

**FOUNDATION INVESTIGATION AND DESIGN REPORT
OZONE CREEK CULVERT REHABILITATION
HIGHWAY 17, TOWNSHIP OF PATIENCE
DISTRICT OF THUNDER BAY, ONTARIO
W.P. 6101-10-01, SITE 48C-112**

Geocres Number: 52H-29

Report to

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PART 1 FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of the Ozone Creek Culvert located on Highway 17 east of Nipigon, in the Township of Patience, Thunder Bay District, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the site, and based on the data obtained, to provide a borehole location plan, record of borehole sheets, a 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 MMM Group Limited (MMM), under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0011.

2 SITE DESCRIPTION

The culvert site is located on Highway 17 approximately 18 km east of the intersection of Highways 11 and 17 in Nipigon, in the Thunder Bay District, Ontario. The Ozone Creek meanders southerly into Lake Superior (Nipigon Bay) approximately 500 m to the south.

The existing culvert was built in 1960 and rehabilitated in 1996 under Contract No. 96-219. The culvert is a twin concrete box structure with cell widths of 4.9 m each and a cell height of 6.1 m. The total length of the culvert is 15.2 m. The culvert invert (top of base slab) indicated on the archive design drawings is at Elev. 187.3, and the base slab is 0.9 m thick.

Concrete flumes are provided at both ends of the culvert. The flumes are 8.4 m (south) and 8.5 m (north) in length, with the outer 2.1 m of the north flume wall (inlet) angled outwards at 30°. The

existing approach embankments decrease in height from as much as 6.7 m adjacent to the culvert to approximately 4.6 m some 15 m away from the culvert.

The land surrounding the site is gently undulating and treed, with occasional clearings. Bedrock is exposed adjacent to the highway approximately 70 m to the west and 300 m to the east of the culvert. A railway crosses the creek about 75 m to the south. Photographs of the culvert and surrounding area are presented in Appendix C.

The site lies within the physiographical region known as the Quetico Subprovince of the Superior Province, which is characterized by granitic and metasedimentary bedrock. The bedrock is either exposed or overlain by a thin glaciolacustrine and quiet basin deposits consisting of silts and clays with minor sands.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out between June 17 and 20, 2013. A total of four boreholes, denoted as OZC-01 to OZC-04, were advanced to depths ranging from 10.2 m to 17.0 m below the existing highway grade. The locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawing included in Appendix D.

Details of the borehole depths and completion are summarized in Table 3.1 below.

Table 3.1 – Borehole Summary

Borehole	Drilling and Coring Depth/ Base of Hole Elevation(m)	Completion Details
OZC-01	10.2 / 184.5	Borehole backfilled with bentonite holeplug and cuttings to 0.8 m, concrete to 0.1 m then asphalt cold patch to surface.
OZC-02	14.6 / 180.1	Standpipe piezometer consisting of 19 mm diameter Schedule 40 PVC pipe with a 4.5 m slotted screen installed.
OZC-03	17.0 / 177.7	Standpipe piezometer consisting of 19 mm diameter Schedule 40 PVC pipe with a 4.5 m slotted screen installed.
OZC-04	15.8 / 178.9	Borehole backfilled with bentonite holeplug and cuttings to 0.6 m, concrete to 0.1 m then asphalt cold patch to surface.

All boreholes were advanced using a CME75 truck-mounted drill rig in combination with hollow stem augers and NW casing methods to advance the boreholes in the overburden. Samples of the overburden soils were obtained from the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

Core samples of the underlying bedrock were recovered from two boreholes using NQ rock coring equipment. All rock cores were logged, photographed and the Total Core Recovery (TCR), Solid Core Recovery (SCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

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.

Groundwater conditions in the open boreholes were observed during the drilling operations. Standpipe piezometers consisting of 19 mm PVC pipe with a slotted screen were installed in Boreholes OZC-02 and OZC-03. Following the final water level reading, the piezometers were decommissioned in general accordance with MOE Regulation 903.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets included in Appendix A. Selected samples were also subjected to gradation analysis and Atterberg Limits testing, and the results of this testing program are summarized on the Record of Borehole sheets in Appendix A and shown on the figures included in Appendix B.

Point load tests (PLT) were performed on selected intact rock core samples. Unconfined compressive strengths (UCS) of the rock cores correlated from the PLT results are shown on the Record of Borehole sheets in Appendix A, and the results of the testing are enclosed in Appendix B. Photographs of the rock cores are also included in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. A stratigraphic profile is presented on the "Borehole Locations and Soil Strata" drawing in Appendix D. 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.

The subsurface stratigraphy encountered below the existing embankment fill at the site generally consists of a glaciolacustrine silty clay deposit underlain by bedrock. In the boreholes advanced some 15 m away from the culvert, the silty clay was underlain by a layer of silt.

More detailed descriptions of the individual strata are presented below.

5.1 Asphalt and Concrete

An asphalt pavement layer was encountered in all boreholes. The thickness of the asphalt layer ranged from 90 to 150 mm. Boreholes OZC-02 and OZC-03 were advanced through the approach slabs of the culvert and encountered 250 and 400 mm of concrete below the asphalt.

5.2 Fill

Granular embankment fill was encountered below the asphalt or concrete slab in all boreholes. The fill consists of various proportions of sand and gravel with trace silt and was classified as sand, trace gravel to sandy gravel. Occasional cobbles were encountered in the fill. The thickness of the fill ranged from 4.5 to 6.2 m, with the base of the fill encountered at depths of 4.6 to 6.7 m (Elev. 190.1 to 188.0 m).

SPT 'N' values recorded in the embankment fill ranged from 11 to 98 blows per 0.3 m penetration, indicating a variable compact to very dense relative density. 'N' values in excess of 50 blows for 0.3 m penetration are probably indicative of the presence of cobbles.

Moisture contents of the granular fill ranged from 2 to 20%.

The results of grain size analyses conducted on fill samples are provided on the Record of Borehole sheets in Appendix A, and are illustrated in Figures B1 and B2 of Appendix B. The results are summarized as follows:

Soil Particles	Percentage
Gravel	38 to 72
Sand	27 to 56
Silt and Clay	1 to 6

5.3 Silty Clay

A layer of grey silty clay was encountered directly below the fill in all boreholes. The thickness of the layer ranged from 4.0 m in Borehole OZC-01 located west of the culvert (within the west approach embankment) to 10.3 m in Borehole OZC-04 located within the east approach embankment. The silty clay extended to depths of 9.0 to 14.9 m (Elev. 185.7 to 179.8).

SPT 'N' values recorded in the silty clay varied between 2 and 14 blows per 0.3 m of penetration, typically between 2 and 5 blows per 0.3 m of penetration. The higher values of 7 to 14 blows per 0.3 m of penetration may indicate on the presence of a crust in the clay deposit. The vane shear tests (VST) measured in-situ undrained shear strengths ranging

from 17 to 21 kPa. Based on the SPT and VST data, the consistency of the silty clay was described as soft with a discontinuous firm to very stiff crust.

The sensitivity of the silty clay, calculated as a ratio of undisturbed strength to remoulded strength, ranged from 3 to 4, suggesting that the silty clay is of normal sensitivity.

The results of grain size analyses conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B3 of Appendix B.

The results are summarized as follows:

Soil Particles	Percentage
Gravel	0
Sand	0 to 2
Silt	24 to 40
Clay	60 to 76

The results of Atterberg Limits tests conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix A and illustrated in Figure B5 of Appendix B. The results indicate that the deposit has plastic limits ranging from 18 to 24% and liquid limits ranging from 41 to 58%, suggesting medium to high plasticity. Plasticity indices, determined as the difference between the plastic limit and liquid limit, ranged from 23 to 35%. Natural moisture contents of the silty clay ranged from 35 to 55%.

5.4 Silt

A layer of grey silt with trace to some sand and clay was encountered below the silty clay in Boreholes OZC-01 and OZC-04. The boreholes were terminated in this deposit at depths of 10.2 and 15.8 m (Elev. 184.5 and 178.9).

Two SPT 'N' values recorded in the silt were 11 and 29 blows per 0.3 m penetration, indicating a compact relative density of the deposit. Moisture contents of 21 and 23% were measured.

The results of grain size analyses conducted on two samples of the silt are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B4 of Appendix B. The results are summarized as follows:

Soil Particles	Percentage
Gravel	0
Sand	2 to 19
Silt	75 to 86
Clay	6 to 12

5.5 Bedrock

Bedrock was encountered below the silty clay in Boreholes OZC-02 and OZC-03 at depths of 11.6 m (Elev. 183.1) and 13.4 m (Elev. 181.3).

The bedrock in the boreholes was classified as a granitic gneiss and consisted of white and pink granite incorporated into the black and white gneiss. In the recovered rock cores, the rock was coarse grained, fresh with occasional horizontal joints. Some mechanical breaks were noted in the recovered core samples. The measured Total Core Recovery (TCR) were 100% for all core runs, and the Rock Quality Designation (RQD) ranged from 83% to 100%, indicating a good to excellent rock quality. Fracture Index (FI) values between 0 and 3 were obtained for the recovered rock cores.

The unconfined compressive strength (UCS) of the rock, estimated from the results of point load tests conducted on the rock core samples, ranged from 113 to 122 MPa (average for each run), indicating a very strong intact rock. The point load test results are included on the borehole logs in Appendix A. The point load test sheets with details of the testing and photographs of the rock core are enclosed in Appendix B.

5.6 Water Levels

The water levels in the boreholes were measured upon completion of drilling operations. It should be noted that water was used during the wash-boring and coring operations, therefore, the measured water levels in open boreholes may not reflect prevailing groundwater levels at the site.

Standpipe piezometers were installed in Boreholes OZC-02 and OZC-03 to monitor groundwater levels after drilling. The water levels measured in the open boreholes upon completion of drilling and in the piezometers are summarized in Table 5.1.

Table 5.1 - Water Level Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
OZC -01	Jun.19, 2013	2.1	192.6	Open borehole
OZC-02	Jun. 19, 2013	5.8	188.9	Open borehole
	Jun. 20, 2013	2.5	192.2	In piezometer
	Jul. 09, 2013	2.4	192.3	
	Jun. 20, 2013	3.0	191.7	Open borehole
OZC-03	Jun. 26, 2013	2.5	192.2	In piezometer
	Jul. 09, 2013	3.5	191.2	
OZC-04	Jun. 18, 2013	3.4	191.3	Open borehole

The high water level in Ozone Creek was shown on the preliminary GA drawing at Elev. 190.7.

The water level in the creek and groundwater levels are expected to fluctuate seasonally and are subject to precipitation patterns, and may vary from the levels presented above.

6 MISCELLANEOUS

Eastern Ontario Diamond Drilling Ltd. supplied the drill rig and conducted the drilling, sampling and in-situ testing operations. A truck-mounted CME 75 drill rig was used for the duration of the investigation.

The drilling and sampling operations were supervised in the field by Mr. George Azzopardi of Thurber Engineering. Mr. Mark Farrant, P.Eng. directed the field operations.

The report was prepared by Ms. Anna Piascik, P.Eng., and reviewed by Mr. Murray Anderson, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects.

THURBER ENGINEERING LTD.

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PART 2 ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 INTRODUCTION

This report presents interpretation of the geotechnical data provided in the factual report, as well as discussions and geotechnical design recommendations for the rehabilitation of the Ozone Creek Culvert on Highway 17 in the Township of Patience, District of Thunder Bay, Ontario.

The existing culvert was built in 1960 and rehabilitated in 1996 under Contract No. 96-219. The culvert is a twin concrete box structure with cell widths of 4.9 m each and a cell height of 6.1 m. The total length of the culvert is 15.2 m. The culvert invert (top of base slab) indicated on the archive design drawings is at Elev. 187.3, and the base slab is 0.9 m thick.

Concrete flumes are provided at both ends of the culvert. The flumes are 8.4 m (south) and 8.5 m (north) in length, with the outer 2.1 m of the north flume wall (inlet) angled outwards at 30°. The existing approach embankments decrease in height from as much as 6.7 m adjacent to the culvert to approximately 4.6 m some 15 m away from the culvert.

The General Arrangement drawing provided by MMM, dated May 2015, indicates that culvert rehabilitation will involve removal of the existing concrete deck, haunches, approach slabs and top of wing walls, replacement of the deck slab with 400 mm thick prestressed concrete deck panels, and replacement of the approach slabs with new 250 mm thick precast slab panels. In addition, the wingwalls will be refaced to 300 m below grade and the centre wall will also be partially refaced.

The new deck panels will be slightly heavier than the existing deck slab and the connection between the panels and existing walls will be pinned rather than fixed (existing). The use of EPS in the approaches is proposed to lessen the lateral pressures on the culvert walls to accommodate the revised deck connection detail.

The discussions and recommendations presented in this report are based on the factual data obtained during the course of the investigation, and are intended to provide the designers with information and parameters related to the foundation aspects of the proposed culvert rehabilitation. The plans and profiles used for preparation of this report were provided by MMM Group Limited.

8 CULVERT DESIGN

8.1 General

In general, the subsurface stratigraphy encountered at the culvert site consisted of existing embankment fill extending to depths between 4.6 and 6.7 m, underlain by a 4.0 to 10.3 m thick layer of soft silty clay. The silty clay was directly underlain by bedrock at depths of 11.6 and 13.4 m (Elev. 183.1 and 181.3) in the boreholes drilled adjacent to the culvert walls. In the boreholes advanced some 15 m away from the culvert, the silty clay was underlain by a layer of silt.

Water levels measured in the piezometers installed in the boreholes ranged from 2.4 to 3.5 m (Elev. 192.3 to 191.2) below grade. The General Arrangement plan indicates a high water level in Ozone Creek at Elev. 190.7 m.

8.2 Bearing Capacity of Founding Soils

The archive design drawings indicate that the culvert base slab is founded at Elev. 186.4. Based on the borehole data, the slab placed at this level is founded on the soft silty clay deposit. Details of the subgrade preparation and bedding thickness design are not available.

The proposed rehabilitation works will result in a slight increase in loading (less than 10%) on the foundation soils. For a base with approximate dimensions of 15 m by 10 m, founded at Elev. 186.4, the following geotechnical resistance and reaction values are recommended to assess the effect of the additional loading:

Factored Geotechnical Resistance at ULS (kPa)	75 kPa
Geotechnical Reaction at SLS (kPa)	50 kPa

The resistance values provided above are for vertical, concentric loads. Where eccentric or inclined loads are applied, the resistance used in design should be reduced in accordance with the CHBDC Clause 6.7.3 and Clause 6.7.4.

The geotechnical SLS resistance value given above is based on an estimated total settlement not exceeding 25 mm.

8.3 Subgrade Reaction

The interaction between the clay subgrade and the existing slab can be analysed using a soil-spring model. A coefficient of subgrade reaction, k_s , of 7,000 kN/m²/m is recommended

for use in the analysis. The spring constant, K_s , at a particular node may be obtained by multiplying k_s by the slab area attributed to that node.

8.4 Lateral Earth Pressure

The rehabilitation of the culvert will include excavation of some 2.4 m of existing backfill from behind the wall to enable structural modifications and EPS placement.

Backfill used to re-establish the approaches should consist of granular material conforming to OPSS.PROV 1010 Granular A, Granular B Type II or Granular B Type III specifications. Backfilling to the culvert should be in accordance with OPSS 902.

Backfill should be placed and compacted in simultaneous equal lifts on both sides of the culvert, and the top of backfill elevation should be within 400 mm on both sides of the culvert at all times. The precast concrete cap panels forming the deck over the culvert should be in place prior to backfilling.

Heavy compaction equipment should not be used adjacent to the walls and deck of the culvert. Compaction equipment to be used adjacent to culverts should be restricted in accordance with OPSS 501 and SP 105S21.

Lateral earth pressures acting on the culvert walls and wing walls may be assumed to be triangularly distributed and to be governed by the characteristics of the culvert backfill and the underlying soils. For a fully drained condition, the pressures should be computed in accordance with the CHBDC, which are generally given by the expression:

$$p_h = K (\gamma h + q)$$

where: p_h = horizontal pressure on the wall at depth h (kPa)

K = earth pressure coefficient (see Table 8.1)

γ = unit weight of retained soil (see Table 8.1)

h = depth below top of fill where pressure is computed (m)

q = value of any surcharge (kPa).

Earth pressure coefficients for backfill to the culvert and wingwalls are dependent on the material used as backfill and the inclination of the ground surface behind the wall. Recommended values are shown in Table 8.1.

The use of a material with a high friction angle and low active pressure coefficient (Granular A or Granular B Type II) is preferred as it results in lower earth pressures acting on the culvert.

Table 8.1 - Earth Pressure Coefficients

Condition	Earth Pressure Coefficient (K)			
	OPSS Granular A or OPSS Granular B Type II $\phi = 35^\circ, \gamma = 22.8 \text{ kN/m}^3$		OPSS Granular B Type I/III or Existing Sand & Gravel Fill $\phi = 32^\circ, \gamma = 21.2 \text{ kN/m}^3$	
	Horizontal Surface	Sloping Surface behind Wall (2H:1V)	Horizontal Surface	Sloping Surface behind Wall (2H:1V)
Active (Unrestrained Wall)	0.27	0.40	0.31	0.48
At rest (Restrained Wall)	0.43	-	0.47	-
Passive (Movement Towards Soil Mass)	3.7	-	3.3	-

Submerged unit weight should be used below groundwater level; the highest groundwater level was measured in the piezometer at Elev. 192.3, or 2.4 m below the existing ground surface.

The parameters in the table correspond to full mobilization of active and passive earth pressures, and require certain relative movements between the wall and adjacent soil to produce these conditions. The values to be used in design can be assessed from Figure C6.16 of the Commentary to the CHBDC. Active pressures should be used for any wingwalls or unrestrained walls.

In accordance with Clause 6.9.3 of the CHBDC, a compaction surcharge should be added. The magnitude should be 12 kPa at the top of fill and decreasing to 0 kPa at a depth of 2.0 m for Granular B Type I or Type III or at a depth of 1.7 m for Granular A or Granular B Type II.

Where EPS is used behind the culvert wall to reduce the lateral earth pressures, it may be assumed that the lateral earth pressures generated by the granular material against the outer end of the EPS will not be transmitted through the EPS to the culvert wall provided the outer end of the EPS is tapered up away from the culvert at an inclination no steeper than 2H:1V. The EPS should be covered by a minimum 1.0 m of granular fill.

9 SEISMIC CONSIDERATIONS

The following seismic parameters should be used for design:

- Velocity Related Seismic Zone 0
- Zonal Velocity Ratio 0.0
- Acceleration Related Seismic Zone 0
- Zonal Acceleration Ratio 0.0
- Peak Horizontal Acceleration 0.011g

The soil profile type at this site has been classified as Type III. Therefore, according to Clause 4.4.6.1, Table 4.4 of the CHBDC, a Site Coefficient “S” (ground motion amplification factor) of 1.5 should be used in seismic design.

In accordance with Clause 4.6.4 of the CHBDC, retaining structures should be designed using active (K_{AE}) and passive (K_{PE}) earth pressure coefficients that incorporate the effects of earthquake loading. The coefficients of horizontal earth pressure for seismic loading presented in Table 9.1 may be used:

Table 9.1 – Earth Pressure Coefficients for Earthquake Loading

Condition	Earth Pressure Coefficient (K)	
	OPSS Granular A or OPSS Granular B Type II $\phi = 35^\circ$ $\gamma = 22.8 \text{ kN/m}^3$	OPSS Granular B Type I, Type III or Existing Granular Fill $\phi = 32^\circ$, $\gamma = 21.2 \text{ kN/m}^3$
Active (K_{AE})*	0.28	0.31
Passive (K_{PE})	3.7	3.2
At Rest (K_{OE})**	0.44	0.49

* After Mononobe and Okabe, passive case assumes a horizontal surface in front of the wall.

** After Woods

The site is underlain primarily by soft clay. In view of these conditions and the velocity related seismic zone of zero, liquefaction is not considered to be a concern at this site.

10 SCOUR AND EROSION PROTECTION

Erosion protection measures such as rock protection must be provided along any surfaces beyond the flume that may be in contact with river flow.

A vegetation cover should be established on all other exposed earth surfaces to protect against surficial erosion, in general accordance with OPSS 804.

11 EXCAVATION AND GROUNDWATER CONTROL

Based on the preliminary GA, excavation for the culvert rehabilitation will be limited to the sand and gravel embankment fill adjacent to the culvert walls and wingwalls, and will be maintained above the high water level of Elev. 190.7. Any excavation below the river level without prior dewatering is not recommended and would require such means as a sheet pile cofferdam enclosure driven to sufficient depth to cut off surface and groundwater inflow and minimize the volume of water to be handled.

All excavation should be carried out in accordance with the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the embankment fill at this site is classified as a Type 3 soil above the water level and Type 4 soil below the water level.

The excavation and backfilling should be carried out in accordance with OPSS 902.

Roadway protection will be required during various stages of construction. Roadway protection should be provided in accordance with OPSS 539 and designed for Performance Level 2. The design of roadway protection is the responsibility of the Contractor and all shoring should be designed by a Professional Engineer experienced in such designs.

12 CONSTRUCTION CONCERNS

Potential construction concerns include, but are not necessarily limited to:

- The water levels in the creek may fluctuate and be at higher elevations at the time of construction than indicated in the report.
- Cobbles or other buried obstructions may be encountered during excavation in the existing embankment fill and may interfere with installation of the roadway protection system.
- Construction operations must consider the need to limit the pressures imposed on the culvert walls, particularly when the top slab is removed. An appropriate setback should be established between the culvert walls and any construction equipment or stockpiled materials to prevent overstressing of the walls.
- The Contractor's selection of construction equipment and methodology should include assessment of the capability of the existing embankment to support the proposed construction equipment and any temporary structures or fill (i.e., as a pad for crane support). Site conditions may limit the type of equipment suitable for use during construction. The design and safety of any temporary works is the responsibility of the Contractor.

13 CLOSURE

Engineering analysis and preparation of the report were carried out by Ms. A. Piascik, P.Eng. and Mr. M. Anderson, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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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.

EXPLANATION OF ROCK LOGGING TERMS


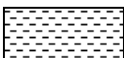



ROCK WEATHERING CLASSIFICATION

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

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
	(MPa)	(psi)	
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length
Solid Core Recovery:(SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run
Rock Quality Designation:(RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index:(FI)	Frequency of natural fractures per 0.3m of core run.

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			

RECORD OF BOREHOLE No OZC-01

1 OF 2

METRIC

WP# 6101-10-00 LOCATION Ozone Creek Bridge N 5 432 043.1 E 228 896.0 ORIGINATED BY GA
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.06.19 - 2013.06.19 CHECKED BY MEF

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							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							W P W W L		
194.7	GROUND SURFACE						20	40	60	80	100	20	40	60			
0.0	ASPHALT:(150mm)																
0.2	SAND, some gravel Dense to Very Dense Brown Wet (FILL)		1	SS	39								○				
			2	SS	45									○			
																	
			3	SS	56								○				
			4	SS	47									○			
191.7																	
3.0	SAND and GRAVEL, trace silt Compact to Dense Brown Wet (FILL)		5	SS	40								○				
																	
			6	SS	18								○				
189.7																	
5.0	Silty CLAY, trace sand Soft to Firm Grey Wet																
			7	SS	5									┌───○───┐			
			8	SS	2										○		
																	
185.7																	
9.0	SILT, some sand, trace clay Compact Grey Wet		9	SS	11								○				

Continued Next Page

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

RECORD OF BOREHOLE No OZC-01

2 OF 2

METRIC

WP# 6101-10-00 LOCATION Ozone Creek Bridge N 5 432 043.1 E 228 896.0 ORIGINATED BY GA
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.06.19 - 2013.06.19 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)					
							20	40	60	80	100	20	40	60	kn/m ³	GR SA SI CL	
184.5	Continued From Previous Page																
10.2	END OF BOREHOLE AT 10.2m. BOREHOLE OPEN TO 10.2m AND WATER LEVEL AT 2.1m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.8m, CONCRETE TO 0.1m, THEN ASPHALT PATCH TO SURFACE.																

RECORD OF BOREHOLE No OZC-02

1 OF 2

METRIC

WP# 6101-10-00 LOCATION Ozone Creek Bridge N 5 432 049.8 E 228 909.7 ORIGINATED BY GA
 HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.06.18 - 2013.06.19 CHECKED BY MEF

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
194.7	GROUND SURFACE							20 40 60 80 100							
0.0	ASPHALT:(115mm)							20 40 60 80 100							
0.1															
194.3	CONCRETE:(250mm)														
0.4	Sandy GRAVEL, trace silt Compact Brown Moist to Wet (FILL)														
			1	SS	14		194								
			2	SS	29		193								64 33 3 (SI+CL)
			3	SS	11		192								
			4	SS	20		191								72 27 1 (SI+CL)
							190								
			5	SS	19		189								
							188								
							187								
							186								
							185								
188.6															
6.1	Silty CLAY, trace sand Soft to Firm Grey Wet		6	SS	7		188								
							187								
			7	SS	2		186								
							185								

Continued Next Page

+ 3, × 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

[illegible]

ONTMT4S 1197.GPJ 2015TEMPLATE(MTO).GDT 6/4/15

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No OZC-03

1 OF 2

METRIC

WP# 6101-10-00 LOCATION Ozone Creek Bridge N 5 432 043.0 E 228 923.3 ORIGINATED BY GA
HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2013.06.19 - 2013.06.20 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
194.7	GROUND SURFACE											
0.0	ASPHALT:(90mm)											
0.1	CONCRETE:(400mm)											
194.2												
0.5	SAND and GRAVEL, trace silt Compact to Dense Brown Wet (FILL)		1	SS	16		194					
			2	SS	42		193					
	Occasional cobbles		3	SS	40		192					51 46 3 (SI+CL)
191.7												
3.0	Sandy GRAVEL, trace silt Compact Brown/Grey Wet (FILL)		4	SS	13		191					
			5	SS	13		190					
188.8							189					
5.9	SAND, occasional gravel Compact Grey Wet (FILL)		6	SS	11		188					
188.0	Wood fragments (0.3m) at 6.7m											
6.7	Silty CLAY Soft Grey Wet		7	SS	2		187					0 0 24 76
			1	TW			186					
							185					

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

METRIC

[illegible]

ONTMT4S 1197.GPJ 2015TEMPLATE(MTO).GDT 6/4/15

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No OZC-04

1 OF 2

METRIC

WP# 6101-10-00 LOCATION Ozone Creek Bridge N 5 432 049.9 E 228 936.3 ORIGINATED BY GA
 HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.06.17 - 2013.06.18 CHECKED BY MEF

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						
194.7	GROUND SURFACE													
0.0	ASPHALT:(100mm)													
0.1	SAND and GRAVEL, trace silt Very Dense Brown Wet (FILL)		1	SS	54		194							
			2	SS	50									
			3	SS	50		193							
			4	SS	89		192							
191.7			5	SS	98		191							
3.0	SAND, trace gravel Very Dense Brown Wet (FILL)													
190.1			6	SS	14		190							
4.6	Silty CLAY, varved Soft to Stiff Grey Wet						189							
			7	SS	9		188							
	Occasional sand layers						187							
			8	SS	3		186							
			9	SS	2		185							

Continued Next Page

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

RECORD OF BOREHOLE No OZC-04

2 OF 2

METRIC

WP# 6101-10-00 LOCATION Ozone Creek Bridge N 5 432 049.9 E 228 936.3 ORIGINATED BY GA
 HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.06.17 - 2013.06.18 CHECKED BY MEF

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			
								20 40 60 80 100									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)					
	Continued From Previous Page																
	Silty CLAY , varved Soft to Stiff Grey Wet						184										
			10	SS	2		183										
			11	SS	2		182										
			12	SS	2		181										
179.8							180										
14.9	SILT , some clay, trace sand Compact Grey Wet																
			13	SS	29		179										
178.9																	
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.8m AND WATER LEVEL AT 3.4m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.6m, CONCRETE TO 0.1m THEN ASPHALT PATCH TO SURFACE.																

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

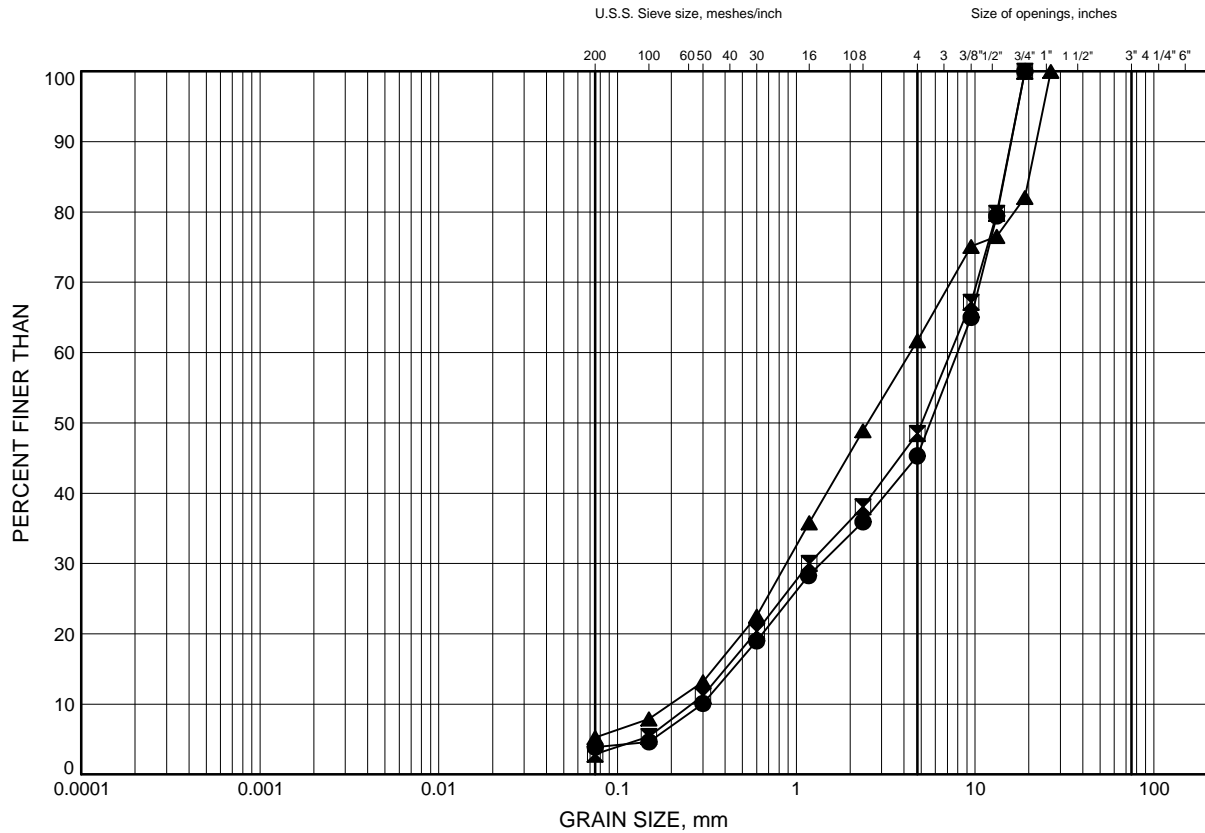
Appendix B

Laboratory Test Results Soil and Rock

Ozone Creek Bridge 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)
●	OZC-01	4.88	189.82
⊠	OZC-03	2.59	192.11
▲	OZC-04	2.59	192.11

Date June 2015
WP# 6101-10-00

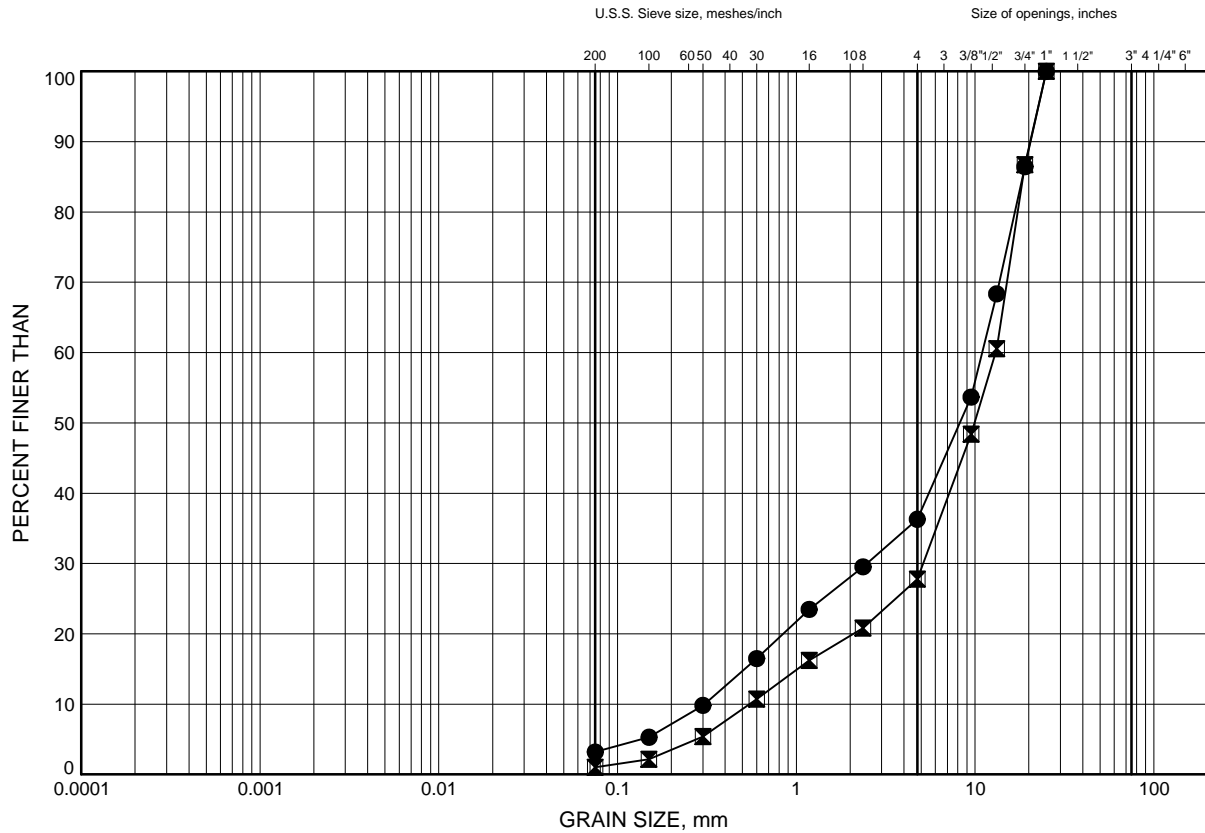


Prep'd AN
Chkd. AMP

Ozone Creek Bridge GRAIN SIZE DISTRIBUTION

FIGURE B2

SANDY GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OZC-02	1.83	192.87
⊠	OZC-02	3.35	191.35

Date June 2015
WP# 6101-10-00



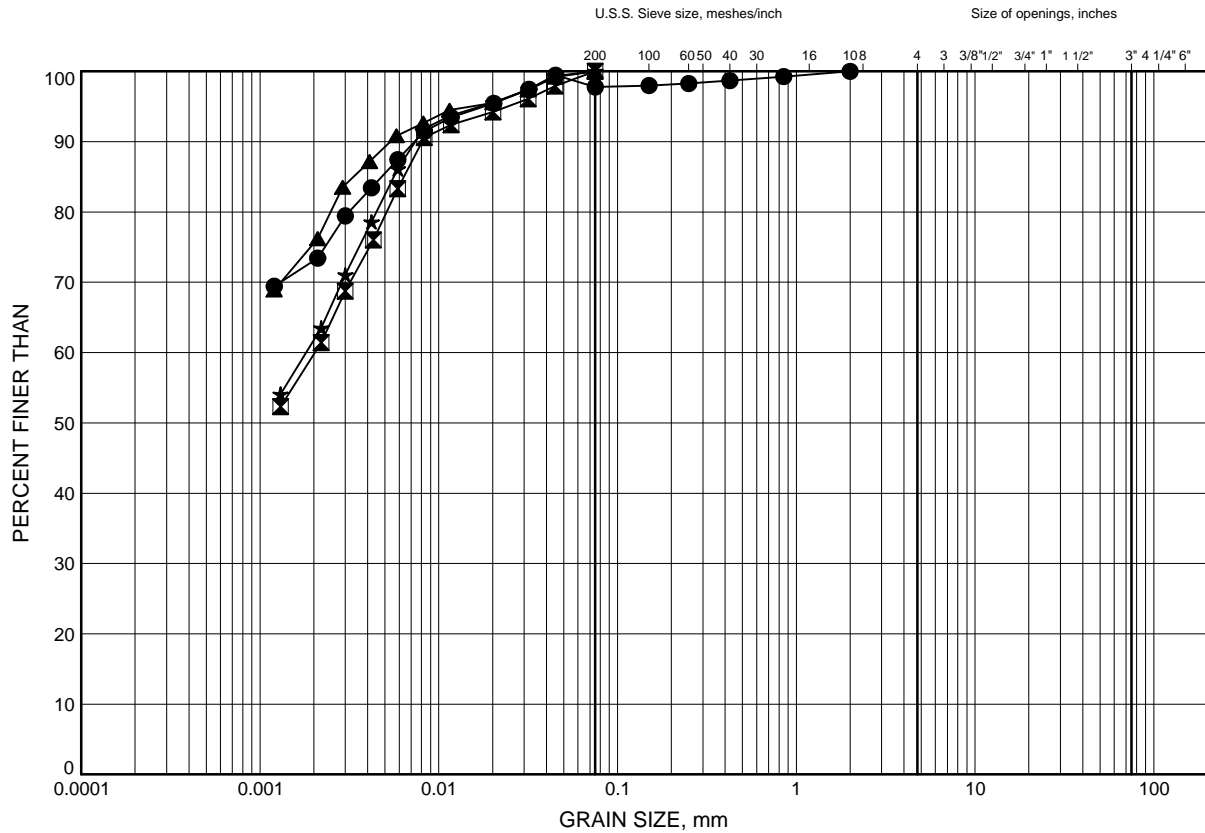
Prep'd AN
Chkd. AMP

Ozone Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OZC-01	6.40	188.30
⊠	OZC-02	10.97	183.73
▲	OZC-03	7.92	186.78
★	OZC-04	12.50	182.20

Date June 2015
 WP# 6101-10-00

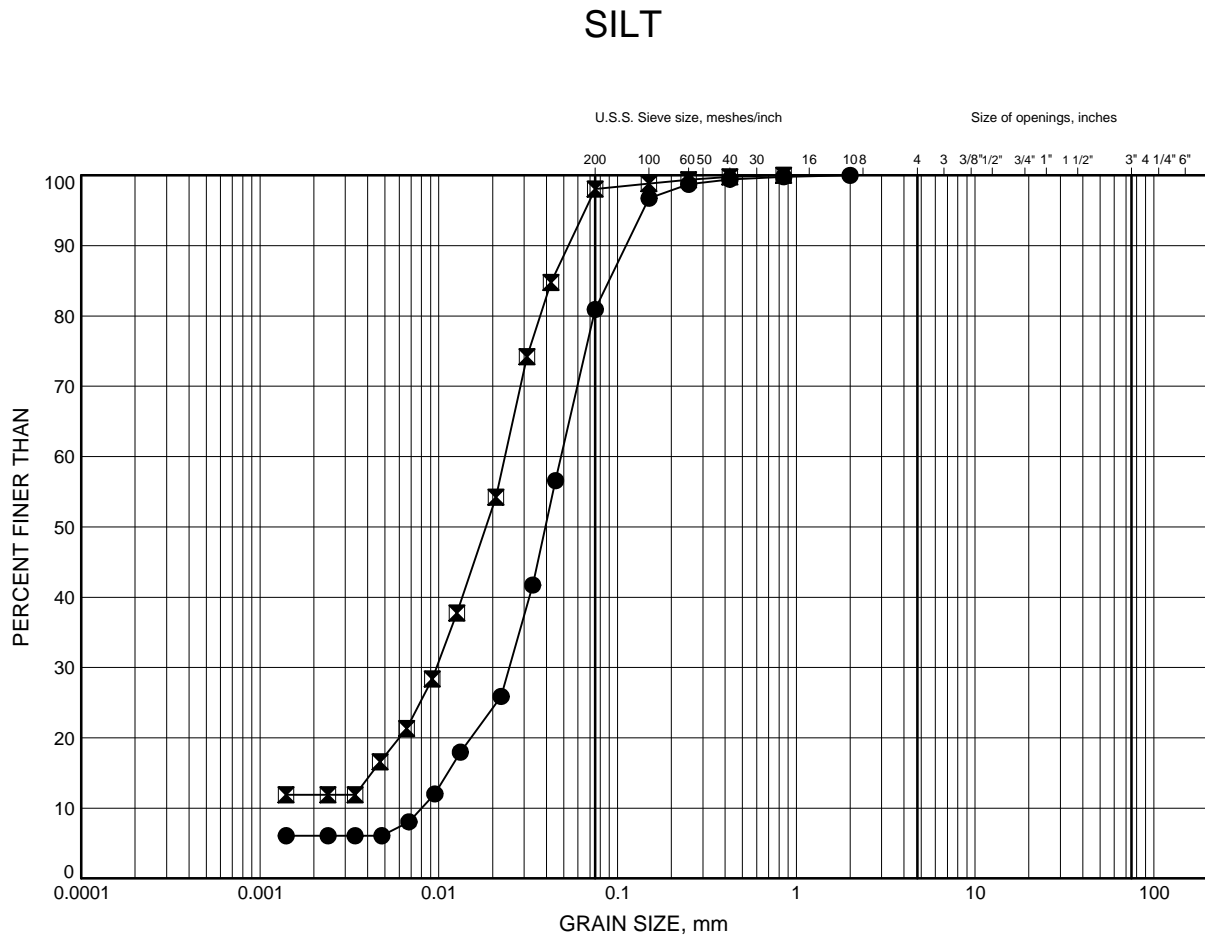


Prep'd AN
 Chkd. AMP

Ozone Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B4



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OZC-01	9.45	185.25
×	OZC-04	15.54	179.16

Date June 2015
 WP# 6101-10-00

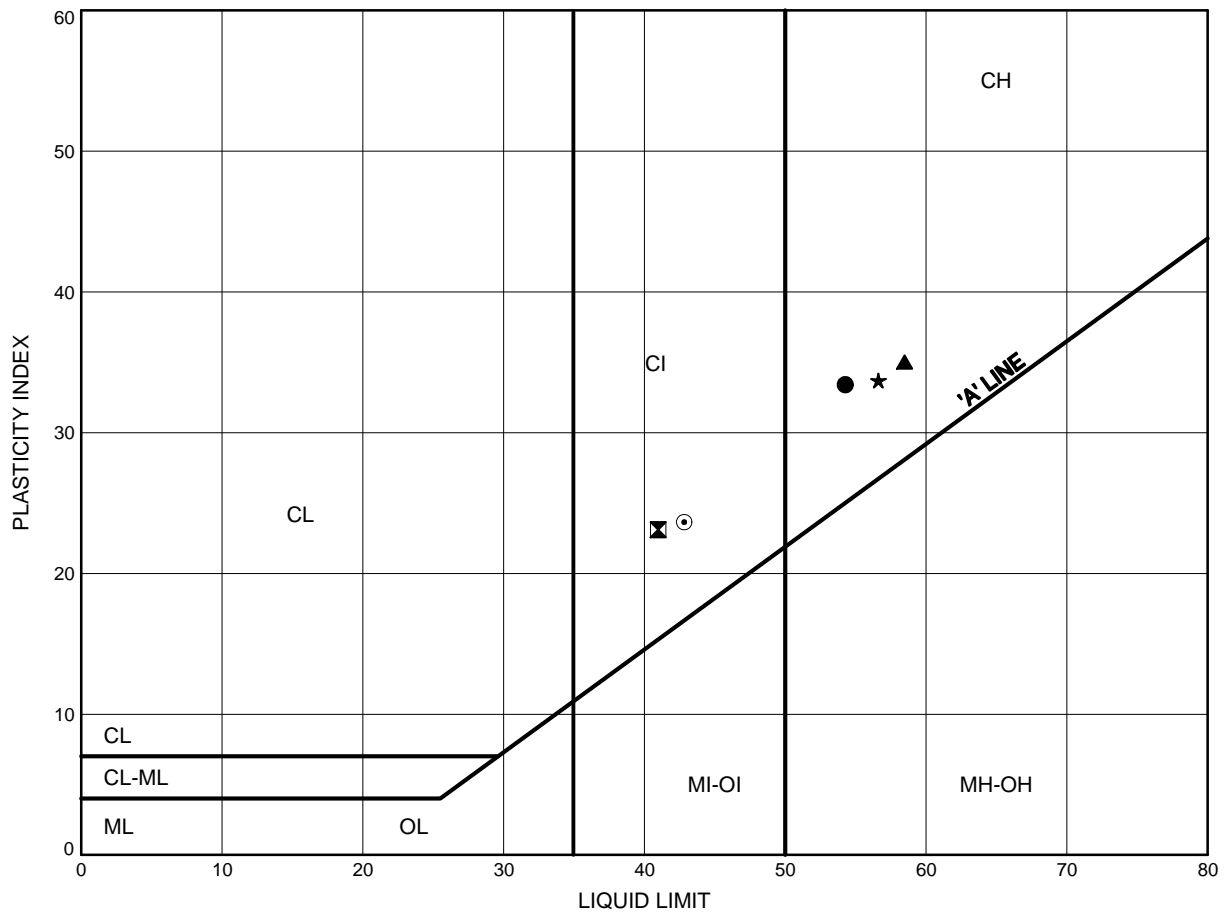


Prep'd AN
 Chkd. AMP

Ozone Creek Bridge
ATTERBERG LIMITS TEST RESULTS

FIGURE B5

SILTY CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OZC-01	6.40	188.30
⊠	OZC-02	10.97	183.73
▲	OZC-03	7.92	186.78
★	OZC-04	6.40	188.30
⊙	OZC-04	12.50	182.20

Date June 2015
 WP# 6101-10-00



Prep'd AN
 Chkd. AMP



POINT LOAD TEST SHEET

Job No : 19-1351-197

Client : MRC

Project Name : Ozone Creek / HWY 17

Date Drilled : 22/6/2013

Core Size : NQ BH No : OZC-02

Date Tested : 3/7/2013

Tester : ISP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (kPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	11.7	D	7260	47.3	103.5	72.0	Granite	
2	1	12.0	D	12140	47.1	89.7	121.2	Granite	
3	1	12.4	D	9060	47.2	99.0	90.1	Granite	
4	1	12.8	D	19030	47.3	105.8	188.6	Granite	
5	2	13.2	D	4410	47.4	92.4	43.6	Granite	
6	2	13.6	D	16030	47.4	112.2	158.5	Granite	
7	2	14.1	D	16630	47.3	87.2	165.1	Granite	
8	2	14.6	D	10780	47.2	102.7	107.2	Granite	
9									
10									
11						Run 1	118.0		Very Strong
12						Run2	118.6		Very Strong
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have $0.7 \times D$ on either side of test point.



POINT LOAD TEST SHEET

Job No : 19-1351-197

Client : MRC

Project Name : Ozone Creek / HWY17

Date Drilled : 20/6/2013

Core Size : NQ BH No : OZC-03

Date Tested : 3/7/2013

Tester : ISP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (kPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	13.5	D	12530	46.8	83.7	126.2	Granite	
2	1	13.6	D	10970	47.1	116.2	109.6	Granite	
3	1	14.3	D	14950	47.0	125.2	149.7	Granite	
4	1	14.8	D	12720	47.6	128.3	125.0	Granite	
5	2	15.0	D	12550	47.4	103.0	124.3	Granite	
6	2	15.5	D	15960	47.4	129.1	157.8	Granite	
7	2	16.0	D	22010	47.2	96.7	219.0	Granite	
8	2	16.4	D	9030	47.3	123.1	89.4	Granite	
9	3	16.5	D	18730	47.3	108.2	185.7	Granite	
10	3	16.8	D	15220	47.3	134.9	151.2	Granite	
11									
12					RUN1	113.4			
13					RUN2	113.0			
14					RUN3	121.5			
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have $0.7 \times D$ on either side of test point.



Photograph 1 – Rock core recovered from Borehole OZC-02



Photograph 2 – Rock core recovered from Borehole OZC-03

Appendix C

Site Photographs



Photograph 1 – Ozone Creek Culvert looking east along Highway 17



Photograph 2 – Ozone Creek Culvert looking west along Highway 17



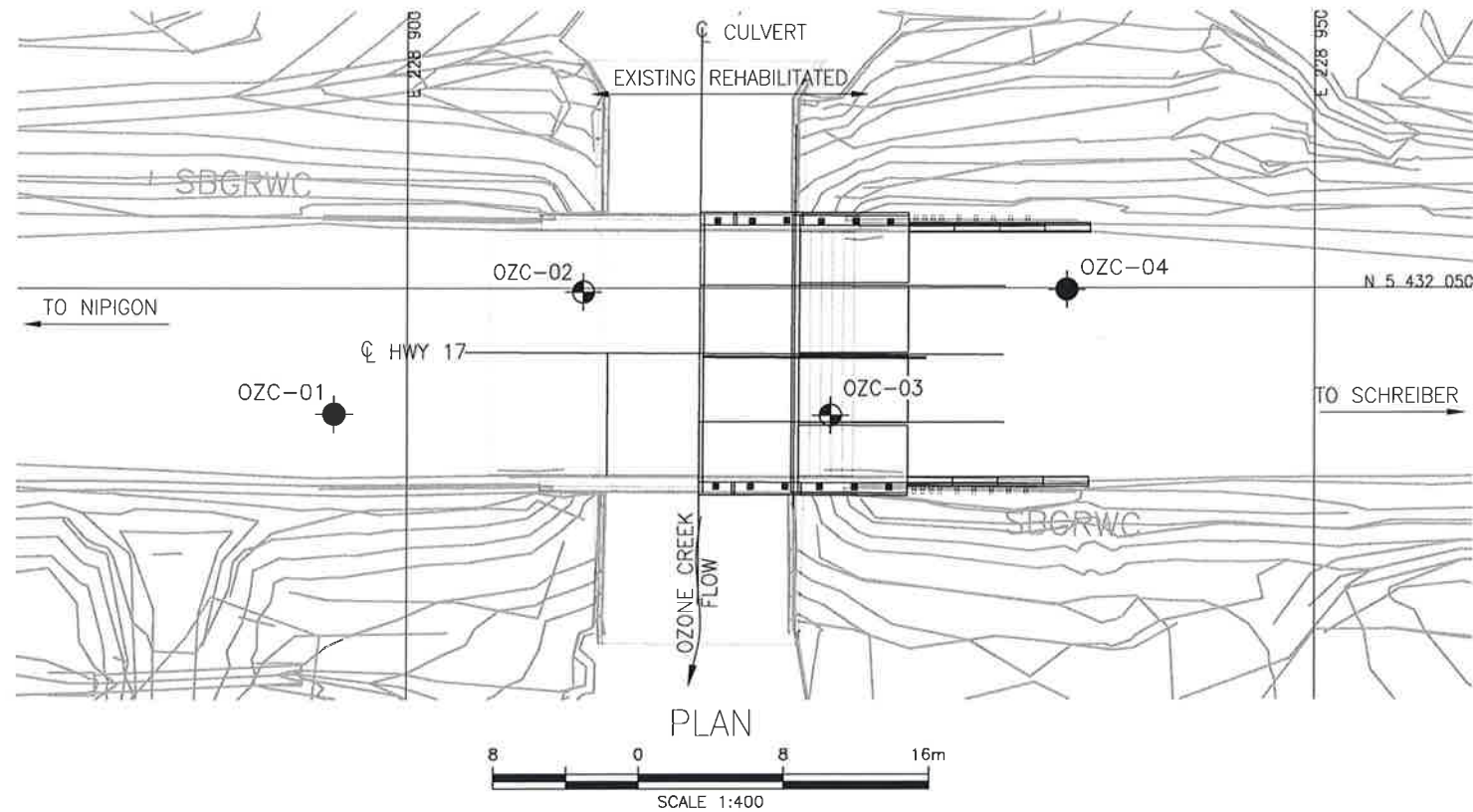
Photograph 3 – North Elevation of Ozone Creek Culvert



Photograph 4 – South Elevation of Ozone Creek Culvert

Appendix D

Borehole Locations and Soil Strata Drawing



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



CONT No
WP No 6101-10-01

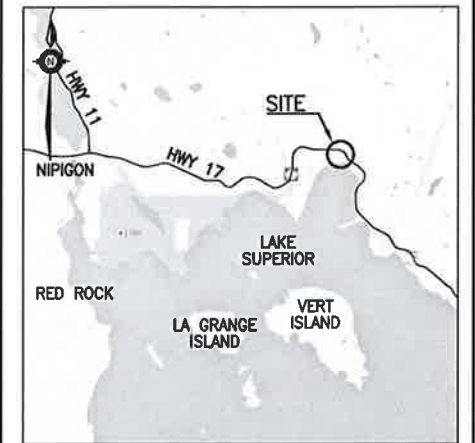
HIGHWAY 17
OZONE CREEK CULVERT
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET
11



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND



Borehole



Borehole/DCPT

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

CON

Blows /0.3m (60° Cone, 475J/blow)

PH

Pressure, Hydraulic



Water Level In Open Borehole



.....

Water Level In Piezometer

90%

Rock Quality Designation (RQD)

A/E

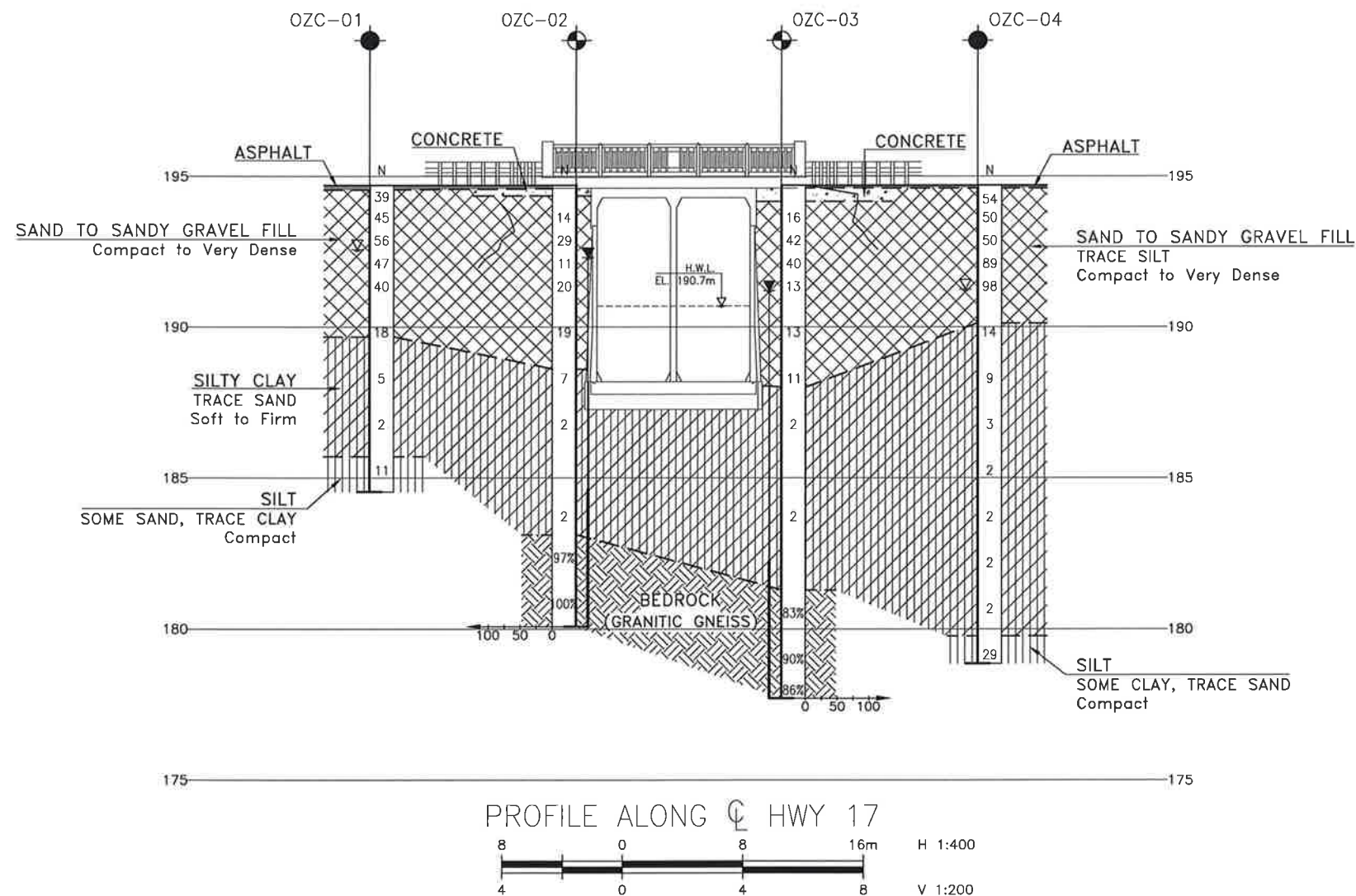
Auger Refusal

NO	ELEVATION	NORTHING	EASTING
OZC-01	194.7	5 432 043.1	228 896.0
OZC-02	194.7	5 432 049.8	228 909.7
OZC-03	194.7	5 432 043.0	228 923.3
OZC-04	194.7	5 432 049.9	228 936.3

-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. 52H-29



1500

DATE	BY	DESCRIPTION		
DESIGN ANP	CHK ANP	CODE	LOAD	DATE JUNE 2015
DRAWN AN	CHK	SITE 48C-112	STRUCT	DWG 1