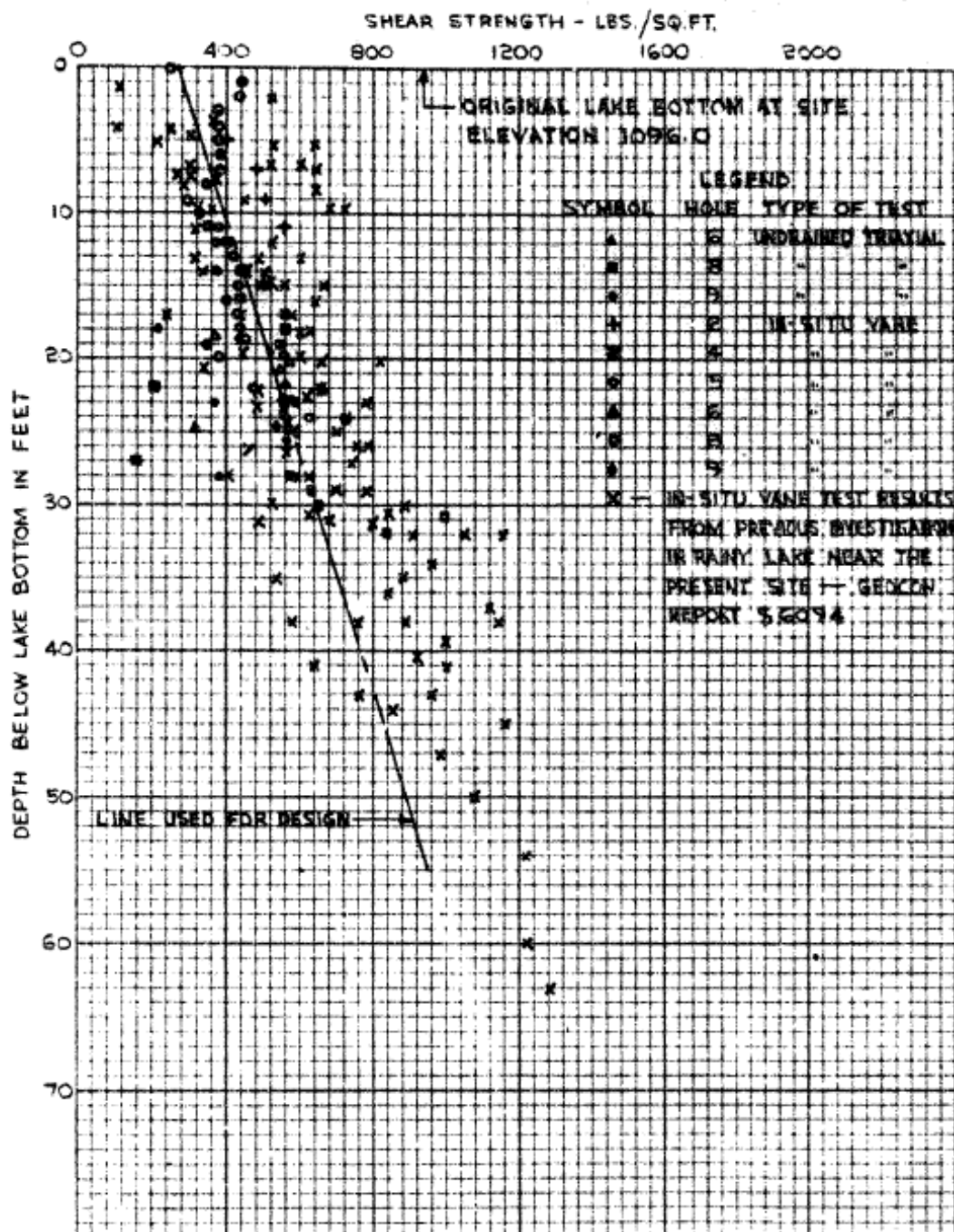
γ - WET UNIT WEIGHT
K - PERMEABILITY
C - CONSOLIDATION

WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SC

SOIL PROFILE					SAMPLES							
ELEV. DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT PLOT	ELEVATION SCALE	WATER CONTENT W% O NAT □ LW △ PW			OTHER TESTS	CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS / FT.
					DYNAMIC PENETRATION TEST BLOWS PER FOOT							
1111.0 0.0		GROUND LEVEL		1120								
				1110								
				1100								
		GREY SILTY CLAY		1090								
				1080								
1069.0 42.0		GREY SANDY TILL		1070								
1066.0 45.0		END OF HOLE		1060								

SHEAR STRENGTH VS DEPTH BELOW LAKE BOTTOM VARVED SILTY CLAY

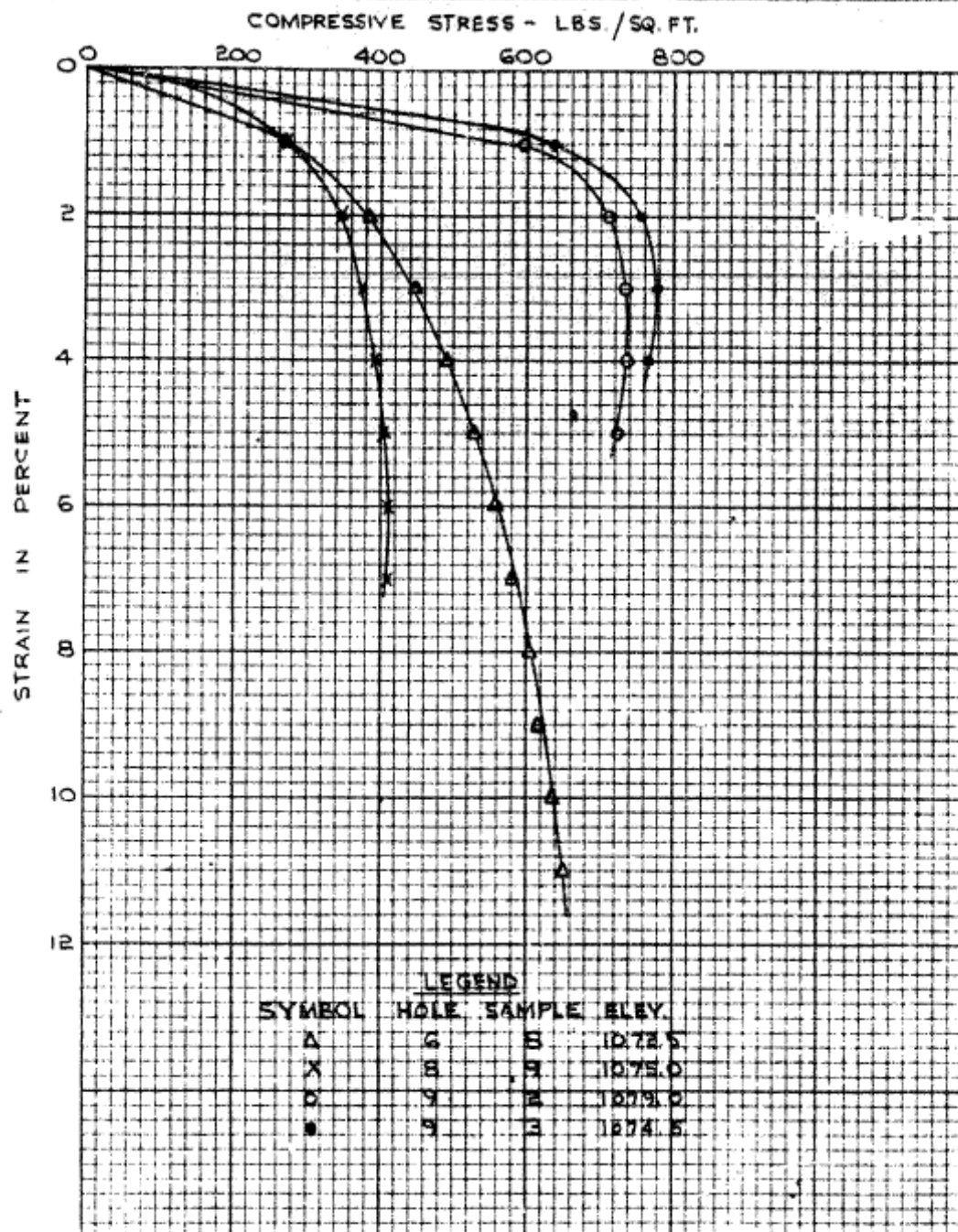
APPENDIX II
FIGURE 1
PROJECT S 7034



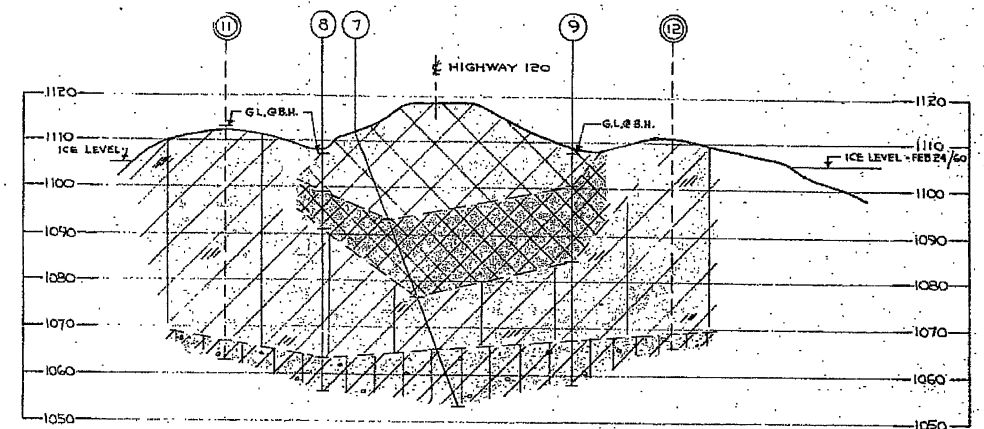
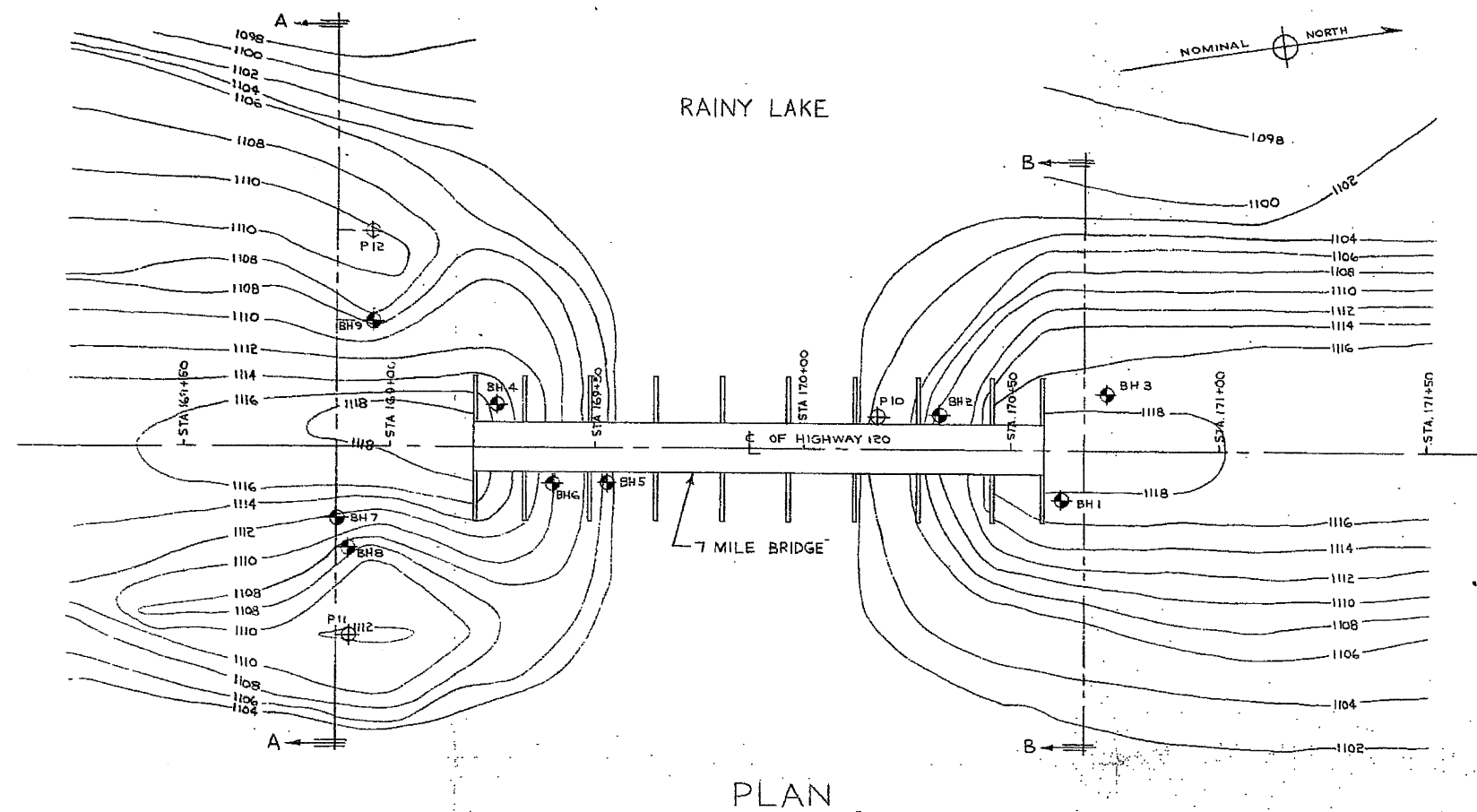
GEOCON

UNDRAINED TRIAXIAL COMPRESSION TESTS
TYPICAL STRESS-STRAIN CURVES
GREY VARVED SILTY CLAY

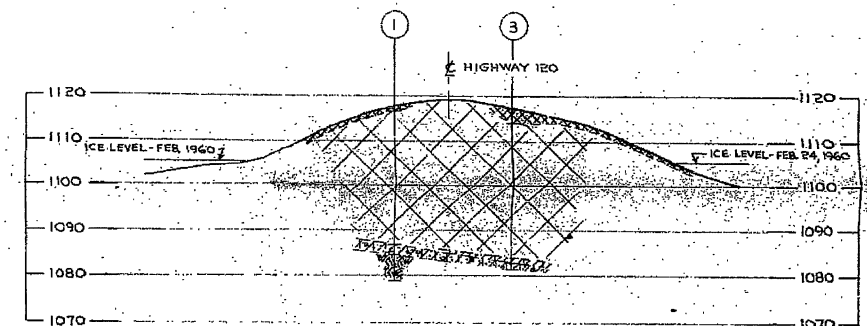
APPENDIX II
FIGURE 2
PROJECT S 7034



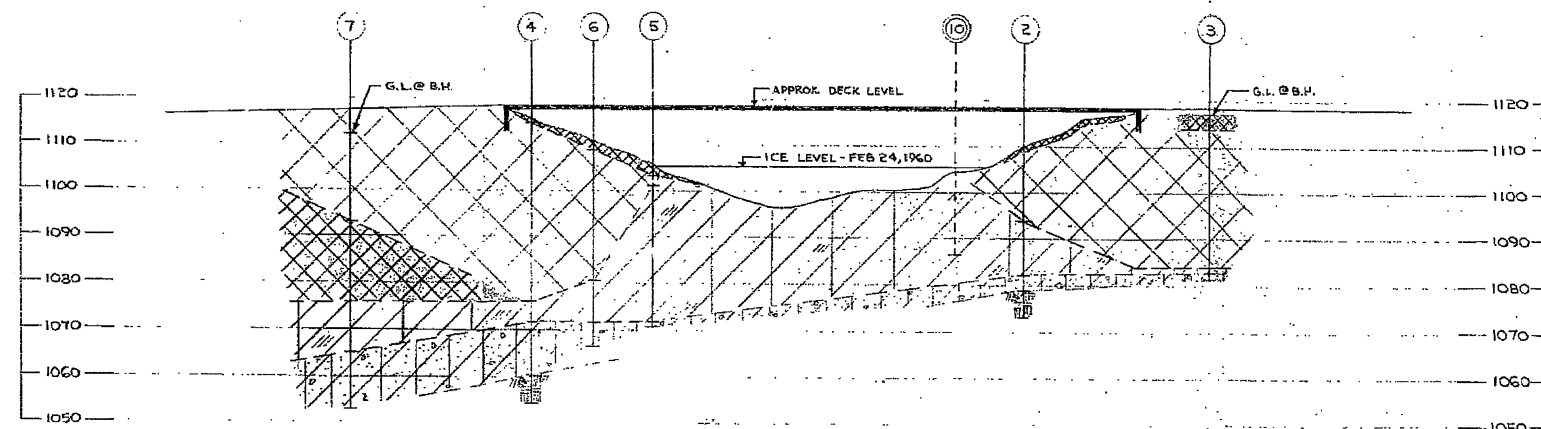
GEOCON



SECTION A-A



SECTION B-B



SECTION ALONG CENTRE LINE - HIGHWAY 120

STRATIGRAPHY

- ROCK FILL
- LOOSE TO COMPACT BROWN GRANULAR FILL
- SOFT TO FIRM GREY VARVED SILTY CLAY
- COMPACT GREY SANDY TILL
- SOUND GREY SYENITE GNEISS BEDROCK

LEGEND

- BOREHOLE IN PLAN
- BOREHOLE IN ELEVATION
- PROBING IN PLAN
- PROBING IN ELEVATION

SPECIAL NOTE: DATA CONCERNING THE VARIOUS STRATIGRAPHY HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.

REVISIONS			REFERENCE		REFERENCE		DEPARTMENT OF HIGHWAYS, ONTARIO		GEOCON LTD	
MARK	DATE	DESCRIPTION	DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION	TORONTO	ONTARIO		
							SEVEN MILE BRIDGE STRUCTURE		DATE APRIL 6, 1960	SCALE " = 20'-0"
							BORING PLAN AND SOIL STRATIGRAPHY		MADE BY J.A. JLS	No. 57034-2

Appendix D

Site Photographs



Photograph 1 – North Side of Seven Mile Bridge, looking east



Photograph 2 – North Side of Seven Mile Bridge, looking west



Photograph 3 – South Side of Seven Mile Bridge, looking east



Photograph 4 – South Side of Seven Mile Bridge, looking west



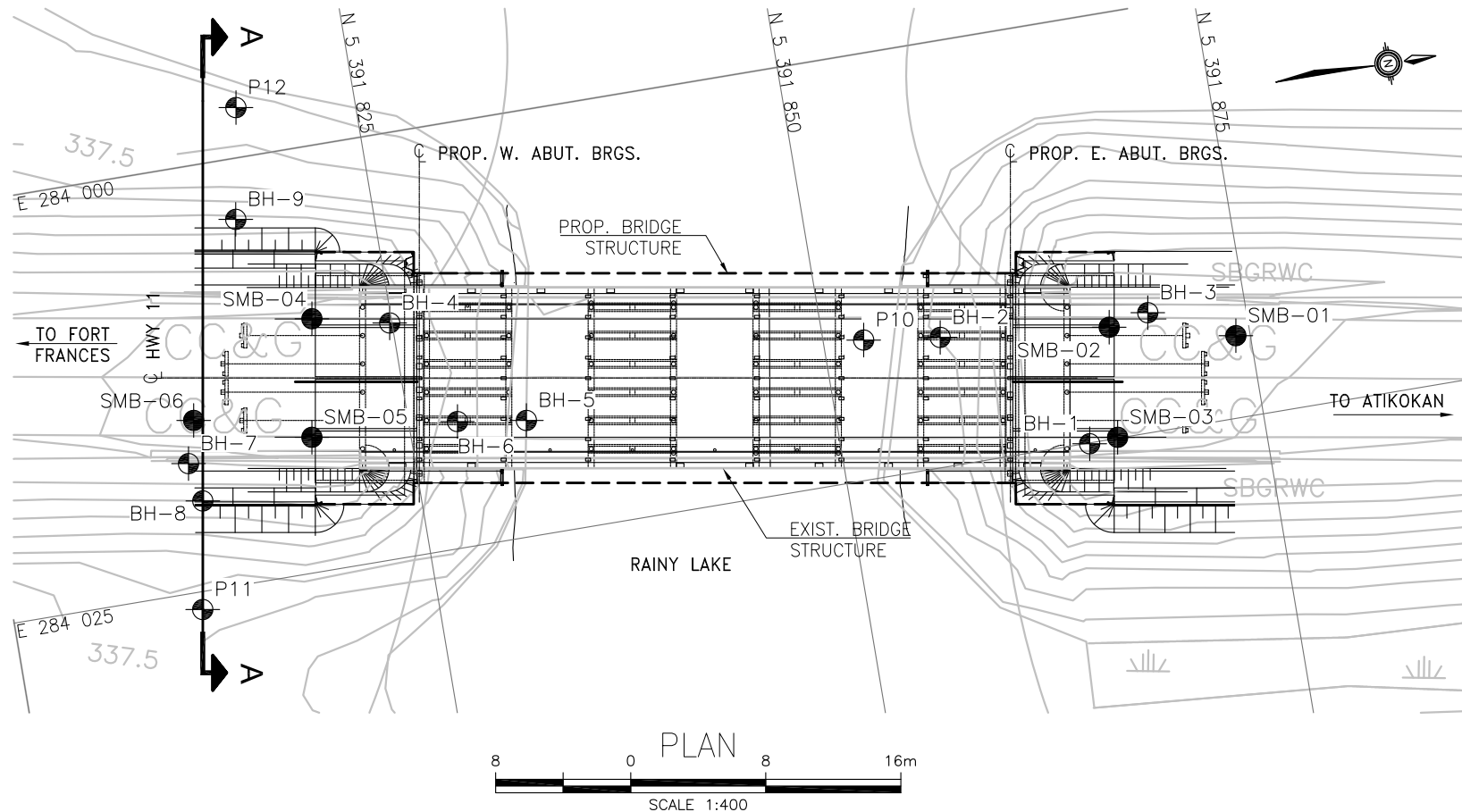
Photograph 5 – Seven Mile Bridge, looking east



Photograph 6 – Seven Mile Bridge, looking west

Appendix E

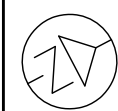
Drawing titled “Borehole Locations and Soil Strata”



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



HWY 11
CONT No. 2013-6021
WP No. 6049-08-02

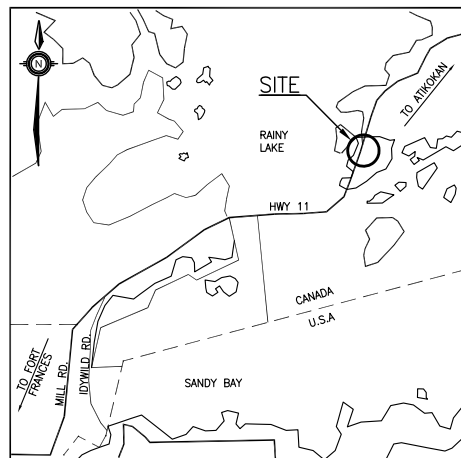


HIGHWAY 11
SEVEN MILE BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET
12



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

	Borehole (Current Investigation)
	Borehole (Previous Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level During Drilling
	Water Level In Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

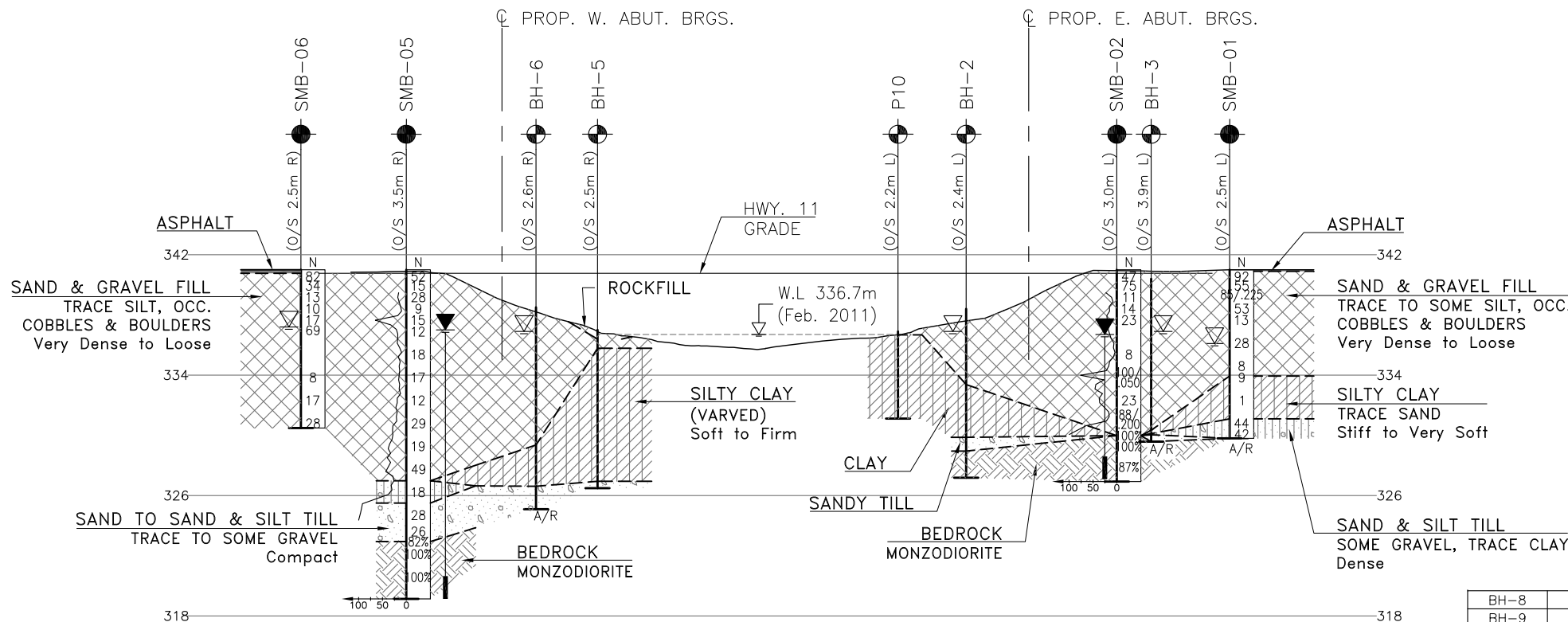
NO	ELEVATION	NORTHING	EASTING
SMB-01	341.0	5 391 874.2	284 020.2
SMB-02	341.0	5 391 866.8	284 018.4
SMB-03	341.0	5 391 866.3	284 024.9
SMB-04	341.0	5 391 820.4	284 010.1
SMB-05	341.0	5 391 819.2	284 017.1
SMB-06	341.1	5 391 812.5	284 014.9
BH-1	340.7	5 391 864.6	284 025.0
BH-2	338.4	5 391 856.9	284 017.4
BH-3	340.4	5 391 869.2	284 018.0
BH-4	339.9	5 391 824.9	284 011.1
BH-5	337.0	5 391 831.9	284 018.2
BH-6	338.5	5 391 827.9	284 017.6
BH-7	338.9	5 391 811.7	284 017.4

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52C-28

BH-8	337.4	5 391 812.2	284 019.7
BH-9	337.6	5 391 816.9	284 003.6
P10	336.9	5 391 852.4	284 016.8
P11	339.2	5 391 811.1	284 026.1
P12	338.6	5 391 818.0	283 997.1



PROFILE ALONG C HWY 11

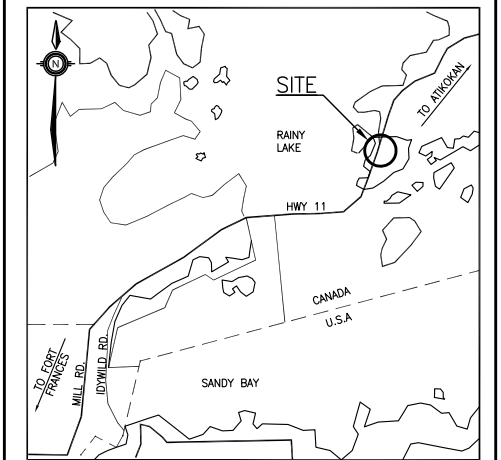
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK	RPR
DRAWN	AN	CHK	SITE
LOAD			
DATE	OCT. 2013		
DWG	2		

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HWY 11
CONT No. 2013-6021
WP No. 6049-08-02





HIGHWAY 11
SEVEN MILE BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET
13



KEYPLAN

LEGEND

- | | |
|---------------------------------------------------------------------------------------|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level During Drilling |
|  | Water Level In Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

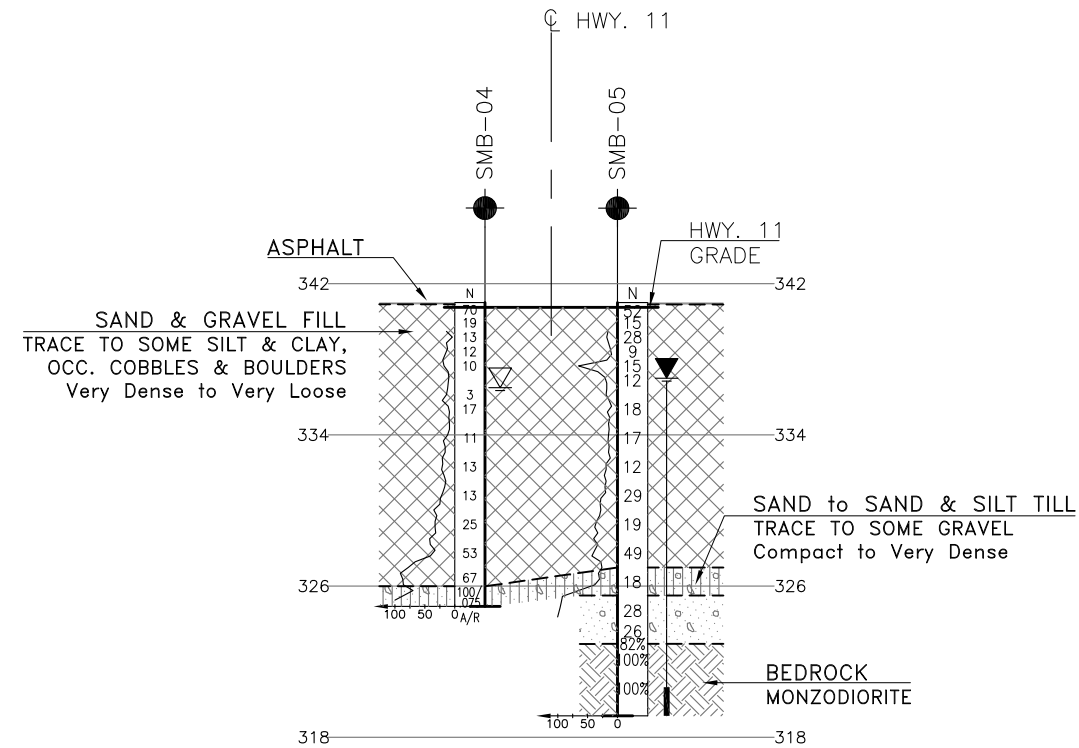
NO	ELEVATION	NORTHING	EASTING
SMB-01	341.0	5 391 874.2	284 020.2
SMB-02	341.0	5 391 866.8	284 018.4
SMB-03	341.0	5 391 866.3	284 024.9
SMB-04	341.0	5 391 820.4	284 010.1
SMB-05	341.0	5 391 819.2	284 017.1
SMB-06	341.1	5 391 812.5	284 014.9
BH-1	340.7	5 391 864.6	284 025.0
BH-2	338.4	5 391 856.9	284 017.4
BH-3	340.4	5 391 869.2	284 018.0
BH-4	339.9	5 391 824.9	284 011.1
BH-5	337.0	5 391 831.9	284 018.2
BH-6	338.5	5 391 827.9	284 017.6
BH-7	338.9	5 391 811.7	284 017.4

-NOTES-

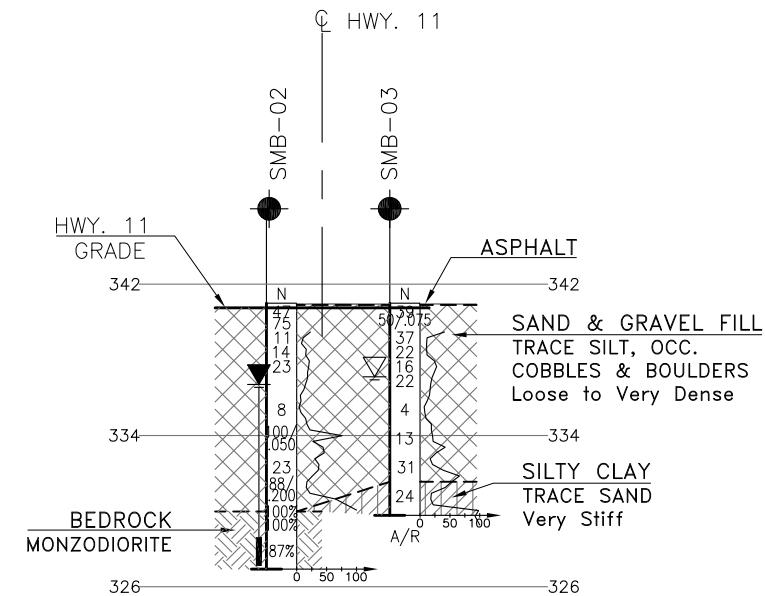
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52C-28

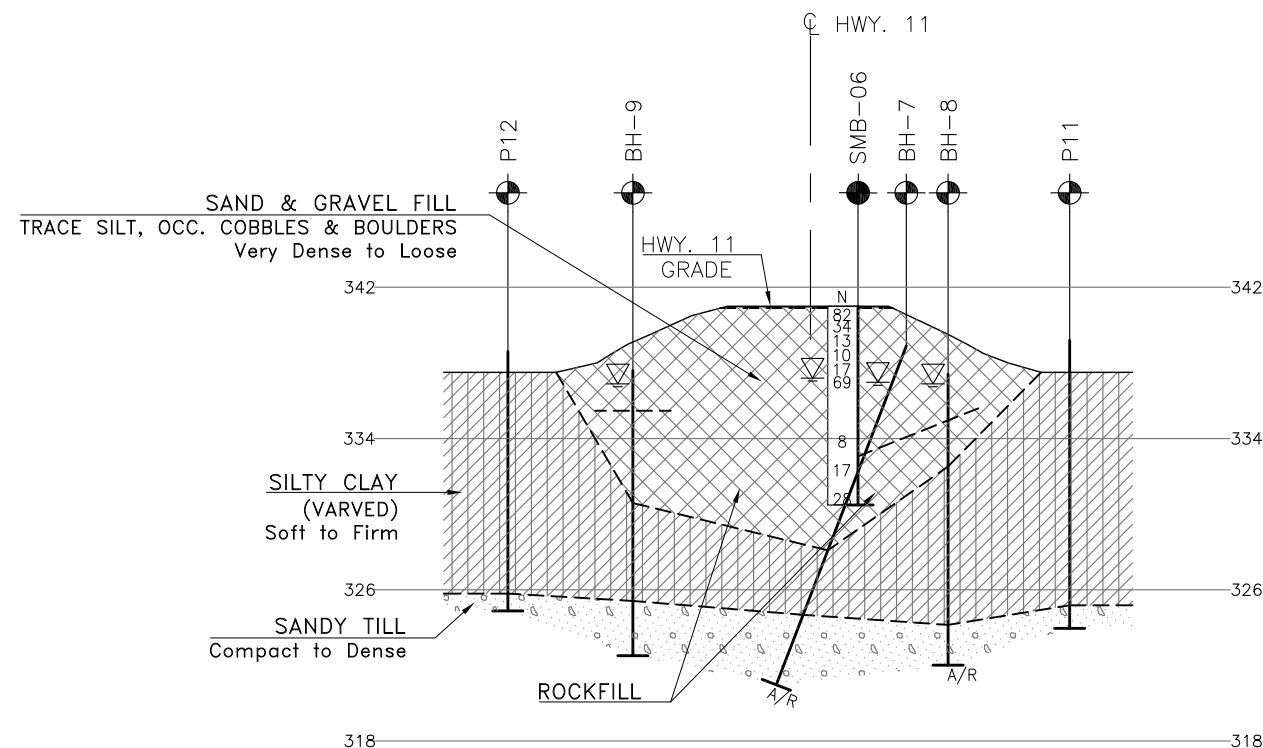
BH-8	337.4	5 391 812.2	284 019.7
BH-9	337.6	5 391 816.9	284 003.6
P10	336.9	5 391 852.4	284 016.8
P11	339.2	5 391 811.1	284 026.1
P12	338.6	5 391 818.0	283 997.1



SECTION ALONG WEST ABUTMENT



SECTION ALONG EAST ABUTMENT



SECTION ALONG A-A



REVISIONS										
	DATE	BY	DESCRIPTION							
DESIGN	RPR	CHK	RPR	CODE		LOAD	DATE	OCT. 2013		
DRAWN	AN	CHK		SITE	45-76	STRUCT	DWG	3		