REPORT

January 29, 2016

FOUNDATION INVESTIGATION AND DESIGN REPORT

BARRIE-COLLINGWOOD RAILWAY OVERHEAD STRUCTURE (SITE NO. 30-177/1&2) HIGHWAY 400 FROM ESSA ROAD TO DUNLOP STREET WEST BARRIE, ONTARIO GWP 2159-11-00

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GEOCRES No. 31D-631

Report Number: 1532543-2

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Table of Contents

REFERENCES

DRAWINGS

Drawing 1 Highway 400 NBL – BCR Overhead Structure, Borehole Locations and Soil Strata
Drawing 2 Highway 400 NBL – BCR Overhead Structure, Soil Strata
Drawing 3 Highway 400 SBL – BCR Overhead Structure, Soil Strata

APPENDIX A Borehole Records from Current Investigation

Lists of Abbreviations and Symbols
Records of Boreholes 15-1(BCR), 15-2(BCR), 15-7 to 15-10, HF3, P-RW3, TRW-1

APPENDIX B Geotechnical Laboratory Test Results

Figure B1A/B Grain Size Distribution – Sand and Silt to Sand Fill
Figure B2A/B Grain Size Distribution – Silt to Sand
Figure B3 Grain Size Distribution – Clayey Silt
Figure B4 Plasticity Chart – Clayey Silt

APPENDIX C Borehole Records from Previous Investigation (GEOCRES No. 31D-590)

Boreholes F5 and F6

APPENDIX D Existing BCR Overhead Structure Drawings (February 1950)

APPENDIX E Non-Standard Special Provisions

NSSP Working Slab
OC Preload Period – Embankment Widening Construction
NSSP Temporary Protection Systems (Amendment to OPSS.PROV 539)
NSSP Excavating and Backfilling – Structures (Amendment to OPSS 902)

PART A

FOUNDATION INVESTIGATION REPORT
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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield Limited (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services to support the detail design for the Barrie-Collingwood Railway (BCR) overhead structure site. This report addresses the foundation investigation completed for the proposed construction of the new BCR overhead structure to carry the Highway 400 northbound lanes over the rail line.

The purpose of this investigation is to establish the subsurface conditions at the location of the proposed overhead structure, approach embankments and wing walls, by means of a limited borehole investigation and geotechnical laboratory testing on selected samples.

Golder has completed the foundation engineering services in accordance with Proposal No. GEOTETOB22161AA, dated March 13, 2015, originally provided to MH by Coffey Geotechnics Inc. (Coffey).

2.0 SITE DESCRIPTION

The existing overhead structure carrying Highway 400 over BCR is located between the Dunlop Street and Essa Road interchanges, in Barrie, Ontario, at the location shown on the Key Plan on Drawing 1. The BCR overhead structure is located approximately 180 m south of the Tiffin Street overpass structure site.

This portion of Highway 400, including the existing BCR overhead structure, was built between 1950 and 1955. The existing structure consists of a 10.5 m long, single-span, concrete rigid frame structure supported on spread footings. The existing overhead structure carries six active lanes of Highway 400 traffic above BCR.

At this location, Highway 400 is constructed on fill / raised embankments. The existing Highway 400 grade is at about Elevation 243 m at the structure, while the ground surface surrounding the rail line is at about Elevation 234.5 m under the bridge. The existing Highway 400 approach embankments are up to about 8.5 m in height.

3.0 INVESTIGATION PROCEDURES

3.1 Previous Investigation by Others

Coffey completed a preliminary foundation investigation for the BCR overhead structure site comprising two boreholes (Boreholes F5 and F6) in October 2014. The borehole records are provided in Appendix C. The locations of these boreholes are summarized below and are shown on Drawing 1; Borehole F5 was advanced from the existing Highway 400 grade, while Borehole F6 was advanced from the existing rail grade.

Borehole Number	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
F5	4,914,403.1	288,402.0	243.0	18.9
F6	4,914,429.1	288,399.8	234.6	6.1

The results of this previous investigation are presented in Coffey's Preliminary Foundation Investigation and Design Report (GEOCRES No. 31D-590) dated February 11, 2015.

3.2 Current Investigation

The foundation investigation for the BCR structure site was carried out between June 24 and July 16, 2015, during which time a total of seven boreholes (Boreholes 15-7 to 15-10, HF-3, TRW-1 and P-RW3) were advanced using a track-mounted drill rig, supplied and operated by specialist drilling subcontractors. Two additional boreholes (15-1(BCR) and 15-2(BCR)) were drilled within the Highway 400 SBL at this structure site in November 2015. The locations of these boreholes are shown on Drawing 1.

The boreholes were advanced to depths ranging from 10.1 m to 17.4 m below existing ground surface using hollow stem auger drilling methods. Soil samples were obtained in the boreholes at 0.75 m and 1.5 m intervals of depth using 50 mm outer diameter split-spoon samplers driven by an automatic hammer, in accordance with the Standard Penetration Test (SPT) procedure. Each of the boreholes was terminated at the previously established depths provided in the Coffey proposal, to avoid penetrating into a trichloroethylene (TCE) plume that is present in the vicinity of the site.

The groundwater conditions were observed in the open boreholes during and immediately following the drilling operations, and a standpipe piezometer was installed in Boreholes 15-1(BCR) and 15-10 to permit monitoring of the groundwater level at the site. The piezometers consist of 50 mm diameter PVC pipe, with a slotted screen sealed within a sand filter pack at a selected depth interval within the borehole. Above the sand filter pack and piezometer screen, the annulus surrounding the piezometer pipes was backfilled to the ground surface with bentonite pellets. The piezometer installation details and water level readings are indicated on the record for Boreholes 15-1(BCR) and 15-10 contained in Appendix A. All remaining boreholes were backfilled with bentonite upon completion, in accordance with Ontario Regulation 903 (as amended).

The field work was supervised on a full-time basis by a member of Golder's staff who observed the drilling, sampling and in situ testing operations, and logged the subsurface conditions encountered in the boreholes. The soil samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Mississauga for further examination and laboratory testing. Index and classification tests consisting of water contents, Atterberg limits and grain size distributions were carried out on selected soil samples.

The borehole locations were measured relative to site features, and the ground surface elevations were obtained from the digital terrain model provided by MH. The borehole locations, including MTM NAD83 northing and easting coordinates and ground surface elevations referenced to geodetic datum, are summarized below and are shown on Drawing 1.

Borehole Number	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
15-1(BCR)	4,914,393.4	288,377.2	242.0	17.4
15-2(BCR)	4,914,425.5	288,367.3	241.1	17.4
15-7	4,914,422.5	288,388.8	243.1	17.2
15-8	4,914,416.4	288,424.7	234.2	10.1
15-9	4,914,402.9	288,423.0	237.3	14.0
15-10	4,914,439.4	288,392.5	237.8	14.0
HF3	4,914,383.3	288,436.2	238.6	10.1
P-RW3	4,914,460.1	288,390.7	234.3	10.1

Borehole Number	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
T-RW1	4,914,430.8	288,380.2	243.0	12.8

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

This section of Highway 400 lies within the Simcoe Lowlands, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, Third Edition, 1984). The soil deposits are typically interlayered non-cohesive, sands and silt layers, with occasional cohesive clayey silt silty clay layers.

4.2 Subsurface Conditions

The detailed soil and groundwater conditions encountered in the boreholes advanced as part of the current investigation, and the results of in situ and geotechnical laboratory testing, are given on the borehole records contained in Appendix A. The results of geotechnical laboratory testing from Golder's current investigation are also presented on Figures B1A to B4 contained in Appendix B. The borehole records and laboratory test results of the previous investigation (GEOCRES No. 31D-590) are contained in Appendix C.

The stratigraphic boundaries shown on the borehole records and on the interpreted stratigraphic profiles and cross-sections on Drawings 1 to 3 are inferred from observations of drilling progress and from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

In general, the subsoils encountered in the boreholes consist of fill underlain by a deposit of loose to very dense silt to sandy silt to silty sand to sand. Clayey silt layers are present within this non-cohesive deposit. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Asphalt

Approximately 100 mm to 260 mm of asphalt was encountered immediately below the ground surface in Boreholes 15-7, F5 and TRW-1, which were drilled through the existing Highway 400 pavement on the east edge of the Highway 400 northbound lanes.

Approximately 200 mm to 230 mm of asphalt was encountered immediately below the ground surface in Boreholes 15-1(BCR) and 15-2(BCR), which were drilled through the existing Highway 400 pavement along the Highway 400 southbound lanes.

4.2.2 Fill

All of the boreholes encountered fill materials of variable composition and thickness. As boreholes were advanced from both the Highway 400 embankment level and the rail level, the elevation of the surface of the fill materials varies. The elevations of the surface and base of the fill and the thickness of the fill materials as encountered in the boreholes are summarized below.

Borehole No.	Fill Surface Depth (m)	Fill Surface Elevation (m)	Fill Thickness (m)	Base of Fill Elevation (m)
15-1(BCR)	0.2	241.8	8.2	233.6
15-2(BCR)	0.2	240.9	8.5	232.4
15-7	0.2	242.9	7.0	235.9
15-8	0.0	234.2	3.8	230.4
15-9	0.0	237.3	2.2	235.1
15-10	0.0	237.8	3.0	234.9
F5	0.3	242.7	8.8	233.9
F6	0.0	234.6	1.5	233.1
HF3	0.0	238.6	3.0	235.7
P-RW3	0.0	234.3	4.1	230.2
T-RW1	0.1	242.9	8.6	234.3

The fill materials vary in composition from sand, to silty sand, to sand and silt, to gravelly sand containing trace clay. Rootlets and organics were encountered within the fill in Boreholes 15-8, 15-9, 15-10, T-RW1 and F6 to a maximum depth of approximately 1.5 m below ground surface. The results of grain size distribution tests completed on eight selected samples of the fill from the current investigation are shown on Figures B1A and B1B in Appendix B.

The Standard Penetration Test (SPT) "N"-values measured within the fill range from 1 blow to 64 blows per 0.3 m of penetration, indicating a variable, very loose to very dense relative density.

4.2.3 Sand to Silt

A deposit of sand to silt was encountered below the fill in all boreholes. All boreholes terminated within this non-cohesive deposit, with the exception of Boreholes 15-9 and 15-10 which terminated in an underlying clayey silt deposit or layer. The elevations of the surface and base of the sand to silt deposit and the thickness of this stratum as encountered in the boreholes are summarized below.

Borehole No.	Sand to Silt Surface Depth (m)	Sand to Silt Surface Elevation (m)	Sand to Silt Thickness (m)	Sand to Silt Base Elevation (m)	Description
15-1 (BCR)	8.4	233.6	>9.0	Below 224.6	Silty Sand to Sandy Silt
15-2 (BCR)	8.7	232.4	>8.7	Below 223.7	Sand to Silt
15-7	7.2	235.9	>10.0	Below 225.9	Silty Sand to Sand and Silt
15-8	3.8	230.4	0.7	229.7	Silt
	5.8	228.4	>4.3	Below 224.1	Sandy Silt to Sand
15-9	2.2	235.1	8.0	227.1	Sand to Silt
15-10	3.0	234.9	10.2	224.7	Silt to Sand and Silt

Borehole No.	Sand to Silt Surface Depth (m)	Sand to Silt Surface Elevation (m)	Sand to Silt Thickness (m)	Sand to Silt Base Elevation (m)	Description
F5	9.1	233.9	>9.8	Below 224.1	Silty Sand to Sandy Silt
F6	1.5	233.1	>4.6	Below 228.5	Silty Sand
HF3	3.0	235.7	1.4	234.3	Silt
	5.8	232.8	>4.3	Below 228.6	Silt and Sand to Sand
P-RW3	4.1	230.2	>6.0	Below 224.2	Sand to Silt
TRW-1	8.7	234.3	>4.1	Below 230.2	Silt to Sand

A clayey silt interlayer was encountered within the sand to silt stratum in Boreholes HF3 and 15-8, at depths of about 4.4 m and 4.5 m, respectively, corresponding to Elevations 234.3 m and 229.7 m. The clayey silt interlayer has a thickness of 1.4 m and 1.3 m in Boreholes HF3 and 15-8, respectively.

The results of the grain size distribution tests completed on 12 selected samples of the non-cohesive deposit are shown on Figures B2A and B2B in Appendix B. In the previous investigation, grain size distribution tests were completed on two selected samples, and the results from these tests are contained in Appendix C.

The SPT "N"-values measured within the sand to silt deposit range from 3 blows to 72 blows per 0.3 m of penetration, indicating a variable, very loose to very dense relative density.

4.2.4 Clayey Silt

A clayey silt deposit was encountered in some boreholes, as follows:

- As an interlayer within the sand to silt deposit in two boreholes (HF3 and 15-8) on the south side of the proposed BCR overhead structure; and
- As a lower unit below the sand to silt deposit, in Boreholes 15-9 and 15-10. These boreholes terminated within the clayey silt deposit, penetrating it for a thickness of 3.8 m and 0.9 m thick, respectively.

The elevation of the surface and base of the deposit and the thickness of the stratum as encountered in the boreholes are summarized below.

Borehole No.	Clayey Silt Surface Depth (m)	Clayey Silt Surface Elevation (m)	Clayey Silt Thickness (m)	Clayey Silt Base Elevation (m)
15-8	4.5	229.7	1.3	228.4
15-9	10.2	227.1	>3.8	>223.3
15-10	13.1	224.7	>0.9	>223.8
HF3	4.4	234.3	1.4	232.8

The results of the grain size distribution tests completed on two selected samples of the clayey silt deposit are shown on Figure B3 in Appendix B. Atterberg limits tests were conducted on two selected samples and

measured plastic limits of 12 and 18 per cent, liquid limits of 17 and 21 per cent, and plasticity indices of about 4 and 6 per cent. These test results, which are plotted on a plasticity chart on Figure B4 in Appendix B, confirm that the deposit consists of clayey silt of low plasticity.

The SPT "N"-values measured within the clayey silt interlayer/deposit range from 8 blows to 21 blows per 0.3 m of penetration, suggesting a stiff to very stiff consistency.

4.3 Groundwater Conditions

The observed water levels in the open boreholes following completion of drilling, and the water levels measured in the installed piezometers, are summarized as follows:

Structure	Foundation Element	Borehole No.	Ground Surface Elevation (m)	Groundwater Elevation (m)	Date of Measurement	Notes
Highway 400 SBL	South Abutment	15-1 (BCR)	242.0	227.9	November 9, 2015	Open Borehole
				229.6	January 7, 2016	Piezometer
	North Abutment	15-2 (BCR)	241.1	228.2	November 8, 2015	Open Borehole
Highway 400 NBL	South Approach	HF3	238.6	235.1	July 16, 2015	Open Borehole
		15-9	237.3	233.5	July 16, 2015	Open Borehole
	South Abutment	15-8	234.2	230.8	July 16, 2015	Open Borehole
	North Abutment	15-7	243.1	230.9	June 24, 2015	Open Borehole
		F6	234.8	230.5	October 31, 2014	Piezometer
				230.4	November 17, 2015	Piezometer
	North Approach	15-10	237.8	233.0	October 7, 2015	Piezometer
				232.9	November 6, 2015	Piezometer
		P-RW3	234.3	225.0*	July 6, 2015	Open Borehole
		TRW-1	243.0	Dry	June 25, 2015	Open Borehole

* Wet soils observed in Borehole P-RW3 above this elevation.

The water levels observed in the open boreholes do not represent the stabilized groundwater level at the site. The groundwater levels at the site are expected to fluctuate seasonally in response to changes in precipitation and snow melt, and are expected to be higher during the spring season.

5.0 CLOSURE

This Foundation Investigation Report was prepared by Ms. Caitlyn Cartwright, E.I.T. and Ms. Nikol Kochmanová, P.Eng., and reviewed by Ms. Lisa Coyne, P.Eng., a Designated MTO Foundations Contact and Principal with Golder.

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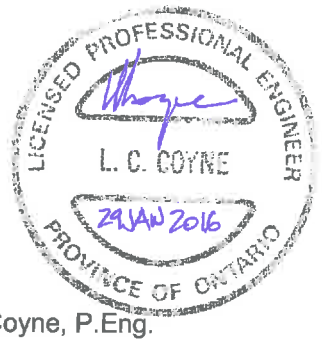

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PART B

FOUNDATION DESIGN REPORT
BARRIE-COLLINGWOOD RAILWAY OVERHEAD STRUCTURE (SITE NO. 30-177/1&2)
HIGHWAY 400 FROM ESSA ROAD TO DUNLOP STREET WEST
BARRIE, ONTARIO
G.W.P. 2159-11-00

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6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides foundations engineering recommendations for the assessment of the existing BCR overhead structure foundations to support the SBL rehabilitation, and for detail design of the new northbound Highway 400-BCR overhead structure, which is to be located to the east of the existing BCR overhead structure.

The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the current subsurface investigation, supplemented with boreholes advanced during the preliminary geotechnical investigation by Coffey. The discussion and recommendations presented are intended to provide the designers with sufficient information to assess the feasible foundation alternatives and to carry out the detail design of the structure foundations and approach embankments. Where comments are made on construction, they are provided to highlight those aspects which could affect the design of the project, and for which special provisions may be required in the Contract Documents. Those requiring information on the aspects of construction should make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

6.2 Assessment of Existing Structure Foundations

The existing BCR overhead structure was built between 1950 and 1955 and is a 10.5 m long, single-span concrete rigid frame structure supported on spread footings. Based on the drawings dated February 1950 (see Appendix D), the existing footings are 1.2 m wide and founded at about Elevation 233.5 m to 233.9 m. Based on visual observations during Golder's site visits in Summer 2015, the existing overhead structure abutments appear to be performing satisfactorily as signs of distress, such as cracking or settlement of the abutment walls, are not evident.

Based on the results from Boreholes 15-1(BCR) and 15-2(BCR) drilled within the Highway 400 southbound lanes, together with the data from other boreholes at the site, the existing footings are inferred to be founded on compact sand to silt, with the groundwater level more than one footing width below the base of the footing. For assessment of the bridge deck rehabilitation/replacement on Highway 400 SBL, the existing footings may be taken to have a factored geotechnical resistance at Ultimate Limit States (ULS) of 375 kPa, and a geotechnical resistance at Serviceability Limit States (SLS, for 25 mm of settlement) of 300 kPa. These geotechnical resistance values have been calculated for loads applied perpendicular to the surface of the footing.

The resistance to lateral forces / sliding resistance between the existing concrete footings and the subgrade are outlined in Section 6.3.1.4.

6.3 Foundation Options for New NBL Structure

It is understood that the existing BCR Overhead structure will be rehabilitated. Prior to rehabilitation of the existing structure, a new Highway 400 NBL overhead structure will be constructed to the east of the existing structure.

Based on the General Arrangement (GA) drawings provided by Morrison Hershfield (MH) on August 12, 2015, the Highway 400 pavement grade at the existing BCR overhead structure is at about Elevation 243.0 m; the rail grade is at about Elevation 235.0 m, with the surrounding grade at about Elevation 234.5 m. The existing single-span overhead structure is founded on spread footings at about Elevation 233.5 m to 233.9 m. The new Highway 400 NBL grade is proposed to be raised by a maximum of 0.5 m, resulting in approach embankments that are up to approximately 9 m in height. Retaining walls will be required adjacent to the abutments to support the sides of the Highway 400 northbound embankments.

It is understood that a trichloroethylene (TCE) plume exists in the vicinity of the Highway 400 / BCR overhead structure. Details regarding the TCE plume, as well as potential risks and design recommendations, are detailed in three Morrison Hershfield reports:

- TCE Plume Risk Assessment Report No. 1 – Structural and Geotechnical Field Investigations, dated April 2014;
- TCE Plume Risk Assessment Report No. 2 – Design Alternatives, dated September 2014; and
- TCE Plume Risk Assessment Report No. 3 – Construction Methods, dated January 2015.

A review of these reports indicates that excavations for the foundations should not extend below the water table, indicated in the reports as 4.0 m below the existing BCR grades (Elevation 230.5 m). **Further, deep foundation systems (piles, caissons, etc.) are not considered feasible due to the potential for intercepting the TCE plume.** As such, the overpass structures must be supported on shallow foundations; the associated retaining walls may also be supported on shallow foundations, or may be constructed as retained soil system (RSS) walls.

6.3.1 Strip or Spread Footings

6.3.1.1 Frost Protection

All footings should be founded at a minimum depth of 1.5 m below lowest surrounding grade, or provided with an equivalent thickness of insulation for frost protection, in accordance with Ontario Provincial Standard Drawing (OPSD) 3090.101 (*Foundation Frost Penetration Depths for Southern Ontario)*. As a guide, the MTO has adopted 25 mm (1 inch) of rigid polystyrene foam insulation as equivalent to 0.3 m reduction in soil cover.

6.3.1.2 Founding Elevations

Spread footings for support of the new NBL overhead structure and associated wingwalls/concrete retaining walls should be founded below existing fill materials, on the generally compact sand to silt deposit, or on compacted granular fill following subexcavation and replacement of any loose fill materials, provided that this can be achieved while minimizing or avoiding dewatering requirements. The base of the fill materials was generally encountered between about Elevation 233.1 m and 235.9 m in the boreholes near the proposed abutments, except Borehole 15-8 (southeast of the proposed south abutment) where fill was interpreted to extend to about Elevation 230.4 m. The fill encountered in the boreholes is generally compact based on the borehole results, with the exception of the fill in Borehole F6 near the proposed north abutment and in Borehole P-RW3 within the north approach area, where very loose to loose sand to silty sand fill was encountered.

As noted above, excavations for the footings are recommended from an environmental perspective to remain above the groundwater level at the site, to avoid requirements for dewatering that could impact the mobility of the TCE plume. The groundwater level was observed to be as low as about Elevation 230.8 m to 230.9 m in open boreholes immediately following drilling at the south and north abutment, although these represent

unstabilized groundwater levels; the water level in the piezometer in Borehole F6 (near the proposed north abutment) was measured at Elevation 230.4 m in November 2015. However, higher groundwater levels have also been measured at the site in boreholes within the approach embankment areas, between Elevation 233.0 m and 235.1 m.

It is therefore recommended that foundation excavations be maintained above approximately Elevation 232.5 m to avoid a requirement for dewatering to maintain a stable subgrade, either for forming and pouring the concrete footings, or for placement and compaction of any granular fill materials below the new footings. Based on the above considerations, the following table summarises the recommended maximum (highest) founding elevations for strip or spread footings for support of the abutments and associated wing walls for both structures.

Foundation Element	Borehole Nos.	Founding Stratum	Founding Elevation
South Abutment	F5 15-8	Compact silty sand fill / Compact silty sand to sandy silt	232.5 m
North Abutment	15-7 F6	Compact sand and silt to silty sand	232.5 m

Because of the potential for variability in the fill in the vicinity of Borehole 15-8, it is recommended that a Non-Standard Special Provision (NSSP) be included in the Contract Documents to amend OPSS 902 (Excavation and Backfilling for Structures), to require inspection of the footing subgrade and removal of any softened/loosened or deleterious materials. This NSSP, which is provided in Appendix E, limits such subexcavation to a maximum depth of 0.5 m below the subgrade level.

6.3.1.3 Geotechnical Resistance

For 5 m wide concrete footings founded at the elevations given in Section 6.3.1.2, the factored axial geotechnical resistance at ULS may be taken as 500 kPa. The geotechnical resistance at SLS, for 25 mm of settlement, may be taken as 325 kPa.

These design values take into account the depth of footing embedment relative to the BCR grade (i.e., a minimum of 1.5 m). The geotechnical resistances provided are dependent on the footing size, configuration and applied loads; therefore, the geotechnical resistances should be reviewed if the selected footing width or founding elevation differs from the values given above.

The geotechnical resistances provided above are given for loadings that will be applied perpendicular to the surface of the footings. Where the load is not applied perpendicular to the surface of the footing, inclination of the load should be taken into account in accordance with Section 6.7.4 of the *Canadian Highway Bridge Design Code (CHBDC),* using the curves for cohesive soils and non-cohesive soil.

The base of each footing excavation should be cleaned of loose / softened material. It is recommended that the founding level for the footings be inspected by geotechnical personnel immediately prior to pouring concrete to confirm the adequacy of the foundation conditions for the above-noted geotechnical resistances. If the concrete

for the footings cannot be poured immediately after excavation and inspection, it is recommended that a concrete working slab (100 mm thickness of 20 MPa compressive strength concrete) be placed on the subgrade within four hours to protect the integrity of the bearing stratum. This requirement can either be added as a note on the Contract Drawings or included as a Non-Standard Special Provision (NSSP) in the Contract Documents. An NSSP is included for this item in Appendix E.

6.3.1.4 Resistance to Lateral Loads

Resistance to lateral forces / sliding resistance between the concrete footings and the subgrade should be calculated in accordance with Section 6.7.5 of the *CHBDC*. For cast-in-place concrete footings constructed on a concrete working slab that is cast on top of the generally compact sand to silt soils, the coefficient of friction, tan δ or ϕ', can be taken as follows:

- Cast-in-place footing to concrete working slab: tan δ = 0.7
- Cast-in-place concrete working slab to sand to silt deposit: tan ϕ' = 0.58

6.4 Lateral Earth Pressures for Design

The lateral earth pressures acting on the abutment stems and any associated wing walls/retaining walls will depend on the type and method of placement of the backfill materials, the nature of the soils behind the backfill, the magnitude of surcharge including construction loadings, the freedom of lateral movement of the structure, and the drainage conditions behind the walls. Seismic (earthquake) loading must also be taken into account in the design.

The following recommendations are made concerning the design of the walls. It should be noted that these design recommendations and parameters assume level backfill and ground surface behind the walls. Where there is sloping ground behind the walls, the coefficient of lateral earth pressure must be adjusted to account for the slope.

- Select, free-draining granular fill, in accordance with OPSS.PROV 1010 Granular 'A' or Granular 'B' Type II, should be used as backfill behind the walls. Longitudinal drains and weep holes should be installed to provide positive drainage of the granular backfill. Other aspects of the granular backfill requirements with respect to sub drains and frost taper should be in accordance with OPSD 3101.150 (*Wall, Abutments, Backfill)* and OPSD 3121.150 (*Walls, Retaining, Backfill).*
- A minimum compaction surcharge of 12 kPa should be included in the lateral earth pressures for the structural design of the wall stem, in accordance with *CHBDC* Section 6.9.3 and Figure 6.6. Compaction equipment should be used in accordance with OPSS.PROV 501. Other surcharge loadings should be accounted for in the design as required.
- For restrained structures, the granular fill may be placed in a zone with the width equal to at least 1.5 m behind the back of the walls (Figure C6.20 (a) of the *Commentary* to the *CHBDC*). For unrestrained structures, the granular fill should be placed within the wedge-shaped zone defined by a line drawn at 1.5 horizontal to 1 vertical (1.5H:1V) extending up and back from the rear face of the footing (Figure C6.20 (b) of the *Commentary* to the *CHBDC*).

- For restrained structures, the pressures are based on the proposed new Highway 400 NBL embankment fill materials and the following parameters (unfactored) may be used assuming the use of granular earth fill such as Select Subgrade Material (SSM) for embankment construction:

Unfactored Parameters		Earth Fill
Soil unit weight:		21 kN/m^3
Coefficients of static lateral earth pressure:	At rest, K_o	0.47
	Active, K_a	0.31

- For unrestrained structures, where the pressures are based on OPSS.PROV 1010 granular fill behind the wall, the following parameters (unfactored) may be assumed:

Unfactored Parameters		Granular A	Granular B Type II
Soil unit weight:		22 kN/m^3	22 kN/m^3
Coefficients of static lateral earth pressure:	At rest, K_o	0.43	0.43
	Active, K_a	0.27	0.27

If the wall support and superstructure allow lateral yielding of the stem, active earth pressures may be used in the geotechnical design of the structure. If the abutment support does not allow lateral yielding (such as for a rigid frame structure), at-rest earth pressures should be assumed for geotechnical design. The movement required to allow active pressures to develop within the backfill, and thereby assume an unrestrained structure for design, should be calculated in accordance with Section C6.9.1 and Table C6.6 of the *Commentary* to the *CHBDC*.

6.4.1 Seismic Considerations

6.4.1.1 Site Coefficient

For seismic design purposes, the Site Coefficient, S, for this site, based on experience and considering the guidelines in Section 4.4.6 of the *CHBDC* may be taken as 1.2, consistent with Soil Profile Type II.

6.4.1.2 Seismic Analysis Coefficient

The potential for seismic (earthquake) loading may also need to be considered for the design of abutment stems/wing walls/retaining walls and for the assessment of liquefaction potential of foundation soils in accordance with Section 4.6 of the *CHBDC,* as significant seismic loading will result in increased lateral earth pressures acting on the abutment stem and retaining walls.

According to Table A3.1.1 of the *CHBDC*, this site is located in Seismic Zone 1. The site-specific zonal acceleration ratio for Barrie is 0.05. Based on experience, for the subsurface conditions at this site, a 20 percent amplification of the ground motion may occur (i.e. Site Coefficient, S=1.2 for Soil Profile II from Table 4.4 of

CHBDC), resulting in an increase in the peak horizontal ground acceleration (PHA) from 0.05 g to 0.06 g at the ground surface. Based on Section 4.4.4 of the *CHBDC*, this bridge structure is assigned Seismic Performance Zone 1. Given this, and in accordance with Section 4.4.5.2 of the *CHBDC* (single-span bridges), no seismic analysis is required for structures located in Seismic Performance Zone 1.

6.5 Retained Soil System (RSS) Walls

Geotechnical/foundation design recommendations for retained soil system (RSS) walls adjacent to the abutments are addressed in the Foundation Investigation and Design Report for retaining walls for this project, for consistency along the full length of the walls.

6.6 Approach Embankments

As noted above, a new northbound overhead structure is to be constructed to the east of the existing Highway 400 embankment, requiring construction of a new embankment to support the northbound lanes. As per the GA drawings, the pavement grade at the proposed NBL approach embankments is at approximately Elevation 243.5 m. The existing site grades in the area of the proposed approach embankments for the structure, as measured in Boreholes 15-7, F5 and TRW-1 were about Elevation 234.5 m. As such, the construction of the new north and south approach embankment areas will require raising the grades by up to about 9 m above existing grades.

6.6.1 Subgrade Preparation and Embankment Construction

It is recommended that all topsoil/organic material or loose materials present within the footprint of the new northbound Highway 400 approach embankments be stripped prior to placement of new embankment fill. The approach embankment fill for the new northbound lanes should be placed and compacted in accordance with OPSS.PROV 206 (Earth Excavation and Grading) and OPSS.PROV 501 (Compacting). Benching of the east side of the existing embankment should be carried out to “key in” the new fill materials for the northbound lane embankment to the existing fill materials, in accordance with OPSD 208.010 (Benching of Earth Slopes).

6.6.2 Approach Embankment Settlement

Settlement will occur under the additional loading from up to 9 m of fill for the proposed new Highway 400 NBL approach embankments. Analyses were performed using the commercially available software program “Settle3D” produced by Rocscience Inc. to estimate the settlement of the foundation soils underlying the proposed 9 m high approach embankments.

The values of the parameters used in the analyses of settlement for the NBL approach embankment as given below are based on field and geotechnical laboratory test data and correlations suggested by Bowles (1984) from the soil conditions encountered in the boreholes at this site. An average groundwater level of approximately Elevation 232.0 m was used in the model.

Approach Embankment	Soil Layer	Approximate Thickness (m)	Bulk Unit Weight (kN/m3)	Young's Modulus, E (MPa)
North Embankment 15-10 F6 P-RW3	Loose to compact silty sand to sand fill	4.0	19	10
	Compact silty sand to sand and silt	1.5	19	25
	Very loose to compact sand to silt	5.0	19	15
	Very stiff clayey silt	1.0	19	30
South Embankment HF3 15-9 15-8	Loose to compact silty sand to sand fill	4.0	19	15
	Loose to compact silt to sand	1.0	19	20
	Stiff clayey silt	1.5	19	20
	Compact to dense silty sand to sand	3.0	19	25
	Stiff to very stiff clayey silt	4.0	19	30

The analyses were carried out for both the north and south approach embankments and assume that all organic and loose surficial soils have been removed prior to embankment fill placement. The estimated magnitude of settlement for the approach embankment areas is provided in the table below.

Location	Estimated Elastic Settlement (mm)
North Approach Embankment	90
South Approach Embankment	85

The majority of the settlement is expected to occur during or shortly after construction in response to filling, based on the non-cohesive nature of the silt to sand deposits, and the generally very stiff to hard nature of the cohesive layers. However, it is recommended that the embankment for the new northbound lanes be constructed and allowed to settle (i.e. preloaded) for a minimum period of six weeks prior to final paving / approach slab construction. An Operational Constraint is provided in Appendix E to address this requirement. In addition, a limited settlement monitoring program is recommended within the Highway 400 NBL embankment widening areas, including at the approaches to the BCR overhead structure. The details of this settlement instrumentation and monitoring plan have been prepared in conjunction with that for the retaining walls proposed along the east side of the Highway 400 NBL widening.

6.6.3 Approach Embankment Stability

The Highway 400 embankments in the proposed Highway 400 NBL-BCR overhead structure area will be contained by retaining walls, and the global stability of these retaining walls is addressed in the Foundation Investigation and Design Report for the retaining walls, for consistency along the full length of the retaining walls on this project.

6.7 Design and Construction Considerations

6.7.1 Open-Cut Excavations

The foundation excavations will extend through existing fill materials and into the generally compact sand to silt deposit. Where space permits, open-cut excavations into these materials should be carried out in accordance with the guidelines outlined in the Occupational Health and Safety Act and Regulations for Construction Projects. The existing fill materials, as well as the generally compact non-cohesive soils, are classified as Type 3 soil. Temporary excavations (i.e. those which are open for a relatively short time period) should be made with side slopes no steeper than 1 horizontal to 1 vertical (1H:1V).

6.7.2 Protection Systems

Given the proximity of the new NBL structure to the existing Highway 400 embankment, excavations into the existing east embankment side slope will be needed to permit the construction of the new structure. It is anticipated that temporary protection systems will be required along the east side of Highway 400 to facilitate construction of the new abutments. Temporary protection systems are also expected to be required in front of the new abutment footings, to separate the foundation excavation from the rail line.

These temporary excavation support systems should be designed and constructed in accordance with OPSS.PROV 539 (Temporary Protection Systems). The lateral movement of protection systems along Highway 400 should meet Performance Level 2 as specified in OPSS 539, provided that any utilities that may be present adjacent to the temporary shoring systems, as well as the existing adjacent abutments, can tolerate this level of deformation. Depending on the proximity of the shoring line to the existing rail tracks, the lateral movement of protection systems installed in front of the new footing excavations may be required to meet Performance Level 1b; this will apply if the temporary protection system is to be installed within the zone of influence of the footing excavation, as represented by a line extending upward at 1H:1V from the base of the excavation.

As discussed in Section 6.3 and in Section 6.7.3 below, the footing founding levels have been selected to avoid the requirement for dewatering, in order to avoid impacts on the TCE plume in the vicinity of the site. The vertical elements of temporary protection systems, such as soldier piles or steel sheetpiles, may penetrate below the groundwater table within the sand/silt deposit. However, any vertical elements must be designed and constructed such that they do not penetrate through the underlying clayey silt/silty clay deposit at the following elevations/locations:

- Elevation 225 m in the vicinity of the north abutments; and
- Elevation 225 m in the vicinity of the south abutments.

Additionally, should an interlocking sheetpile wall be adopted by the Contractor for use as a temporary protection system, removal of the sheetpiles is recommended following construction completion.

An Operational Constraint is provided in Appendix E to address these requirements, for inclusion in the Contract Documents.

6.7.3 Groundwater Control for Foundation Excavations

As discussed in Section 6.2, the foundation recommendations for the proposed Highway 400 NBL-BCR overhead structure have been developed to maintain the foundation excavations sufficiently above the anticipated groundwater level at the site, to avoid the requirement for dewatering, which could disturb the TCE plume in the vicinity of this site.

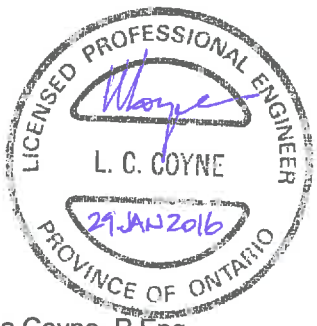
6.7.4 Subgrade Protection

The sand to silt soils that will form the subgrade for the support of shallow foundations will be susceptible to loosening and degradation on exposure to water and construction traffic. It is recommended that a working slab of concrete be placed on the footing subgrade to form a working mat, and to protect the subgrade from such degradation. This subgrade protection can be illustrated on the General Arrangement and Foundation Layout drawings, and a Non-Standard Special Provision can be included in the Contract Documents. A sample Non-Standard Special Provision to address subgrade protection is provided in Appendix E.

7.0 CLOSURE

This Foundation Design Report was prepared by Ms. Nikol Kochmanová, P. Eng., and reviewed by Ms. Lisa Coyne, P.Eng., a Designated MTO Foundations Contact and Principal with Golder

GOLDER ASSOCIATES LTD.



Nikol Kochmanová, P.Eng.
Geotechnical Engineer

Lisa Coyne, P.Eng.
Designated MTO Foundations Contact, Principal

CC/NK/LCC/sm

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Canadian Geotechnical Society, 1992. *Canadian Foundation Engineering Manual*, 3rd Edition. The Canadian Geotechnical Society, BiTech Published Ltd., British Columbia.

Canadian Geotechnical Society, 2006. *Canadian Foundation Engineering Manual*, 4th Edition. The Canadian Geotechnical Society, BiTech Publisher Ltd., British Columbia.

Canadian Standards Association (CSA), 2006. *Canadian Highway Bridge Design Code* and *Commentary on CAN/CSA S6 06*. CSA Special Publication, S6.1 06.

Chapman, L.J., and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, 3rd Edition. Ontario Geological Survey, Special Volume 2. Ontario Ministry of Natural Resources.

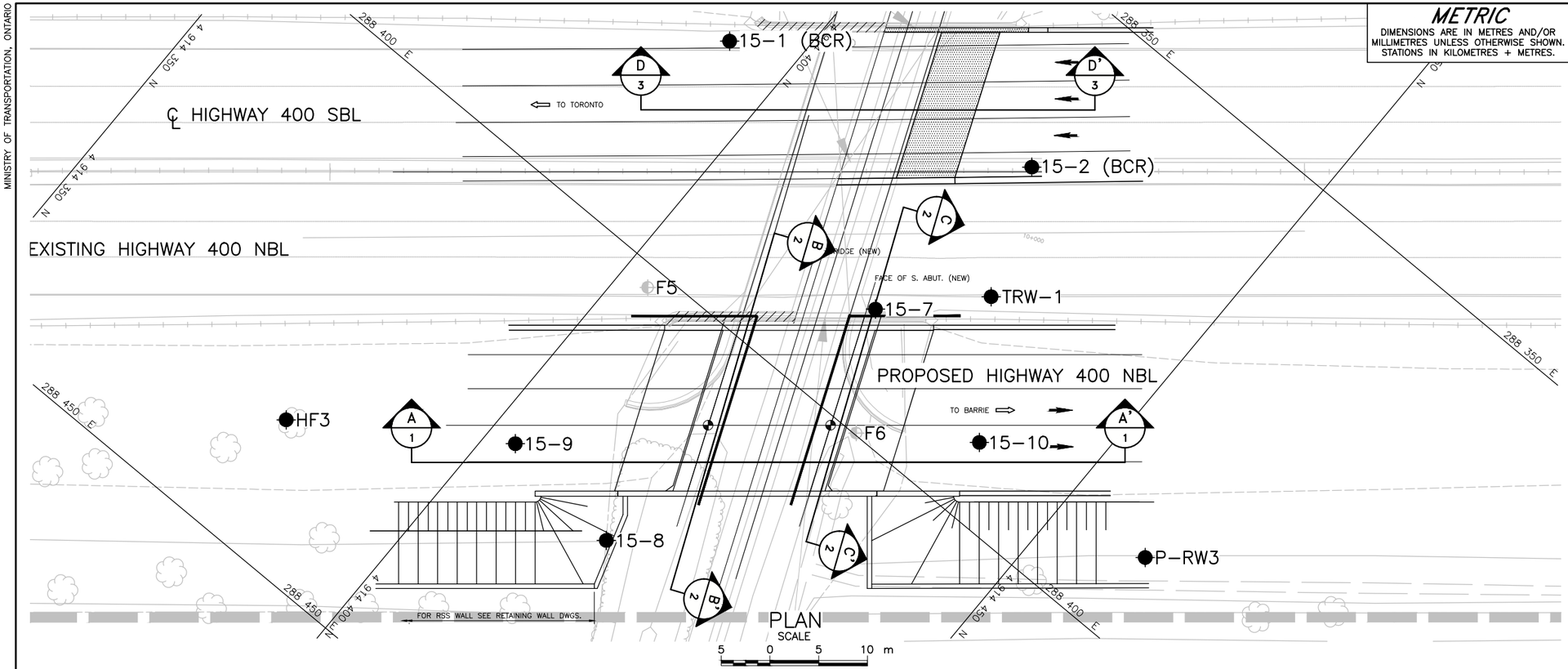
Ontario Provincial Standard Specifications (OPSS)

OPSS.PROV 206	Construction Specification for Grading
OPSS.PROV 501	Construction Specification for Compacting
OPSS.PROV 539	Construction Specification for Temporary Protection Systems
OPSS 902	Construction Specification for Excavating and Backfilling - Structures
OPSS.PROV 1010	Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material

Ontario Provincial Standard Drawings (OPSD)

OPSD 208.010	Benching of Earth Slopes
OPSD 3090.101	Foundation Frost Depths for Southern Ontario
OPSD 3101.150	Walls – Abutment, Backfill – Minimum Granular Requirement
OPSD 3121.150	Walls – Retaining, Backfill – Minimum Granular Requirement

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

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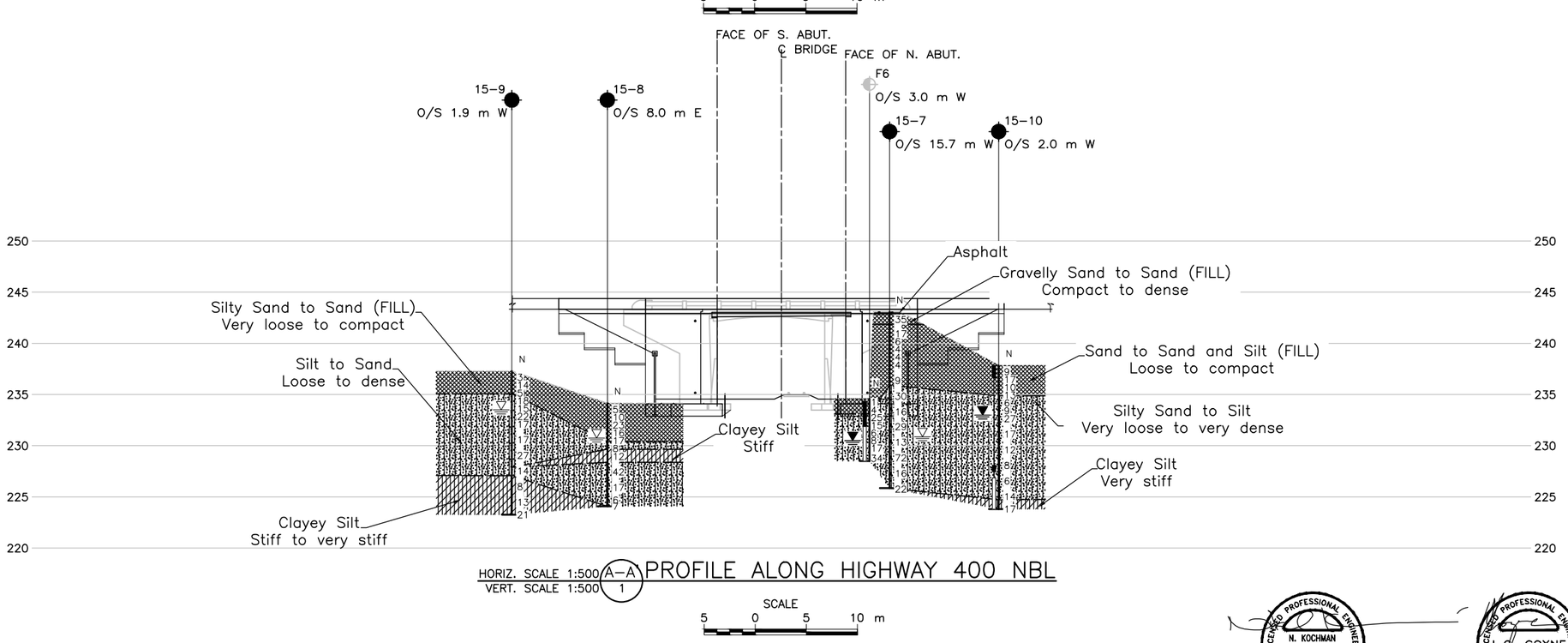

HORIZ. SCALE 1:500 A–A
VERT. SCALE 1:500 1
PROFILE ALONG HIGHWAY 400 NBL

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REFERENCE

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PLOT DATE: January 25, 2016
FILENAME: S:\HWY_400_Tiffin_Street_Overpass\10_CADD\C3D\1532543A002.dwg

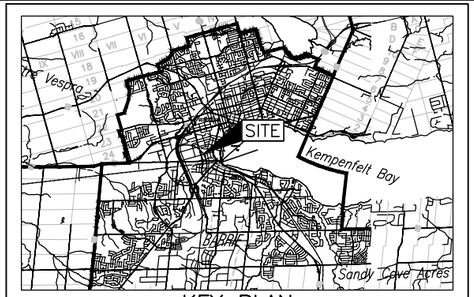
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2159–11–00

HIGHWAY 400 NBL
BCR OVERHEAD STRUCTURE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Golder Associates



KEY PLAN

LEGEND

- Borehole – Current Investigation
- Borehole – Previous Investigation By Others (2014)
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- R — Refusal
- WL in piezometer, measured on Nov. 06, 2015
- WL upon completion of drilling

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
15–1 (BCR)	242.0	4914393.4	288377.2
15–2 (BCR)	241.1	4914425.5	288367.3
15–7	243.1	4914422.5	288388.8
15–8	234.2	4914416.4	288424.7
15–9	237.3	4914402.9	288423.0
15–10	237.8	4914439.4	288392.5
F5	243.0	4914403.1	288402.0
F6	234.6	4914429.1	288399.8
HF3	238.6	4914383.3	288436.2
P–RW3	234.3	4914460.1	288390.6
TRW–1	243.0	4914430.8	288380.2

NOTES

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The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

LICENCED PROFESSIONAL ENGINEER N. KOCHMAN 100117863 JAN 25, 2016 PROVINCE OF ONTARIO

LICENCED PROFESSIONAL ENGINEER L.C. COYNE JAN 25, 2016 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31D–631

HWY. 400	PROJECT NO. 1532543		DIST. CENTRAL
SUBM'D. NLP	CHKD. NLP	DATE: 01/25/2016	SITE: 30/177–1
DRAWN: JJL	CHKD. NK	APPD. LCC	DWG. 1

MINISTRY OF TRANSPORTATION, ONTARIO

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

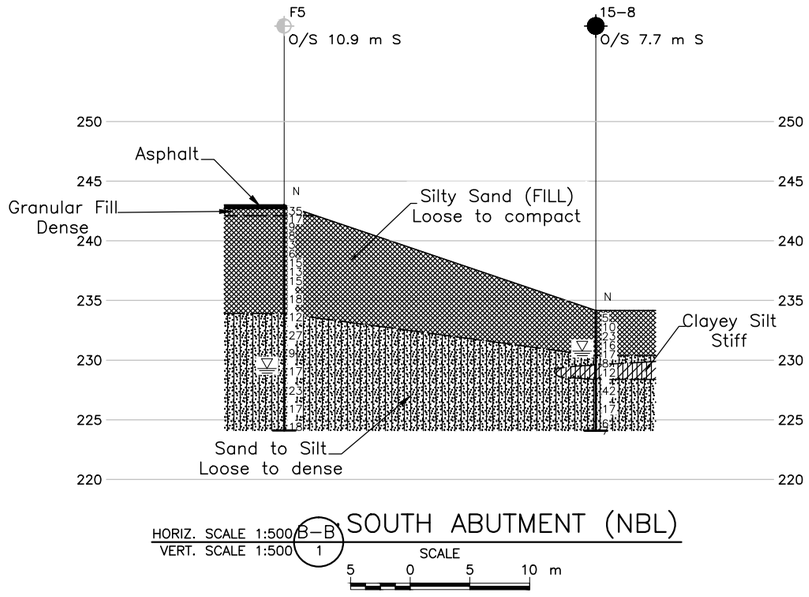
CONT No.
GWP No. 2159-11-00

HIGHWAY 400 NBL
BCR OVERHEAD STRUCTURE

SOIL STRATA

SHEET

Golder Associates



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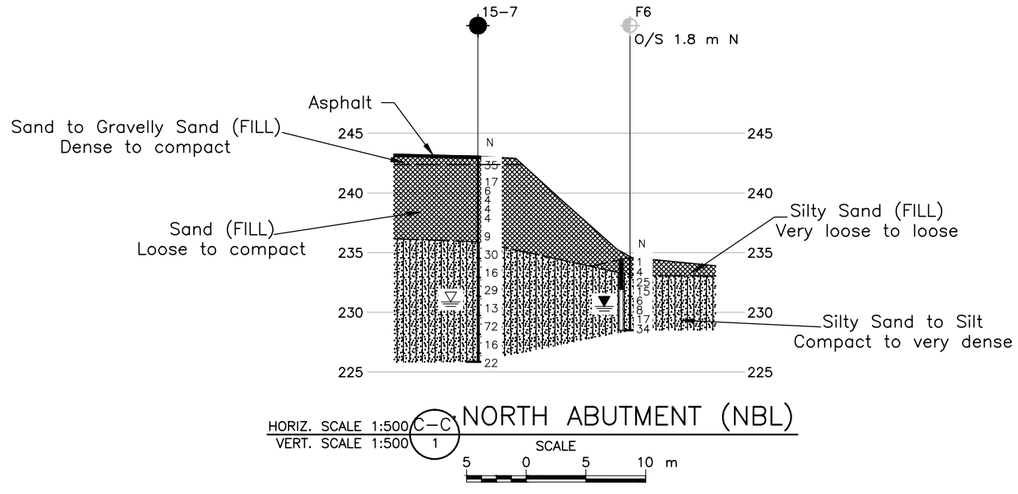

HORIZ. SCALE 1:500 / VERT. SCALE 1:500 — C-C (1) — NORTH ABUTMENT (NBL)

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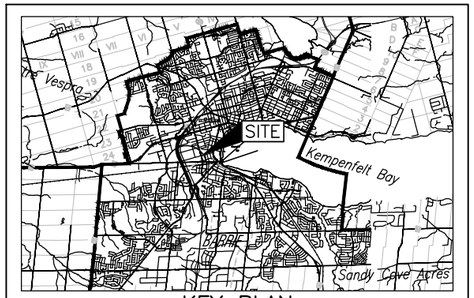

KEY PLAN

LEGEND

- Borehole – Current Investigation
- Borehole – Previous Investigation By Others (2014)
- Seal
- Piezometer
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- WL in piezometer, measured on OCT 21, 2014
- WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
15-7	243.1	4914422.5	288388.8
15-8	234.2	4914416.4	288424.7
F5	243.0	4914403.1	288402.0
F6	234.6	4914429.1	288399.8

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LICENSED PROFESSIONAL ENGINEER — L.C. COYNE — JAN 25, 2016 — PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31D-631

HWY. 400		PROJECT NO. 1532543	DIST. CENTRAL
SUBM'D. NLP	CHKD. NLP	DATE: 01/25/2016	SITE: 30/177-1
DRAWN: JJL	CHKD. NK	APPD. LCC	DWG. 2

PLOT DATE: January 25, 2016
FILENAME: S:\WP_400_Tiffin_Street_Overpass\10_CADD\CSD\1532543A0002.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

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

CONT No.
GWP No. 2159-11-00

HIGHWAY 400 SBL
BCR OVERHEAD STRUCTURE

SOIL STRATA

SHEET
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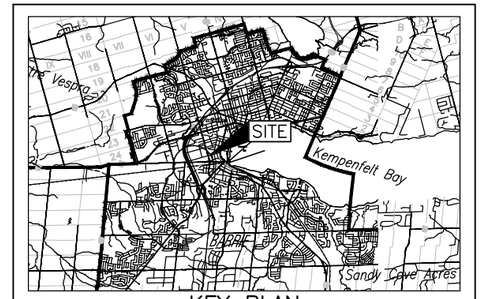
Golder Associates



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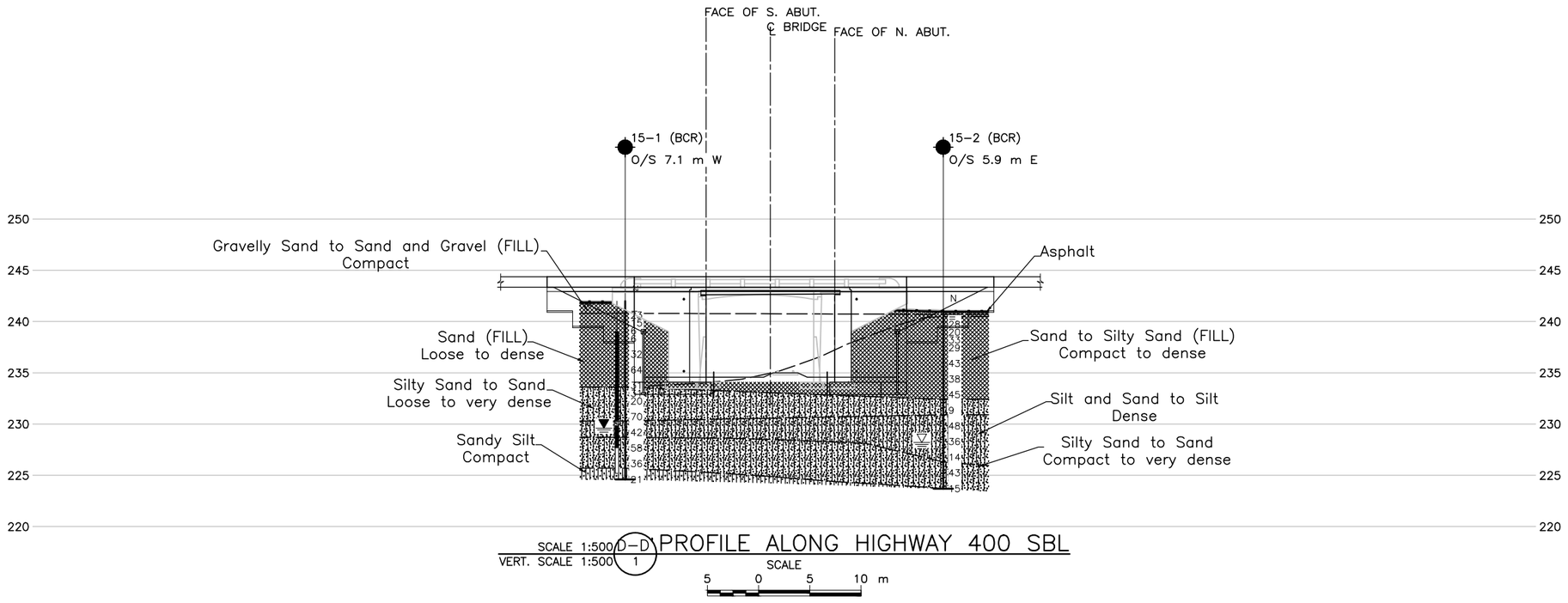

SCALE 1:500 D-D PROFILE ALONG HIGHWAY 400 SBL
VERT. SCALE 1:500 1
SCALE
5 0 5 10 m

LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL in piezometer, measured on Jan. 07, 2016
- WL upon completion of drilling

BOREHOLE CO-ORDINATES

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15-2 (BCR)	241.1	4914425.5	288367.3

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N. KOCHMAN
100117863
JAN 25, 2016
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
L.C. COYNE
JAN 25, 2016
PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31D-631

HWY. 400	PROJECT NO. 1532543		DIST. CENTRAL
SUBM'D. NLP	CHKD. NK	DATE: 01/25/2016	SITE: 30/177-1
DRAWN: JJL	CHKD. NK	APPD. LCC	DWG. 3

PLOT DATE: January 25, 2016
FILENAME: S:\HWY_400_Tiffin_Street_Overpass\12_CADD\CSD\1532543A002.dwg

APPENDIX A

Borehole Records from Current Investigation

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan\delta$
c′	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan\phi'$

2 shear strength = (compressive strength)/2

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d:

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60º cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

Density Index / Relative Density	N Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency

	c_u, s_u kPa	c_u, s_u psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

V. MINOR SOIL CONSTITUENTS

Per cent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (non-cohesive (cohesionless)) or With (cohesive)	Sand and Gravel / Silty Clay with sand / Clayey Silt with sand

Golder Associates

RECORD OF BOREHOLE No 15-1 (BCR)

1 OF 2 **METRIC**

PROJECT 1532543 | G.W.P. 2159-11-00 | LOCATION N 4914393.4; E 288377.2 | ORIGINATED BY DM

DIST Central | HWY 400 | BOREHOLE TYPE 203 mm O.D. Hollow Stem Augers | COMPILED BY NK/NLP

DATUM GEODETIC | DATE November 9, 2015 | CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
242.0	GROUND SURFACE						
0.0	ASPHALT						
241.5	Sand and gravel, trace silt (FILL) Compact Brown Moist	1	SS	-			
0.5		A 2 B	SS	23	241		
240.8	Gravelly sand, some silt (FILL) Compact Brown Moist						
1.2	Sand, trace to some gravel, trace to some silt (FILL) Loose to dense Brown Moist	3	SS	15			
		4	SS	6	240		11 78 8 3
		5	SS	6	239		
		A 6 B	SS	32	238		
		7	SS	64	237		
233.6		8	SS	31	236		
8.4	SILTY SAND, trace clay, trace fibrous organics Compact to very dense Dark brown to brown Moist to wet	9	SS	31	235		
		10	SS	20	234		0 74 22 4
		11	SS	70	233		
230.3					232		
11.7	SILT and SAND Dense Light brown Wet	12	SS	42	231		
228.7					230		
13.3	SILTY SAND Dense to very dense Light brown to grey Wet	13	SS	58	229		
					228		

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

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

WATER CONTENT (%): 10 20 30

GROUND WATER CONDITIONS

SOIL PROFILE | STRAT PLOT | SAMPLES

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

SUD-MTO 001 1532543.GPJ GAL-MISS.GDT 22/01/16 DATA INPUT:

Golder Associates

RECORD OF BOREHOLE No 15-1 (BCR)

 METRIC

PROJECT 1532543
G.W.P. 2159-11-00
DIST Central HWY 400
DATUM GEODETIC
LOCATION N 4914393.4; E 288377.2
BOREHOLE TYPE 203 mm O.D. Hollow Stem Augers
DATE November 9, 2015
ORIGINATED BY DM
COMPILED BY NK/NLP
CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SILTY SAND Dense to very dense Light brown to grey Wet		14	SS	36		226		○ at 20		0 67 30 3
225.7											
16.3	Sandy SILT Compact Grey Wet		15	SS	21		225				
224.6											
17.4	END OF BOREHOLE										

Notes:

1. Water level in open borehole at a depth of 14.1 m (Elev. 227.9 m) upon completion of drilling.

2. Water level measured in piezometer at 12.4 m (Elev. 229.6 m) on January 7, 2016.

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No 15-2 (BCR)

1 OF 2 **METRIC**

PROJECT 1532543 | G.W.P. 2159-11-00 | LOCATION N 4914425.5; E 288367.3 | ORIGINATED BY DM

DIST Central | HWY 400 | BOREHOLE TYPE 203 mm O.D. Hollow Stem Augers | COMPILED BY NK/NLP

DATUM GEODETIC | DATE November 8, 2015 | CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
241.1	GROUND SURFACE						241				
0.0	ASPHALT										
	Gravelly sand, trace silt (FILL) Grey Moist		1	AS	-						
0.6			2	AS	-						
	Sand, some gravel, some silt (FILL) Brown Moist		3	SS	28		240				
	Sand, some silt to silty sand, trace to some gravel, trace clay (FILL) Compact to dense Brown Moist Clay pockets observed in Sample 4.		4	SS	20		239				
			5	SS	33						
			6	SS	29		238				
			7	SS	43		237				
			8	SS	38		236				14 69 13 4
			9	SS	45		235				
232.4							234				
8.7	SILTY SAND to SAND, trace gravel, trace organics to 9.17 m Loose Brown to orange Moist		A 10 B	SS	9		233				
230.9							232				
10.2	SANDY SILT, trace to some clay Dense Light brown Moist to wet		11	SS	48		231				
			12	SS	36	▽	230				0 25 70 5
227.8							229				
13.3	SILT, trace to some clay Compact Light brown Wet		13	SS	14		228			NP	0 0 89 11
226.3							227				
14.8											

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No 15-2 (BCR)

2 OF 2 **METRIC**

PROJECT 1532543 | G.W.P. 2159-11-00 | LOCATION N 4914425.5; E 288367.3 | ORIGINATED BY DM

DIST Central | HWY 400 | BOREHOLE TYPE 203 mm O.D. Hollow Stem Augers | COMPILED BY NK/NLP

DATUM GEODETIC | DATE November 8, 2015 | CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---									
	SILTY SAND to SAND Compact to dense Brown to grey Wet						226			
			14	SS	43					
							225			
223.7			15	SS	15		224			
17.4	END OF BOREHOLE									

Notes:

1. Water level in open borehole at a depth of 14.0 m (Elev. 227.1 m) on completion of drilling.

2. Water level in open borehole at a depth of 12.9 m (Elev. 228.2 m) on auger removal.

3. Borehole sloughed to a depth of 12.8 m on auger removal.

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

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

Golder Associates

RECORD OF BOREHOLE No 15-7

1 OF 2 **METRIC**

PROJECT 1532543 | G.W.P. 2159-11-00 | LOCATION N 4914422.5; E 288388.8 | ORIGINATED BY AK

DIST Central | HWY 400 | BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers | COMPILED BY NLP

DATUM GEODETIC | DATE June 24, 2015 | CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
243.1	GROUND SURFACE						243				
0.0	ASPHALT										
0.2	Sand, some gravel, some silt (FILL) Dense Brown		1	SS	35				○		12 71 17 0
242.4 0.7	Moist						242				
241.9 1.2	Gravelly sand, trace silt (FILL) Compact Brown Moist										
	Sand, some silt, trace gravel, trace clay (FILL) Loose to compact Brown Moist		2	SS	17						
			3	SS	6		241				
	Gravelly sand encountered in Sample 4.		4	SS	4				○		24 67 7 2
			5	SS	4		240				
			6	SS	4						
			7	SS	9		239				
235.9											
7.2	Silty SAND, trace gravel Dense to compact Light brown Moist		8	SS	30		238				
	- Oxidation staining below 9.2 m		9	SS	16		237				
232.9											
10.2	SAND and SILT, some gravel, trace clay Compact Grey Moist to wet		10	SS	29		236		○		11 39 47 3
230.9						▽	235				
12.2	Silty SAND Compact to very dense Grey Moist		11	SS	13		234				
			12	SS	72		233				
							232				
							231				
							230				
							229				

Continued Next Page

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SUD-MTO 001 1532543.GPJ GAL-MISS.GDT 16/10/15 DATA INPUT:

Golder Associates

RECORD OF BOREHOLE No 15-7

2 OF 2 **METRIC**

PROJECT 1532543
G.W.P. 2159-11-00
DIST Central HWY 400
DATUM GEODETIC

LOCATION N 4914422.5; E 288388.8
BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers
DATE June 24, 2015

ORIGINATED BY AK
COMPILED BY NLP
CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Silty SAND Compact to very dense Grey Moist						228				
			13	SS	16						
							227				
225.9			14	SS	22		226				
17.2	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 12.2 m (Elev. 230.9 m) during drilling operations.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SUD-MTO 001 1532543.GPJ GAL-MISS.GDT 16/10/15 DATA INPUT:

Golder Associates

RECORD OF BOREHOLE No 15-8

1 OF 1 **METRIC**

PROJECT 1532543 | G.W.P. 2159-11-00 | LOCATION N 4914416.4; E 288424.7 | ORIGINATED BY AK

DIST Central | HWY 400 | BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers | COMPILED BY NLP

DATUM GEODETIC | DATE July 16, 2015 | CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
234.2	GROUND SURFACE										
0.0	Silty sand, trace gravel, organic staining, rootlets and organic inclusions (FILL) Loose to compact Dark brown to brown Moist		1	SS	5		234				
232.9			2	SS	10		233		○		
1.2	Silty sand (FILL) Compact Light brown Moist to wet		3	SS	23						
			4	SS	16		232		○		
			5	SS	17	▽	231				
230.4											
3.8	SILT, trace sand, trace clay Loose Light brown Wet		6	SS	8		230		○		0 1 96 3
229.7											
4.5	CLAYEY SILT, trace sand Stiff Light brown Moist		7	SS	12		229				
228.4											
5.8	SAND, some silt, trace clay Dense to compact Grey Wet		8	SS	42		228		○		0 84 15 1
			9	SS	17		227				
							226				
225.6											
8.5	SANDY SILT, trace clay Loose Grey Wet		10	SS	6		225		○		
			11	SS	7						
224.1											
10.1	END OF BOREHOLE										

NOTE:

1. Water level in open borehole at a depth of 3.4 m (Elev. 230.8 m) during drilling operations.

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SUD-MTO 001 1532543.GPJ GAL-MISS.GDT 16/10/15 DATA INPUT:

Golder Associates

RECORD OF BOREHOLE No 15-9

1 OF 2 **METRIC**

PROJECT 1532543
G.W.P. 2159-11-00
LOCATION N 4914402.9; E 288423.0
ORIGINATED BY AK
DIST Central HWY 400
BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers
COMPILED BY NLP
DATUM GEODETIC
DATE July 16, 2015
CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.3	GROUND SURFACE										
0.0	Silty sand, trace gravel, organic staining, rootlets (FILL) Very loose Dark brown		1	SS	3		237		○		
236.6 / 0.7	Moist										
	Sand, trace gravel, trace silt, organic staining (FILL) Compact Brown		2	SS	14		236		○		
235.8 / 1.5	Moist										
	Silty sand (FILL) Loose Brown to light brown		3	SS	5		235		○		
235.1 / 2.2	Moist										
	Silty SAND to SAND, trace to some silt Compact Light brown to grey Moist to wet		4	SS	18		234		○		
			5	SS	15	▽					
			6	SS	22		233		○		
			7	SS	17		232				
			8	SS	17		231		○		
			9	SS	27		230				
227.9			10A / 10B	SS	14		229				
9.4	SILT, trace to some sand, trace clay Compact Grey Moist to wet						228		○		0 6 91 3
227.1											
10.2	CLAYEY SILT, trace to some sand Stiff to very stiff Grey Moist		11	SS	8		227				
			12	SS	13		226		⊢○		0 10 76 14
223.3			13	SS	21		225				
14.0							224				

Continued Next Page

+3, ×3: Numbers refer to Sensitivity

○3% STRAIN AT FAILURE

SUD-MTO 001 1532543.GPJ GAL-MISS.GDT 16/10/15 DATA INPUT:

Golder Associates

RECORD OF BOREHOLE No 15-9

2 OF 2 **METRIC**

PROJECT 1532543 | G.W.P. 2159-11-00 | LOCATION N 4914402.9; E 288423.0 | ORIGINATED BY AK

DIST Central | HWY 400 | BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers | COMPILED BY NLP

DATUM GEODETIC | DATE July 16, 2015 | CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 3.8 m (Elev. 233.5 m) during drilling operations.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No 15-10

1 OF 2 **METRIC**

PROJECT 1532543 | G.W.P. 2159-11-00 | LOCATION N 4914439.4; E 288392.5 | ORIGINATED BY AK

DIST Central | HWY 400 | BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers | COMPILED BY NLP

DATUM GEODETIC | DATE July 8, 2015 | CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.8	GROUND SURFACE										
0.0	Silty sand, trace gravel (FILL) Loose to compact Dark brown to brown, organic staining Moist		1	SS	9		237				
236.4			2	SS	17				○		
1.5	Sand and silt, trace clay, organic inclusions (FILL) Compact Brown to grey Moist		3	SS	10		236				
234.9			4	SS	13		235		○		0 49 50 1
3.0	SILT Loose Grey Moist to wet		5	SS	6						
233.3			6	SS	9		234		○		
4.5	SAND and SILT, trace clay Compact to loose Grey Moist to wet		7	SS	27	▼	233				
			8	SS	17		232		○		0 53 46 1
			9	SS	12		231				
			10	SS	8		230		○		
226.7			11	SS	6		229				
11.1	SILT, trace clay, trace sand Compact Grey Wet		12	SS	14		228		○		0 3 94 3
224.7							227				
13.1	CLAYEY SILT, some sand Very stiff Grey Moist		13	SS	17		226				
223.8							225				
14.0							224				

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SUD-MTO 001 1532543.GPJ GAL-MISS.GDT 16/10/15 DATA INPUT:

Golder Associates

RECORD OF BOREHOLE No 15-10

2 OF 2 **METRIC**

PROJECT 1532543 | G.W.P. 2159-11-00 | LOCATION N 4914439.4; E 288392.5 | ORIGINATED BY AK

DIST Central | HWY 400 | BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers | COMPILED BY NLP

DATUM GEODETIC | DATE July 8, 2015 | CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	END OF BOREHOLE										
	NOTE:										
	1. Water level in piezometer measured a depth of 4.8 m (Elev. 233.0 m) on October 7, 2015.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No HF3

1 OF 1 **METRIC**

PROJECT 1532543
G.W.P. 2159-11-00
DIST Central HWY 400
DATUM GEODETIC
LOCATION N 4914383.3; E 288436.2
BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers
DATE July 16, 2015
ORIGINATED BY AK
COMPILED BY NLP
CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
238.6	GROUND SURFACE										
0.0 / 237.9	Silty sand, trace gravel, organic staining, rootlets (FILL) Loose Dark brown		1	SS	5		238				
0.7 / 236.5	Moist Silt and sand, trace clay (FILL) Loose Brown Moist		2	SS	9						
			3	SS	9		237		○		0 41 56 3
2.1 / 235.7	Sandy silt (FILL) Compact Brown Moist		4	SS	13		236				
3.0 / 234.3	SILT, some sand, trace gravel Compact Light brown to grey Moist to wet		5	SS	12	▽	235		○		
			6	SS	16						
4.4 / 232.8	CLAYEY SILT Stiff Light brown Moist		7	SS	13		234		H ○		0 0 90 10
5.8	SAND and SILT to SAND, trace clay Compact Grey Wet		8	SS	22		233				
							232				
			9	SS	19		231		○		
							230				
			10	SS	12						
228.6			11	SS	14		229		○		
10.1	END OF BOREHOLE										

NOTES:

1. Water level in open borehole at a depth of 3.5 m (Elev. 235.1 m) during drilling operations.

2. Borehole caved to 7.6 m (Elev. 231.0 m) after removal of augers.

+³, ×³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

SUD-MTO 001 1532543.GPJ GAL-MISS.GDT 16/10/15 DATA INPUT:

Golder Associates

RECORD OF BOREHOLE No P-RW3

1 OF 1 **METRIC**

PROJECT 1532543 | G.W.P. 2159-11-00 | LOCATION N 4914460.1; E 288390.7 | ORIGINATED BY AK

DIST Central | HWY 400 | BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers | COMPILED BY AC

DATUM GEODETIC | DATE July 6, 2015 | CHECKED BY SEMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
234.3	GROUND SURFACE										
0.0	Sand, trace gravel, trace silt (FILL) Loose to compact Dark brown to brown Moist		1	SS	6		234				
			2	SS	10		233		○		
232.1			3	SS	5						
2.2	Silt and sand to silt, trace clay (FILL) Very loose to compact Grey Moist		4	SS	13		232		○		0 41 58 1
			5	SS	2		231				
230.2			6A 6B	SS	10		230		○		
4.1	SAND, trace to some silt Compact to loose Brown to grey Moist to wet		7	SS	15		229				
			8	SS	7		228		○		
227.1											
7.2	SILT, some sand, trace clay Very loose to compact Grey Wet		9	SS	3		227				
			10	SS	13	▽	226		○		0 12 87 1
224.2			11	SS	9		225				
10.1	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 9.3 m (Elev. 225.0 m) during drilling operations.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SUD-MTO 001 1532543.GPJ GAL-MISS.GDT 16/10/15 DATA INPUT:

Golder Associates

RECORD OF BOREHOLE No TRW-1

1 OF 1 **METRIC**

PROJECT 1532543 | G.W.P. 2159-11-00 | LOCATION N 4914430.8; E 288380.2 | ORIGINATED BY DM

DIST Central | HWY 400 | BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers | COMPILED BY AC

DATUM GEODETIC | DATE June 24-25, 2015 | CHECKED BY SEMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
243.0	GROUND SURFACE										
0.0	ASPHALT										
	Sand, some gravel, trace silt (FILL) Brown Moist										
242.2											
0.9	Silty sand, trace clay, trace to some gravel (FILL) Compact to dense Brown Moist -Minor organic staining at 1.5 m		1	AS	-		242				
			2	SS	26		241		○		7 64 22 7
			3	SS	25		240				
			4	SS	24		239				
			5	SS	21		238				
			6	SS	35		237		○		
236.4			7A 7B	SS	40		236				
6.6	Trace organics at depth of 6.6 m Sand, trace silt, trace gravel (FILL) Dense Light brown Moist		8A 8B 8C	SS	31		235				
234.3											
8.7	SAND, trace silt Compact Brown Moist		9	SS	25		234				
232.8							233				
10.2	Silty SAND Compact Light brown Moist -Becoming wet below a depth of 10.8 m		10A 10B 10C	SS	18		232				
231.3											
11.7	SILT, trace clay, trace sand, slight plasticity Loose Brown Wet		11	SS	9		231		○	NP	0 0 95 5
230.2											
12.8	END OF BOREHOLE NOTES: 1. Borehole dry upon completion of drilling. 2. Hole caved to a depth of 11.6 m (Elev. 231.4 m) upon removal of augers.										

+ ³, × ³: Numbers refer to Sensitivity ○ ³% STRAIN AT FAILURE

SUD-MTO 001 1532543.GPJ GAL-MISS.GDT 16/10/15 DATA INPUT:

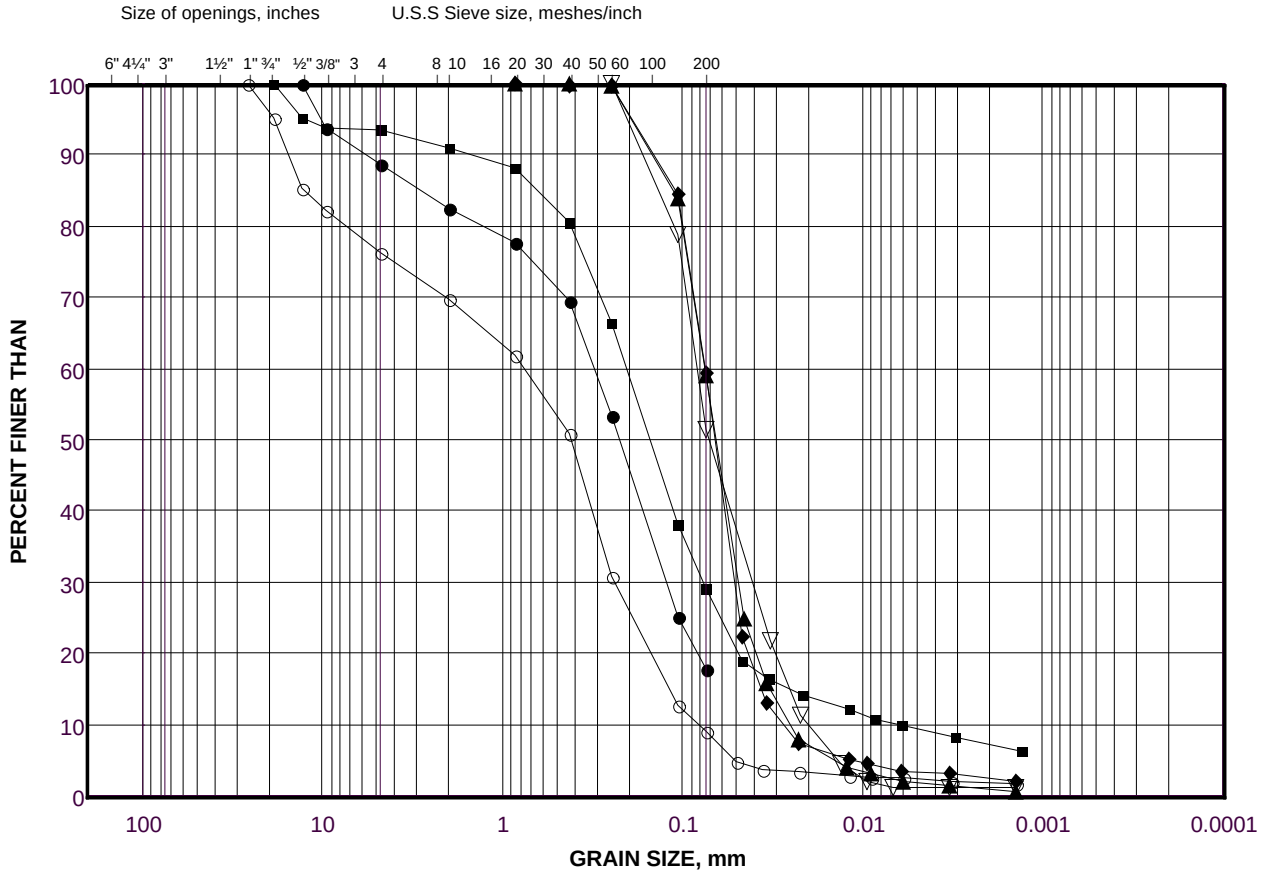
APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Sand and Silt to Sand Fill

FIGURE B1A



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	15-7	1	242.4
■	TRW-1	2	241.2
◆	HF3	3	236.8
▲	P-RW3	4	231.7
▽	15-10	4	235.2
❍	15-7	4	239.7

Project Number: 1532543

Checked By: LCC

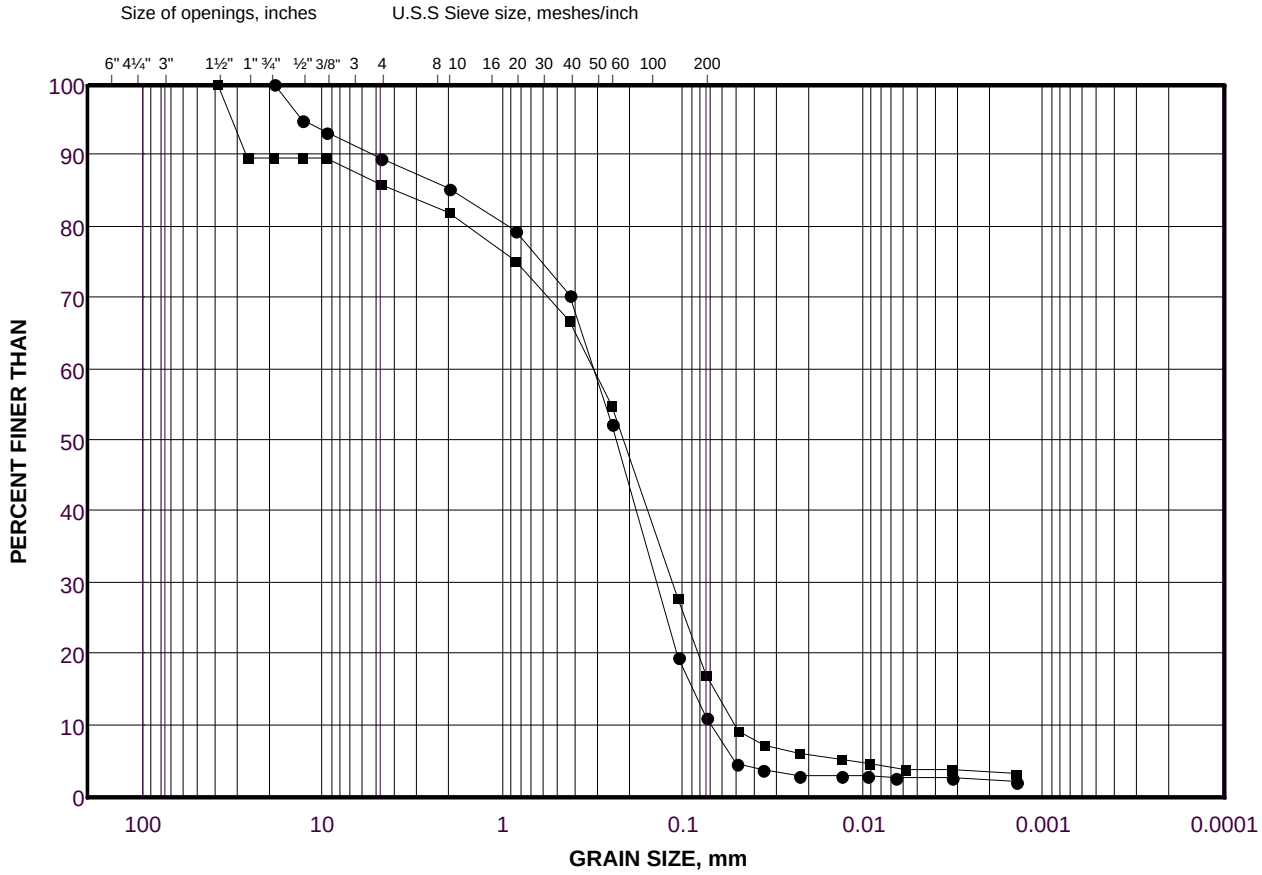
Golder Associates

Date: 14-Oct-15

GRAIN SIZE DISTRIBUTION

Sand and Silt to Sand Fill

FIGURE B1B



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	15-1 (BCR)	4	239.4
■	15-2 (BCR)	8	234.7

Project Number: 1532543

Checked By: LCC

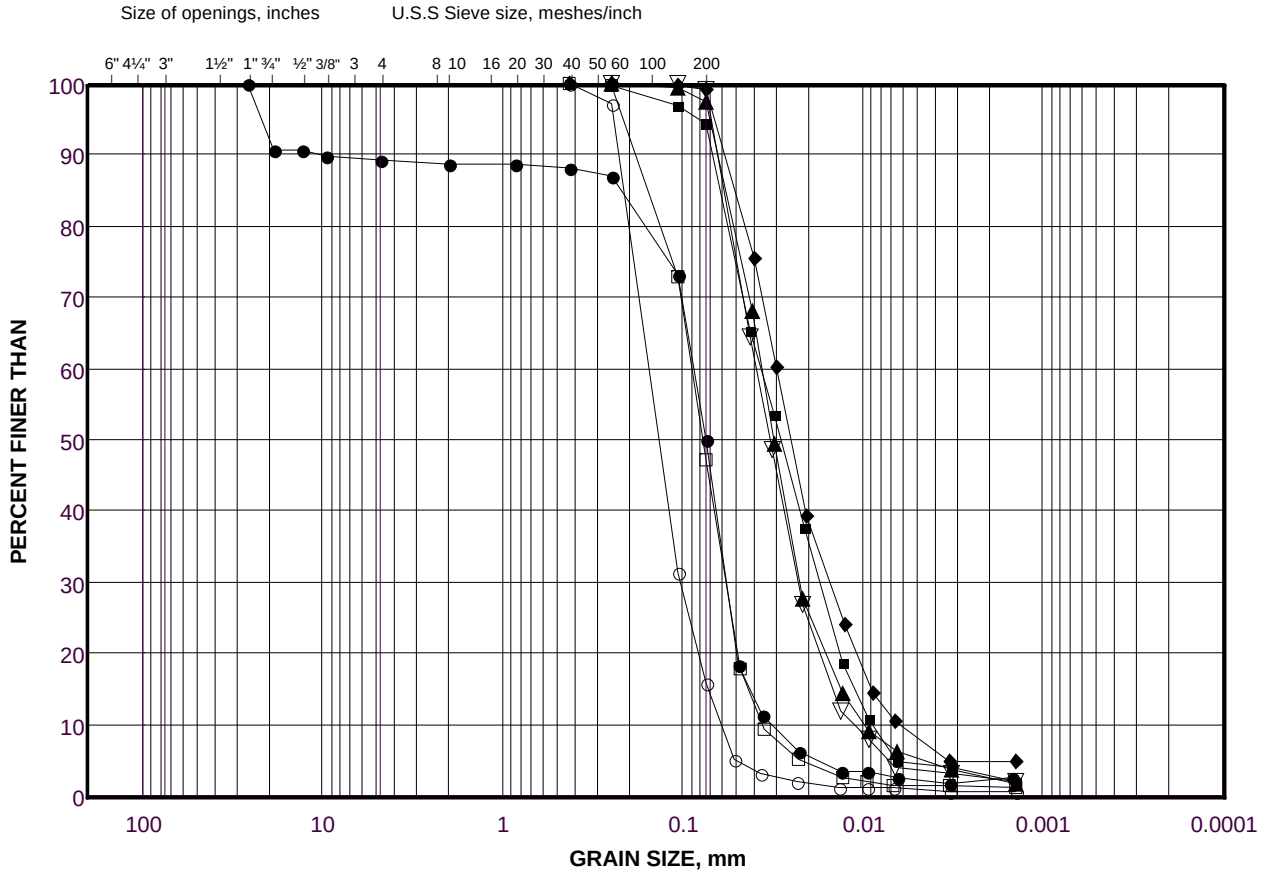
Golder Associates

Date: 29-Jan-16

GRAIN SIZE DISTRIBUTION

Silt to Sand

FIGURE B2A



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	15-7	10	232.2
■	15-9	10B	227.9
◆	TRW-1	11	230.5
▲	15-10	12	225.3
▽	15-8	6	230.1
❍	15-8	8	227.8
□	15-10	8	231.4

Project Number: 1532543

Checked By: LCC

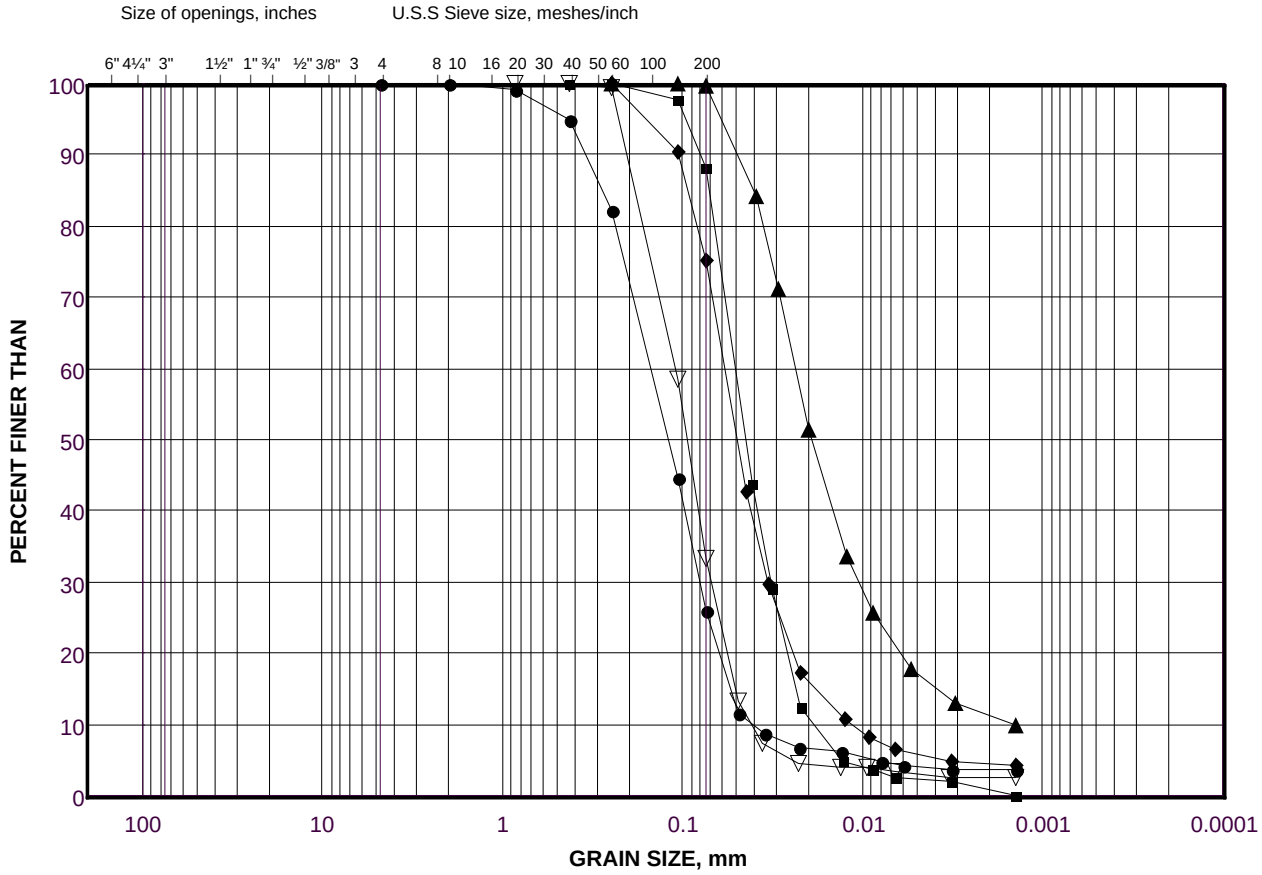
Golder Associates

Date: 14-Oct-15

GRAIN SIZE DISTRIBUTION

Silt to Sand

FIGURE B2B



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	15-1 (BCR)	10	232.60
■	P-RW3	10	225.2
◆	15-2 (BCR)	12	228.6
▲	15-2 (BCR)	13	227.1
▽	15-1 (BCR)	14	226.5

Project Number: 1532543

Checked By: LCC

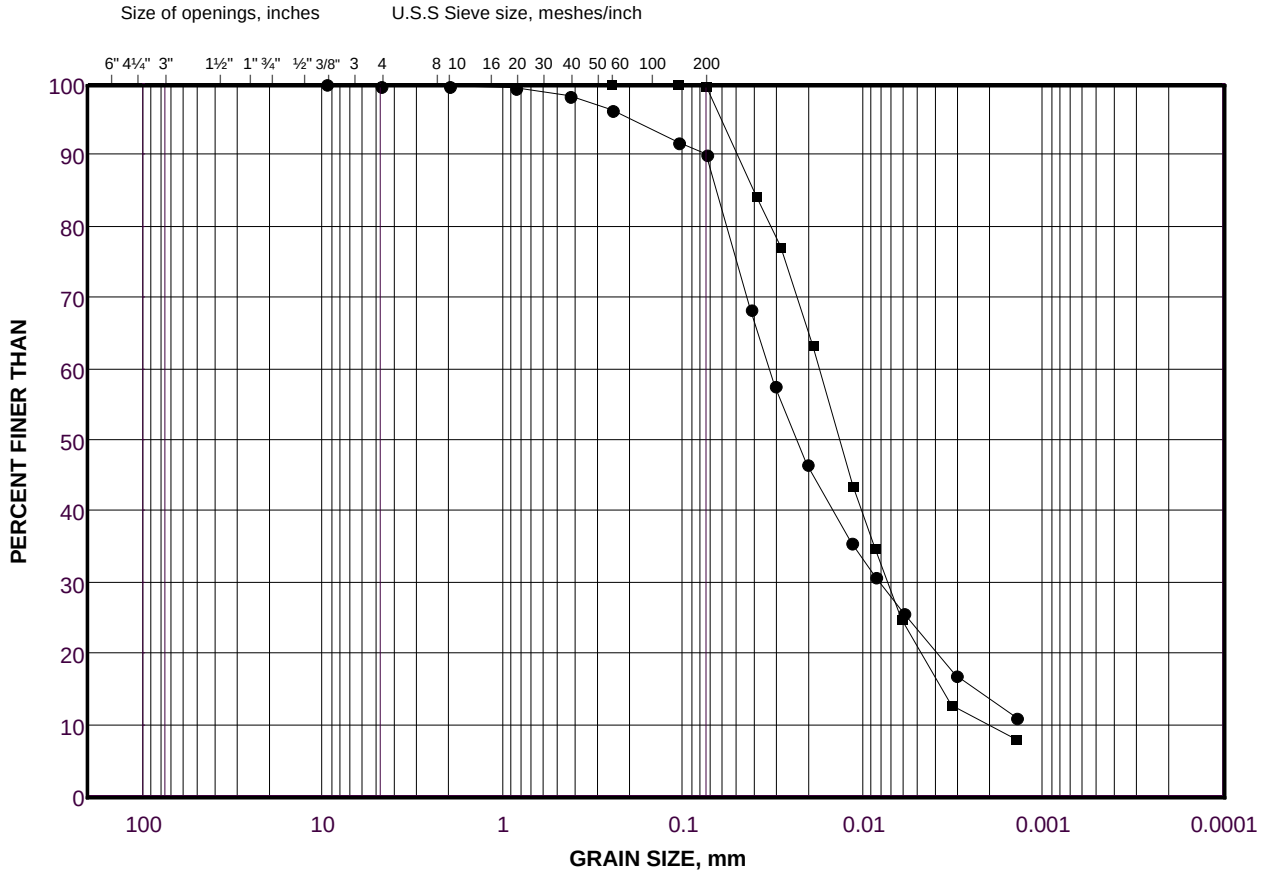
Golder Associates

Date: 20-Jan-16

GRAIN SIZE DISTRIBUTION

Clayey Silt

FIGURE B3



LEGEND

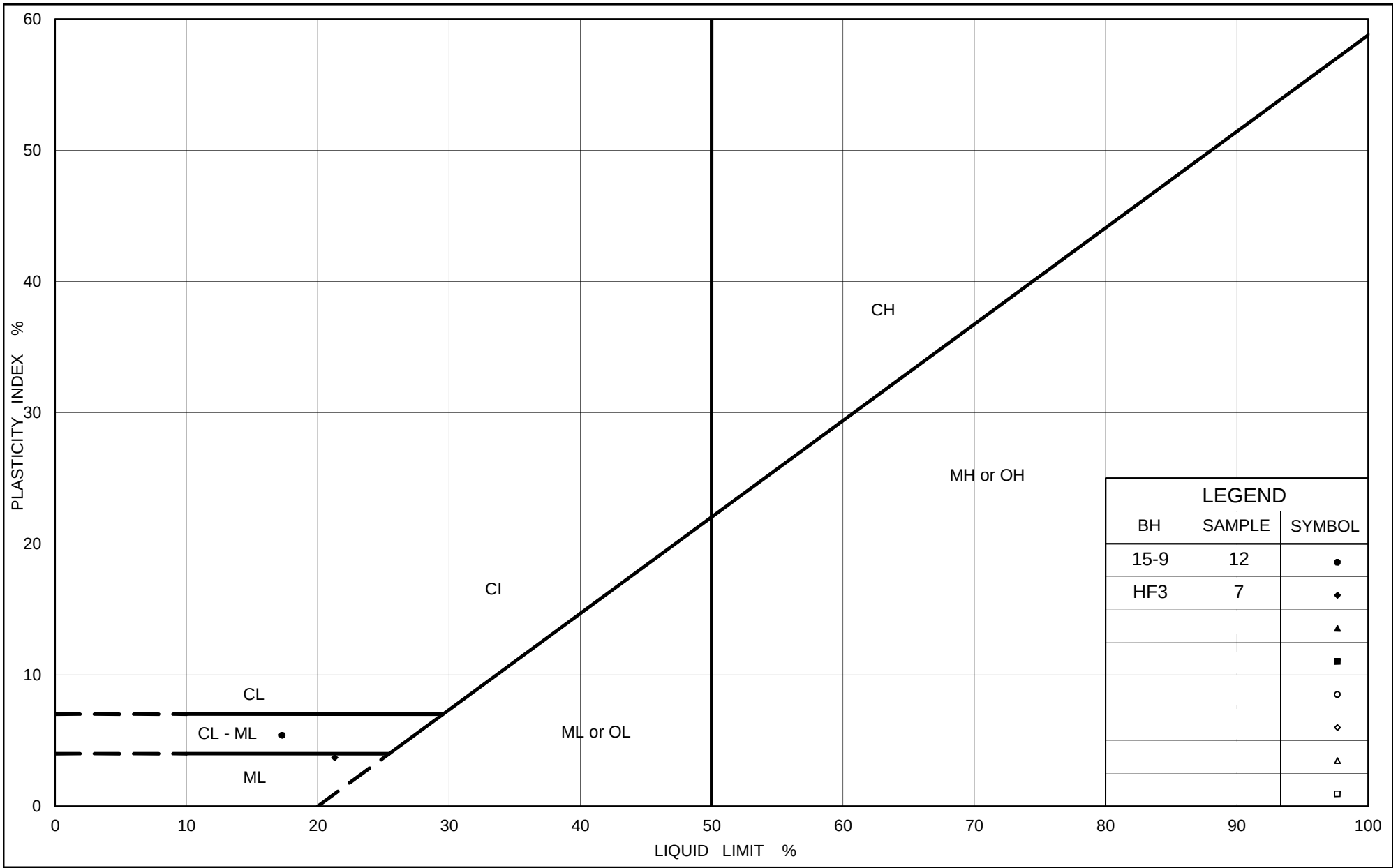
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	15-9	12	224.8
■	HF3	7	233.7

Project Number: 1532543

Checked By: LCC

Golder Associates

Date: 14-Oct-15



Golder Associates

PLASTICITY CHART
Clayey Silt

Figure No. B4

Project No. 1532543

Checked By: LCC

APPENDIX C

Borehole Records from Previous Investigation (GEOCRES No. 31D-590)

RECORD OF BOREHOLE No BH F5 1 OF 2 METRIC

GWP 2074-11-00 LOCATION 29+533, 11.9 m Rt C/L (N 4914403.1, E288402) ORIGINATED BY LG

DIST HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MP

DATUM Geodetic DATE 21/10/2014 CHECKED BY SH

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa): ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
243.0	GROUND SURFACE						243				
242.7 0.3	260 mm ASPHALT										
242.1 0.9	PAVEMENT GRANULAR FILL: 0.2 m thick Sand and Gravel; 0.4 m thick Sand, some gravel		1	SS	35						
	FILL: Silty Sand, trace to some gravel, brown to grey, loose to dense, moist to wet		2	SS	17		242				
			3	SS	9						
	loose		4	SS	8		241				
			5	SS	3						
			6	SS	6		240				
	silty clay lenses		7	SS	15						
			8	SS	13		239				
			9	SS	15						
233.9			10	SS	18		238				
9.1	sand, some silt		11	SS	12						0 81 15 4
	SILTY SAND TO SANDY SILT, brown to grey, loost to compact, moist to wet		12	SS	27		237				
	loose		13	SS	9		236				
			14	SS	17	▼	235				wet spoon
228.0							234				
							233				
							232				
							231				
							230				
							229				
							228				

Continued Next Page

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

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

RECORD OF BOREHOLE No BH F5 2 OF 2 METRIC

GWP 2074-11-00 LOCATION 29+533, 11.9 m Rt C/L (N 4914403.1, E288402) ORIGINATED BY LG

DIST _____ HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MP

DATUM Geodetic DATE 21/10/2014 CHECKED BY SH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) o UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
228.0 0.0	**SILTY SAND TO SANDY SILT** brown to grey, loose to compact moist to wet						228				added bentonite (quick gel) for further drilling
			15	SS	23				o		
							227				
			16	SS	17				o		
							226				
	loose										
							225				
224.1 18.9			17	SS	8				o		
	End of Borehole Cave-in @ 13.7 m										

+³, ×³: Numbers refer to Sensitivity

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

GEOTETOB22161AA; Hwy 400/ Tiffin Street

RECORD OF BOREHOLE No BH F6 1 OF 1 METRIC

GWP 2074-11-00 LOCATION 29+554, 26.8 m Rt C/L (N 4914429.1, E288399.8) ORIGINATED BY LG

DIST HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MP

DATUM Geodetic DATE 03/10/2014 CHECKED BY SH

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) o UNCONFINED + FIELD VANE • POCKET PENETR. × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
234.8	GROUND SURFACE										
0.0	FILL: Silty Sand trace gravel, trace rootlet brown, moist		1	SS	1		234		o		
233.1			2	SS	4				o		
1.5	SILTY SAND brown, compact to dense moist to wet		3	SS	25		233		o		0 53 (47)
			4	SS	15		232				
	silt, loose trace clay layer		5	SS	6		231		o		wet spoon
			6	SS	8				o		0 2 90 8
			7	SS	17		230		o		
228.5			8	SS	34		229		o		
6.1	End of Borehole Water level @ 3.9 m (not stabilized)* upon completion. Piezometer installed to 6.1 m. Piezometer water level records : Oct. 31, 2014 4.1 m (El. 230.5 m)										

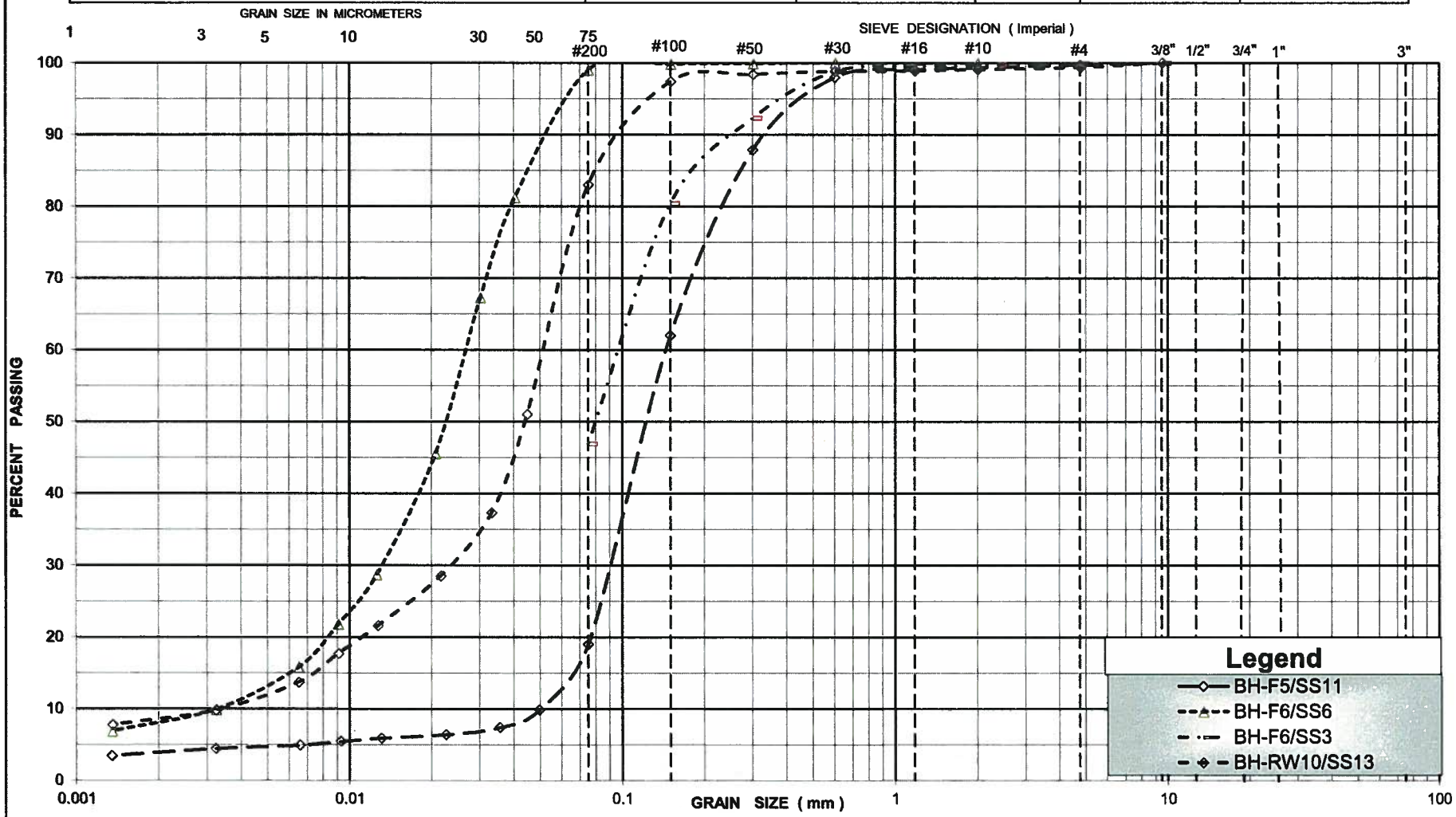
+³, ×³: Numbers refer to Sensitivity

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

UNIFIED SOIL CLASSIFICATION SYSTEM

LS 702/ ASTM D 422

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



coffey

GRAIN SIZE DISTRIBUTION

Sandy Silt to Silty Sand and Silt to Sand & Silt

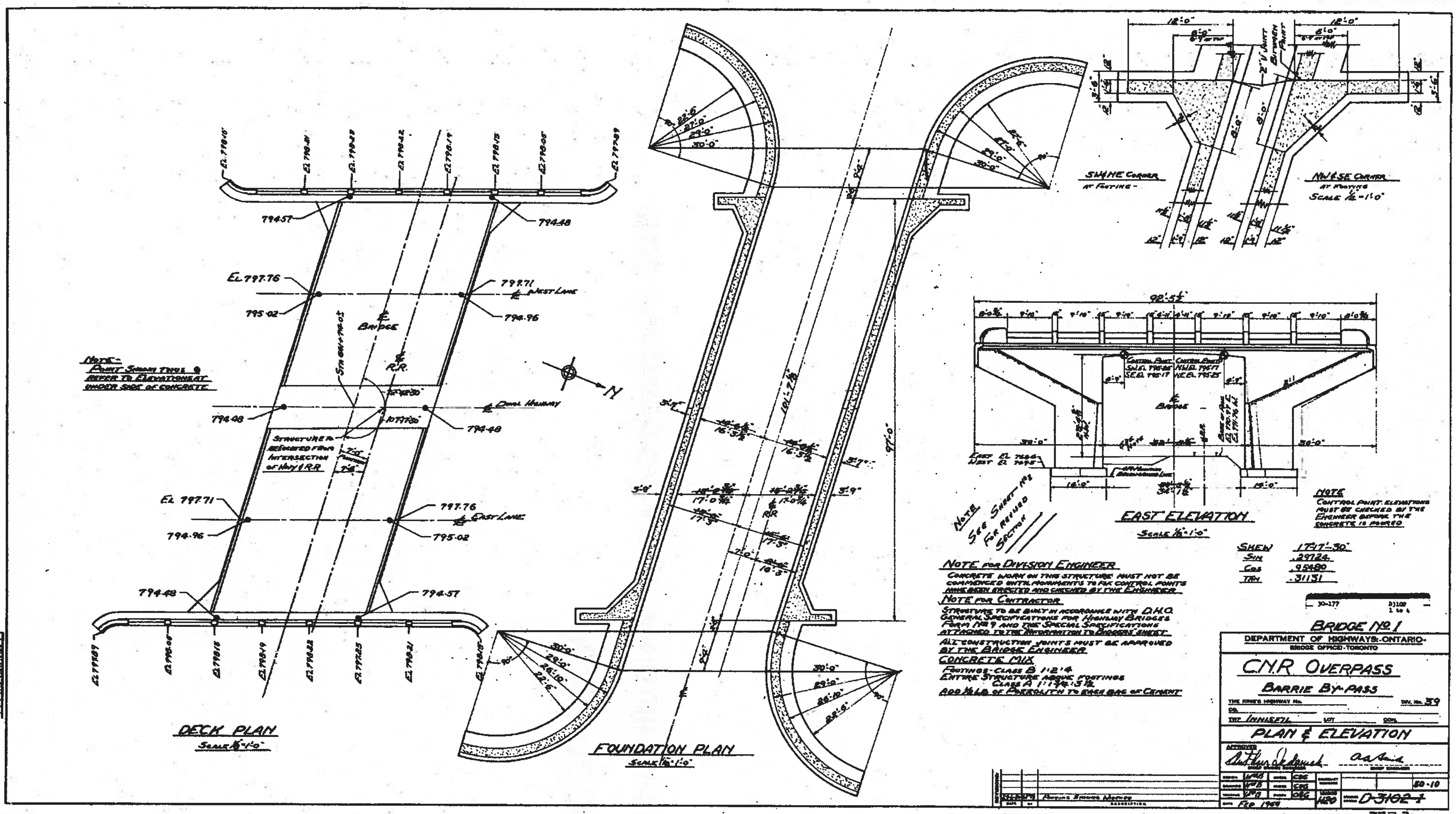
FIGURE NO. : B-2

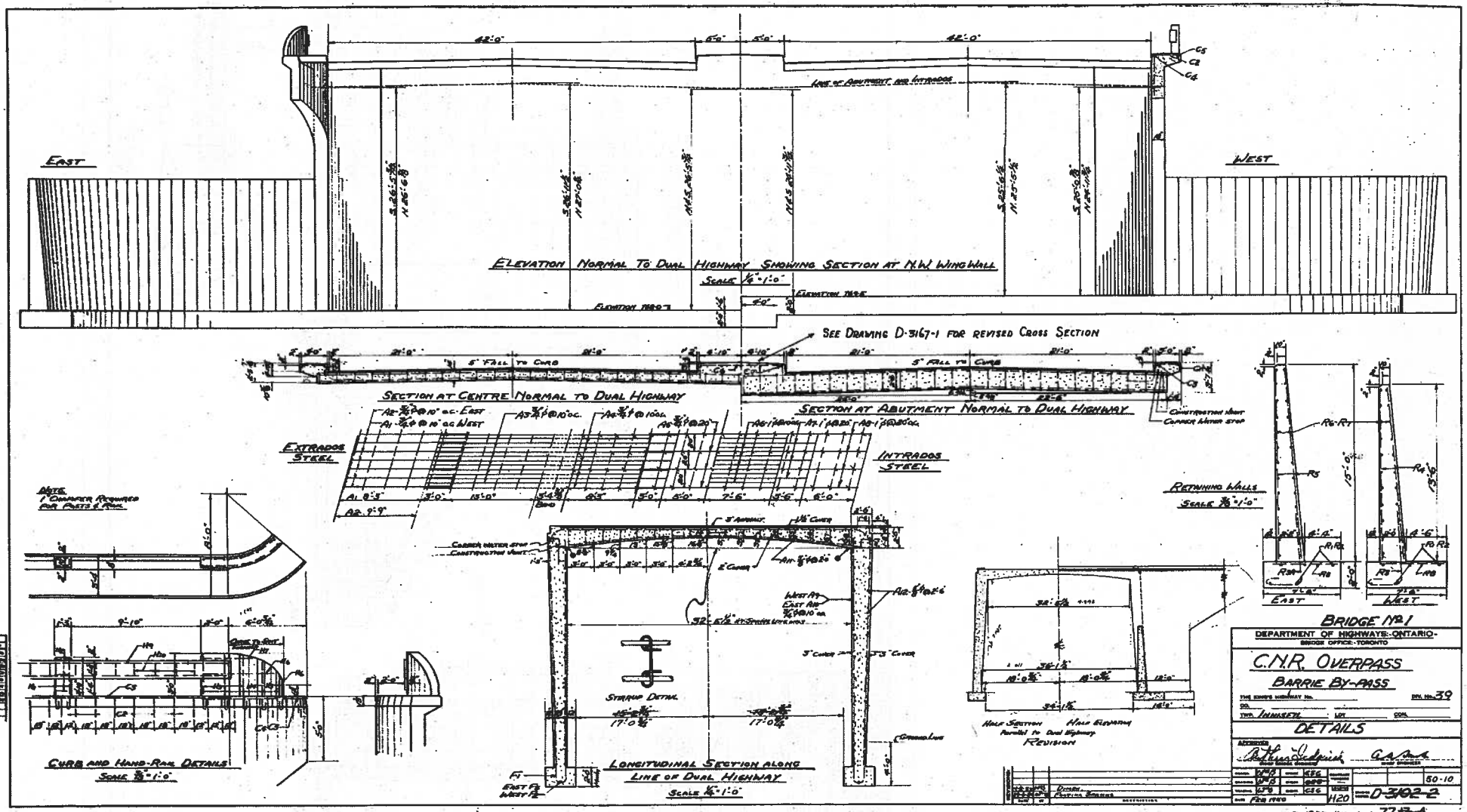
PROJECT NO.: GEOTETOB22161AA

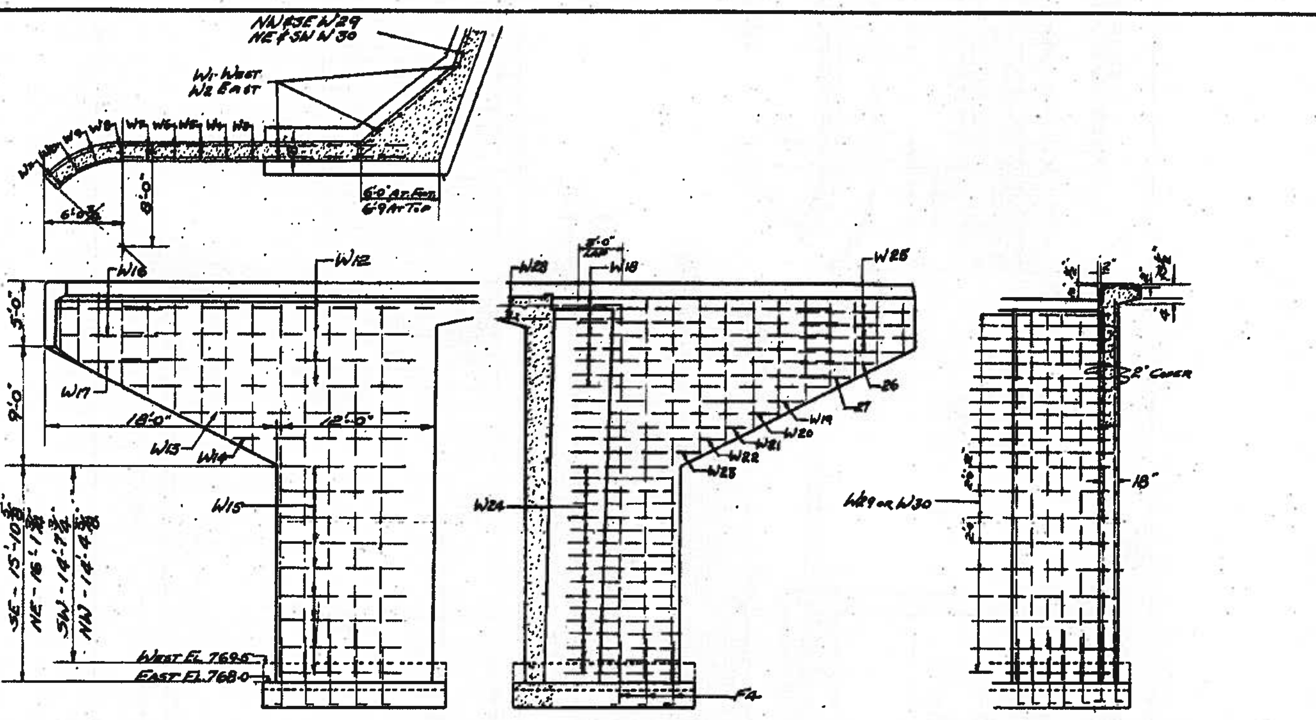
DATE : NOV 19, 2014

APPENDIX D

Existing BCR Overhead Structure Drawings (February 1950)


DECK PLAN
SCALE 1/8"=1'-0"
FOUNDATION PLAN
SCALE 1/8"=1'-0"
EAST ELEVATION
SCALE 1/8"=1'-0"
SW & NE CORNER AT FOOTING
NW & SE CORNER AT FOOTING
SCALE 1/2"=1'-0"
NOTE - POINT SHOWN THUS ● REFER TO ELEVATIONS AT UNDER SIDE OF CONCRETE
STRUCTURE IS REFERENCED FROM INTERSECTION OF HWY & RR
NOTE SEE SHEET Nº2 FOR REVISED SECTION
NOTE
CONTROL POINT ELEVATIONS MUST BE CHECKED BY THE ENGINEER BEFORE THE CONCRETE IS POURED
SKEW 17°17'-30"
SIN .29724
COS .95480
TAN .31131
NOTE FOR DIVISION ENGINEER
CONCRETE WORK ON THIS STRUCTURE MUST NOT BE COMMENCED UNTIL MONUMENTS TO FIX CONTROL POINTS HAVE BEEN ERECTED AND CHECKED BY THE ENGINEER
NOTE FOR CONTRACTOR
STRUCTURE TO BE BUILT IN ACCORDANCE WITH D.H.O. GENERAL SPECIFICATIONS FOR HIGHWAY BRIDGES FORM Nº9 AND THE SPECIAL SPECIFICATIONS ATTACHED TO THE INFORMATION TO BIDDERS SHEET
ALL CONSTRUCTION JOINTS MUST BE APPROVED BY THE BRIDGE ENGINEER
CONCRETE MIX
FOOTINGS - CLASS B 1:2:4
ENTIRE STRUCTURE ABOVE FOOTINGS CLASS A 1:1¾:3½
ADD ¼ LB. OF POZZOLITH TO EACH BAG OF CEMENT
BRIDGE Nº1
DEPARTMENT OF HIGHWAYS - ONTARIO -
BRIDGE OFFICE - TORONTO
C.N.R. OVERPASS
BARRIE BY-PASS
DIV. No. 39
TWP INNISFIL
PLAN & ELEVATION
FEB 1959
D-3102-1
TWP 77-177-1-A


EAST
WEST
ELEVATION NORMAL TO DUAL HIGHWAY SHOWING SECTION AT N.W. WING WALL
SCALE 1/8"-1'-0"
SEE DRAWING D-3147-1 FOR REVISED CROSS SECTION
SECTION AT CENTRE NORMAL TO DUAL HIGHWAY
SECTION AT ABUTMENT NORMAL TO DUAL HIGHWAY
EXTRADOS STEEL
INTRADOS STEEL
RETAINING WALLS
SCALE 3/8"-1'-0"
CURB AND HAND-RAIL DETAILS
SCALE 3/8"-1'-0"
LONGITUDINAL SECTION ALONG LINE OF DUAL HIGHWAY
SCALE 1/4"-1'-0"
HALF SECTION PARALLEL TO DUAL HIGHWAY
HALF ELEVATION
REVISION
BRIDGE No. 1
DEPARTMENT OF HIGHWAYS-ONTARIO
BRIDGE OFFICE-TORONTO
C.N.R. OVERPASS
BARRIE BY-PASS
DRN. No. 39
DETAILS
50-10
D-3102-2



OUTER FACE

INNER FACE

WING WALL

SCALE 5/16" = 1'-0"

PRINT RECORD		
No.	For	Date
1	Check	[illegible]
30	Tender	3/3/60
1	Check	13-4-60
1	"	4-5-60
14	De.P.L. By	9.5.60

BRIDGE No. 1

DEPARTMENT OF HIGHWAYS - ONTARIO -
BRIDGE OFFICE - TORONTO

C.N.R. OVERPASS
BARRIE BY-PASS

THE KING'S HIGHWAY No. DIV. No. 39
CO.
TWP. INNISFIL LOT CON.

WING WALL DETAILS

APPROVED
CHIEF BRIDGE ENGINEER
CHIEF ENGINEER

DESIGN	[illegible]	CHECK	CSC	CONTRACT NUMBER	50-10
DRAFTING	[illegible]	CHECK	CSC		
TRACING	[illegible]	CHECK	CSC	LOADING H20	DRAWING NUMBER D-3102-3
DATE	FEB. 1960				

REVISIONS | DATE | BY | DESCRIPTION

TWP# 77-177-3-A 77-B-5

APPENDIX E

Non-Standard Special Provisions and Operational Constraints

WORKING SLAB - Item No.

Special Provision

1.0 SCOPE

This Special Provision covers the requirements for the supply and placement of a concrete working slab under structure foundations.

2.0 REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 902 Excavating and Backfilling - Structures

3.0 DEFINITIONS - Not Used

4.0 DESIGN AND SUBMISSION REQUIREMENTS - Not Used

5.0 MATERIALS

Concrete for working slabs shall have a minimum 28 day strength of 20 MPa.

6.0 EQUIPMENT - Not Used

7.0 CONSTRUCTION

7.01 Excavation

Excavation for the working slab shall be according to OPSS 902.

7.02 Protection of Founding Soil

Following inspection and approval of the prepared subgrade, a working slab with a minimum thickness of 100 mm shall be placed on the foundation subgrade as specified in the Contract Documents.

7.03 Dewatering

Dewatering shall be carried out according to OPSS 902.

8.0 QUALITY ASSURANCE - Not Used

9.0 MEASUREMENT FOR PAYMENT - Not Used

10.0 BASIS OF PAYMENT

10.01 Working Slab - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material to do the work.

END OF SECTION

OPERATIONAL CONSTRAINT – Preload Period – Embankment Widening Construction

Special Provision

The Contractor shall schedule his operations to include the following preloading times for the new Highway 400 northbound lane (NBL) embankment, to allow time for settlement:

- The new Highway 400 NBL embankment shall be constructed up to the top of the granular sub-base material, and the fills shall remain in place for a minimum period of six (6) weeks before paving.

- The pipe culverts at Station 29+280 and 10+120 shall be constructed within the casing/primary liner a minimum of six (6) weeks following completion of the new Highway 400 NBL embankment fill to the top of the granular sub-base material.

Prior to placement of the Granular A base material and paving, the Contractor shall conduct a survey to determine the elevations of the top of the Granular B sub-base material, and shall place additional Granular B material as and where required to achieve the pavement design sub-base elevation.

The Contractor shall not proceed with final granular placement and paving until approval has been given by the Contract Administrator.

Temporary Protection Systems – Item No.

Special Provision

Amendment to OPSS.PROV 539

539.07 CONSTRUCTION

539.07.01 General

Section 539.07.01 is amended by the addition of the following:

The Contractor is advised of the presence of a trichloroethylene (TCE) plume within the limits of the project. Vertical elements of the temporary protection system (eg., soldier piles or sheetpiles) may penetrate below the groundwater table into the sand/silt deposit. However, such vertical elements shall not penetrate into or through the underlying clayey silt to silty clay deposit. The surface of this deposit was encountered at the following elevations, and vertical elements in these areas shall not penetrate below this level.

Tiffin Street Overpasses:

- Elevation 223.5 m in the vicinity of the north abutments
- Elevation 222 m in the vicinity of the south abutments

Barrie-Collingwood Railway (BCR) Overhead Structure:

- Elevation 225 m in the vicinity of the north abutments
- Elevation 225 m in the vicinity of the south abutments

539.07.02 Removals

Section 539.07.02 is amended by the addition of the following:

Where an interlocking sheetpile wall is adopted as a temporary protection system measure on this project, removal of the sheetpile wall is required following completion of construction to minimize impacts on the TCE plume, unless otherwise approved by the Contract Administrator.

Excavating and Backfilling – Structures – Item No.

Special Provision

Amendment to OPSS 902

902.07 CONSTRUCTION

902.07.05 Excavation

902.07.05.02 Excavation for Foundations

Section 902.07.05.02 is amended by the addition of the following:

The footing subgrade shall be inspected by the Quality Verification Engineer (QVE) prior to placement of the concrete working slab. Where softened/loosened or deleterious materials are present at the subgrade level, they shall be subexcavated, but such subexcavation shall not extend more than 0.5 m below the subgrade level, in order to maintain the excavation above the groundwater level at the site.

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