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FINAL REPORT

Foundation Investigation and Design Report

Applewood Creek Culvert (CV02/03) Replacement QEW Widening from East of Cawthra Road to The East Mall Cities of Mississauga and Etobicoke MTO GWP 2102-13-00 & 2432-13-00

Submitted to:

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the widening of Queen Elizabeth Way (QEW) from Cawthra Road to the East Mall in the Cities of Mississauga and Etobicoke, Regional Municipality of Peel/City of Toronto, Ontario. This report addresses the results of the foundation investigation carried out for the replacement of Applewood Creek Culvert (CV02/03).

The purpose of this investigation is to establish the subsurface soil and bedrock conditions at the proposed culvert location by borehole drilling, rock coring and laboratory testing and analytical laboratory testing on selected soil and rock core samples.

The Terms of Reference (TOR) and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated January 2016, which forms part of the Consultant's Assignment Number (Number 2015-E-0001) for this project. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated June 6, 2016.

2.0 SITE DESCRIPTION

Culvert CV02/03, also known as the Applewood Creek Culvert, originates on Harvest Drive north of the QEW and crosses under the QEW and under the South Service Road off-ramp to Dixie Road (W-N/S Ramp) in the City of Mississauga, Ontario. Residential areas are located to the north of the QEW outside the right of way at the location of the culvert inlet and a commercial development and parking lot is present to the south of the QEW outside the right of way beyond the culvert outlet.

The QEW grade at the site is at approximately Elevation 104 m, while the present ground surface to the north of the QEW is at about Elevation 104.5 m and to the south of the QEW is at about Elevation 103 m. The invert of the existing culvert is at approximate Elevation 101.3 m at the north end, and at Elevation 99.8 m at the south end.

3.0 INVESTIGATION PROCEDURES

The field work for this subsurface investigation was carried out in October 2016 and on June 18, 2021 during which time a total of four sampled boreholes, designated as Boreholes CV02/03-1 to CV02/03-3 and 21-27, were advanced near the culvert on the North Service Road and South Service Road, as well as near the existing off-ramp from South Service Road/QEW to Dixie Road. The borehole locations shown on Drawing 1.

The 2016 borehole investigation was carried out using a truck-mounted CME 75 drill rig, supplied and operated by Davis Drilling of Milton, Ontario, while the 2021 investigation used a Geoprobe 6620DT drill rig, supplied and operated by Altech Drilling and Investigative Services Ltd. of Cambridge, Ontario. The boreholes were advanced through the overburden using 108 mm outside diameter solid stem augers and NW casing. Soil samples were obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures. Samples of the bedrock were obtained using an 'NQ' size rock core barrel and coring techniques at two of the boreholes.

The boreholes were advanced to depths between 5.0 m and 7.7 m below existing ground surface, including coring of bedrock for a core length of 3.2 m in Borehole CV02/03-1 and 4.6 m in Borehole 21-27.

The groundwater conditions and water levels in the open boreholes were observed during the drilling operations prior to introduction of water for bedrock coring where applicable. All boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903, Wells (as amended). Boreholes CV02-03-1 and CV02-03-2 were also sealed at ground surface with cold patch asphalt.

The field work was observed by members of Golder's engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, and logged the boreholes. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected samples. Unconfined compression (uniaxial) strength (UCS), Young's modulus and Poisson's ratio testing was carried out on selected specimens of the bedrock core.

One selected bedrock core sample and one selected soil sample were submitted to Maxxam Analytics (Maxxam) (rebranded to Bureau Veritas Laboratories in 2019) of Mississauga, Ontario which is a Standards Council of Canada (SCC) accredited laboratory for chemical analysis. The sample of bedrock core was crushed and homogenized by Maxxam prior to testing. The homogenized bedrock sample and the soil sample were analyzed for corrosivity testing (parameters include conductivity, resistivity, soluble chloride, soluble sulphate and pH).

The borehole locations and the ground surface elevations of the as-drilled locations were obtained using a GPS Trimble XH 3.5G, having an accuracy of 0.1 m in the vertical and 0.1 m in the horizontal direction. The locations given in the borehole/drillhole records and shown on Drawing 1 are positioned relative to MTM NAD 83 (Zone 10) northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, ground surface elevations and drilled depths are summarized below.

Borehole No.	Location (MTM NAD 83)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (Latitude)	Easting (Longitude)		
CV02/03-1	4,828,381.4 (43.595345)	299,091.3 (-79.570703)	104.5	7.7 (including 3.2 m of bedrock core)
CV02/03-2	4,828,357.9 (43.595134)	299,131.5 (-79.570206)	103.9	6.2
CV02/03-3	4,828,335.4 (43.594932)	299,149.6 (-79.569981)	103.2	5.0
21-27	4,82833.0 (43.594919)	299,168.6 (-79.569749)	101.8	6.9 (including 4.6 m of bedrock core)

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The project area is located within the Iroquois Plain physiographic region, as delineated in The Physiography of Southern Ontario (Chapman and Putman, 1984)[1].

The glacial Iroquois Plain stretches along the northern shoreline of Lake Ontario, extending from the Niagara Escarpment in the west to the Scarborough Bluffs in the east. The Iroquois Plain soils consist of glaciolacustrine sediments deposited in Lake Iroquois, primarily sands, silts and gravels, with a shallow cover of till remaining over the bedrock. The Georgian Bay Formation which underlies the study area consists mainly of blue-grey shale, containing siltstone, sandstone and limestone interbeds. Outcrops of this formation are commonly found along water courses on the west side of Toronto and in Mississauga, notably in the Humber River, Mimico Creek, Etobicoke Creek and Credit River valleys.

4.2 Subsurface Conditions

The subsurface soil, bedrock and groundwater conditions as encountered in the boreholes and the results of the geotechnical laboratory tests carried out on selected soil and bedrock samples are presented on the borehole and drillhole records provided in Appendix A. Photographs of the recovered bedrock core samples are presented on Figures A1 and A2, in Appendix A. The results of the in-situ field tests (i.e., SPT “N”-values) as presented on the borehole records and in sub-sections of Section 4.2 are uncorrected. Lists of abbreviations and symbols and lithological, geotechnical rock description terminology, field estimation of rock hardness and rock weathering classification are also included in Appendix A to assist in the interpretation of the borehole and drillhole records. The results of the geotechnical laboratory testing on the soil and bedrock samples are also presented in Appendix B.

Stratigraphic boundaries shown on the borehole records and on the stratigraphic profile on Drawing 1 are inferred from non-continuous sampling, observations of drilling progress and the results of the Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations. It should be noted that the interpreted stratigraphy shown on Drawing 1 is a simplification of the subsurface conditions.

In general, the subsurface conditions in the area of the proposed culvert replacement consist of a layer of asphalt pavement, underlain by a layer of non-cohesive fill associated with the existing road structure. The fill is underlain by a sandy silt to silty sand to sand deposit, further underlain by a clayey silt residual soil deposit or bedrock. Borehole CV02/03-3, which was advanced on the shoulder of the South Service Road off-ramp to Dixie Road, encountered the fill layer that extending from ground surface to the surface of the shale bedrock. A detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Asphalt

An approximately 150 mm and 230 mm thick layer of asphalt pavement was encountered from ground surface in Boreholes CV02/03-1 and CV02/03-2, respectively.

[1] Chapman, L.J. and Putman, D.F., 1984, The Physiography of Southern Ontario, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.)

4.2.2 Topsoil

An approximately 100 mm thick layer of topsoil was encountered at ground surface in Borehole 21-27. The water content measured on one sample of the topsoil is about 20%.

This material was classified solely based on visual and textural evidence. Testing of organic content or for other nutrients was not carried out. Therefore, the use of materials classified as topsoil cannot be relied upon for support and growth of landscaping vegetation.

4.2.3 Fill

Fill was encountered underlying the asphalt pavement in Boreholes CV02/03-1 and CV02/03-2, below the topsoil in Borehole 21-27, and immediately below ground surface in Borehole CV02/03-3. The fill layer is approximately 0.3 m thick in Boreholes CV02/03-1 and CV02/03-2, approximately 1.6 m in Borehole 21-27, and about 4.9 m thick in Borehole CV02/03-03.

In Boreholes CV02/03-1 and CV02/03-2, the fill consists of sand and gravel and is associated with the road structure. In Borehole CV02/03-3, the fill consists of silt and sand, trace to some clay, trace gravel interlayered with silty sand and gravel at random depths. In Borehole 21-27, the fill consists of clayey silt, trace to some sand, trace gravel.

The Standard Penetration Test (SPT) “N”-values measured within the silt and sand fill layer range from 4 blows to 14 blows per 0.3 m of penetration, indicating a loose to compact relative density. The SPT “N”-values measured within the clayey silt layer is 18 blows and 26 blows per 0.3 m of penetration, indicating a very stiff consistency.

Grain size distribution testing was carried out on one sample of the fill layer from Borehole CV02/03-3 and the result is shown on Figure B1 in Appendix B. The water content measured on six samples of the silt and sand fill layer ranges between about 7% and 18%. The water content measured on two samples of the clayey silt fill layer is about 13% and 18%.

4.2.4 Sandy Silt to Silty Sand to Sand

A deposit of sandy silt to silty sand to sand was encountered underlying the sand and gravel fill in Boreholes CV02/03-1 and CV02/03-2. The top of the sandy silt to silty sand to sand deposit was encountered at about Elevation 104.0 m and 103.4 m in Boreholes CV02/03-1 and CV02/03-2, respectively, and the deposit extends for a thickness of about 1.8 m in both boreholes.

The Standard Penetration Test (SPT) “N”-values measured within the sandy silt to silty sand to sand deposit range from 5 blows to 20 blows per 0.3 m of penetration, indicating a loose to compact relative density.

The deposit consists of brown sandy silt to silty sand in Borehole CV02/03-1 and brown sand containing some silt and trace gravel in Borehole CV02/03-2. Grain size distribution tests were carried out on two samples of the silty sand to sand portion of the deposit and the test results are shown on Figure B2 in Appendix B. The water content measured on three samples of the sandy silt to silty sand to sand deposit ranges between about 5% and 18%.

4.2.5 Residual Soil

A 0.8 m thick residual soil deposit was encountered underlying the sand deposit in Borehole CV02/03-2 at a depth of about 2.3 m below ground surface (Elevation 101.6 m). Residual soil is a heterogeneous mix of fully weathered bedrock that is disintegrated into a soil-like texture material that no longer retains the structure of parent bedrock. The residual soil deposit consists of clayey silt containing some sand and shale fragments.

The SPT “N”-values measured within the residual soil deposit is 15 blows per 0.3 m of penetration, suggesting a stiff consistency.

The water content measured on one sample of the residual soil is about 16%.

4.2.6 Shale Bedrock

Bedrock was sampled in all boreholes by split-spoon sampler and the bedrock was confirmed by rock coring in Boreholes CV02/03-1 and 21-27.

The depths to bedrock below ground surface, as determined from coring and inferred from the augering and split spoon sampling, and the corresponding bedrock surface elevation are summarized below.

Borehole No.	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	Comments
CV02/03-1	2.3	102.2	2.2 m split-spoon sampling and 3.2 m bedrock cored
CV02/03-2	3.1	100.8	3.1 m split-spoon sampling
CV02/03-3	4.9	98.3	0.1 m split-spoon sampling
21-27	1.7	100.1	0.6 m split-spoon sampling and 4.6 m bedrock cored

Inferred highly to moderately weathered shale bedrock was encountered at depths ranging from 1.7 m to 4.9 m below ground surface (Elevations 102.2 m to 98.3 m) as inferred based on drilling behaviour, observations of drilling cuttings and split-spoon sampling. The bedrock surface generally declines from north to south, with a local low point around Borehole CV02/03-3 which may be related to the former alignment of the creek channel in this area.

SPT “N”-values measured within the upper zone of inferred highly to moderately weathered shale bedrock range from 15 blows per 0.3 m of penetration to 100 blows for 0.08 of penetration, suggesting a very stiff to hard consistency as well as blockage of sampling equipment by fragments of rock.

A grain size distribution test was carried out on one sample of the inferred highly weathered bedrock obtained by split-spoon sampling and the result is shown on Figure B3 in Appendix B. The split-spoon samples obtained from within the inferred highly to moderately weathered bedrock do not contain larger fragments of rock due to the sampler size and sampling method. Larger fragments of unweathered shale bedrock may be present in-situ. In addition, the percentage of gravel sized particles may include highly to moderately weathered shale fragments that either remain intact after or were broken down during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behaviour of the in-situ or excavated completely to moderately weathered shale bedrock.

Atterberg limits testing was carried out on the finer fractions of one sample of the inferred completely weathered bedrock and measured a liquid limit of about 34%, a plastic limit of about 21%, and a corresponding plasticity index of 13%. The result, which is plotted on a plasticity chart on Figure B4 in Appendix B, indicates that the finer fraction of the inferred highly weathered shale bedrock consists of clayey silt of low plasticity. The water content of two samples of the inferred highly to moderately weathered shale bedrock is 11% and 14%.

Based on a review of the bedrock core samples, the bedrock consists of shale of the Georgian Bay Formation. In general, the bedrock core samples are described as moderately to slightly weathered, very thinly laminated, fine grained, non-porous, weak, grey, with strong limestone interbeds at varying intervals, as presented in the drillhole records in Appendix A, and shown on the photographs of the recovered core samples on Figures A1 and A2 in Appendix A. The degree of weathering of the bedrock samples (i.e,. slightly to moderately weathered –W2 to W3), and the strength classification of the intact rock mass based on field identification (i.e., weak – R2) is described in accordance with the International Society for Rock Mechanics (ISRM[2]) standard classification system.

The Rock Quality Designation (RQD) measured on the core samples ranges from about 20% to 94%, indicating a rock mass of poor to excellent quality as per Table 3.10 of CFEM (2006)[3]. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of samples recovered are between 72% and 100% and between 43% and 100%, respectively.

One Unconfined Compression (UC) test carried out on a selected core sample of the shale bedrock obtained in Borehole CV02/03-1 measured a uniaxial compressive strength of about 17.6 MPa, as detailed in Appendix B. The Young's modulus was estimated to be 1,200 MPa based on Geomechanica's test results. It is noted that the top 25 mm of the bedrock core sample tested consisted of limestone. Based on the laboratory UC test, in accordance with Table 3.5 in CFEM (2006)[4], the shale bedrock is classified as weak (R2, 5 MPa < UCS < 25 MPa).

4.2.7 Groundwater Conditions

The overburden samples obtained from the boreholes were generally moist. Boreholes CV02/03-1 and 21-27 were dry upon completion of drilling and prior to rock coring. The water level in Borehole CV02/03-2 was measured at a depth of 4.1 m below ground surface, corresponding to Elevation 99.8 m upon completion of drilling. The water level was not measured in Borehole CV02/03-3; however, wet soil was encountered below a depth of 3.8 m below ground surface, corresponding to Elevation 99.4 m.

It should be noted that the groundwater level in the area is subject to seasonal fluctuations and precipitation events, and should be expected to be higher during wet periods of the year.

4.2.8 Corrosivity Testing Results

Two samples were collected and submitted to Bureau Veritas Laboratories (previously known as Maxxam) for analysis of parameters used to assess corrosion potential and sulphate attack. The detailed test results are presented in Appendix C and summarized as follows:

[2] International Society for Rock Mechanics Commission on Test Methods, 1985. Int. J. Rock Mech.Min. Sci. & Geomech. Abstr. Vol 22, No. 2, pp. 51-60.

[3] Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual (CFEM), 4th Edition. The Canadian Geotechnical Society, BiTech Published Ltd., British Columbia.

[4] Canadian Geotechnical Society, 2006. *Canadian Foundation Engineering Manual* (CFEM), 4th Edition. The Canadian Geotechnical Society, BiTech Published Ltd., British Columbia.

Borehole No.	Sample No.	Sample Depth (Elevation) (m)	Material Type	Parameters				
				Chloride (µg/g)	Sulphate (µg/g)	pH	Conductivity (µmho/cm)	Resistivity (ohm-cm)
CV02/03-1	Run 1	5.3 (99.2)	Bedrock	100	250	8.01	682	1,500
21-27	SA 2	0.8 – 1.4 (101.0 – 100.4)	Clayey Silt Fill	53	<20	7.40	262	3,800

5.0 CLOSURE

This report was prepared by Ms. Katie Nero, P.Eng. Ms. Lisa Coyne, P.Eng., a Principal and MTO Foundations Designated Contact for Golder, conducted a technical and quality control review of the report.

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PART B

FOUNDATION DESIGN REPORT
CULVERT CV02/03 REPLACEMENT
QEW WIDENING FROM EAST OF CAWTHRA ROAD TO THE EAST MALL
CITIES OF MISSISSAUGA AND ETOBICOKE
MTO GWP 2102-13-00 & 2432-13-00

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

This section of the report provides detail foundation engineering design recommendations for the proposed culvert replacement associated with the widening of the Queen Elizabeth Way (QEW) from Cawthra Road to the East Mall, Mississauga/Etobicoke. These recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the subsurface investigation. The discussion and recommendations presented are intended to provide the designer with sufficient information to assess the feasible culvert alternative types and carry out the design of the culvert foundations.

The foundation investigation report, discussion and recommendations are intended for the use of the Ministry of Transportation, Ontario (MTO) and their designers and shall not be used or relied upon for any other purpose or by any other parties, including the construction or design-build contractor. The contractor must make their own interpretation based on the factual data in Part A (Foundation Investigation Report) of this report. Where comments are made on construction, they are provided to highlight those aspects that 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 must make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling, and the like.

6.1 General

Based on the General Arrangement (GA) drawing provided to Golder by AECOM on July 13, 2021, the existing 1350 mm wide by 2250 mm high box culvert is to be replaced by twin 3000 mm wide by 2100 mm high (interior dimension) box culverts for the sections crossing beneath the QEW and the QEW W-N/S ramp to Dixie Road. Based on visual observation, the existing low embankment of the QEW, service roads and ramps appear to be performing satisfactorily in the vicinity of the existing and proposed culvert, with no visual evidence of settlement.

The new twin box culverts will be constructed to match the existing culvert invert at Elevation 101.3 m at the upstream (north) end and Elevation 99.8 m at the downstream (south) end. The proposed culvert is to be constructed on an alignment immediately to the west of the existing culvert, with the tie-in sections at a skew of about 158 degrees at the north end and 180 degrees at the south end, respectively. It is understood that the proposed culvert is to be constructed using open-cut methods, (i.e., trenchless methods are not proposed). Cast-in-place culverts have been proposed for this site; both cast-in-place and pre-cast culverts are considered feasible from a geotechnical/foundations perspective.

6.2 Consequence and Site Understanding Classification

In accordance with Section 6.5 of the 2019 Canadian Highway Bridge Design Code and its Commentary (CHBDC, 2019), the culvert replacement and its foundation system are considered to be classified as having a “typical consequence level” associated with exceeding limits states design. In addition, given the level of foundation investigation completed to date in comparison to the degree of site understanding in Section 6.5 of CHBDC (2014), the level of confidence for design is considered to be a “typical degree of site and prediction model understanding.” Accordingly, the appropriate corresponding ULS and SLS consequence factor, Ψ, from Table 6.1 and geotechnical resistance factors, ϕ_{gu} and ϕ_{gs}, from Table 6.2 of the CHBDC (2019) have been used for design, as indicated in the sections below.

6.3 Seismic Design

6.3.1 Seismic Site Classification

Subsurface ground conditions for seismic site characterization were established based on the results of the field investigation and laboratory testing. The SPT "N"-values measured in the soil layers and the interpreted shear wave velocity of soils up to 30 m below founding level were used to define the seismic site classification in accordance with Table 4.1 of the CHBDC (2019). Based on this methodology it is considered that a Site Class of C would be applicable for the design of the replacement structure.

6.3.2 Spectral Response Values and Seismic Performance Category

The CHBDC (2019) states that the seismic hazard values associated with the design earthquakes should be those established for the National Building Code of Canada (NBCC) by the Geological Survey of Canada (GSC). The GSC has developed a new set of seismic hazard maps (referred to as the 5th generation seismic hazard maps) that were made available for public use in December 2015, through the Natural Resources Canada (2017) website.

In accordance with Section 7.5.5.2 of the CHBDC (2019), buried structures should be designed to resist inertial forces associated with a seismic event having a 2% exceedance in 50 years (i.e., a 2,475 year return period), where the horizontal ground acceleration ratio A_H is equal to the peak ground acceleration, PGA, as specified in Section 4.4.3 of CHBDC (2019). Therefore, based on Section 4.4.3 of the CHBDC (2019) and the location of the culvert (Latitude 43.595 and Longitude -79.571), the reference Site Class C PGA value, which corresponds to the site-specific PGA value, based on the 5th generation seismic hazard maps published by the GSC is as follows.

Seismic Hazard Values (Site Class C)	2% Exceedance in 50 years (2,475 years return period)
PGA (g)	0.146

6.4 Culvert Replacement Options

Although it is recognized that the CV02/03 culvert replacement is planned to consist of cast-in-place box culverts, this section of the report presents advantages, disadvantages and geotechnical recommendations for both cast-in-place and pre-cast box culvert replacement, as well as for open footing culvert replacement alternatives.

Either a box culvert or open footing (shallow foundation) concrete culvert is feasible for the replacement of the existing culvert. Deep foundations are not required at this site, as the founding stratum for shallow foundations for an open footing culvert or for the concrete base slab for a box culvert will provide sufficient bearing resistance and acceptable settlement performance. Both pre-cast concrete elements (box culvert segments or footing elements) and cast-in-place concrete elements are feasible from a foundations perspective. Pre-cast culverts are frequently quicker to install and, therefore, could pose less disruption to traffic; however, cast-in-place work is expected to be required to tie the replacement culverts into the existing culvert to the north and south.

A summary of the advantages and disadvantages associated with each option is provided below, and a comparison of the alternative culvert type/foundation options based on advantages, disadvantages and risk consequences and relative costs is provided in Table 1 following the text of this report.

- **Cast-in-place or pre-cast concrete box culvert founded on shale bedrock:** A box culvert on granular bedding (for pre-cast elements) or founded directly on the shale bedrock (for cast-in-place elements) is considered feasible for the culvert replacement. Based on the proposed invert elevations noted in Section 6.1, excavation into the bedrock up to about 0.9 m to 1.5 m deep may be required, depending on the surface of the bedrock across the proposed culvert alignment footprint; this excavation depth accounts for the concrete base slab thickness as well as the granular bedding layer where applicable. Near the downstream end in the vicinity of Borehole CV02/03-3, existing loose to compact fill was encountered to below the proposed culvert invert elevation; due to the potential for variability in the fill, the potential presence of organic materials if this area represents the former creek channel, and the planned grade raise associated with ramp realignment in this area, it is recommended that where encountered this fill be subexcavated up to 2 m to the bedrock surface and backfilled with suitable granular material to the founding level. Temporary protection systems would be required during excavation and construction.
- **Cast-in-place or pre-cast open footing culvert founded on shale bedrock:** An open footing culvert founded on/within the shale bedrock is considered feasible for the culvert replacement. Based on the proposed invert elevations, excavations of up to about 1.4 m to 2.5 m into the bedrock will be required to provide adequate frost protection. At the downstream end, by Borehole CV02/03-3, loose fill was encountered within the founding elevation and excavation of up to about 2 m deep will be required to found the footings on the shale bedrock or on engineered granular fill following subexcavation to the shale surface. As for the box culvert option, temporary protection systems would be required during excavation and construction.

Based on the above considerations, the preferred option from a geotechnical/foundations perspective is to replace the existing culvert with either cast-in-place concrete box culverts founded on the shale bedrock or pre-cast concrete box culverts founded on granular bedding on the shale bedrock or locally on granular backfill placed following subexcavation to the bedrock.

6.5 Concrete Box Culvert

6.5.1 Frost Protection

It is not necessary to found box culverts at the standard depth for frost protection purposes, as the box structure is fully buried and the sections are tolerant of small magnitudes of movement related to freeze-thaw cycles, should these occur. The box culvert should, however, be founded below or following subexcavation of any existing loose fill or alluvium/organic material and following cleaning of loosened/highly fractured shale material.

6.5.2 Founding Elevations and Concrete Working Slab/Bedding Requirements

It is understood that the replacement culvert will be founded to match the existing culvert invert at Elevations 101.3 m and 99.8 m on the upstream and downstream ends, respectively. The new culvert will therefore be founded on a thin layer of granular bedding or a concrete working slab placed on the shale bedrock surface, below any embankment fill, and soft or loose soils. Near the downstream end, up to approximately 2 m of subexcavation of the existing loose to compact silt and sand fill to the bedrock surface will be required, and will need to be replaced with suitable granular material such as OPSS.PROV 1010 (*Aggregates*) Granular ‘A’ or Granular ‘B’ Type II, that is placed and compacted in accordance with the requirements OPSS.PROV 501 (*Compacting*).

The shale bedrock subgrade will be susceptible to disturbance and degradation on exposure to water and construction traffic. To protect the subgrade from such degradation, the following measures are recommended:

- **For cast-in-place culverts:** A 100 mm thick, 20 MPa concrete working slab should be placed on the subgrade within the culvert footprint. The cast-in-place box culverts can then be formed directly on top of the working slab; no granular bedding or levelling layer is required for cast-in-place culvert construction. The requirements for the concrete working slab are provided in Section 6.10.4 and a Non-Standard Special Provision (NSSP) is provided in Appendix D.
- **For pre-cast culverts:** The bedding and/or leveling pad requirements should be in accordance with OPSS 422 *(Precast Reinforced Concrete Box Culverts and Box Sewers in Open Cut)*. It is recommended that pre-cast box culvert segments be placed on a minimum thickness of 300 mm of granular bedding material meeting OPSS.PROV 1010 *(Aggregates)* Granular A or Granular B Type II. Alternatively, a concrete working slab could be placed on the subgrade within the culvert footprint, covered by a levelling layer of 75 mm of OPSS.PROV 1010 (*Aggregates*) Granular 'A' or concrete fine aggregate meeting the gradation requirements set out in OPSS.PROV 1002 *(Aggregates - Concrete)*.

Groundwater and/or surface water control will be required during the excavation operations and construction of box culvert replacement. It is assumed that the existing culvert will remain in place until the new culvert has been constructed and that surface water conveyed by the existing culvert will bypass the new construction area. Groundwater seepage from the sand deposits and from the clayey silt residual soil deposit into the excavation is expected to be relatively minor and should be able to be controlled by pumping from properly filtered sumps. As discussed further in Section 6.10, it is recommended that an NSSP be included in the Contract Documents to address groundwater control requirements for the culvert replacement.

The box culvert subgrade should be inspected by qualified geotechnical personnel following excavation to confirm that all existing fill, surficial organic soils, loose/fractured bedrock or other unsuitable material have been removed, in accordance with OPSS 422 (*Box Culverts and Box Sewers in Open Cut*) for pre-cast culverts, and OPSS.PROV 902 (*Excavating and Backfilling Structures*) for cast-in-place culverts.

6.5.3 Factored Geotechnical Resistances

For a box culvert between the QEW and the W-N/S Ramp, founded at the elevations provided in Section 6.5.2 on the shale bedrock or compacted granular backfill/bedding layer, the following factored ultimate geotechnical resistances and factored serviceability geotechnical resistances (for 25 mm of settlement) may be used for design:

Culvert Span	Founding Material	Factored Ultimate Geotechnical Resistance (kPa)	Factored Serviceability Geotechnical Resistance (kPa) for 25 mm of Settlement	Factored Serviceability Geotechnical Resistance (kPa) for 10 mm of Settlement
3.5 (Each)	Shale Bedrock	450	650	260
	Compacted Granular Fill Over Shale	400	500	200

The factored ultimate and factored serviceability geotechnical resistances are dependent on the culvert dimensions and founding elevation and as such, the geotechnical resistances should be reviewed if the culvert dimensions or founding elevation differs from those provided and outlined in Sections 6.1 and 6.5.1.

The factored ultimate geotechnical resistance provided above is based on loading applied perpendicular to the top surface of the culvert. Where the load is not applied perpendicular to the top surface of the culvert, inclination of the load should be taken into account in accordance with Section 6.10.2 of the *Commentary to the CHBDC (2019)*.

6.5.4 Resistance to Lateral Loads/Sliding Resistance

Resistance to lateral forces/sliding resistance between the base slab for the box culvert and the subgrade should be calculated in accordance with Section 6.10.4 of the CHBDC (2019). The following unfactored coefficients of friction may be used:

Founding Material	Unfactored Coefficient of Friction
Cast-in-place concrete box culvert on concrete working slab	tan δ = 0.7
Concrete working slab on shale bedrock	tan δ = 0.7
Pre-cast concrete box culvert on compacted granular bedding	tan δ = 0.4
Compacted granular bedding on shale bedrock	tan ϕ' = 0.7

6.6 Rigid Frame Open Footing Culvert

6.6.1 Founding Elevations

A frost penetration depth of 1.2 m applies per Ontario Provincial Standard Drawing (OPSD) 3090.101 *(Foundation Frost Depths for Southern Ontario).* The open footing founding elevation would therefore be at about Elevation 100.1 m to 98.6 m from the upstream to the downstream ends, respectively. Near the downstream end of the culvert, by Borehole CV02/03-3, additional subexcavation of the existing loose fill material will be required to found the footings on the shale bedrock at approximately Elevation 98.3 m as discussed below.

The shale bedrock subgrade will be susceptible to disturbance and degradation on exposure to water and construction traffic. Where open footing culverts are adopted, it is recommended that a concrete working slab be placed within four hours following inspection and approval of the subgrade, to protect the subgrade from softening. An NSSP for working slab is included in Appendix D for inclusion in the Contract Documents.

The footing subgrade should be inspected by qualified geotechnical personnel following excavation, in accordance with OPSS 902 (*Excavating and Backfilling Structures*), to check that all existing fill, loose/fractured bedrock and/or other unsuitable material have been removed. Where subexcavation of fill is required near the southern (outlet) end of the culvert, the sub-excavated area could be backfilled with granular material meeting OPSS.PROV 1010 (*Aggregates*) Granular 'A' or Granular 'B' Type II that is placed and compacted in accordance with OPSS.PROV 501 (*Compacting*), or the thickness of the footing increased to the full excavation depth.

6.6.2 Factored Geotechnical Resistance

Strip footings placed on the properly prepared shale bedrock subgrade should be designed based on the following factored ultimate geotechnical resistance and serviceability geotechnical resistance (for 25 mm of settlement):

Footing Width (m)	Founding Material	Factored Ultimate Geotechnical Resistance (kPa)	Factored Serviceability Geotechnical Resistance(kPa) (for 15 mm of Settlement)
0.6 to 1.2	Shale Bedrock	325	300
	Compacted Granular Backfill	250	300

The structural engineer must verify that the selected footing width is sufficient to resist overturning. The factored ultimate and factored serviceability geotechnical resistances are dependent on the culvert footing and founding elevation and as such, the geotechnical resistances should be reviewed if the footing width is greater than the width specified above or the founding elevation differs from that given in Section 6.6.1.

The factored ultimate geotechnical resistance provided is based on loading applied perpendicular to the surface of the footings. Where the load is not applied perpendicular to the surface of the footings, inclination of the load should be taken into account in accordance with Section 6.10.2 of the *Commentary to the CHBDC (2019)*.

6.6.3 Resistance to Lateral Loads / Sliding Resistance

Resistance to lateral forces / sliding resistance between the base of the concrete footings and the subgrade should be calculated in accordance with Section 6.10.4 of the CHBDC (2019). The following unfactored coefficients of friction may be used:

Founding Material	Unfactored Coefficient of Friction
Cast-in-place concrete footing or working slab on shale bedrock	tan δ = 0.7
Cast-in-place concrete footing or working slab on compacted granular fill	tan ϕ' = 0.7

6.7 Lateral Earth Pressures for Design

The lateral earth pressures acting on the culvert walls will depend on the type and method of placement of the backfill material, the nature of the soils/embankment fill 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. 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 meeting the specifications of OPSS.PROV 1010 (*Aggregates*) Granular 'A' or Granular 'B' Type II should be used as backfill behind the culvert walls, and on top of the culvert for a thickness of not less than 300 mm. Granular 'B' Type III can be used if the excavation is dry. Backfill should be placed in a maximum of 200 mm loose lift thickness and nominally compacted. Compaction (including type of equipment, target densities, etc.) should be carried out in accordance with OPSS.PROV 501 (*Compacting*), as amended by SP 105S22.

- A minimum compaction surcharge of 12 kPa should be included in the lateral earth pressures for the structural design of the walls, in accordance with CHBDC (2019) Section 6.12.3 and Figure 6.8. Care must be taken during the compaction operation not to overstress the wall. Heavy construction equipment should be maintained at a distance of at least 1 m away from the walls while the backfill soils are being placed. Hand-operated compaction equipment should be used to compact the backfill soils within a 1 m wide zone adjacent to the walls. Other surcharge loadings should be accounted for in the design, as required.
- For restrained walls, granular fill should be placed in a zone with the width equal to at least 1.2 m behind the back of the wall (Figure C6.31(a) of the *Commentary to the CHBDC (2019)*.). For unrestrained walls, fill should be placed within the wedge-shaped zone defined by a line drawn flatter than 1 horizontal to 1 vertical (1H:1V) extending up and back from the rear face of the base of the walls (Figure C6.31(b) of the *Commentary to the CHBDC (2019)*.

6.7.1 Static Lateral Earth Pressures for Design

The following recommendations are provided regarding the lateral earth pressures for static (i.e., not earthquake) loading conditions.

- For restrained walls, the pressures are based on the soil strata adjacent to the culvert and the following parameters (unfactored) may be used assuming the use of earth fill or existing native materials:

Material	Earth Fill or Existing Native Materials
Soil Unit Weight:	20 kN/m^3
Coefficients of static lateral earth pressure: Active, Ka At rest, Ko	 0.33 0.50

- For unrestrained walls, the pressures are based on using engineered granular fill behind the walls and the following parameters (unfactored) may be used:

Material	Granular A	Granular B Type II	Granular B Type III
Soil Unit Weight:	22 kN/m^3	21 kN/m^3	21 kN/m^3
Coefficients of static lateral earth pressure: Active, Ka At rest, Ko	 0.27 0.43	 0.27 0.43	 0.33 0.50

If the culvert structure does not allow lateral yielding, at-rest earth pressures should be assumed for the foundation design. If the culvert structure allows for lateral yielding, active earth pressures should be used in the foundation 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 C6.12.1 and Table C6.12 of the *Commentary to the CHBDC (2019).*

6.7.2 Seismic Lateral Earth Pressures for Design

Seismic (earthquake) loading must be taken into account in the design in accordance with Section 4.6 of the CHBDC (2019). In this regard, the following should be included in the assessment of lateral earth pressures:

- Seismic loading will result in increased lateral earth pressures acting on the culvert walls. The walls should be designed to withstand the combined lateral loading for the appropriate static pressure conditions given in Section 6.4.1, above, plus the earthquake-induced dynamic earth pressure.
- In accordance with Sections 4.6 and C.4.6 of the *Commentary to the CHBDC (2019)*, for structures which do not allow lateral yielding, the horizontal seismic coefficient (k_h) used in the calculation of the seismic active pressure coefficient is taken as 1.0 times the PGA. For structures which allow lateral yielding, (k_h) is taken as 0.5 times the PGA.
- The following seismic active pressure coefficients (K_{AE}) for the two backfill cases (restrained and unrestrained walls) may be used in design. It should be noted that these seismic earth pressure coefficients assume that the back of the culvert walls is vertical and the ground surface behind the wall is flat. Where sloping backfill is present above the top of the wall, the lateral earth pressures under seismic loading conditions should be calculated by treating the weight of the backfill located above the top of the wall as a surcharge.
- Seismic Active Pressure Coefficients, K_{AE}

Wall Type	Design Earthquake	Site PGA	KAE for Granular A	KAE for Granular B Type II	KAE for Earth Fill or Existing Native Materials
Yielding Wall	2,475-Yr	0.146	0.29	0.29	0.35
Non-Yielding Wall	2,475-Yr	0.146	0.34	0.34	0.40

The earthquake-induced dynamic pressure distribution, which is to be added to the static earth pressure distribution, is a linear distribution with maximum pressure at the top of the wall and minimum pressure at its toe (i.e., an inverted triangular pressure distribution).

6.8 Culvert Backfill and Erosion Protection

For a pre-cast box culvert replacement, the bedding, levelling pad, backfill and clay seal requirements should be in accordance with OPSS 422 *(Box Culverts and Box Sewers in Open Cut).* It is recommended that pre-cast elements be provided with at least 300 mm of OPSS.PROV 1010 (*Aggregates*) Granular 'A' material for bedding purposes.

For a cast-in-place box culvert replacement, the backfill and clay seal requirements should be in accordance with OPSS.PROV 902 (*Excavating and Backfilling Structures*).

Backfill and cover for the concrete culvert should be completed similar to OPSD 803.010 *(Backfill and Cover for Concrete Culverts)*. Backfill to culvert walls should consist of granular fill meeting the requirements of OPSS.PROV 1010 (*Aggregates*) Granular 'A' or Granular 'B' Type II. The backfill and bedding should be placed and compacted in accordance with OPSS.PROV 501 (*Compacting*), as amended by SP 105S22. The culvert replacement should be designed for the full overburden pressure and live load, assuming that the embankment fill has a unit weight of 22 kN/m^3 for Granular A, and 21 kN/m^3 for OPSS.PROV 1010 (*Aggregates*) Granular 'B' Type II or Select Subgrade Material, or earth fill, meeting the requirements of OPSS.PROV 212 (*Earth Borrow*) above and/or surrounding the culvert.

To prevent surface water from flowing either beneath the culvert, potentially causing undermining and scouring, or around the culvert, creating seepage through the embankment fill and potentially causing erosion and loss of fine soil particles, a clay seal or concrete cut-off wall is recommended at the upstream and downstream end of the culvert. If a clay seal is adopted, the clay material should meet the requirements of OPSS.PROV 1205 (*Clay Seal*), and the seal should extend from a depth of 1 m below the scour level to a minimum horizontal distance of 2 m on either side of the culvert inlet opening, and a minimum vertical height equivalent to the high water level including along the embankment slope.

Provision should also be made for scour and erosion protection at the culvert inlet and outlet. The requirements for and design of erosion protection measures for the inlet and outlet of the culvert should be assessed by the hydraulic design engineer. However, as a minimum rip-rap treatment for the outlet of the culvert should be consistent with the standard presented in OPSD 810.010 (*Rip-Rap Treatment*) using OPSS.PROV 1004 (*Aggregates – Miscellaneous*) R-10 or R-50 size rip-rap material as may be required based on the hydraulic and geomorphologic design. Erosion protection for the inlet of the culverts should also follow the standard presented in OPSD 810.010 (*Rip-Rap Treatment*) similar to the outlet, but with the rip-rap placed up to the high water level or to the retaining walls, in combination with the cut-off measures noted above.

6.9 Analytical Testing of Construction Materials

The results of analytical tests carried out on one soil sample and one rock sample are presented in Section 4.2.8 and on the Certificate of Analysis in Appendix C. The analytical test results were compared to CSA A23.1 Table 3 (*Additional requirements for concrete subjected to sulphate attack*) to assess the potential severity of sulphate attack on concrete during its service life. The sulphate concentrations measured on the samples range from less than 0.002% to 0.025%, which indicates a less than Moderate degree of exposure (i.e., below the class S3 exposure limits) and may be considered negligible according to Table 7.2 of MTO's *Gravity Pipe Design Guidelines* (2014). Therefore, based on the samples tested, when the designer is selecting the exposure class for the concrete structure, the effects of sulphates from within the site soils and bedrock in contact with any portion of the proposed structure constructed below the ground surface may not need to be considered. However, given that the proposed structure will be exposed to de-icing salt/chemicals, consideration should also be given by the designer to designing the concrete structure for a "C" type exposure class as defined by CSA A23.1 Table 1.

The pH measured on the samples range from about 7.4 to about 8.0, which is not considered to be detrimental to culvert durability as it is less than a pH of 8.5 according to the MTO *Gravity Pipe Design Guidelines* (2014). The resistivity measured in the two samples range from 1,500 ohm-cm to 3,800 ohm-cm which indicates that the soil corrosiveness is moderate (4,500 > R > 2,000) to severe (2,000 > R) as per Table 3.2 of the MTO *Gravity Pipe Design Guideline* (2014).

These recommendations are provided as guidance only; the structural designer should take the results of the laboratory testing, the potential for corrosion and the corrosion susceptibility of materials to be used in construction of the structure foundations in Table 7.1 of the MTO *Gravity Pipe Design Guideline* (2014) into consideration of the ultimate selection of materials. Ultimately, it is the designer's decision to determine the appropriate exposure class and to ensure that all aspects of CSA A23.1 Section 4.1.1 (Durability Requirements) are satisfied.

6.10 Construction Considerations

6.10.1 Surface Water and Groundwater Control

Control of the surface water and groundwater will be necessary for the construction of the culvert replacement, to allow excavation and foundation construction to be carried out in dry conditions.

As the replacement culvert will be reconstructed to the west, creek flows can be maintained in the existing culvert during construction with cofferdams or diversions as necessary during connections at the inlet and outlet. Precipitation runoff in the construction area should be directed away from the excavation areas, to prevent ponding of water that could result in disturbance and weakening of the shale bedrock subgrade or granular backfill/bedding material.

Excavations that extend below the groundwater level, as anticipated at the culvert site, will require groundwater control measures to ensure the new culvert (including subexcavation, backfill and granular bedding placement) can be completed in dry and stable conditions. Control of water from dewatering operations should be carried out in accordance with OPSS.PROV 517 (*Dewatering*), as modified by the Special Provision (SP) 517F01 (*Dewatering System, Temporary Flow Passage System*) recommending that a design engineer carry out the design, including the fill-in section of the Special Provision. Additionally, reference should be made to OPSS 902 (*Excavation for Structure*), as amended by Special Provision (SP) FOUN0003 as required; a copy of SP FOUN0003 for inclusion in the Contract Documents is provided in Appendix D. It is noted that the hydraulic engineer / designer will need to fill in the data for “return period” and the “survey distance” in this SP.

6.10.2 Excavation and Temporary Protection Systems

Temporary excavations for the culvert replacement will be made through the existing fill, sandy silt to silty sand to sand deposit and clayey silt residual soil deposit (where present), and will terminate on/into the shale bedrock. Excavation works must be carried out in accordance with the guidelines outlined in the Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects. The existing fill would be classified as Type 3 soil, while the native deposit would be classified as a Type 2 soil, according to the OHSA. Temporary excavations (i.e., those that are open for a relatively short time period) should be made with side slopes no steeper than 1 horizontal to 1 vertical (1H:1V).

It is understood that approximately 6 m high temporary protection systems will be required for the culvert replacement works, installed parallel to QEW between stages to maintain traffic on QEW, and potentially installed along the culvert alignment to facilitate foundation excavation, although trench boxes in combination with partial open-cut excavations may be feasible as part of the construction staging. The temporary excavation support systems for the culvert replacement works should be designed and constructed in accordance with OPSS.PROV 539 *(Temporary Protection Systems),* as amended by SP 105S09. The lateral movement of the temporary shoring system should meet Performance Level 2 as specified in OPSS.PROV 539 *(Temporary Protection Systems),* provided that any adjacent utilities can tolerate this magnitude of deformation.

It is considered that either a driven, interlocking sheetpile system or a soldier pile and timber lagging system would be suitable for the roadway protection, based on the subsurface soil and groundwater conditions. An interlocking sheetpile system would contribute to both ground and groundwater/surface water control, which is considered to be advantageous for this site but cannot be keyed into the bedrock. The sheetpiles or soldier piles would have to be socketed to sufficient depth to provide the necessary passive resistance for the retained soil height of up to approximately 5 m. Lateral support to the sheetpiles or soldier piles could be provided in the form of struts or temporary anchors.

While the selection and design of the temporary protection system will be the responsibility of the contractor, the following information is provided to MTO and its designers to aid in assessment of the approximate construction costs during detail design.

Soil Type	Unit Weight	Internal Angle of Friction	Undrained Shear Strength	Coefficient of Lateral Earth Pressure		
	(kN/m^3)	(Degrees)	(kPa)	Active, Ka	At Rest, Ko	Passive, Kp
Loose to Compact Silt and Sand to Sand and Gravel Fill	19	28	--	0.36	0.53	2.77
Very Stiff Clayey Silt Fill	19	28	100	0.36	0.53	2.77
Loose to Compact Sandy Silt to Sand	20	30	--	0.33	0.50	3.00
Stiff Clayey Silt (Residual Soil)	22	32	100	0.31	0.47	3.25
Highly to Moderately Weathered Shale Bedrock	26	40	--	0.22	0.36	4.60

Notes:
1) The lateral earth pressure coefficients presented above are based on a horizontal surface adjacent to the excavation. If sloped surfaces are expected, the coefficients showed need to be corrected accordingly.
2) The total passive resistance below the base of the excavation (i.e., within the shored excavation and / or adjacent to the temporary protection system, may be calculated based on the value of K_p indicated above but reduced by an appropriate factor that considers the allowable wall movement in accordance with Figure C6:16 of the CHBDC (2019) to account for the fact that a large strain would be required for mobilization of the full passive resistance.

It should be noted that the pressure distributions given above are the minimum for the ultimate stress condition a stiffer design may be required than predicted by these distributions in order to maintain displacements within an acceptable range. In addition, the earth pressure coefficients provided above are based on a horizontal surface adjacent to the top of the excavation; if sloped surfaces are present, the coefficient of earth pressure should be adjusted accordingly.

If a watertight shoring system is selected or if the backfill materials behind lagging will not allow drainage, the shoring designer will also need to account for hydrostatic pressures. Depending on the time of year, there may be perched water in the fill materials. If groundwater is present it would be necessary to control seepage or include measures to mitigate loss of soil particles through lagging boards if a soldier pile and lagging system is employed. For all excavations with groundwater seepage, the formation of ice on the shaft walls should be expected during the winter months. The accumulation of ice on the walls should be closely monitored and periodic removal will be required to prevent ice from falling into the excavation and endangering workers in the shaft.

6.10.3 Bedrock Excavation

Bedrock excavation will be required to reach the design founding level for the culvert replacement, especially if an open footing culvert is selected as the replacement structure. Bedrock excavation would likely be carried out using ripping and hoe-ramming techniques. The completely to highly weathered shale should be considered analogous to a soil behaviour that would fall under the general characteristics of Soil Type 2; however, given the variable nature of this material, the soil behaviour type and its relation to excavation support must be examined and judged for each exposure during construction. Temporary excavations into the moderately weathered shale bedrock can

be made near vertical; however, the moderately weathered shale bedrock represents a transition between highly weathered and slightly weathered bedrock and, depending on the extent of weathering and the duration the excavation remains open, temporary protections system may be required to extend through this material.

The shale bedrock at the site is weak to excellent quality, and contains strong to very strong limestone interbeds. It is recommended that an NSSP be included in the Contract Documents to warn the Contractor of the bedrock characteristics, that excavation into the bedrock will require appropriate equipment and construction procedures, and that the bedrock excavation shall not disturb the existing culvert. An NSSP is provided in Appendix D for inclusion in the Contract Documents.

6.10.4 Bedrock Subgrade Inspection and Protection

The shale bedrock that will be exposed at the box culvert or open footing foundation subgrade level will be susceptible to weathering and/or disturbance from water and construction traffic. For pre-cast box culverts, a 300 mm thick layer of granular bedding can be used to protect the shale subgrade, as well as for bedding for the culvert segments. For cast-in-place box culverts or open footing culverts, to limit this degradation, it is recommended that a concrete working slab be placed on the subgrade within four hours after preparation, inspection and approval of the footing subgrade. This requirement can be addressed with a note on the General Arrangement drawing and/or with an NSSP (see Appendix D if applicable for inclusion in the Contract Documents).

6.10.5 Vibration Monitoring

Vibration monitoring and condition surveys are recommended during installation of temporary protection systems to confirm that construction techniques and associated vibration levels experienced at nearby structures and utilities are maintained below tolerable levels, and to mitigate potential claims from nearby property owners.

An example NSSP is provided in Appendix D based on the following maximum peak particle velocity (PPV) values:

- Utilities: 50 mm/s;
- Conventional commercial/industrial buildings: 50 mm/s; and,
- Residential homes and wells: 25 mm/s.

It is considered good practice to conduct vibration monitoring and pre- and post-construction condition surveys at existing structures within an approximately 100 m radius of any installation of deep foundations and/or temporary protection systems. In some cases, agencies may choose to expand the radius beyond that anticipated for attenuation of construction-induced vibrations.

7.0 CLOSURE

This report was prepared by Ms. Katie Nero, P.Eng. Ms. Lisa Coyne, P.Eng., a Principal and MTO Foundations Designated Contact for Golder, conducted a technical and quality control review of the report.

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Ontario Provincial Standard Specifications (OPSS)

OPSS 422	Construction Specification for Precast Reinforced Concrete Box Culverts and Box Sewers in Open Cut
OPSS.PROV 501	Construction Specification for Compacting
OPSS.PROV 517	Construction Specification for Dewatering
OPSS.PROV 539	Construction Specification for Temporary Protection Systems
OPSS.PROV 902	Construction Specification for Excavating and Backfilling Structures
OPSS.PROV 1002	Material Specification for Aggregates - Concrete
OPSS.PROV 1010	Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material
SP 105S22	Special Provision – Amendment to OPSS 501, Revised March 2018
SP 105S09	Special Provision – Amendment to OPSS 539, Revised August 2021
SP 517F01	Special Provision - Amendment to OPSS 517, Revised July 2017
FOUN0001	Special Provision – Working Slab
FOUN0003	Dewatering Structure Excavations

Ontario Provincial Standard Drawings (OPSD)

OPSD 803.010	Backfill and Cover for Concrete Culverts with Spans Less Than or Equal to 3.0 m
OPSD 3090.101	Foundation Frost Depths for Southern Ontario

Ontario Water Resources Act

Ontario Regulation 903 Wells (as amended)

Ontario Occupational Health and Safety Act

Ontario Regulation 213 Construction Projects (as amended)

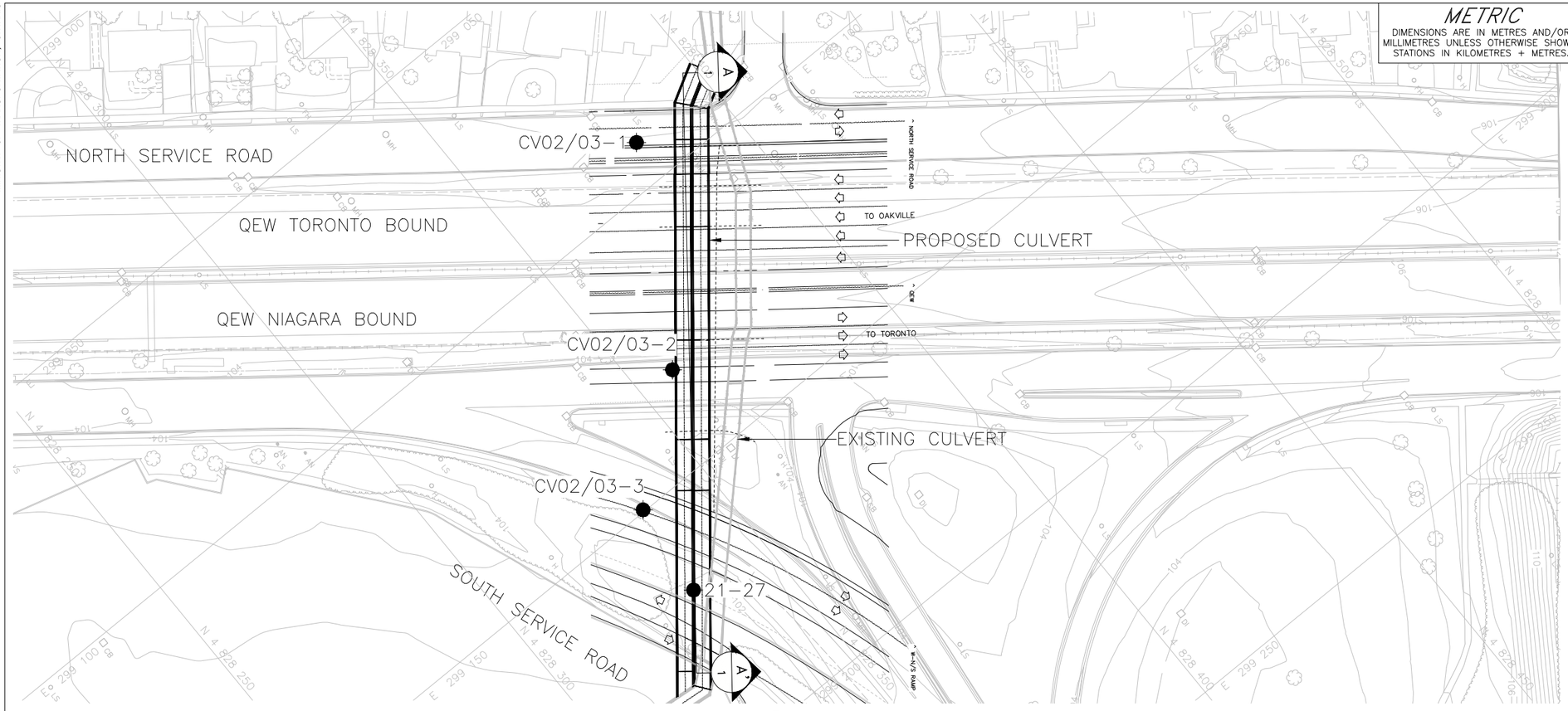
Table 1 - Comparison of Culvert Alternatives - Culvert CV02/03 Replacement

Option	Advantages	Disadvantages	Risks/Consequences including Relative Costs
Box culvert replacement	• Minimizes depth of excavation, excavation support and dewatering requirements, shorter duration for dewatering and surface water pumping compared to open footing option. • Pre-cast box sections generally allow for faster construction than cast-in-place open footings; however, cast-in-place sections likely required to tie into existing culvert north and south of replacement section. • Cast-in-place box culvert does not require the transportation of numerous box segments to site. • More tolerant of differential settlement than open footing culvert. • A box culvert would minimize the depth of excavation within the shale bedrock as the proposed culvert invert is at about the same elevation as the bedrock surface.	• Where excavation extends below the groundwater level, dewatering would still be required. • Transportation of numerous large pre-cast box segments to site, including via local roads, may be more onerous than local construction of open footing structure or cast-in-place box culverts. • Cast-in-place box culverts likely require a longer duration for construction, and surface water pumping, as compared with pre-cast culvert segments.	• Some risk of disturbance of the subgrade during construction; can be mitigated with appropriate groundwater control and use of a concrete working slab. • Limited risk related to settlement performance.

Option	Advantages	Disadvantages	Risks/Consequences including Relative Costs
Open footing culvert replacement	Would satisfy any fisheries requirements related to natural channel substrate, if applicable.	• Excavation depths are greater than for box culvert option, resulting in increased excavation support and possible dewatering requirements, as well as deeper excavation into the shale bedrock. • Cast-in-place footings likely require a longer duration for construction, and surface water pumping, as compared with pre-cast culvert segments. • Excavation into the shale bedrock likely required.	• Some risk of disturbance of the subgrade during construction; can be mitigated with appropriate groundwater control and use of a concrete working slab. Overall longer construction period potentially resulting in higher costs, including cost for bedrock surface preparation/excavation for footing construction.

DRAWINGS

MINISTRY OF TRANSPORTATION, ONTARIO



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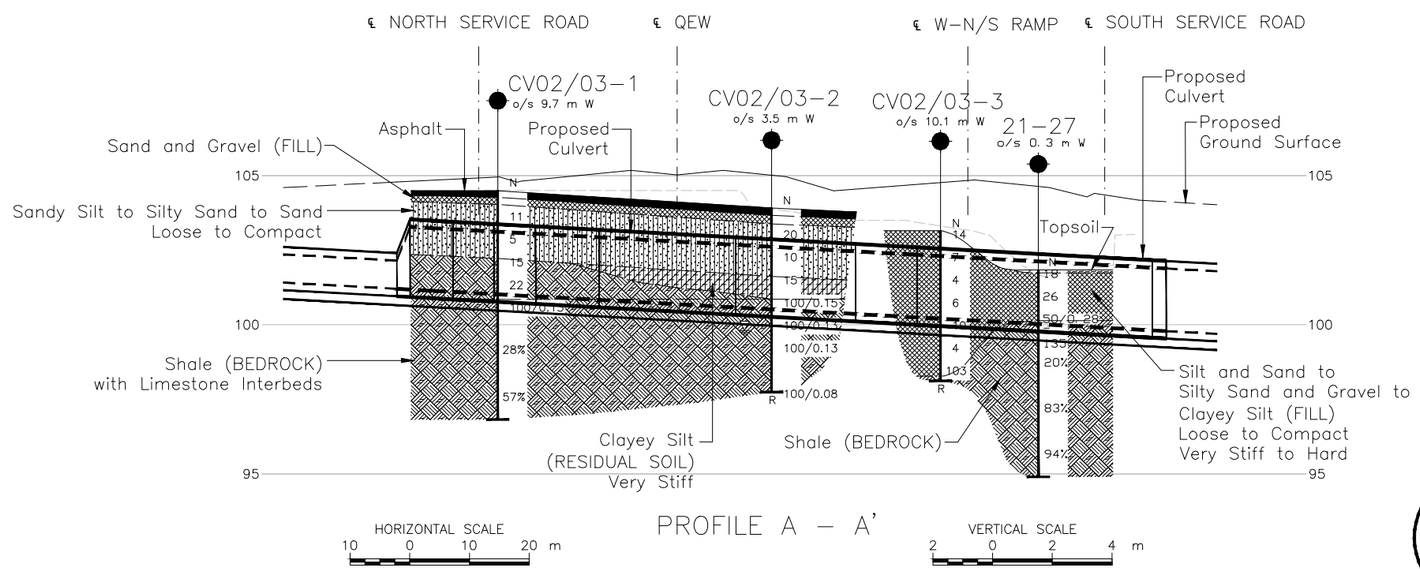
SCALE
10 0 10 20 m



PROFILE A – A'

HORIZONTAL SCALE
10 0 10 20 m

VERTICAL SCALE
2 0 2 4 m

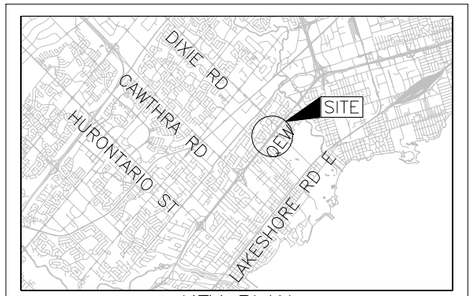
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2012-13-00 & 2432-13-00

CULVERT CV02/03 REPLACEMENT
QEW – CAWTHRA TO EAST MALL WIDENING
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

GOLDER
MEMBER OF WSP



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

●	Borehole
N	Standard Penetration Test Value
16	Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
100%	Rock Quality Designation (RQD)
▽	WL upon completion of drilling
R	Refusal

BOREHOLE CO-ORDINATES (MTM NAD ZONE 10)

No.	ELEVATION	NORTHING	EASTING
21-27	101.8	4828333.0	299168.6
CV02/03-1	104.5	4828381.4	299091.3
CV02/03-2	103.9	4828357.9	299131.5
CV02/03-3	103.2	4828335.4	299149.6

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

General arrangement plan profile and cross section provided in digital format by AECOM, drawing file no. QEW – WestofDixieRd_Culvert_GA.dwg, received July 13, 2021.
Base plans provided in digital format by AECOM, drawing file nos. QEW_DixieIC_base.dwg and QEW_DixieIC_plan.dwg, dated July 20, 2016, received Dec. 06, 2016.
Existing ground contours provided in digital format by AECOM, drawing file no. QEW_DixieIC_Contours3D.dwg, received Nov. 08, 2016, contour interval 0.5 m.
Key plan base data – MNRF LIO, obtained 2015.

LICENSED PROFESSIONAL ENGINEER
L.C. COYNE
Sept. 24, 2021
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. NERO
100538674
Sept. 24, 2021
PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 30M11-292

HWY. QEW		PROJECT NO. 1530382	DIST. CENTRAL
SUBM'D. NK	CHKD. KN	DATE: 09/24/2021	SITE: .
DRAWN: DD	CHKD. KN	APPD. LCC	DWG. 1

PLOT DATE: September 24, 2021
FILENAME: S:\Clients\MTO\QEW-DixieVIA_PRO\1530382\VIA_PROD\2012_Applewood_Geotechnical\1530382-2012-BC-0001.dwg

APPENDIX A

Borehole/Drillhole Records and Bedrock Core Photographs

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS
MINISTRY OF TRANSPORTATION, ONTARIO

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>200	>8
COBBLES	Not Applicable	75 to 200	3 to 8
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
FINES	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY COMPONENTS[1,2]

Percentage by Mass	Modifier
> 35	Use 'and' to combine primary and secondary component (*i.e.,* SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (*i.e.,* some sand)
≤ 10	trace (*i.e.,* trace fines)

1. Only applicable to components not described by Primary Group Name.
2. Classification of Primary Group Name based on Unified Soil Classification System (ASTM D2487) for coarse-grained soils; fine-grained soils described per current MTO Soil Classification System.

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.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)
An 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 (u) and sleeve friction (f_s) are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); 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, 60° 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

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC / SC	Rock core / Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample
OD / ID	Outer Diameter / Inner Diameter
HSA / SSA	Hollow-Stem Augers / Solid-Stem Augers

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , 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, Gs)
DS	direct shear test
GS	specific gravity
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 (FV)	field vane (LV-laboratory vane test)
γ	unit weight

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

COARSE-GRAINED SOILS

Compactness[1]

Term	SPT 'N' (blows/0.3m)[2]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

1. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.
2. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

FINE-GRAINED SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	< 12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	> 200	> 30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

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 $\gamma = \rho \cdot g$ (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 = $(w_l - w_p)$
NP	non-plastic
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
$C_{\alpha(e)}$	secondary compression index
C_α	rate of secondary compression
$C_{\alpha(\varepsilon)}$	modified 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
c′	effective cohesion
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
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 or 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

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING CLASSIFICATION

Fresh (W1): no visible sign of rock material weathering.

Slightly Weathered (W2): discoloration indicates weathering of rock mass material on discontinuity surfaces. **Less than 5%** of rock mass is altered or weathered.

Moderately Weathered (W3): less than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Highly Weathered (W4): more than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Completely Weathered (W5): 100% of the rock mass is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact.

Residual Soil (W6): all rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole, a discontinuity with a 90^{o} angle is horizontal.

Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

AXJ Axial Joint
BD Bedding
BC Broken Core
CC Continuous Core
CL Closed
CO Contact
CU Curved
CT Coated
FLT Fault
FOL Foliation
FR Fracture
GO Gouge
IN Infilled
IR Irregular
JN Joint
KV Karstic Void
K Slickensided
LC Lost Core
MB Mechanical Break
PL Planar
PO Polished
RO Rough
SA Slightly Altered
SH Shear
SM Smooth
SR Slightly Rough
SY Stylolite
UN Undulating
VN Vein
VR Very Rough

ISRM Intact Rock Material Strength Classification

Grade	Description	Approx. Range of Uniaxial Compressive Strength (MPa)
R0	Extremely weak rock	0.25 – 1.0
R1	Very weak rock	1.0 – 5.0
R2	Weak rock	5.0 – 25
R3	Medium strong rock	25 – 50
R4	Strong rock	50 -100
R5	Very strong rock	100 -250
R6	Extremely strong rock	>250

FIELD ESTIMATION OF ROCK HARDNESS

Grade	Description	Field Identification	Approx. Range of UCS (MPa)
R0	Extremely Weak Rock	Indented by thumbnail	0.25 - 1
R1	Very Weak Rock	Material can be peeled or shaped with a knife. Crumbles under firm blows from geological hammer.	1 - 5
R2	Weak Rock	Knife cuts material but too hard to shape into triaxial specimens or material can be peeled with a knife with difficulty. Shallow (<5mm) indentations made by firm blows from pick of a geological hammer.	5 - 25
R3	Moderately Strong Rock	Cannot be peeled or scraped with a knife. Hand held specimens can be fractured with single firm blow of geological hammer.	25 - 50
R4	Strong Rock	Hand held specimen requires more than one blow of geological hammer to fracture.	50 - 100
R5	Very Strong Rock	Hand held specimen requires many blows of geological hammer to fracture.	100 - 250
R6	Extremely Strong Rock	Specimen can only be chipped under repeated hammer blows, rings when hit.	> 250

Notes:

1. Hand held specimens should have height approximately 2 times the diameter.
2. Materials having a uniaxial compressive strength of less than approximately 0.5 MPa and cohesionless materials should be classified using soil classification systems.
3. Rocks with a uniaxial compressive strength below 25 MPa (i.e. below R2) are likely to yield highly ambiguous results under point load testing.

Reference:

Brown, 1981. "Suggested Methods for Rock Characterization Testing and Monitoring", International Society for Rock Mechanics.

Hoek, E., Kaiser, P.K., Bawden, W.F., 1995. "Support of Underground Excavations in Hard Rock", Balkema, Rotterdam.

ROCK WEATHERING CLASSIFICATION

Term	Symbol	Description	Discoloration Extent	Fracture Condition	Surface Characteristics
Residual soil	W6	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	Throughout	N/A	Resembles soil
Completely weathered	W5	100% of rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	Throughout	Filled with alteration minerals	Resembles soil
Highly weathered	W4	More than 50% of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.	Throughout	Filled with alteration minerals	Friable and possibly pitted
Moderately weathered	W3	Less than 50% of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones. Visible texture of the host rock still preserved. Surface planes are weathered (oxidized or carbonate filling) even when breaking the “intact rock”.	>20% of fracture spacing on both sides of fracture	Discoloured, may contain thick filling	Partial to complete discoloration, not friable except poorly cemented rocks
Slightly weathered	W2	Discoloration indicates weathering of rock material on discontinuity surfaces (usually oxidized). Less than 5% of rock mass altered.	<20% of fracture spacing on both sides of fracture	Discoloured, may contain thin filling	Partial discoloration
Fresh	W1	No visible sign of rock material weathering.	None	Closed or discoloured	Unchanged

Reference:

Brown, 1981. "Suggested Methods for Rock Characterization Testing and Monitoring", International Society for Rock Mechanics.

GOLDER

RECORD OF BOREHOLE No CV02/03-1 SHEET 1 OF 1 METRIC

PROJECT 1530382

G.W.P. 2102-13-00; 2432-13-00 LOCATION N 4828381.4; E 299091.3 MTM NAD 83 ZONE 10 (LAT. 43.595345; LONG. -79.570703) ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE CME 75, 108 mm O.D. Continuous Flight Solid Stem Augers COMPILED BY ACK

DATUM Geodetic DATE October 5, 2016 CHECKED BY SMM

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
104.5	GROUND SURFACE										
0.0 / 104.3	ASPHALT (150mm)										
104.0 / 0.5	Sand and gravel (FILL) Brown Moist										
	Sandy SILT to Silty SAND Loose to compact Brown Moist		1	SS	11		104				
			2	SS	5		103		○		0 72 24 4
102.2											
2.3	Inferred completely to moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		3	SS	15		102		○ —		2 25 57 16
			4	SS	22		101		○		
			5	SS	100/0.13						
100.0							100				
4.5	Moderately weathered Bedrock cored from depths of 4.5 m to 7.7 m. For bedrock coring details refer to Record of Drillhole CV02/3-1.		1	RC	REC 100%		99				RQD = 28%
			2	RC	REC 72%		98				RQD = 57%
96.8							97				
7.7	END OF BOREHOLE NOTE: 1. Open borehole dry upon completion of drilling and prior to rock coring.										

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

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PROJECT: 1530382

RECORD OF DRILLHOLE: CV02/03-1

SHEET 1 OF 1

LOCATION: N 4828381.4 ;E 299091.3

DRILLING DATE: October 5, 2016

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75 (Truck Mounted)

DRILLING CONTRACTOR: Davis Drilling Ltd.

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: Jr	DISCONTINUITY DATA: Ja	ROCK STRENGTH INDEX	WEATHERING INDEX	FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION
		Continued from Record of Borehole CV02/3-1		99.99															
5	Casing NW; Rotary Drill NQ Core	Moderately weathered, very thinly laminated, grey, fine grained, non-porous, weak SHALE with strong limestone interbeds [Georgian Bay Formation] - For broken cores, clay seams, limestone layers and lost cores refer to features column and legend		4.52	1							CO,CU,RO BD,PL,SM BD,PL,SM CO,UN,SM JN,IR,RO PC, Cl+Br CO,IR,SM BD,IR,RO PC, Cl BD,UN,RO CC, Cl BD,UN,SM BD,PL,SM BD,PL,SM CC, Cl BD,IR,RO BD,IR,SM						R1 R1 R1 R1 R1 R1
6												BD,PL,RO PC, Cl JN,UN,SM							
7					2							CO,PL,SM PC, Ml BD,IR,SM PC, Cl CO,UN,RO PC, Br BD,PL,SM PC, Cl CO,IR,RO PC, Ml CO,UN,SM						R1 R1 R1	UCS = 17.6 MPa
				96.82															
		END OF DRILLHOLE		7.69															
8																			
9																			
10																			
11																			
12																			
13																			

FEATURES LEGEND

BROKEN CORE; CLAY SEAM; LIMESTONE; LOST CORE

DEPTH SCALE

1 : 50

GOLDER

LOGGED: PKS

CHECKED: CEC/AB

GTA-RCK 054 S:\CLIENTS\MTO\CEW-DIXIE\02_DATA\GINT\CEW-DIXIE.GPJ GAL-MISS.GDT 19-5-27

GOLDER

RECORD OF BOREHOLE No CV02/03-2 SHEET 1 OF 1 METRIC

PROJECT 1530382
G.W.P. 2102-13-00; 2432-13-00
LOCATION N 4828357.9; E 299131.5 MTM NAD 83 ZONE 10 (LAT. 43.595134; LONG. -79.570206)
ORIGINATED BY PKS
DIST Central HWY QEW
BOREHOLE TYPE CME 75, 108 mm O.D. Continuous Flight Solid Stem Augers
COMPILED BY ACK
DATUM Geodetic
DATE October 4, 2016
CHECKED BY SMM

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
103.9	GROUND SURFACE										
0.0 / 103.7	ASPHALT (230mm)										
0.2 / 103.4	Sand and gravel (FILL) Brown Moist										
0.5	SAND, some silt, trace gravel Compact Brown Moist		1	SS	20		103		○		3 81 13 3
			2	SS	10		102		○		
101.6											
2.3 / 100.8	CLAYEY SILT, some sand, containing trace shale fragments (RESIDUAL SOIL) Very stiff Grey Moist		3	SS	15		101		○		
3.1	Inferred moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation) - Auger grinding at depths of 3.7 m, 4.7 m, and 5.5 m		4	SS	100/0.15						
			5	SS	100/0.13	▽	100				
			6	SS	100/0.13		99				
97.7			7	SS	100/0.08		98				
6.2	END OF BOREHOLE										

NOTE:

1. Water level in open borehole at a depth of 4.1 m below ground surface (Elev. 99.8 m) upon completion of drilling.

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

GTA-MTO 001 S:\CLIENTS\MTO\QEW-DIXIE\02_DATA\GINT\QEW-DIXIE.GPJ GAL-GTA.GDT 19-5-27

GOLDER

RECORD OF BOREHOLE No CV02/03-3 SHEET 1 OF 1 METRIC

PROJECT 1530382
G.W.P. 2102-13-00; 2432-13-00
LOCATION N 4828335.4; E 299149.6 MTM NAD 83 ZONE 10 (LAT. 43.594932; LONG. -79.569981)
ORIGINATED BY PKS
DIST Central HWY QEW
BOREHOLE TYPE CME 75, 108 mm O.D. Continuous Flight Solid Stem Augers
COMPILED BY ACK
DATUM Geodetic
DATE October 17, 2016
CHECKED BY SMM

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
103.2	GROUND SURFACE										
0.0	Silt and sand, trace to some clay, trace gravel to silty sand and gravel (FILL) Loose to compact Brown Moist		1	SS	14		103		○		
			2	SS	7		102		○		
			3	SS	4				○		
			4	SS	6		101		○		4 54 35 7
			5	SS	10		100		○		
	- Wet below a depth of 3.8 m		6	SS	4		99		○		
98.3			7	SS	103				○		
	Inferred highly weathered, grey SHALE (BEDROCK) (Georgian Bay Formation)										
5.0	END OF BOREHOLE										

NOTE:

1. Water level not measured upon completion of drilling. Wet soil below a depth of 3.8 m (Elev. 99.4 m).

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

GTA-MTO 001 S:\CLIENTS\MTO\QEW-DIXIE\02_DATA\GINT\QEW-DIXIE.GPJ GAL-GTA.GDT 19-5-27

GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No 21-27

SHEET 1 OF 1 **METRIC**

PROJECT 1530382
G.W.P. 2102-13-00; 2432-13-00
LOCATION N 4828333.0; E 299168.6 MTM NAD 83 ZONE 10 (LAT. 43.594919; LONG. -79.569749)
ORIGINATED BY AM
DIST Central HWY QEW
BOREHOLE TYPE Geoprobe 6620DT
COMPILED BY ML/KN
DATUM Geodetic
DATE June 18, 2021
CHECKED BY KN

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
101.8	GROUND SURFACE										
0.0	TOPSOIL (100 mm)		1A								
0.1	CLAYEY SILT (CL), trace to some sand, trace gravel (FILL) Very stiff to hard Grey to brown		1B	SS	18				○		
			2	SS	26		101		○		
100.1			3	SS	50/0.28				○		
1.7	Inferred moderately to highly weathered SHALE (BEDROCK) Grey		4	AS	-		100				
99.5											
2.3	SHALE (BEDROCK) Bedrock cored from depths of 2.3 m to 6.9 m (Elev. 99.5 m to 94.9 m). For bedrock coring details refer to Record of Drillhole 21-27.		5	SS	135		99				
			1	RC	REC 73%						RQD = 20%
			2	RC	REC 100%		98				RQD = 83%
							97				
			3	RC	REC 100%		96				RQD = 94%
94.9							95				
6.9	END OF BOREHOLE NOTE: 1. Borehole open and dry prior to bedrock coring.										

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

GTA-MTO 001 S:\CLIENTS\MTO\QEW-DIXIE\02_DATA\GINT\QEW-DIXIE.GPJ GAL-GTA.GDT 9/1/21

PROJECT: 1530382

RECORD OF DRILLHOLE: 21-27

SHEET 1 OF 1

LOCATION: N 4828333.0 ;E 299168.6

DRILLING DATE: June 18, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Geoprobe 6620DT

DRILLING CONTRACTOR: Altech Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: Jr	DISCONTINUITY DATA: Ja	ROCK STRENGTH INDEX: R4	ROCK STRENGTH INDEX: R3	ROCK STRENGTH INDEX: R2	ROCK STRENGTH INDEX: R1	WEATHERING INDEX: W1	WEATHERING INDEX: W2	WEATHERING INDEX: W3	WEATHERING INDEX: W4	WEATHERING INDEX: W5	WEATHERING INDEX: W6	FEATURES	R0/R1 ZONES	NOTES WATER LEVELS INSTRUMENTATION
		Continued from Record of Borehole BH21-27		99.50																							
3		Slightly weathered, thinly bedded, weak SHALE		2.34	1							BD,IR,RO BD,IR,SM BD,CU,SM BD,PL,SM BD,PL,RO BD,PL,RO BD,PL,RO BD,PL,RO BD,PL,SM PL,CL BD,IR,SM CO,PL,SM	3 2 2 1 1.5 1 2 1 3 2 3 2 1.5	1 1 1 1 1 4 1 1 1 1 1 4 4											R0 R1
4					2							CO,ST,RO BD,IR,SM BD,IR,RO BD,IR,SM BD,PL,RO PC,CL BD,IR,SM BD,PL,RO BD,PL,SM PC,CL BD,IR,SM CO,IR,RO	PL,CL	2 2 1.5 1 2 1 3 3 1 1	1 1 1 4 1 4 1 1 4 1											
5												BD,PL,RO PC,CL BD,PL,SM BD,PL,SM BD,PL,RO BD,CU,RO BD,CU,SM PC,CL BD,ST,SM CC,CL BD,IR,SM		1 1 2 1.5 3 2 2 2 1 1.5	1 1 4 1 4 4 1 4 8 8 4 1											
6					3							CC,CL BD,IR,SM BD,PL,RO CC,CL BD,IR,RO BD,IR,RO CC,CL BD,PL,SM PC,CL BD,PL,SM	PC,CL	3 3 4 3 4 1 1	4 4 4 4 4 1 1											R1
7		END OF DRILLHOLE		94.90 6.94																							
8																											
9																											
10																											
11																											

FEATURES LEGEND

BROKEN CORE; CLAY SEAM; LIMESTONE; LOST CORE

DEPTH SCALE

1 : 50

GOLDER
MEMBER OF WSP

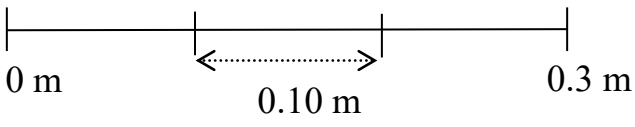
LOGGED:

CHECKED:

GTA-RCK 054 S:\CLIENTS\MTO\QEW-DIXIE\02_DATA\GINT\QEW-DIXIE.GPJ GAL-MISS.GDT 8/19/21

Borehole CV02/03-1: Bedrock cored between depths of about 4.52 m to 7.69 m

Scale



PROJECT

Culvert CV02/03 Replacement
QEW Widening from East Cawthra Road to the East Mall
Mississauga, Ontario

TITLE

BEDROCK CORE PHOTOGRAPHS
BOREHOLE CV02/03-1

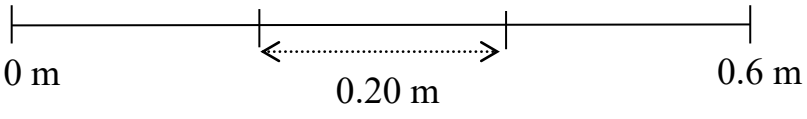
GOLDER

PROJECT No. 1530382			FILE No. ----		
DESIGN	KN	20210823	SCALE	NTS	VER. 1.
CADD	--	--			
CHECK	LCC	20210831	**FIGURE A1**		
REVIEW	LCC	20210831			

REVISION DATE: 20210819 BY: KN/ER Project: 1530382

Borehole 21-27: Bedrock cored between depths of about 2.34 m to 5.14 m

Scale



PROJECT

Culvert CV02/03 Replacement
QEW Widening from East Cawthra Road to the East Mall
Mississauga, Ontario

TITLE

BEDROCK CORE PHOTOGRAPHS
BOREHOLE 21-27

GOLDER

PROJECT No. 1530382			FILE No. ----		
DESIGN	KN	20210823	SCALE	NTS	VER. 1.
CADD	--	--			
CHECK	LCC	20210831	**FIGURE A2**		
REVIEW	LCC	20210831			

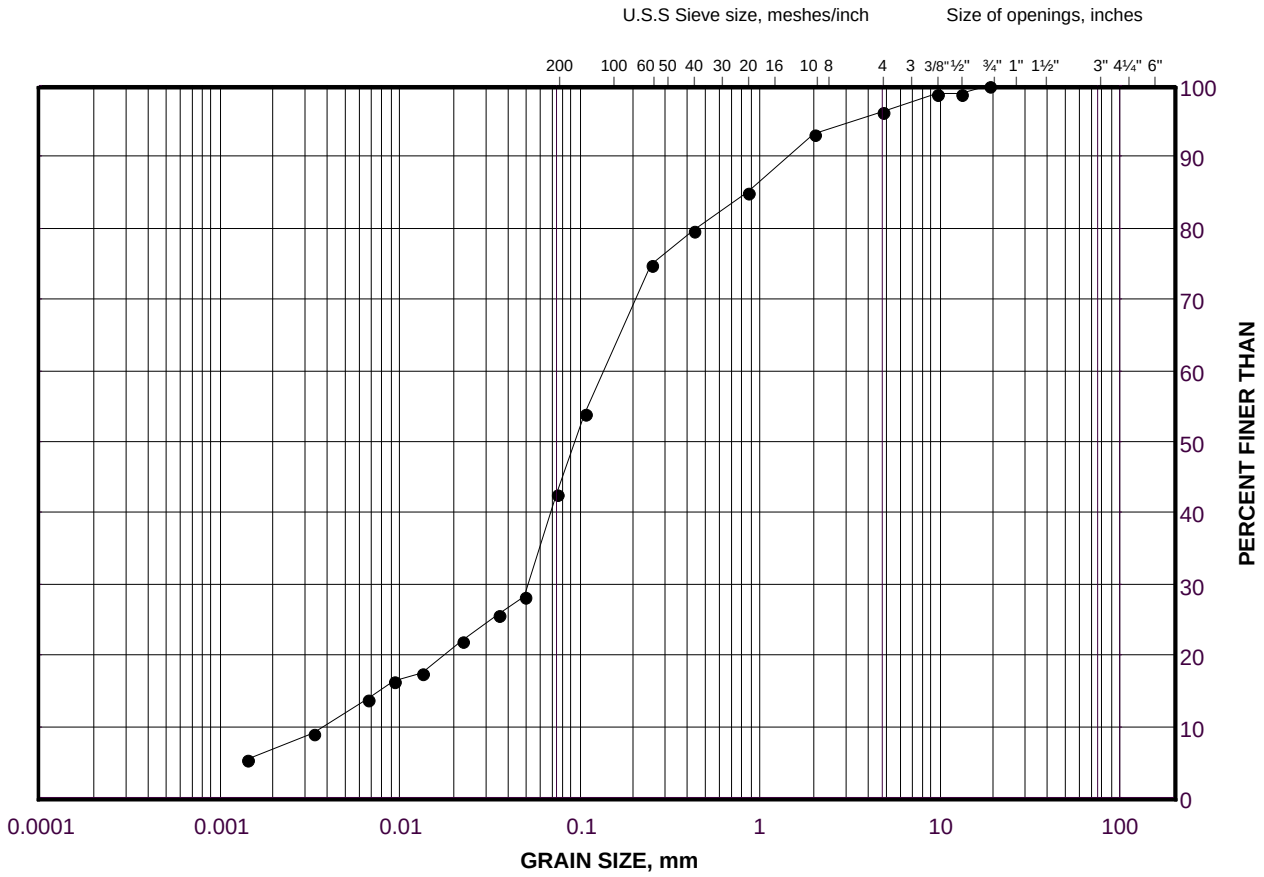
APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Silt and Sand (Fill)

FIGURE B1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	CV 02/03-3	4	100.6

Project Number: 1530382

Checked By: NK

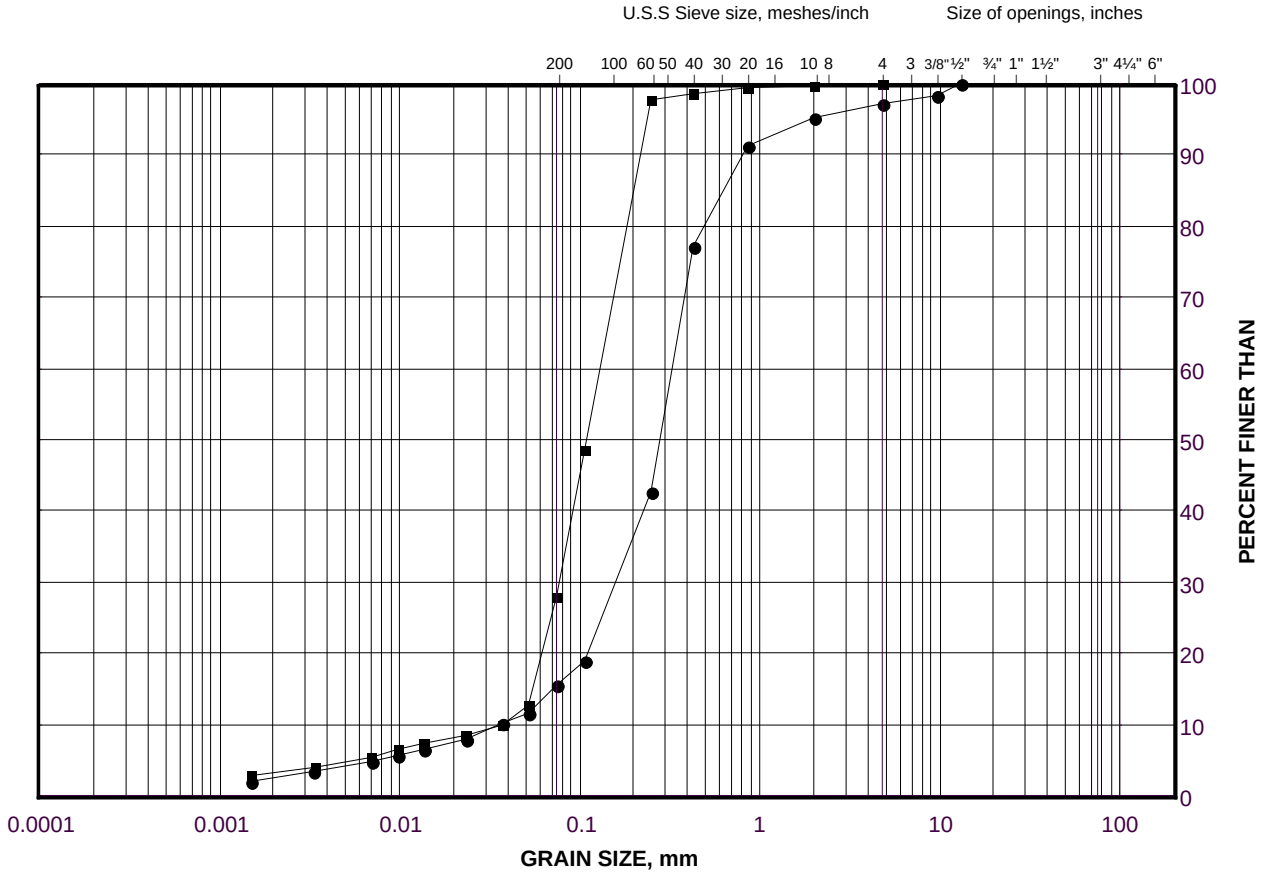
Golder Associates

Date: 04-Jul-17

GRAIN SIZE DISTRIBUTION

Silty Sand to Sand

FIGURE B2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	CV 02/03-2	1	102.8
■	CV 02/03-1	2	102.7

Project Number: 1530382

Checked By: NK

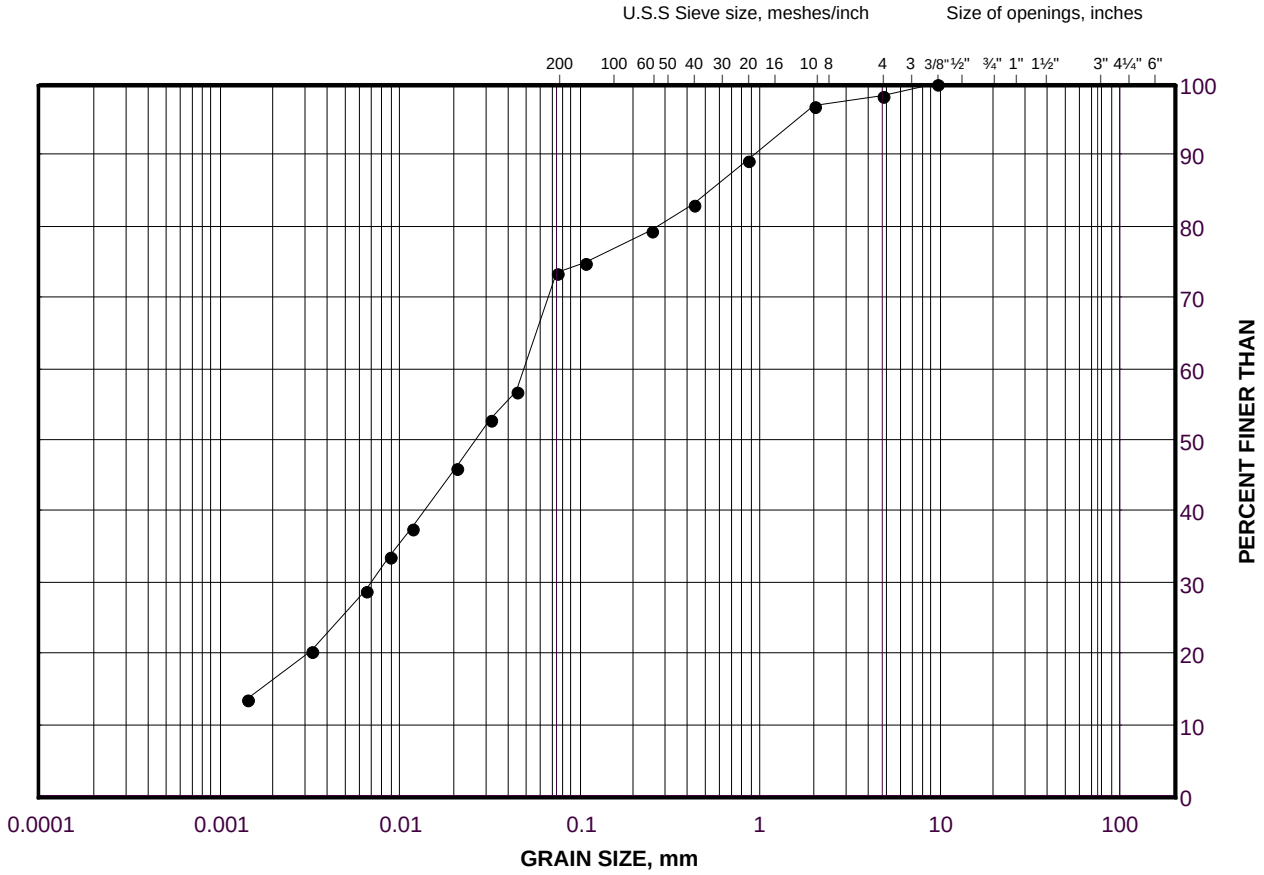
Golder Associates

Date: 04-Jul-17

GRAIN SIZE DISTRIBUTION

Inferred Completely to Moderately Weathered Shale (Bedrock)

FIGURE B3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	CV 02/3-1	3	101.9

NOTES:

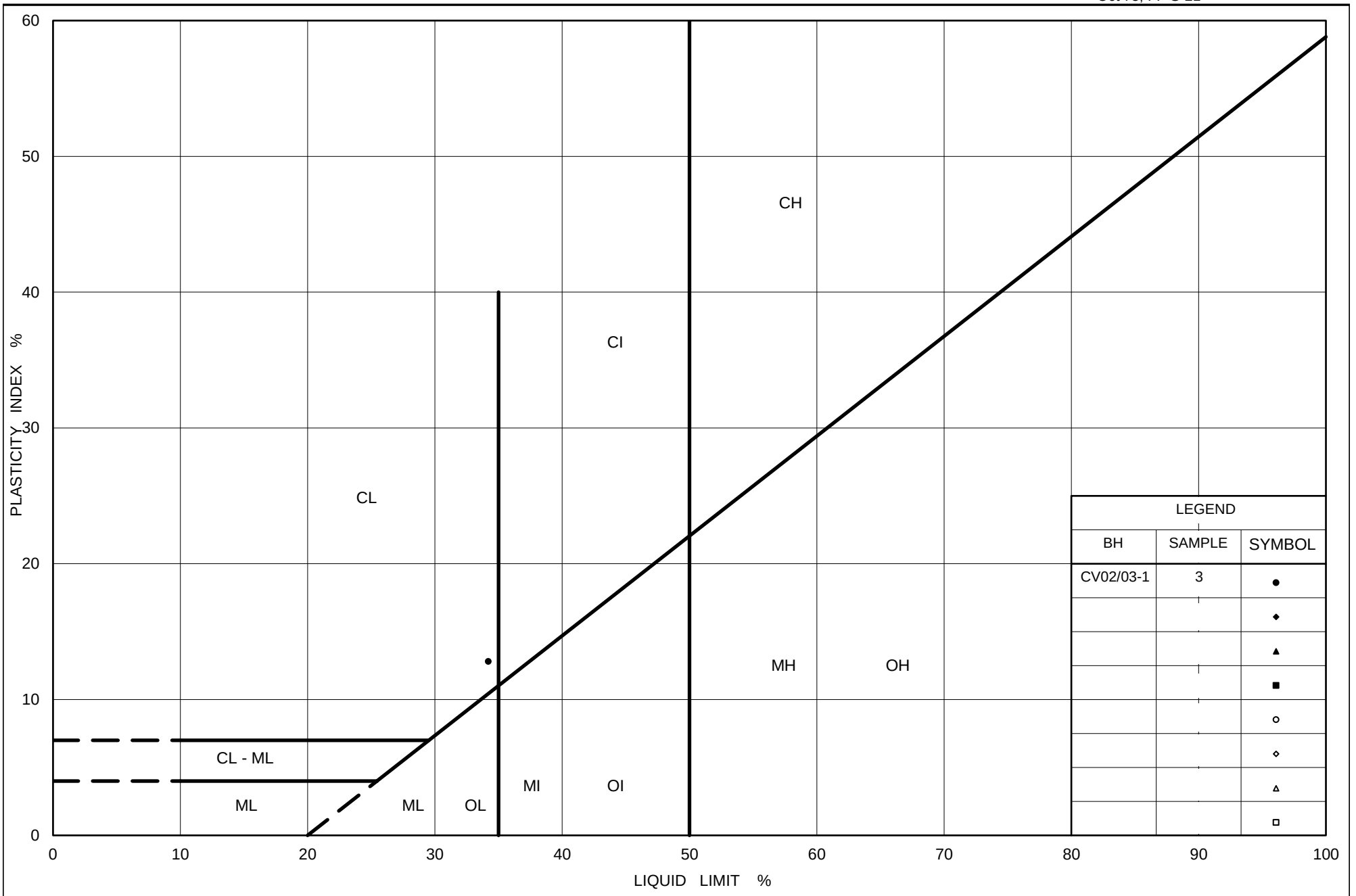
1. The sample of inferred completely to moderately weathered bedrock was obtained by split-spoon sampling, and as such, the particle size(s) are effected by the sampling method and are limited to the size of the sampler. Larger fragments of shale bedrock may be present in-situ.
2. The percentage of gravel size particles may include shale fragments that either remained intact after or were broken during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behavior of the in-situ or excavated completely to moderately weathered shale bedrock.

Project Number: 1530382

Checked By: NK

Golder Associates

Date: 04-Jul-17



Ministry of Transportation

Ontario

PLASTICITY CHART

Inferred Completely to Moderately Weathered Shale (Bedrock)

Figure No. B4

Project No. 1530382

Checked By:NK

Geomechanica Inc.
Suite 900 – 390 Bay St.
Toronto Ontario
Canada M5H 2Y2

December 16, 2016

Ms. Sandra McGaghran
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario
Canada L5N 7K2

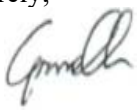
Re: UCS Testing of shale samples - Golder Associates Project No. 1530382

Dear Ms. McGaghran:

On December 2, 2016 three (3) NQ-sized core samples were received by Geomechanica Inc. via drop-off. These samples were identified as shale from a drilling investigation near the QEW and Dixie Road in Mississauga, Ontario. Three (3) uniaxial compressive strength (UCS) test specimens were prepared and tested (one from each sample). The tangent elastic modulus was measured during one (1) of these three tests.

Details regarding the steps of specimen preparation and testing along with the test results and photographs of specimens before and after testing are presented in the accompanying laboratory report.

Sincerely,



Giovanni Grasselli Ph.D., P. Eng.

Geomechanica Inc.
Tel: (647) 478-9767
Email: giovanni.grasselli@geomechanica.com

GEOMECHANICA

Rock Laboratory Testing Results

A report submitted to:

Ms. Sandra McGaghran
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario
Canada L5N 7K2

Prepared by:

Bryan Tatone, PhD
Omid Mahabadi, PhD
Giovanni Grasselli, PhD, PEng

Geomechanica Inc
#900-390 Bay St
Toronto ON
M5H 3V9 Canada
Tel: +1-647-478-9767
info@geomechanica.com

December 16, 2016
Project number: 1530382

Abstract

This document summarizes the results of Uniaxial Compressive Strength (UCS) testing of 3 NQ-sized rock core samples for Golder Associates Ltd. (Golder Project No. 1530382). The samples were identified as shale from a drilling investigation near the QEW and Dixie Road in Mississauga Ontario. The results, including the tabulated values of the UCS, bulk density, and elastic modulus along with photos of the test specimens before and after testing, are presented herein.

In this document:

1 Uniaxial Compressive Strength Tests

1.1 Introduction

This section summarizes the results of rock laboratory testing of NQ-sized shale samples under unconfined uniaxial compression. The tests were performed in Geomechanica's rock testing laboratory in Vaughan, Ontario using a 150 ton (1.3 MN) Forney hydraulic loading frame equipped with pressure-compensated control valve to maintain a nearly constant axial displacement rate of 0.1 mm/min (Figure 1). The specimen preparation and testing procedure included the following:

1. Unwrapping of the core samples, inspecting them for damage, and re-wrapping them in electrical tape to maintain the moisture content and avoid breakage during handling and preparation.

2. Diamond sawing the core samples to length such that cylindrical specimens with nearly parallel end faces were obtained. When possible, specimens were cut such that they had a length:diameter ratio of at least 2:1. For this project, 1 out of the 3 core samples provided was too short to obtain the desired length to diameter ratio.

3. Surface grinding of specimens to obtain flat and parallel end faces within ± 0.025 mm.

4. Loading the specimens into a stiff hydraulic loading frame and applying a small axial load of 0.5-1.0 kN, removing of the electrical tape, and subsequently loading the specimen to rupture while continuously recording axial force and axial deformation (for select specimens) to determine the peak strength (UCS) and (tangent) Young's modulus (E) (for select specimens).

Figure 1: Forney loading frame used for uniaxial compression testing.

1.2 Results

The results of UCS testing are summarized in Table 1. The stress-strain curve for CV 02/03-1 is shown in Figure 2. The Young's modulus value presented in Table 1 represents the tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50% of the UCS.

Table 1: Summary of UCS test results.

Sample	Rock type	Depth from (m)	Depth to (m)	Bulk density (g/cm^3)	UCS (MPa)	Young's modulus, E_{50} (GPa)	Notes
SWM-A-2	Shale	5.10	5.30	2.59	17.7	-	
CV 02/03-1	Shale	7.47	7.70	2.60	17.6	1.2	[1]
HML-1	Shale	7.41	7.50	2.59	17.8	-	[2]
Min				2.59	17.6	1.2	
Max				2.60	17.8	1.2	
Mean				2.59	17.7	1.2	
Standard Deviation				0.01	0.1	-	

[1] Top 25 mm of specimen is limestone
[2] Specimen length:diameter < 2:1

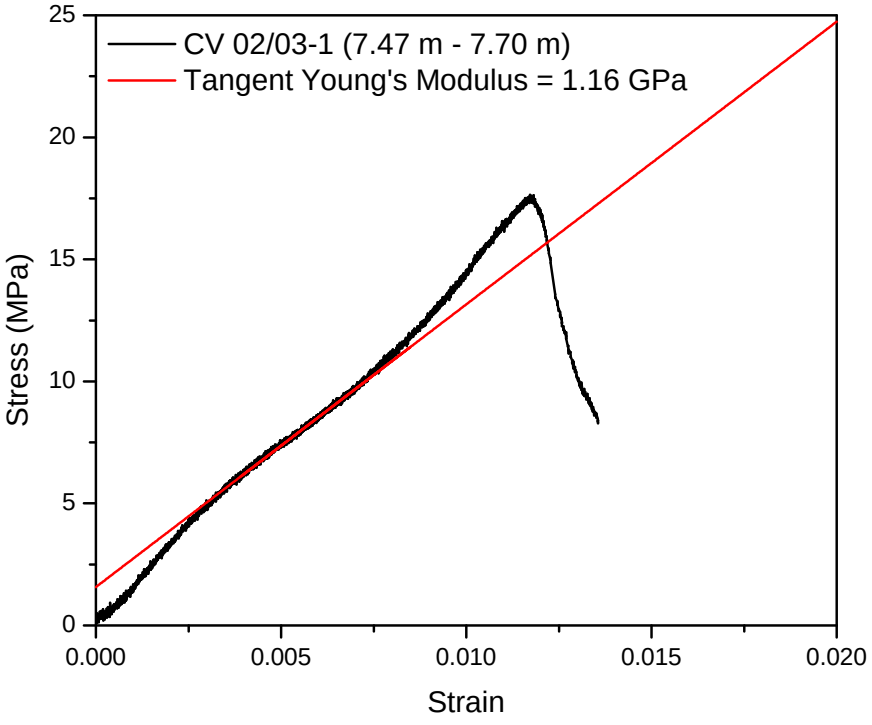


Figure 2: Measured stress-strain curves for samples from different boreholes.

1.3 Specimen photographs

Photographs of the specimens before and after testing are shown in Figure 3.

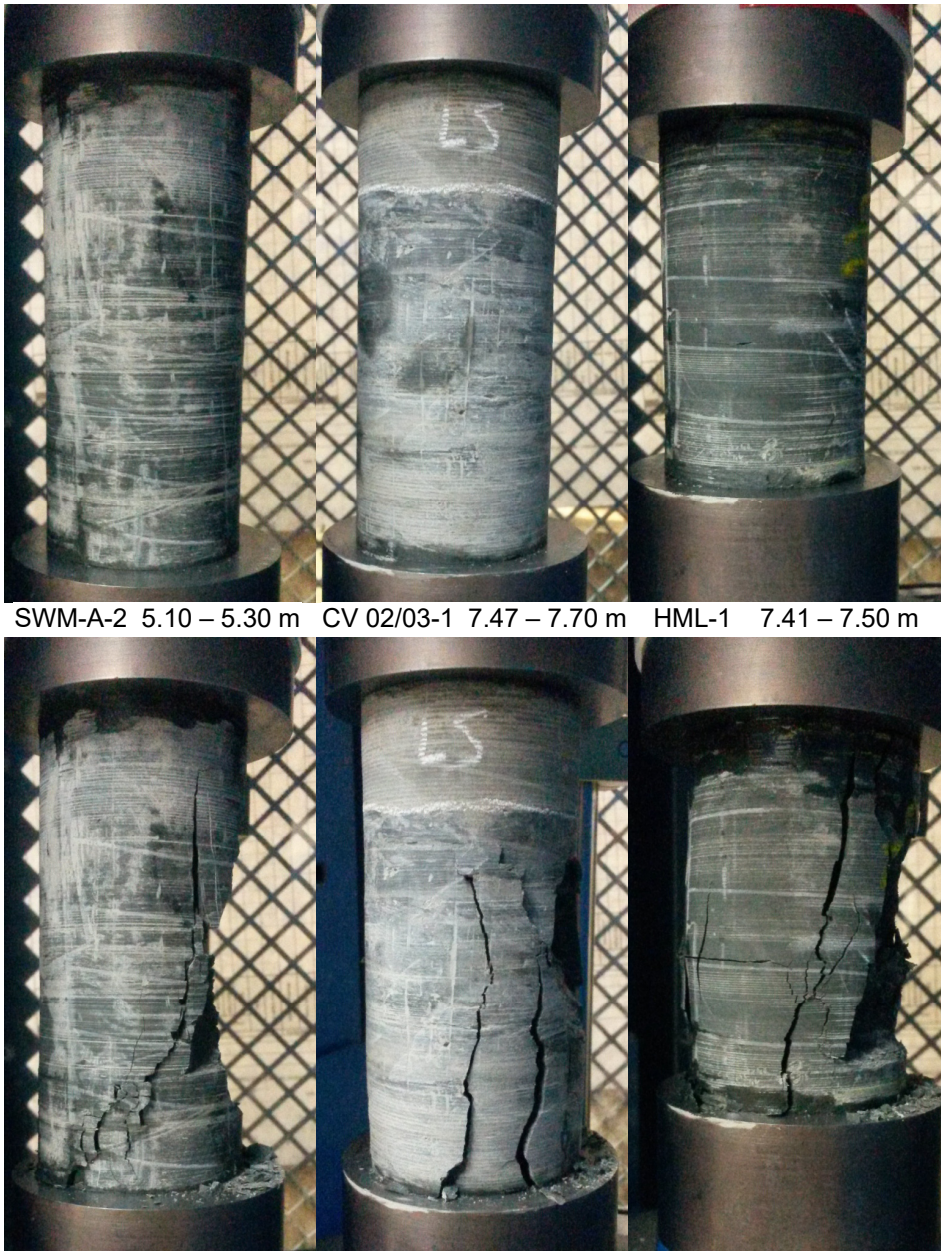


Figure 3: Photographs of test specimens before testing (top) and after testing (bottom).

APPENDIX C

Analytical Laboratory Test Results

Your Project #: 1530382
Site Location: QEW-CAWTHRA
Your C.O.C. #: 70344

Attention:Alysha Kobylinski

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2016/11/19
Report #: R4252452
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6O5411
Received: 2016/11/10, 17:14

Sample Matrix: SOLID
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Chloride (20:1 extract)	5	N/A	2016/11/16	CAM SOP-00463	EPA 325.2 m
Conductivity	5	N/A	2016/11/16	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	5	2016/11/16	2016/11/16	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	5	2016/11/10	2016/11/17	CAM SOP-00414	SM 22 2510 m
Sulphate (20:1 Extract)	5	N/A	2016/11/16	CAM SOP-00464	EPA 375.4 m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods. Results relate to samples tested.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 1530382
Site Location: QEW-CAWTHRA
Your C.O.C. #: 70344

Attention:Alysha Kobylinski

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2016/11/19
Report #: R4252452
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6O5411
Received: 2016/11/10, 17:14

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B6O5411
Report Date: 2016/11/19

Golder Associates Ltd
Client Project #: 1530382
Site Location: QEW-CAWTHRA
Sampler Initials: AJ

RESULTS OF ANALYSES OF SOLID

Maxxam ID		DKV715	DKV715		DKV716		
Sampling Date		2016/11/03	2016/11/03		2016/11/10		
COC Number		70344	70344		70344		
	UNITS	RW3-3-4.33M-4.43M	RW3-3-4.33M-4.43M Lab-Dup	QC Batch	OHS-4-SA4-2.29M-2.59M	RDL	QC Batch
Calculated Parameters							
Resistivity	ohm-cm	2000		4745989	850		4745989
Inorganics							
Soluble (20:1) Chloride (Cl)	ug/g	<20		4748291	500	20	4748291
Conductivity	umho/cm	499		4749169	1180	2	4749169
Available (CaCl2) pH	pH	8.18		4750330	7.92		4750333
Soluble (20:1) Sulphate (SO4)	ug/g	250	230	4748348	270	20	4748348

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Maxxam ID		DKV716		DKV717	DKV718		
Sampling Date		2016/11/10		2016/11/10	2016/11/03		
COC Number		70344		70344	70344		
	UNITS	OHS-4-SA4-2.29M-2.59M Lab-Dup	QC Batch	OHS-5-SA5-3.81M-4.42M	CV01-01-8.74M-8.80M	RDL	QC Batch
Calculated Parameters							
Resistivity	ohm-cm		4745989	1400	1000		4745989
Inorganics							
Soluble (20:1) Chloride (Cl)	ug/g		4748291	40	260	20	4748291
Conductivity	umho/cm		4749169	720	965	2	4749169
Available (CaCl2) pH	pH	7.90	4750333	7.86	8.14		4750330
Soluble (20:1) Sulphate (SO4)	ug/g		4748348	560	320	20	4748348

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B6O5411
Report Date: 2016/11/19

Golder Associates Ltd
Client Project #: 1530382
Site Location: QEW-CAWTHRA
Sampler Initials: AJ

RESULTS OF ANALYSES OF SOLID

Maxxam ID		DKV719		
Sampling Date		2016/11/03		
COC Number		70344		
	UNITS	**CV02/3-1-5.27M-5.32M**	**RDL**	**QC Batch**
Calculated Parameters				
Resistivity	ohm-cm	1500		4745989
Inorganics				
Soluble (20:1) Chloride (Cl)	ug/g	100	20	4748291
Conductivity	umho/cm	682	2	4749169
Available (CaCl2) pH	pH	8.01		4750330
Soluble (20:1) Sulphate (SO4)	ug/g	250	20	4748348

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B6O5411
Report Date: 2016/11/19

Golder Associates Ltd
Client Project #: 1530382
Site Location: QEW-CAWTHRA
Sampler Initials: AJ

TEST SUMMARY

Maxxam ID: DKV715
Sample ID: RW3-3-4.33M-4.43M
Matrix: SOLID

Collected: 2016/11/03
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4748291	N/A	2016/11/16	Alina Dobreanu
Conductivity	AT	4749169	N/A	2016/11/16	Tahir Anwar
pH CaCl2 EXTRACT	AT	4750330	2016/11/16	2016/11/16	Neil Dassanayake
Resistivity of Soil		4745989	2016/11/17	2016/11/17	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

Maxxam ID: DKV715 Dup
Sample ID: RW3-3-4.33M-4.43M
Matrix: SOLID

Collected: 2016/11/03
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

Maxxam ID: DKV716
Sample ID: OHS-4-SA4-2.29M-2.59M
Matrix: SOLID

Collected: 2016/11/10
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4748291	N/A	2016/11/16	Alina Dobreanu
Conductivity	AT	4749169	N/A	2016/11/16	Tahir Anwar
pH CaCl2 EXTRACT	AT	4750333	2016/11/16	2016/11/16	Neil Dassanayake
Resistivity of Soil		4745989	2016/11/17	2016/11/17	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

Maxxam ID: DKV716 Dup
Sample ID: OHS-4-SA4-2.29M-2.59M
Matrix: SOLID

Collected: 2016/11/10
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	4750333	2016/11/16	2016/11/16	Neil Dassanayake

Maxxam ID: DKV717
Sample ID: OHS-5-SA5-3.81M-4.42M
Matrix: SOLID

Collected: 2016/11/10
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4748291	N/A	2016/11/16	Alina Dobreanu
Conductivity	AT	4749169	N/A	2016/11/16	Tahir Anwar
pH CaCl2 EXTRACT	AT	4750330	2016/11/16	2016/11/16	Neil Dassanayake
Resistivity of Soil		4745989	2016/11/17	2016/11/17	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

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Maxxam Job #: B6O5411
Report Date: 2016/11/19

Golder Associates Ltd
Client Project #: 1530382
Site Location: QEW-CAWTHRA
Sampler Initials: AJ

TEST SUMMARY

Maxxam ID: DKV718
Sample ID: CV01-01-8.74M-8.80M
Matrix: SOLID

Collected: 2016/11/03
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4748291	N/A	2016/11/16	Alina Dobreanu
Conductivity	AT	4749169	N/A	2016/11/16	Tahir Anwar
pH CaCl2 EXTRACT	AT	4750330	2016/11/16	2016/11/16	Neil Dassanayake
Resistivity of Soil		4745989	2016/11/17	2016/11/17	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

Maxxam ID: DKV719
Sample ID: CV02/3-1-5.27M-5.32M
Matrix: SOLID

Collected: 2016/11/03
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4748291	N/A	2016/11/16	Alina Dobreanu
Conductivity	AT	4749169	N/A	2016/11/16	Tahir Anwar
pH CaCl2 EXTRACT	AT	4750330	2016/11/16	2016/11/16	Neil Dassanayake
Resistivity of Soil		4745989	2016/11/17	2016/11/17	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

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Maxxam Job #: B6O5411
Report Date: 2016/11/19

Golder Associates Ltd
Client Project #: 1530382
Site Location: QEW-CAWTHRA
Sampler Initials: AJ

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	14.0°C

Results relate only to the items tested.

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Maxxam Job #: B6O5411
Report Date: 2016/11/19

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1530382
Site Location: QEW-CAWTHRA
Sampler Initials: AJ

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4748291	Soluble (20:1) Chloride (Cl)	2016/11/16	NC	70 - 130	108	70 - 130	<20	ug/g	0.49	35
4748348	Soluble (20:1) Sulphate (SO4)	2016/11/16	NC	70 - 130	107	70 - 130	<20	ug/g	9.4	35
4749169	Conductivity	2016/11/16			99	90 - 110	<2	umho/cm	0.93	10
4750330	Available (CaCl2) pH	2016/11/16			99	97 - 103			0.28	N/A
4750333	Available (CaCl2) pH	2016/11/16			99	97 - 103			0.26	N/A

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

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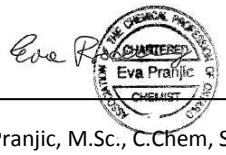
Maxxam Job #: B6O5411
Report Date: 2016/11/19

Golder Associates Ltd
Client Project #: 1530382
Site Location: QEW-CAWTHRA
Sampler Initials: AJ

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam IMMEDIATE TEST
Maxxam Analytics International Corporation o/a Maxxam Analytics
6740 Campobello Road, Mississauga, ON L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: (800) 563-6266

CHAIN OF CUSTODY RECORD

70344 Page 1 of 1

INVOICE INFORMATION	REPORT INFORMATION (if differs from invoice)	PROJECT INFORMATION	MAXXAM JOB NUMBER
Company Name: Golder Associates	Company Name:	Quotation #:	
Contact Name: Alysha Kobylinski	Contact Name:	P.O. #:	CHAIN OF CUSTODY #
Address: 6925 CENTURY AVE, SUITE 100 Mississauga, ON	Address:	Project #: 1530382	00
Phone: 647-618-1364 Fax: 905-567-6561	Phone: Fax:	Site Location: QEW - CAWTHRA	
Email: Alysha_Kobylinski@golder.com	Email:	Site #:	
		Sampled By:	

Note: For MOE Regulated Drinking Water samples, please use the Drinking Water CofC.

Regulation 153 (2011): [ ] Table 1 [ ] Res/Park [ ] Med/Fine; [ ] Table 2 [ ] Ind/Comm [ ] Coarse; [ ] Table 3 [ ] Agri/Other; [ ] Table ____ — For RSC: [ ] Yes [X] No

Other Regulations: [ ] CCME [ ] Sanitary Sewer Bylaw; [ ] Reg. 558 [ ] Storm Sewer Bylaw; [ ] MISA; Municipality: ____; [ ] PWQO; [ ] Other (specify): ____

Include Criteria on Certificate of Analysis (Y/N)?

SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM.

ANALYSIS REQUESTED (Please be specific)

	Sample Identification	Date Sampled	Time Sampled	Matrix (GW, SW, Soil, etc.)	MOE Regulated Drinking Water? (Y / N)	Metals Field Filtered? (Y / N)	CORROSIVITY PACKAGE	# of Cont.	COMMENTS / TAT COMMENTS
1	RW3-3-4.33m-4.43m	NOV 3,2016	AM	ROCK	N	N	X	1	
2	OHS-4-SA4-2.29m-2.59m	NOV 10,2016	AM	SOIL	N	N	X	1	
3	OHS-5-SA5-3.81m-4.42m	NOV 10,2016	AM	SOIL	N	N	X	1	
4	CV01-01-8.74m-8.80m	NOV 3,2016	AM	ROCK	N	N	X	1	
5	CV02/3-1-5.27m-5.32m	NOV 3,2016	AM	Rock	N	N	X	1	
6									
7									
8									
9									
10									

10-Nov-16 17:14
Ema Gitej
B6O5411
KP7 ENV-803

TURNAROUND TIME (TAT) REQUIRED

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS.

Regular (Standard) TAT: [X]
(5-7 working days for most tests)

Rush TAT:
Samples must be received by 3pm to guarantee your TAT
Rush Confirmation #: PN ____
[ ] 1 day [ ] 2 days [ ] 3 days
Date Req'd: ____

TATs for certain tests are > 5 days. Please contact your Project Manager for details.

*RELINQUISHED BY (Signature/Print)	Date (YYYY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date (YYYY/MM/DD)	Time:	#JARS USED AND NOT SUBMITTED
Amelia Jewison	2016/11/10	17:10	[illegible] UMM	2016/11/10	17:14	

Laboratory Use Only

Custody Seal	Yes	No
Present		✓
Intact		✓

Temperature (°C) on Receipt: 10.1/12.1/14.9°C

*MANDATORY SECTIONS IN GREY MUST BE FILLED OUT. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

COC-1004 (10/11) - ENV. ENG. White: Maxxam Yellow: M[illegible] Pink: Client

Your Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Your C.O.C. #: 657051-10-01, 657051-11-01

Attention: Katelyn Nero

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2021/07/10
Report #: R6713209
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H7791
Received: 2021/06/28, 09:18

Sample Matrix: Soil
Samples Received: 20

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Methylnaphthalene Sum	4	N/A	2021/07/06	CAM SOP-00301	EPA 8270D m
Methylnaphthalene Sum	2	N/A	2021/07/07	CAM SOP-00301	EPA 8270D m
ABN Compounds in SPLP Leachates	1	2021/07/05	2021/07/08	CAM SOP-00301	EPA 8270 m
ABN Compounds in SPLP Leachates	4	2021/07/07	2021/07/08	CAM SOP-00301	EPA 8270 m
Hot Water Extractable Boron	1	2021/07/05	2021/07/05	CAM SOP-00408	R153 Ana. Prot. 2011
Hot Water Extractable Boron	5	2021/07/05	2021/07/06	CAM SOP-00408	R153 Ana. Prot. 2011
1,3-Dichloropropene Sum	5	N/A	2021/07/08		EPA 8260D m
1,3-Dichloropropene Sum	6	N/A	2021/07/07		EPA 8260C m
Chloride (20:1 extract)	5	2021/07/05	2021/07/05	CAM SOP-00463	SM 23 4500-Cl E m
Chloride (20:1 extract)	1	2021/07/05	2021/07/06	CAM SOP-00463	SM 23 4500-Cl E m
Free (WAD) Cyanide	6	2021/07/05	2021/07/05	CAM SOP-00457	OMOE E3015 m
Cyanide (WAD) in Leachates	3	N/A	2021/07/06	CAM SOP-00457	OMOE 3015 m
Conductivity	5	2021/07/05	2021/07/05	CAM SOP-00414	OMOE E3530 v1 m
Conductivity	1	2021/07/06	2021/07/06	CAM SOP-00414	OMOE E3530 v1 m
Conductivity	6	2021/07/06	2021/07/06	CAM SOP-00414	OMOE E3530 v1 m
Hexavalent Chromium in Soil by IC (1)	6	2021/07/05	2021/07/06	CAM SOP-00436	EPA 3060/7199 m
Dinitrotoluene Sum	5	N/A	2021/07/08	CAM SOP - 00301	EPA 8270
Petroleum Hydrocarbons F2-F4 in Soil (2)	2	2021/07/02	2021/07/02	CAM SOP-00316	CCME CWS m
Petroleum Hydrocarbons F2-F4 in Soil (2)	4	2021/07/05	2021/07/05	CAM SOP-00316	CCME CWS m
Fluoride by ISE in Leachates	3	2021/07/06	2021/07/06	CAM SOP-00449	SM 23 4500-F- C m
Acid Extractable Metals by ICPMS	6	2021/07/05	2021/07/07	CAM SOP-00447	EPA 6020B m
Total Metals in TCLP Leachate by ICPMS	3	2021/07/06	2021/07/06	CAM SOP-00447	EPA 6020B m
Total Metals in SPLP Leachate by ICPMS	5	2021/07/07	2021/07/08	CAM SOP-00447	EPA 6020B m
Ignitability of a Sample	3	2021/07/06	2021/07/06	CAM SOP-00432	EPA 1030 Rev. 1 m
Moisture	6	N/A	2021/07/02	CAM SOP-00445	Carter 2nd ed 51.2 m
Modified SPLP extraction - pH	5	N/A	2021/07/07	CAM SOP-00941	OMOECP LaSB E9003 R3
Modified SPLP extraction - Weight	5	N/A	2021/07/07	CAM SOP-00941	OMOECP LaSB E9003 R3
Nitrate(NO3) + Nitrite(NO2) in Leachate	3	N/A	2021/07/06	CAM SOP-00440	SM 23 4500-NO3I/NO2B
OC Pesticides/PCB (SPLP Leachable)	5	2021/07/07	2021/07/08	CAM SOP-00307	EPA 8081/8082 m
OC Pesticides Summed Parameters	5	N/A	2021/07/07	CAM SOP-00307	EPA 8081/8082 m

Your Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Your C.O.C. #: 657051-10-01, 657051-11-01

Attention: Katelyn Nero

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2021/07/10
Report #: R6713209
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H7791
Received: 2021/06/28, 09:18

Sample Matrix: Soil
Samples Received: 20

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
PAH Compounds in Leachate by GC/MS (SIM)	3	2021/07/06	2021/07/07	CAM SOP-00318	EPA 8270D m
PAH Compounds in Soil by GC/MS (SIM)	4	2021/07/05	2021/07/05	CAM SOP-00318	EPA 8270D m
PAH Compounds in Soil by GC/MS (SIM)	2	2021/07/05	2021/07/06	CAM SOP-00318	EPA 8270D m
Polychlorinated Biphenyl in Soil	6	2021/07/04	2021/07/05	CAM SOP-00309	EPA 8082A m
pH CaCl2 EXTRACT	12	2021/07/05	2021/07/05	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	5	2021/07/02	2021/07/05	CAM SOP-00414	SM 23 2510 m
Resistivity of Soil	1	2021/07/02	2021/07/06	CAM SOP-00414	SM 23 2510 m
Sodium Adsorption Ratio (SAR)	6	N/A	2021/07/07	CAM SOP-00102	EPA 6010C
Sulphate (20:1 Extract)	5	2021/07/05	2021/07/05	CAM SOP-00464	EPA 375.4 m
Sulphate (20:1 Extract)	1	2021/07/05	2021/07/06	CAM SOP-00464	EPA 375.4 m
TCLP Zero Headspace Extraction	3	2021/07/06	2021/07/07	CAM SOP-00430	EPA 1311 m
Volatile Organic Compounds and F1 PHCs	6	N/A	2021/07/07	CAM SOP-00230	EPA 8260C m
VOCs in ZHE Leachates	3	2021/07/07	2021/07/07	CAM SOP-00228	EPA 8260C m
Volatile organics in SPLP leachates	5	N/A	2021/07/08	CAM SOP-00228	EPA 8260D m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope

Your Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Your C.O.C. #: 657051-10-01, 657051-11-01

Attention: Katelyn Nero

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2021/07/10
Report #: R6713209
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H7791
Received: 2021/06/28, 09:18

dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Soils are reported on a dry weight basis unless otherwise specified.
(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following "Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003". Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829
==========
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

SOIL CORROSIVITY PACKAGE (SOIL)

BV Labs ID		PYK389		PYK390	PYK391	PYK392		
Sampling Date		2021/06/15		2021/06/18	2021/06/24	2021/06/24		
COC Number		657051-10-01		657051-10-01	657051-10-01	657051-10-01		
	UNITS	21-33 SA4	QC Batch	21-27 SA2	21-40 SA2	21-42 SA3	RDL	QC Batch
Calculated Parameters								
Resistivity	ohm-cm	880	7441545	3800	1500	1000		7441545
Inorganics								
Soluble (20:1) Chloride (Cl-)	ug/g	660	7443990	53	270	520	20	7443645
Conductivity	umho/cm	1140	7443483	262	649	1000	2	7443483
Available (CaCl2) pH	pH	8.13	7444166	7.40	7.86	7.83		7444166
Soluble (20:1) Sulphate (SO4)	ug/g	38	7444013	<20	23	<20	20	7443646

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs ID		PYK393			PYK393			PYK437		
Sampling Date		2021/06/25			2021/06/25			2021/06/24		
COC Number		657051-10-01			657051-10-01			657051-11-01		
	UNITS	21-23 SA3	RDL	QC Batch	21-23 SA3 Lab-Dup	RDL	QC Batch	21-39 SA4	RDL	QC Batch
Calculated Parameters										
Resistivity	ohm-cm	920		7441545				2100		7441545
Inorganics										
Soluble (20:1) Chloride (Cl-)	ug/g	620	20	7443645	660	20	7443645	240	20	7443645
Conductivity	umho/cm	1090	2	7446235	1100	2	7446235	483	2	7443483
Available (CaCl2) pH	pH	8.08		7444166				8.16		7444166
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	7443646				<20	20	7443646

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL BULK INORGANICS (SOIL)

BV Labs ID		PYK384			PYK384			PYK385		
Sampling Date		2021/06/25			2021/06/25			2021/06/18		
COC Number		657051-10-01			657051-10-01			657051-10-01		
	UNITS	21-23 SA2	RDL	QC Batch	21-23 SA2 Lab-Dup	RDL	QC Batch	21-27 AS4	RDL	QC Batch
Calculated Parameters										
Sodium Adsorption Ratio	N/A	41		7440876				7.1		7440876
Inorganics										
Conductivity	mS/cm	1.2	0.002	7446285				0.41	0.002	7446285
Available (CaCl2) pH	pH	7.90		7444166				8.00		7444166
WAD Cyanide (Free)	ug/g	<0.01	0.01	7443462				<0.01	0.01	7443462
Chromium (VI)	ug/g	<0.18	0.18	7443554				<0.18	0.18	7443554
Metals										
Hot Water Ext. Boron (B)	ug/g	0.093	0.050	7444001	0.086	0.050	7444001	0.40	0.050	7444001
Acid Extractable Antimony (Sb)	ug/g	<0.20	0.20	7444438				<0.20	0.20	7444438
Acid Extractable Arsenic (As)	ug/g	1.1	1.0	7444438				7.3	1.0	7444438
Acid Extractable Barium (Ba)	ug/g	5.0	0.50	7444438				27	0.50	7444438
Acid Extractable Beryllium (Be)	ug/g	<0.20	0.20	7444438				1.0	0.20	7444438
Acid Extractable Boron (B)	ug/g	<5.0	5.0	7444438				14	5.0	7444438
Acid Extractable Cadmium (Cd)	ug/g	<0.10	0.10	7444438				<0.10	0.10	7444438
Acid Extractable Chromium (Cr)	ug/g	7.1	1.0	7444438				29	1.0	7444438
Acid Extractable Cobalt (Co)	ug/g	1.4	0.10	7444438				18	0.10	7444438
Acid Extractable Copper (Cu)	ug/g	5.7	0.50	7444438				28	0.50	7444438
Acid Extractable Lead (Pb)	ug/g	2.4	1.0	7444438				21	1.0	7444438
Acid Extractable Molybdenum (Mo)	ug/g	<0.50	0.50	7444438				<0.50	0.50	7444438
Acid Extractable Nickel (Ni)	ug/g	2.6	0.50	7444438				38	0.50	7444438
Acid Extractable Selenium (Se)	ug/g	<0.50	0.50	7444438				<0.50	0.50	7444438
Acid Extractable Silver (Ag)	ug/g	<0.20	0.20	7444438				<0.20	0.20	7444438
Acid Extractable Thallium (Tl)	ug/g	<0.050	0.050	7444438				0.11	0.050	7444438
Acid Extractable Uranium (U)	ug/g	0.38	0.050	7444438				0.79	0.050	7444438
Acid Extractable Vanadium (V)	ug/g	14	5.0	7444438				37	5.0	7444438
Acid Extractable Zinc (Zn)	ug/g	7.7	5.0	7444438				79	5.0	7444438
Acid Extractable Mercury (Hg)	ug/g	<0.050	0.050	7444438				<0.050	0.050	7444438

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
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BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL BULK INORGANICS (SOIL)

BV Labs ID		PYK386	PYK387	PYK388			PYK388		
Sampling Date		2021/06/24	2021/06/24	2021/06/24			2021/06/24		
COC Number		657051-10-01	657051-10-01	657051-10-01			657051-10-01		
	UNITS	21-39 SA2	21-40 SA5	21-42 SA4	RDL	QC Batch	21-42 SA4 Lab-Dup	RDL	QC Batch
Calculated Parameters									
Sodium Adsorption Ratio	N/A	6.5	0.92	22		7440876			
Inorganics									
Conductivity	mS/cm	0.35	0.28	0.69	0.002	7446285	0.69	0.002	7446285
Available (CaCl2) pH	pH	7.87	7.94	8.11		7444166			
WAD Cyanide (Free)	ug/g	<0.01	<0.01	<0.01	0.01	7443462			
Chromium (VI)	ug/g	<0.18	<0.18	<0.18	0.18	7443554			
Metals									
Hot Water Ext. Boron (B)	ug/g	<0.050	0.77	0.094	0.050	7444001			
Acid Extractable Antimony (Sb)	ug/g	<0.20	<0.20	<0.20	0.20	7444438			
Acid Extractable Arsenic (As)	ug/g	<1.0	4.9	1.1	1.0	7444438			
Acid Extractable Barium (Ba)	ug/g	6.2	48	17	0.50	7444438			
Acid Extractable Beryllium (Be)	ug/g	<0.20	0.72	0.20	0.20	7444438			
Acid Extractable Boron (B)	ug/g	<5.0	13	<5.0	5.0	7444438			
Acid Extractable Cadmium (Cd)	ug/g	<0.10	<0.10	<0.10	0.10	7444438			
Acid Extractable Chromium (Cr)	ug/g	4.5	23	8.1	1.0	7444438			
Acid Extractable Cobalt (Co)	ug/g	1.5	13	3.8	0.10	7444438			
Acid Extractable Copper (Cu)	ug/g	3.2	24	31	0.50	7444438			
Acid Extractable Lead (Pb)	ug/g	2.0	7.3	7.5	1.0	7444438			
Acid Extractable Molybdenum (Mo)	ug/g	<0.50	<0.50	<0.50	0.50	7444438			
Acid Extractable Nickel (Ni)	ug/g	3.2	28	8.6	0.50	7444438			
Acid Extractable Selenium (Se)	ug/g	<0.50	<0.50	<0.50	0.50	7444438			
Acid Extractable Silver (Ag)	ug/g	<0.20	<0.20	<0.20	0.20	7444438			
Acid Extractable Thallium (Tl)	ug/g	<0.050	0.12	0.055	0.050	7444438			
Acid Extractable Uranium (U)	ug/g	0.31	0.56	0.35	0.050	7444438			
Acid Extractable Vanadium (V)	ug/g	11	29	15	5.0	7444438			
Acid Extractable Zinc (Zn)	ug/g	16	68	26	5.0	7444438			
Acid Extractable Mercury (Hg)	ug/g	<0.050	<0.050	<0.050	0.050	7444438			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL BULK INORGANICS (SOIL)

BV Labs ID		PYK445		
Sampling Date		2021/06/15		
COC Number		657051-11-01		
	UNITS	21-33 SA4	RDL	QC Batch
Calculated Parameters				
Sodium Adsorption Ratio	N/A	35		7440876
Inorganics				
Conductivity	mS/cm	1.4	0.002	7446285
Available (CaCl2) pH	pH	8.12		7444166
WAD Cyanide (Free)	ug/g	<0.01	0.01	7443462
Chromium (VI)	ug/g	<0.18	0.18	7443554
Metals				
Hot Water Ext. Boron (B)	ug/g	0.097	0.050	7444351
Acid Extractable Antimony (Sb)	ug/g	<0.20	0.20	7444438
Acid Extractable Arsenic (As)	ug/g	4.6	1.0	7444438
Acid Extractable Barium (Ba)	ug/g	39	0.50	7444438
Acid Extractable Beryllium (Be)	ug/g	0.25	0.20	7444438
Acid Extractable Boron (B)	ug/g	<5.0	5.0	7444438
Acid Extractable Cadmium (Cd)	ug/g	<0.10	0.10	7444438
Acid Extractable Chromium (Cr)	ug/g	9.4	1.0	7444438
Acid Extractable Cobalt (Co)	ug/g	4.8	0.10	7444438
Acid Extractable Copper (Cu)	ug/g	37	0.50	7444438
Acid Extractable Lead (Pb)	ug/g	8.0	1.0	7444438
Acid Extractable Molybdenum (Mo)	ug/g	<0.50	0.50	7444438
Acid Extractable Nickel (Ni)	ug/g	11	0.50	7444438
Acid Extractable Selenium (Se)	ug/g	<0.50	0.50	7444438
Acid Extractable Silver (Ag)	ug/g	<0.20	0.20	7444438
Acid Extractable Thallium (Tl)	ug/g	0.079	0.050	7444438
Acid Extractable Uranium (U)	ug/g	0.36	0.050	7444438
Acid Extractable Vanadium (V)	ug/g	16	5.0	7444438
Acid Extractable Zinc (Zn)	ug/g	34	5.0	7444438
Acid Extractable Mercury (Hg)	ug/g	<0.050	0.050	7444438

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL BULK PAHS (SOIL)

BV Labs ID		PYK384		PYK385		PYK386	PYK387		
Sampling Date		2021/06/25		2021/06/18		2021/06/24	2021/06/24		
COC Number		657051-10-01		657051-10-01		657051-10-01	657051-10-01		
	UNITS	21-23 SA2	QC Batch	21-27 AS4	QC Batch	21-39 SA2	21-40 SA5	RDL	QC Batch
Calculated Parameters									
Methylnaphthalene, 2-(1-)	ug/g	<0.0071	7440873	0.027	7440873	<0.0071	<0.0071	0.0071	7440873
Polyaromatic Hydrocarbons									
Acenaphthene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Acenaphthylene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Anthracene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Benzo(a)anthracene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Benzo(a)pyrene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Benzo(b/j)fluoranthene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Benzo(g,h,i)perylene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Benzo(k)fluoranthene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Chrysene	ug/g	<0.0050	7443487	0.0073	7443509	<0.0050	<0.0050	0.0050	7443487
Dibenzo(a,h)anthracene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Fluoranthene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Fluorene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
Indeno(1,2,3-cd)pyrene	ug/g	<0.0050	7443487	<0.0050	7443509	<0.0050	<0.0050	0.0050	7443487
1-Methylnaphthalene	ug/g	<0.0050	7443487	0.017	7443509	<0.0050	<0.0050	0.0050	7443487
2-Methylnaphthalene	ug/g	<0.0050	7443487	0.010	7443509	<0.0050	<0.0050	0.0050	7443487
Naphthalene	ug/g	<0.0050	7443487	0.044	7443509	<0.0050	<0.0050	0.0050	7443487
Phenanthrene	ug/g	<0.0050	7443487	0.040	7443509	<0.0050	0.0066	0.0050	7443487
Pyrene	ug/g	<0.0050	7443487	0.0062	7443509	<0.0050	<0.0050	0.0050	7443487
Biphenyl	ug/g	<0.0050	7443487	0.030	7443509	<0.0050	<0.0050	0.0050	7443487
Surrogate Recovery (%)									
D10-Anthracene	%	107	7443487	93	7443509	109	107		7443487
D14-Terphenyl (FS)	%	99	7443487	92	7443509	95	99		7443487
D8-Acenaphthylene	%	79	7443487	88	7443509	76	83		7443487

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL BULK PAHS (SOIL)

BV Labs ID		PYK388		PYK445		
Sampling Date		2021/06/24		2021/06/15		
COC Number		657051-10-01		657051-11-01		
	UNITS	21-42 SA4	QC Batch	21-33 SA4	RDL	QC Batch
Calculated Parameters						
Methylnaphthalene, 2-(1-)	ug/g	<0.0071	7440873	<0.0071	0.0071	7440873
Polyaromatic Hydrocarbons						
Acenaphthene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Acenaphthylene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Anthracene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Benzo(a)anthracene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Benzo(a)pyrene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Benzo(b/j)fluoranthene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Benzo(g,h,i)perylene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Benzo(k)fluoranthene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Chrysene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Dibenzo(a,h)anthracene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Fluoranthene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Fluorene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Indeno(1,2,3-cd)pyrene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
1-Methylnaphthalene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
2-Methylnaphthalene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Naphthalene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Phenanthrene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Pyrene	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Biphenyl	ug/g	<0.0050	7443487	<0.0050	0.0050	7443509
Surrogate Recovery (%)						
D10-Anthracene	%	109	7443487	96		7443509
D14-Terphenyl (FS)	%	104	7443487	95		7443509
D8-Acenaphthylene	%	83	7443487	89		7443509

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

O.REG 406 EXCESS SOIL BULK VOCS/F1-F4 (SOIL)

BV Labs ID		PYK384			PYK384			PYK385		
Sampling Date		2021/06/25			2021/06/25			2021/06/18		
COC Number		657051-10-01			657051-10-01			657051-10-01		
	UNITS	21-23 SA2	RDL	QC Batch	21-23 SA2 Lab-Dup	RDL	QC Batch	21-27 AS4	RDL	QC Batch
Inorganics										
Moisture	%	7.0	1.0	7441990				5.7	1.0	7441990
Calculated Parameters										
1,3-Dichloropropene (cis+trans)	ug/g	<0.050	0.050	7440874				<0.050	0.050	7440874
Volatile Organics										
Acetone (2-Propanone)	ug/g	<0.50	0.50	7442303	<0.50	0.50	7442303	<0.50	0.50	7442303
Benzene	ug/g	<0.020	0.020	7442303	<0.020	0.020	7442303	<0.020	0.020	7442303
Bromodichloromethane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Bromoform	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Bromomethane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Carbon Tetrachloride	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Chlorobenzene	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Chloroform	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Dibromochloromethane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
1,2-Dichlorobenzene	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
1,3-Dichlorobenzene	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
1,4-Dichlorobenzene	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Dichlorodifluoromethane (FREON 12)	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
1,1-Dichloroethane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
1,2-Dichloroethane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
1,1-Dichloroethylene	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
cis-1,2-Dichloroethylene	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
trans-1,2-Dichloroethylene	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
1,2-Dichloropropane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
cis-1,3-Dichloropropene	ug/g	<0.030	0.030	7442303	<0.030	0.030	7442303	<0.030	0.030	7442303
trans-1,3-Dichloropropene	ug/g	<0.040	0.040	7442303	<0.040	0.040	7442303	<0.040	0.040	7442303
Ethylbenzene	ug/g	<0.020	0.020	7442303	<0.020	0.020	7442303	<0.020	0.020	7442303
Ethylene Dibromide	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Hexane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Methylene Chloride(Dichloromethane)	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Methyl Ethyl Ketone (2-Butanone)	ug/g	<0.50	0.50	7442303	<0.50	0.50	7442303	<0.50	0.50	7442303

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

O.REG 406 EXCESS SOIL BULK VOCS/F1-F4 (SOIL)

BV Labs ID		PYK384			PYK384			PYK385		
Sampling Date		2021/06/25			2021/06/25			2021/06/18		
COC Number		657051-10-01			657051-10-01			657051-10-01		
	UNITS	21-23 SA2	RDL	QC Batch	21-23 SA2 Lab-Dup	RDL	QC Batch	21-27 AS4	RDL	QC Batch
Methyl Isobutyl Ketone	ug/g	<0.50	0.50	7442303	<0.50	0.50	7442303	<0.50	0.50	7442303
Methyl t-butyl ether (MTBE)	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Styrene	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
1,1,1,2-Tetrachloroethane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
1,1,2,2-Tetrachloroethane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Tetrachloroethylene	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Toluene	ug/g	0.033	0.020	7442303	0.033	0.020	7442303	<0.020	0.020	7442303
1,1,1-Trichloroethane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
1,1,2-Trichloroethane	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Trichloroethylene	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Trichlorofluoromethane (FREON 11)	ug/g	<0.050	0.050	7442303	<0.050	0.050	7442303	<0.050	0.050	7442303
Vinyl Chloride	ug/g	<0.020	0.020	7442303	<0.020	0.020	7442303	<0.020	0.020	7442303
p+m-Xylene	ug/g	<0.020	0.020	7442303	<0.020	0.020	7442303	<0.020	0.020	7442303
o-Xylene	ug/g	<0.020	0.020	7442303	<0.020	0.020	7442303	<0.020	0.020	7442303
Total Xylenes	ug/g	<0.020	0.020	7442303	<0.020	0.020	7442303	<0.020	0.020	7442303
F1 (C6-C10)	ug/g	<10	10	7442303	<10	10	7442303	<10	10	7442303
F1 (C6-C10) - BTEX	ug/g	<10	10	7442303	<10	10	7442303	<10	10	7442303
F2-F4 Hydrocarbons										
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	7443540				<10	10	7441781
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	7443540				<50	50	7441781
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	7443540				<50	50	7441781
Reached Baseline at C50	ug/g	Yes		7443540				Yes		7441781
Surrogate Recovery (%)										
o-Terphenyl	%	91		7443540				97		7441781
4-Bromofluorobenzene	%	99		7442303	98		7442303	97		7442303
D10-o-Xylene	%	88		7442303	88		7442303	85		7442303
D4-1,2-Dichloroethane	%	98		7442303	98		7442303	99		7442303
D8-Toluene	%	97		7442303	98		7442303	98		7442303

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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O.REG 406 EXCESS SOIL BULK VOCS/F1-F4 (SOIL)

BV Labs ID		PYK386	PYK387	PYK388		PYK445		
Sampling Date		2021/06/24	2021/06/24	2021/06/24		2021/06/15		
COC Number		657051-10-01	657051-10-01	657051-10-01		657051-11-01		
	UNITS	21-39 SA2	21-40 SA5	21-42 SA4	QC Batch	21-33 SA4	RDL	QC Batch
Inorganics								
Moisture	%	13	11	5.1	7441990	6.3	1.0	7441990
Calculated Parameters								
1,3-Dichloropropene (cis+trans)	ug/g	<0.050	<0.050	<0.050	7440874	<0.050	0.050	7440874
Volatile Organics								
Acetone (2-Propanone)	ug/g	<0.50	<0.50	<0.50	7442303	<0.50	0.50	7442303
Benzene	ug/g	<0.020	<0.020	<0.020	7442303	<0.020	0.020	7442303
Bromodichloromethane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Bromoform	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Bromomethane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Carbon Tetrachloride	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Chlorobenzene	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Chloroform	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Dibromochloromethane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
1,2-Dichlorobenzene	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
1,3-Dichlorobenzene	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
1,4-Dichlorobenzene	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Dichlorodifluoromethane (FREON 12)	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
1,1-Dichloroethane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
1,2-Dichloroethane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
1,1-Dichloroethylene	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
cis-1,2-Dichloroethylene	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
trans-1,2-Dichloroethylene	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
1,2-Dichloropropane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
cis-1,3-Dichloropropene	ug/g	<0.030	<0.030	<0.030	7442303	<0.030	0.030	7442303
trans-1,3-Dichloropropene	ug/g	<0.040	<0.040	<0.040	7442303	<0.040	0.040	7442303
Ethylbenzene	ug/g	<0.020	<0.020	<0.020	7442303	<0.020	0.020	7442303
Ethylene Dibromide	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Hexane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Methylene Chloride(Dichloromethane)	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Methyl Ethyl Ketone (2-Butanone)	ug/g	<0.50	<0.50	<0.50	7442303	<0.50	0.50	7442303
Methyl Isobutyl Ketone	ug/g	<0.50	<0.50	<0.50	7442303	<0.50	0.50	7442303

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL BULK VOCS/F1-F4 (SOIL)

BV Labs ID		PYK386	PYK387	PYK388		PYK445		
Sampling Date		2021/06/24	2021/06/24	2021/06/24		2021/06/15		
COC Number		657051-10-01	657051-10-01	657051-10-01		657051-11-01		
	UNITS	21-39 SA2	21-40 SA5	21-42 SA4	QC Batch	21-33 SA4	RDL	QC Batch
Methyl t-butyl ether (MTBE)	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Styrene	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
1,1,1,2-Tetrachloroethane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
1,1,2,2-Tetrachloroethane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Tetrachloroethylene	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Toluene	ug/g	<0.020	<0.020	<0.020	7442303	<0.020	0.020	7442303
1,1,1-Trichloroethane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
1,1,2-Trichloroethane	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Trichloroethylene	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Trichlorofluoromethane (FREON 11)	ug/g	<0.050	<0.050	<0.050	7442303	<0.050	0.050	7442303
Vinyl Chloride	ug/g	<0.020	<0.020	<0.020	7442303	<0.020	0.020	7442303
p+m-Xylene	ug/g	<0.020	<0.020	<0.020	7442303	<0.020	0.020	7442303
o-Xylene	ug/g	<0.020	<0.020	<0.020	7442303	<0.020	0.020	7442303
Total Xylenes	ug/g	<0.020	<0.020	<0.020	7442303	<0.020	0.020	7442303
F1 (C6-C10)	ug/g	<10	<10	<10	7442303	<10	10	7442303
F1 (C6-C10) - BTEX	ug/g	<10	<10	<10	7442303	<10	10	7442303
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/g	<10	<10	<10	7443540	<10	10	7441781
F3 (C16-C34 Hydrocarbons)	ug/g	<50	<50	<50	7443540	<50	50	7441781
F4 (C34-C50 Hydrocarbons)	ug/g	<50	<50	<50	7443540	<50	50	7441781
Reached Baseline at C50	ug/g	Yes	Yes	Yes	7443540	Yes		7441781
Surrogate Recovery (%)								
o-Terphenyl	%	90	90	91	7443540	94		7441781
4-Bromofluorobenzene	%	96	96	96	7442303	96		7442303
D10-o-Xylene	%	84	83	80	7442303	83		7442303
D4-1,2-Dichloroethane	%	100	98	98	7442303	101		7442303
D8-Toluene	%	98	98	97	7442303	97		7442303

RDL = Reportable Detection Limit
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BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL SPLP ABNS (SOIL)

BV Labs ID		PYK438		PYK439		PYK440		
Sampling Date		2021/06/18		2021/06/24		2021/06/24		
COC Number		657051-11-01		657051-11-01		657051-11-01		
	UNITS	21-27 SA3	QC Batch	21-40 SA3	QC Batch	21-42 SA5B	RDL	QC Batch
Semivolatile Organics								
Leachable (SPLP) Bis(2-chloroethyl)ether	ug/L	<2.0	7449697	<2.0	7449697	<2.0	2.0	7449697
Leachable (SPLP) Bis(2-chloroisopropyl)ether	ug/L	<2.0	7449697	<2.0	7449697	<2.0	2.0	7449697
Leachable (SPLP) p-Chloroaniline	ug/L	<5.0	7449697	<5.0	7449697	<5.0	5.0	7449697
Leachable (SPLP) 3,3'-Dichlorobenzidine	ug/L	<0.40	7449697	<0.40	7449697	<0.40	0.40	7449697
Leachable (SPLP) Diethyl phthalate	ug/L	<1.0	7449697	<1.0	7449697	<1.0	1.0	7449697
Leachable (SPLP) Dimethyl phthalate	ug/L	<1.0	7449697	<1.0	7449697	<1.0	1.0	7449697
Leachable (SPLP) 2,4-Dinitrophenol	ug/L	<5.0	7449697	<5.0	7449697	<5.0	5.0	7449697
Leachable (SPLP) 2,4-Dinitrotoluene	ug/L	<3.0	7449697	<3.0	7449697	<3.0	3.0	7449697
Leachable (SPLP) 2,6-Dinitrotoluene	ug/L	<3.0	7449697	<3.0	7449697	<3.0	3.0	7449697
Leachable (SPLP) 2,4,6-Trichlorophenol	ug/L	<0.70	7449697	<0.70	7449697	<0.70	0.70	7449697
Calculated Parameters								
Leachable 2,4- & 2,6-Dinitrotoluene	ug/L	<4.2	7441548	<4.2	7441550	<4.2	4.2	7441548
Surrogate Recovery (%)								
Leachable (SPLP) 2,4,6-Tribromophenol	%	79	7449697	83	7449697	75		7449697
Leachable (SPLP) 2-Fluorobiphenyl	%	58	7449697	55	7449697	52		7449697
Leachable (SPLP) D14-Terphenyl (FS)	%	71	7449697	73	7449697	70		7449697
Leachable (SPLP) D5-Nitrobenzene	%	67	7449697	66	7449697	56		7449697

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL SPLP ABNS (SOIL)

BV Labs ID		PYK441	PYK446		
Sampling Date		2021/06/25	2021/05/12		
COC Number		657051-11-01	657051-11-01		
	UNITS	21-23 SA3	21-17 SA2	RDL	QC Batch
Semivolatile Organics					
Leachable (SPLP) Bis(2-chloroethyl)ether	ug/L	<2.0	<2.0	2.0	7449697
Leachable (SPLP) Bis(2-chloroisopropyl)ether	ug/L	<2.0	<2.0	2.0	7449697
Leachable (SPLP) p-Chloroaniline	ug/L	<5.0	<5.0	5.0	7449697
Leachable (SPLP) 3,3'-Dichlorobenzidine	ug/L	<0.40	<0.40	0.40	7449697
Leachable (SPLP) Diethyl phthalate	ug/L	<1.0	<1.0	1.0	7449697
Leachable (SPLP) Dimethyl phthalate	ug/L	<1.0	<1.0	1.0	7449697
Leachable (SPLP) 2,4-Dinitrophenol	ug/L	<5.0	<5.0	5.0	7449697
Leachable (SPLP) 2,4-Dinitrotoluene	ug/L	<3.0	<3.0	3.0	7449697
Leachable (SPLP) 2,6-Dinitrotoluene	ug/L	<3.0	<3.0	3.0	7449697
Leachable (SPLP) 2,4,6-Trichlorophenol	ug/L	<0.70	<0.70	0.70	7449697
Calculated Parameters					
Leachable 2,4- & 2,6-Dinitrotoluene	ug/L	<4.2	<4.2	4.2	7441550
Surrogate Recovery (%)					
Leachable (SPLP) 2,4,6-Tribromophenol	%	83	81		7449697
Leachable (SPLP) 2-Fluorobiphenyl	%	58	53		7449697
Leachable (SPLP) D14-Terphenyl (FS)	%	73	70		7449697
Leachable (SPLP) D5-Nitrobenzene	%	67	62		7449697

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL SPLP METALS (SOIL)

BV Labs ID		PYK438	PYK439	PYK440	PYK441	PYK446		
Sampling Date		2021/06/18	2021/06/24	2021/06/24	2021/06/25	2021/05/12		
COC Number		657051-11-01	657051-11-01	657051-11-01	657051-11-01	657051-11-01		
	UNITS	21-27 SA3	21-40 SA3	21-42 SA5B	21-23 SA3	21-17 SA2	RDL	QC Batch
Metals								
Leachable (SPLP) Antimony (Sb)	ug/L	<0.5	<0.5	1.0	<0.5	<0.5	0.5	7449698
Leachable (SPLP) Arsenic (As)	ug/L	<1	<1	2	<1	<1	1	7449698
Leachable (SPLP) Barium (Ba)	ug/L	<5	<5	10	<5	<5	5	7449698
Leachable (SPLP) Beryllium (Be)	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	7449698
Leachable (SPLP) Boron (B)	ug/L	<10	<10	<10	<10	<10	10	7449698
Leachable (SPLP) Cadmium (Cd)	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	7449698
Leachable (SPLP) Chromium (Cr)	ug/L	<5	<5	<5	<5	<5	5	7449698
Leachable (SPLP) Cobalt (Co)	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	7449698
Leachable (SPLP) Copper (Cu)	ug/L	2	<1	1	<1	1	1	7449698
Leachable (SPLP) Lead (Pb)	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	7449698
Leachable (SPLP) Molybdenum (Mo)	ug/L	<1	<1	1	<1	<1	1	7449698
Leachable (SPLP) Nickel (Ni)	ug/L	<1	<1	<1	<1	<1	1	7449698
Leachable (SPLP) Selenium (Se)	ug/L	<2	<2	<2	<2	<2	2	7449698
Leachable (SPLP) Silver (Ag)	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	7449698
Leachable (SPLP) Thallium (Tl)	ug/L	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	7449698
Leachable (SPLP) Uranium (U)	ug/L	<0.1	<0.1	0.3	<0.1	<0.1	0.1	7449698
Leachable (SPLP) Vanadium (V)	ug/L	<1	2	2	1	1	1	7449698
Leachable (SPLP) Zinc (Zn)	ug/L	<5	<5	<5	<5	<5	5	7449698

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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O.REG 406 EXCESS SOIL SPLP OC PESTICIDES (SOIL)

BV Labs ID		PYK438	PYK439	PYK440	PYK441		
Sampling Date		2021/06/18	2021/06/24	2021/06/24	2021/06/25		
COC Number		657051-11-01	657051-11-01	657051-11-01	657051-11-01		
	UNITS	21-27 SA3	21-40 SA3	21-42 SA5B	21-23 SA3	RDL	QC Batch
Calculated Parameters							
Leachable Heptachlor + Heptachlor epoxide	ug/L	<0.0060	<0.0060	<0.0060	<0.0060	0.0060	7441546
Pesticides & Herbicides							
Leachable (SPLP) Dieldrin	ug/L	<0.006	<0.006	<0.006	<0.006	0.006	7450443
Leachable (SPLP) Endrin	ug/L	<0.006	<0.006	<0.006	<0.006	0.006	7450443
Leachable (SPLP) Heptachlor	ug/L	<0.006	<0.006	<0.006	<0.006	0.006	7450443
Leachable (SPLP) Heptachlor epoxide	ug/L	<0.006	<0.006	<0.006	<0.006	0.006	7450443
Surrogate Recovery (%)							
Leachable (SPLP) 2,4,5,6-Tetrachloro-m-xylene	%	77	60	68	71		7450443
Leachable (SPLP) Decachlorobiphenyl	%	84	77	76	87		7450443

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs ID		PYK441			PYK446		
Sampling Date		2021/06/25			2021/05/12		
COC Number		657051-11-01			657051-11-01		
	UNITS	21-23 SA3 Lab-Dup	RDL	QC Batch	21-17 SA2	RDL	QC Batch
Calculated Parameters							
Leachable Heptachlor + Heptachlor epoxide	ug/L				<0.0060	0.0060	7441546
Pesticides & Herbicides							
Leachable (SPLP) Dieldrin	ug/L	<0.006	0.006	7450443	<0.006	0.006	7450443
Leachable (SPLP) Endrin	ug/L	<0.006	0.006	7450443	<0.006	0.006	7450443
Leachable (SPLP) Heptachlor	ug/L	<0.006	0.006	7450443	<0.006	0.006	7450443
Leachable (SPLP) Heptachlor epoxide	ug/L	<0.006	0.006	7450443	<0.006	0.006	7450443
Surrogate Recovery (%)							
Leachable (SPLP) 2,4,5,6-Tetrachloro-m-xylene	%	63		7450443	59		7450443
Leachable (SPLP) Decachlorobiphenyl	%	83		7450443	69		7450443

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL SPLP PREP (SOIL)

BV Labs ID		PYK438	PYK439	PYK440	PYK441	PYK446	
Sampling Date		2021/06/18	2021/06/24	2021/06/24	2021/06/25	2021/05/12	
COC Number		657051-11-01	657051-11-01	657051-11-01	657051-11-01	657051-11-01	
	UNITS	21-27 SA3	21-40 SA3	21-42 SA5B	21-23 SA3	21-17 SA2	QC Batch
Inorganics							
Dry Weight	g	100	100	100	100	100	7447245
Final pH	pH	9.01	9.08	9.23	9.72	9.68	7447253

QC Batch = Quality Control Batch

BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 406 EXCESS SOIL SPLP VOCS (SOIL)

BV Labs ID		PYK438			PYK438			PYK439		
Sampling Date		2021/06/18			2021/06/18			2021/06/24		
COC Number		657051-11-01			657051-11-01			657051-11-01		
	UNITS	21-27 SA3	RDL	QC Batch	21-27 SA3 Lab-Dup	RDL	QC Batch	21-40 SA3	RDL	QC Batch
Calculated Parameters										
Leachable (ZHE) 1,3-Dichloropropene (cis+trans)	ug/L	<0.42	0.42	7441139				<0.42	0.42	7441139
Volatile Organics										
Leachable (SPLP) Bromomethane	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) Carbon Tetrachloride	ug/L	<0.19	0.19	7448614	<0.19	0.19	7448614	<0.19	0.19	7448614
Leachable (SPLP) Chloroform	ug/L	<1.2	1.2	7448614	<1.2	1.2	7448614	<1.2	1.2	7448614
Leachable (SPLP) 1,2-Dichlorobenzene	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) 1,4-Dichlorobenzene	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) 1,1-Dichloroethane	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) 1,2-Dichloroethane	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) 1,1-Dichloroethylene	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) cis-1,2-Dichloroethylene	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) trans-1,2-Dichloroethylene	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) 1,2-Dichloropropane	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) cis-1,3-Dichloropropene	ug/L	<0.30	0.30	7448614	<0.30	0.30	7448614	<0.30	0.30	7448614
Leachable (SPLP) trans-1,3-Dichloropropene	ug/L	<0.30	0.30	7448614	<0.30	0.30	7448614	<0.30	0.30	7448614
Leachable (SPLP) Ethylene Dibromide	ug/L	<0.19	0.19	7448614	<0.19	0.19	7448614	<0.19	0.19	7448614
Leachable (SPLP) 1,1,1,2-Tetrachloroethane	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) 1,1,2,2-Tetrachloroethane	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) Tetrachloroethylene	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) 1,1,2-Trichloroethane	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Leachable (SPLP) Trichloroethylene	ug/L	<0.40	0.40	7448614	<0.40	0.40	7448614	<0.40	0.40	7448614
Surrogate Recovery (%)										
Leachable (SPLP) 4-Bromofluorobenzene	%	92		7448614	94		7448614	92		7448614
Leachable (SPLP) D4-1,2-Dichloroethane	%	111		7448614	113		7448614	118		7448614
Leachable (SPLP) D8-Toluene	%	93		7448614	94		7448614	93		7448614

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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O.REG 406 EXCESS SOIL SPLP VOCS (SOIL)

BV Labs ID		PYK440	PYK441	PYK446		
Sampling Date		2021/06/24	2021/06/25	2021/05/12		
COC Number		657051-11-01	657051-11-01	657051-11-01		
	UNITS	21-42 SA5B	21-23 SA3	21-17 SA2	RDL	QC Batch
Calculated Parameters						
Leachable (ZHE) 1,3-Dichloropropene (cis+trans)	ug/L	<0.42	<0.42	<0.42	0.42	7441139
Volatile Organics						
Leachable (SPLP) Bromomethane	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) Carbon Tetrachloride	ug/L	<0.19	<0.19	<0.19	0.19	7448614
Leachable (SPLP) Chloroform	ug/L	<1.2	<1.2	<1.2	1.2	7448614
Leachable (SPLP) 1,2-Dichlorobenzene	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) 1,4-Dichlorobenzene	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) 1,1-Dichloroethane	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) 1,2-Dichloroethane	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) 1,1-Dichloroethylene	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) cis-1,2-Dichloroethylene	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) trans-1,2-Dichloroethylene	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) 1,2-Dichloropropane	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) cis-1,3-Dichloropropene	ug/L	<0.30	<0.30	<0.30	0.30	7448614
Leachable (SPLP) trans-1,3-Dichloropropene	ug/L	<0.30	<0.30	<0.30	0.30	7448614
Leachable (SPLP) Ethylene Dibromide	ug/L	<0.19	<0.19	<0.19	0.19	7448614
Leachable (SPLP) 1,1,1,2-Tetrachloroethane	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) 1,1,2,2-Tetrachloroethane	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) Tetrachloroethylene	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) 1,1,2-Trichloroethane	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Leachable (SPLP) Trichloroethylene	ug/L	<0.40	<0.40	<0.40	0.40	7448614
Surrogate Recovery (%)						
Leachable (SPLP) 4-Bromofluorobenzene	%	94	93	93		7448614
Leachable (SPLP) D4-1,2-Dichloroethane	%	116	116	118		7448614
Leachable (SPLP) D8-Toluene	%	92	94	92		7448614

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 153 PCBS (SOIL)

BV Labs ID		PYK384	PYK385	PYK386	PYK387	PYK388	PYK445		
Sampling Date		2021/06/25	2021/06/18	2021/06/24	2021/06/24	2021/06/24	2021/06/15		
COC Number		657051-10-01	657051-10-01	657051-10-01	657051-10-01	657051-10-01	657051-11-01		
	UNITS	**21-23 SA2**	**21-27 AS4**	**21-39 SA2**	**21-40 SA5**	**21-42 SA4**	**21-33 SA4**	**RDL**	**QC Batch**
PCBs									
Aroclor 1242	ug/g	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7443259
Aroclor 1248	ug/g	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7443259
Aroclor 1254	ug/g	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7443259
Aroclor 1260	ug/g	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7443259
Total PCB	ug/g	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7443259
Surrogate Recovery (%)									
Decachlorobiphenyl	%	92	89	90	83	89	86		7443259

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

O.REG 558 TCLP BENZO(A)PYRENE

BV Labs ID		PYK442	PYK443	PYK444		
Sampling Date		2021/06/18	2021/06/24	2021/06/24		
COC Number		657051-11-01	657051-11-01	657051-11-01		
	UNITS	21-27 SA2	21-39 SA3	21-40 SA1	RDL	QC Batch
Polyaromatic Hydrocarbons						
Leachable Benzo(a)pyrene	ug/L	<0.10	<0.10	<0.10	0.10	7447577
Surrogate Recovery (%)						
Leachable D10-Anthracene	%	94	95	93		7447577
Leachable D14-Terphenyl (FS)	%	83	82	78		7447577
Leachable D8-Acenaphthylene	%	99	91	91		7447577

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

O.REG 558 TCLP INORGANICS PACKAGE (SOIL)

BV Labs ID		PYK442	PYK443	PYK444		
Sampling Date		2021/06/18	2021/06/24	2021/06/24		
COC Number		657051-11-01	657051-11-01	657051-11-01		
	UNITS	21-27 SA2	21-39 SA3	21-40 SA1	RDL	QC Batch
Inorganics						
Leachable Fluoride (F-)	mg/L	<0.10	0.20	0.17	0.10	7446441
Leachable WAD Cyanide (Free)	mg/L	<0.010	<0.010	<0.010	0.010	7446451
Leachable Nitrite (N)	mg/L	<0.10	<0.10	<0.10	0.10	7446445
Leachable Nitrate (N)	mg/L	<1.0	<1.0	<1.0	1.0	7446445
Leachable Nitrate + Nitrite (N)	mg/L	<1.0	<1.0	<1.0	1.0	7446445
Metals						
Leachable Arsenic (As)	mg/L	<0.2	<0.2	<0.2	0.2	7446163
Leachable Barium (Ba)	mg/L	0.3	<0.2	1.0	0.2	7446163
Leachable Boron (B)	mg/L	0.2	0.1	0.2	0.1	7446163
Leachable Cadmium (Cd)	mg/L	<0.05	<0.05	<0.05	0.05	7446163
Leachable Chromium (Cr)	mg/L	<0.1	<0.1	<0.1	0.1	7446163
Leachable Lead (Pb)	mg/L	<0.1	<0.1	<0.1	0.1	7446163
Leachable Mercury (Hg)	mg/L	<0.001	<0.001	<0.001	0.001	7446163
Leachable Selenium (Se)	mg/L	<0.1	<0.1	<0.1	0.1	7446163
Leachable Silver (Ag)	mg/L	<0.01	<0.01	<0.01	0.01	7446163
Leachable Uranium (U)	mg/L	<0.01	<0.01	<0.01	0.01	7446163

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

O.REG 558 TCLP VOCS BY HS (SOIL)

BV Labs ID		PYK442	PYK443	PYK444		
Sampling Date		2021/06/18	2021/06/24	2021/06/24		
COC Number		657051-11-01	657051-11-01	657051-11-01		
	UNITS	21-27 SA2	21-39 SA3	21-40 SA1	RDL	QC Batch
Charge/Prep Analysis						
Amount Extracted (Wet Weight) (g)	N/A	25	25	25	N/A	7446933
Volatile Organics						
Leachable Benzene	mg/L	<0.020	<0.020	<0.020	0.020	7448583
Leachable Carbon Tetrachloride	mg/L	<0.020	<0.020	<0.020	0.020	7448583
Leachable Chlorobenzene	mg/L	<0.020	<0.020	<0.020	0.020	7448583
Leachable Chloroform	mg/L	<0.020	<0.020	<0.020	0.020	7448583
Leachable 1,2-Dichlorobenzene	mg/L	<0.050	<0.050	<0.050	0.050	7448583
Leachable 1,4-Dichlorobenzene	mg/L	<0.050	<0.050	<0.050	0.050	7448583
Leachable 1,2-Dichloroethane	mg/L	<0.050	<0.050	<0.050	0.050	7448583
Leachable 1,1-Dichloroethylene	mg/L	<0.020	<0.020	<0.020	0.020	7448583
Leachable Methylene Chloride(Dichloromethane)	mg/L	<0.20	<0.20	<0.20	0.20	7448583
Leachable Methyl Ethyl Ketone (2-Butanone)	mg/L	<1.0	<1.0	<1.0	1.0	7448583
Leachable Tetrachloroethylene	mg/L	<0.020	<0.020	<0.020	0.020	7448583
Leachable Trichloroethylene	mg/L	<0.020	<0.020	<0.020	0.020	7448583
Leachable Vinyl Chloride	mg/L	<0.020	<0.020	<0.020	0.020	7448583
Surrogate Recovery (%)						
Leachable 4-Bromofluorobenzene	%	90	91	90		7448583
Leachable D4-1,2-Dichloroethane	%	116	117	116		7448583
Leachable D8-Toluene	%	86	86	86		7448583

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

MISCELLANEOUS (SOIL)

BV Labs ID		PYK442	PYK443	PYK444	
Sampling Date		2021/06/18	2021/06/24	2021/06/24	
COC Number		657051-11-01	657051-11-01	657051-11-01	
	UNITS	21-27 SA2	21-39 SA3	21-40 SA1	QC Batch
Inorganics					
Ignitability	N/A	NF/NI	NF/NI	NF/NI	7446222
QC Batch = Quality Control Batch					

TEST SUMMARY

BV Labs ID: PYK384
Sample ID: 21-23 SA2
Matrix: Soil

Collected: 2021/06/25
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	7440873	N/A	2021/07/06	Automated Statchk
Hot Water Extractable Boron	ICP	7444001	2021/07/05	2021/07/06	Jolly John
1,3-Dichloropropene Sum	CALC	7440874	N/A	2021/07/07	Automated Statchk
Free (WAD) Cyanide	TECH	7443462	2021/07/05	2021/07/05	Aditiben Patel
Conductivity	AT	7446285	2021/07/06	2021/07/06	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	7443554	2021/07/05	2021/07/06	Rupinder Sihota
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	7443540	2021/07/05	2021/07/05	Jeevaraj Jeevaratrnam
Acid Extractable Metals by ICPMS	ICP/MS	7444438	2021/07/05	2021/07/07	Daniel Teclu
Moisture	BAL	7441990	N/A	2021/07/02	Harry Harry
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	7443487	2021/07/05	2021/07/05	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	7443259	2021/07/04	2021/07/05	Sarah Huang
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Sodium Adsorption Ratio (SAR)	CALC/MET	7440876	N/A	2021/07/07	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MSFD	7442303	N/A	2021/07/07	Anna Gabrielyan

BV Labs ID: PYK384 Dup
Sample ID: 21-23 SA2
Matrix: Soil

Collected: 2021/06/25
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	7444001	2021/07/05	2021/07/06	Jolly John
Volatile Organic Compounds and F1 PHCs	GC/MSFD	7442303	N/A	2021/07/07	Anna Gabrielyan

BV Labs ID: PYK385
Sample ID: 21-27 AS4
Matrix: Soil

Collected: 2021/06/18
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	7440873	N/A	2021/07/07	Automated Statchk
Hot Water Extractable Boron	ICP	7444001	2021/07/05	2021/07/06	Jolly John
1,3-Dichloropropene Sum	CALC	7440874	N/A	2021/07/07	Automated Statchk
Free (WAD) Cyanide	TECH	7443462	2021/07/05	2021/07/05	Aditiben Patel
Conductivity	AT	7446285	2021/07/06	2021/07/06	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	7443554	2021/07/05	2021/07/06	Rupinder Sihota
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	7441781	2021/07/02	2021/07/02	Ravinder Gaidhu
Acid Extractable Metals by ICPMS	ICP/MS	7444438	2021/07/05	2021/07/07	Daniel Teclu
Moisture	BAL	7441990	N/A	2021/07/02	Harry Harry
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	7443509	2021/07/05	2021/07/06	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	7443259	2021/07/04	2021/07/05	Sarah Huang
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Sodium Adsorption Ratio (SAR)	CALC/MET	7440876	N/A	2021/07/07	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MSFD	7442303	N/A	2021/07/07	Anna Gabrielyan

BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

TEST SUMMARY

BV Labs ID: PYK386
Sample ID: 21-39 SA2
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	7440873	N/A	2021/07/06	Automated Statchk
Hot Water Extractable Boron	ICP	7444001	2021/07/05	2021/07/06	Jolly John
1,3-Dichloropropene Sum	CALC	7440874	N/A	2021/07/07	Automated Statchk
Free (WAD) Cyanide	TECH	7443462	2021/07/05	2021/07/05	Aditiben Patel
Conductivity	AT	7446285	2021/07/06	2021/07/06	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	7443554	2021/07/05	2021/07/06	Rupinder Sihota
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	7443540	2021/07/05	2021/07/05	Jeevaraj Jeevaratrnam
Acid Extractable Metals by ICPMS	ICP/MS	7444438	2021/07/05	2021/07/07	Daniel Teclu
Moisture	BAL	7441990	N/A	2021/07/02	Harry Harry
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	7443487	2021/07/05	2021/07/05	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	7443259	2021/07/04	2021/07/05	Sarah Huang
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Sodium Adsorption Ratio (SAR)	CALC/MET	7440876	N/A	2021/07/07	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MSFD	7442303	N/A	2021/07/07	Anna Gabrielyan

BV Labs ID: PYK387
Sample ID: 21-40 SA5
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	7440873	N/A	2021/07/06	Automated Statchk
Hot Water Extractable Boron	ICP	7444001	2021/07/05	2021/07/06	Jolly John
1,3-Dichloropropene Sum	CALC	7440874	N/A	2021/07/07	Automated Statchk
Free (WAD) Cyanide	TECH	7443462	2021/07/05	2021/07/05	Aditiben Patel
Conductivity	AT	7446285	2021/07/06	2021/07/06	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	7443554	2021/07/05	2021/07/06	Rupinder Sihota
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	7443540	2021/07/05	2021/07/05	Jeevaraj Jeevaratrnam
Acid Extractable Metals by ICPMS	ICP/MS	7444438	2021/07/05	2021/07/07	Daniel Teclu
Moisture	BAL	7441990	N/A	2021/07/02	Harry Harry
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	7443487	2021/07/05	2021/07/05	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	7443259	2021/07/04	2021/07/05	Sarah Huang
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Sodium Adsorption Ratio (SAR)	CALC/MET	7440876	N/A	2021/07/07	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MSFD	7442303	N/A	2021/07/07	Anna Gabrielyan

BV Labs ID: PYK388
Sample ID: 21-42 SA4
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	7440873	N/A	2021/07/06	Automated Statchk
Hot Water Extractable Boron	ICP	7444001	2021/07/05	2021/07/06	Jolly John
1,3-Dichloropropene Sum	CALC	7440874	N/A	2021/07/07	Automated Statchk
Free (WAD) Cyanide	TECH	7443462	2021/07/05	2021/07/05	Aditiben Patel

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TEST SUMMARY

BV Labs ID: PYK388
Sample ID: 21-42 SA4
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7446285	2021/07/06	2021/07/06	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	7443554	2021/07/05	2021/07/06	Rupinder Sihota
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	7443540	2021/07/05	2021/07/05	Jeevaraj Jeevaratrnam
Acid Extractable Metals by ICPMS	ICP/MS	7444438	2021/07/05	2021/07/07	Daniel Teclu
Moisture	BAL	7441990	N/A	2021/07/02	Harry Harry
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	7443487	2021/07/05	2021/07/05	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	7443259	2021/07/04	2021/07/05	Sarah Huang
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Sodium Adsorption Ratio (SAR)	CALC/MET	7440876	N/A	2021/07/07	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MSFD	7442303	N/A	2021/07/07	Anna Gabrielyan

BV Labs ID: PYK388 Dup
Sample ID: 21-42 SA4
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7446285	2021/07/06	2021/07/06	Neil Dassanayake

BV Labs ID: PYK389
Sample ID: 21-33 SA4
Matrix: Soil

Collected: 2021/06/15
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7443990	2021/07/05	2021/07/06	Alina Dobreanu
Conductivity	AT	7443483	2021/07/05	2021/07/05	Yogesh Patel
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Resistivity of Soil		7441545	2021/07/05	2021/07/05	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7444013	2021/07/05	2021/07/06	Alina Dobreanu

BV Labs ID: PYK390
Sample ID: 21-27 SA2
Matrix: Soil

Collected: 2021/06/18
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7443645	2021/07/05	2021/07/05	Alina Dobreanu
Conductivity	AT	7443483	2021/07/05	2021/07/05	Yogesh Patel
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Resistivity of Soil		7441545	2021/07/05	2021/07/05	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7443646	2021/07/05	2021/07/05	Alina Dobreanu

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BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

TEST SUMMARY

BV Labs ID: PYK391
Sample ID: 21-40 SA2
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7443645	2021/07/05	2021/07/05	Alina Dobreanu
Conductivity	AT	7443483	2021/07/05	2021/07/05	Yogesh Patel
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Resistivity of Soil		7441545	2021/07/05	2021/07/05	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7443646	2021/07/05	2021/07/05	Alina Dobreanu

BV Labs ID: PYK392
Sample ID: 21-42 SA3
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7443645	2021/07/05	2021/07/05	Alina Dobreanu
Conductivity	AT	7443483	2021/07/05	2021/07/05	Yogesh Patel
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Resistivity of Soil		7441545	2021/07/05	2021/07/05	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7443646	2021/07/05	2021/07/05	Alina Dobreanu

BV Labs ID: PYK393
Sample ID: 21-23 SA3
Matrix: Soil

Collected: 2021/06/25
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7443645	2021/07/05	2021/07/05	Alina Dobreanu
Conductivity	AT	7446235	2021/07/06	2021/07/06	Neil Dassanayake
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Resistivity of Soil		7441545	2021/07/06	2021/07/06	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7443646	2021/07/05	2021/07/05	Alina Dobreanu

BV Labs ID: PYK393 Dup
Sample ID: 21-23 SA3
Matrix: Soil

Collected: 2021/06/25
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7443645	2021/07/05	2021/07/05	Alina Dobreanu
Conductivity	AT	7446235	2021/07/06	2021/07/06	Neil Dassanayake

BV Labs ID: PYK437
Sample ID: 21-39 SA4
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7443645	2021/07/05	2021/07/05	Alina Dobreanu
Conductivity	AT	7443483	2021/07/05	2021/07/05	Yogesh Patel
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Resistivity of Soil		7441545	2021/07/05	2021/07/05	Automated Statchk

BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

TEST SUMMARY

BV Labs ID: PYK437
Sample ID: 21-39 SA4
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate (20:1 Extract)	KONE/EC	7443646	2021/07/05	2021/07/05	Alina Dobreanu

BV Labs ID: PYK438
Sample ID: 21-27 SA3
Matrix: Soil

Collected: 2021/06/18
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
ABN Compounds in SPLP Leachates	GC/MS	7449697	2021/07/05	2021/07/08	Anh Lieu
1,3-Dichloropropene Sum	CALC	7441139	N/A	2021/07/08	Automated Statchk
Dinitrotoluene Sum	CALC	7441548	N/A	2021/07/08	Automated Statchk
Total Metals in SPLP Leachate by ICPMS	ICP/MS	7449698	2021/07/07	2021/07/08	Arefa Dabhad
Modified SPLP extraction - pH	PH	7447253	N/A	2021/07/07	Jian (Ken) Wang
Modified SPLP extraction - Weight		7447245	N/A	2021/07/07	Jian (Ken) Wang
OC Pesticides/PCB (SPLP Leachable)	GC/ECD	7450443	2021/07/07	2021/07/08	Mahmudul Khan
OC Pesticides Summed Parameters	CALC	7441546	N/A	2021/07/07	Ewa Pranjic
Volatile organics in SPLP leachates	HS/MS	7448614	N/A	2021/07/08	Juan Pangilinan

BV Labs ID: PYK438 Dup
Sample ID: 21-27 SA3
Matrix: Soil

Collected: 2021/06/18
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Volatile organics in SPLP leachates	HS/MS	7448614	N/A	2021/07/08	Juan Pangilinan

BV Labs ID: PYK439
Sample ID: 21-40 SA3
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
ABN Compounds in SPLP Leachates	GC/MS	7449697	2021/07/07	2021/07/08	Anh Lieu
1,3-Dichloropropene Sum	CALC	7441139	N/A	2021/07/08	Automated Statchk
Dinitrotoluene Sum	CALC	7441550	N/A	2021/07/08	Automated Statchk
Total Metals in SPLP Leachate by ICPMS	ICP/MS	7449698	2021/07/07	2021/07/08	Arefa Dabhad
Modified SPLP extraction - pH	PH	7447253	N/A	2021/07/07	Jian (Ken) Wang
Modified SPLP extraction - Weight		7447245	N/A	2021/07/07	Jian (Ken) Wang
OC Pesticides/PCB (SPLP Leachable)	GC/ECD	7450443	2021/07/07	2021/07/08	Mahmudul Khan
OC Pesticides Summed Parameters	CALC	7441546	N/A	2021/07/07	Ewa Pranjic
Volatile organics in SPLP leachates	HS/MS	7448614	N/A	2021/07/08	Juan Pangilinan

BV Labs ID: PYK440
Sample ID: 21-42 SA5B
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
ABN Compounds in SPLP Leachates	GC/MS	7449697	2021/07/07	2021/07/08	Anh Lieu

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TEST SUMMARY

BV Labs ID: PYK440 **Collected:** 2021/06/24
Sample ID: 21-42 SA5B **Shipped:**
Matrix: Soil **Received:** 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
1,3-Dichloropropene Sum	CALC	7441139	N/A	2021/07/08	Automated Statchk
Dinitrotoluene Sum	CALC	7441548	N/A	2021/07/08	Automated Statchk
Total Metals in SPLP Leachate by ICPMS	ICP/MS	7449698	2021/07/07	2021/07/08	Arefa Dabhad
Modified SPLP extraction - pH	PH	7447253	N/A	2021/07/07	Jian (Ken) Wang
Modified SPLP extraction - Weight		7447245	N/A	2021/07/07	Jian (Ken) Wang
OC Pesticides/PCB (SPLP Leachable)	GC/ECD	7450443	2021/07/07	2021/07/08	Mahmudul Khan
OC Pesticides Summed Parameters	CALC	7441546	N/A	2021/07/07	Ewa Pranjic
Volatile organics in SPLP leachates	HS/MS	7448614	N/A	2021/07/08	Juan Pangilinan

BV Labs ID: PYK441 **Collected:** 2021/06/25
Sample ID: 21-23 SA3 **Shipped:**
Matrix: Soil **Received:** 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
ABN Compounds in SPLP Leachates	GC/MS	7449697	2021/07/07	2021/07/08	Anh Lieu
1,3-Dichloropropene Sum	CALC	7441139	N/A	2021/07/08	Automated Statchk
Dinitrotoluene Sum	CALC	7441550	N/A	2021/07/08	Automated Statchk
Total Metals in SPLP Leachate by ICPMS	ICP/MS	7449698	2021/07/07	2021/07/08	Arefa Dabhad
Modified SPLP extraction - pH	PH	7447253	N/A	2021/07/07	Jian (Ken) Wang
Modified SPLP extraction - Weight		7447245	N/A	2021/07/07	Jian (Ken) Wang
OC Pesticides/PCB (SPLP Leachable)	GC/ECD	7450443	2021/07/07	2021/07/08	Mahmudul Khan
OC Pesticides Summed Parameters	CALC	7441546	N/A	2021/07/07	Ewa Pranjic
Volatile organics in SPLP leachates	HS/MS	7448614	N/A	2021/07/08	Juan Pangilinan

BV Labs ID: PYK441 Dup **Collected:** 2021/06/25
Sample ID: 21-23 SA3 **Shipped:**
Matrix: Soil **Received:** 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
OC Pesticides/PCB (SPLP Leachable)	GC/ECD	7450443	2021/07/07	2021/07/08	Mahmudul Khan

BV Labs ID: PYK442 **Collected:** 2021/06/18
Sample ID: 21-27 SA2 **Shipped:**
Matrix: Soil **Received:** 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Cyanide (WAD) in Leachates	SKAL/CN	7446451	N/A	2021/07/06	Aditiben Patel
Fluoride by ISE in Leachates	ISE	7446441	2021/07/06	2021/07/06	Surinder Rai
Total Metals in TCLP Leachate by ICPMS	ICP1/MS	7446163	2021/07/06	2021/07/06	Nan Raykha
Ignitability of a Sample	BAL	7446222	2021/07/06	2021/07/06	Min Yang
Nitrate(NO3) + Nitrite(NO2) in Leachate	LACH	7446445	N/A	2021/07/06	Chandra Nandlal
PAH Compounds in Leachate by GC/MS (SIM)	GC/MS	7447577	2021/07/06	2021/07/07	Mitesh Raj
TCLP Zero Headspace Extraction		7446933	2021/07/06	2021/07/07	Omer Imtiaz Uddin
VOCs in ZHE Leachates	GC/MS	7448583	2021/07/07	2021/07/07	Juan Pangilinan

TEST SUMMARY

BV Labs ID: PYK443
Sample ID: 21-39 SA3
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Cyanide (WAD) in Leachates	SKAL/CN	7446451	N/A	2021/07/06	Aditiben Patel
Fluoride by ISE in Leachates	ISE	7446441	2021/07/06	2021/07/06	Surinder Rai
Total Metals in TCLP Leachate by ICPMS	ICP1/MS	7446163	2021/07/06	2021/07/06	Nan Raykha
Ignitability of a Sample	BAL	7446222	2021/07/06	2021/07/06	Min Yang
Nitrate(NO3) + Nitrite(NO2) in Leachate	LACH	7446445	N/A	2021/07/06	Chandra Nandlal
PAH Compounds in Leachate by GC/MS (SIM)	GC/MS	7447577	2021/07/06	2021/07/07	Mitesh Raj
TCLP Zero Headspace Extraction		7446933	2021/07/06	2021/07/07	Omer Imtiaz Uddin
VOCs in ZHE Leachates	GC/MS	7448583	2021/07/07	2021/07/07	Juan Pangilinan

BV Labs ID: PYK444
Sample ID: 21-40 SA1
Matrix: Soil

Collected: 2021/06/24
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Cyanide (WAD) in Leachates	SKAL/CN	7446451	N/A	2021/07/06	Aditiben Patel
Fluoride by ISE in Leachates	ISE	7446441	2021/07/06	2021/07/06	Surinder Rai
Total Metals in TCLP Leachate by ICPMS	ICP1/MS	7446163	2021/07/06	2021/07/06	Nan Raykha
Ignitability of a Sample	BAL	7446222	2021/07/06	2021/07/06	Min Yang
Nitrate(NO3) + Nitrite(NO2) in Leachate	LACH	7446445	N/A	2021/07/06	Chandra Nandlal
PAH Compounds in Leachate by GC/MS (SIM)	GC/MS	7447577	2021/07/06	2021/07/07	Mitesh Raj
TCLP Zero Headspace Extraction		7446933	2021/07/06	2021/07/07	Omer Imtiaz Uddin
VOCs in ZHE Leachates	GC/MS	7448583	2021/07/07	2021/07/07	Juan Pangilinan

BV Labs ID: PYK445
Sample ID: 21-33 SA4
Matrix: Soil

Collected: 2021/06/15
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	7440873	N/A	2021/07/07	Automated Statchk
Hot Water Extractable Boron	ICP	7444351	2021/07/05	2021/07/05	Medhat Nasr
1,3-Dichloropropene Sum	CALC	7440874	N/A	2021/07/07	Automated Statchk
Free (WAD) Cyanide	TECH	7443462	2021/07/05	2021/07/05	Aditiben Patel
Conductivity	AT	7446285	2021/07/06	2021/07/06	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	7443554	2021/07/05	2021/07/06	Rupinder Sihota
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	7441781	2021/07/02	2021/07/02	Ravinder Gaidhu
Acid Extractable Metals by ICPMS	ICP/MS	7444438	2021/07/05	2021/07/07	Daniel Teclu
Moisture	BAL	7441990	N/A	2021/07/02	Harry Harry
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	7443509	2021/07/05	2021/07/06	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	7443259	2021/07/04	2021/07/05	Sarah Huang
pH CaCl2 EXTRACT	AT	7444166	2021/07/05	2021/07/05	Neil Dassanayake
Sodium Adsorption Ratio (SAR)	CALC/MET	7440876	N/A	2021/07/07	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MSFD	7442303	N/A	2021/07/07	Anna Gabrielyan

BV Labs Job #: C1H7791
Report Date: 2021/07/10

Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

TEST SUMMARY

BV Labs ID: PYK446
Sample ID: 21-17 SA2
Matrix: Soil

Collected: 2021/05/12
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
ABN Compounds in SPLP Leachates	GC/MS	7449697	2021/07/07	2021/07/08	Anh Lieu
1,3-Dichloropropene Sum	CALC	7441139	N/A	2021/07/08	Automated Statchk
Dinitrotoluene Sum	CALC	7441550	N/A	2021/07/08	Automated Statchk
Total Metals in SPLP Leachate by ICPMS	ICP/MS	7449698	2021/07/07	2021/07/08	Arefa Dabhad
Modified SPLP extraction - pH	PH	7447253	N/A	2021/07/07	Jian (Ken) Wang
Modified SPLP extraction - Weight		7447245	N/A	2021/07/07	Jian (Ken) Wang
OC Pesticides/PCB (SPLP Leachable)	GC/ECD	7450443	2021/07/07	2021/07/08	Mahmudul Khan
OC Pesticides Summed Parameters	CALC	7441546	N/A	2021/07/07	Ewa Pranjic
Volatile organics in SPLP leachates	HS/MS	7448614	N/A	2021/07/08	Juan Pangilinan

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	6.7°C

Detection limit of Chloroform was raised due to a higher than usual background level present.

Sample PYK385 [21-27 AS4] : VOCF1 Analysis: The sample extract was transferred from the soil before 14 days. Analysis was completed within the 40 day specified hold time.

Sample PYK438 [21-27 SA3] : SPLP VOCs Extraction: Sample extracted past holding time. Analysis was performed past sample holding time. This may increase the variability associated with these results. Reported result in a minimum concentration and is not acceptable for establishing that the waste does not exceed the regulatory level.

Sample PYK442 [21-27 SA2] : NF/NI = Non Flammable and Non Ignitable.

TCLP VOCs Extraction: Sample extracted past holding time. Analysis was performed past sample holding time. This may increase the variability associated with these results. Reported result in a minimum concentration and is not acceptable for establishing that the waste does not exceed the regulatory level.

Sample PYK443 [21-39 SA3] : NF/NI = Non Flammable and Non Ignitable.

Sample PYK444 [21-40 SA1] : Sample has been analyzed for TCLP VOC, TCLP Metals & Inorganics, TCLP Benzo(a)Pyrene and Ignitability as per client request.

NF/NI = Non Flammable and Non Ignitable.

Sample PYK445 [21-33 SA4] : VOCF1 Analysis: The sample was analyzed after the 14 day holding time specified by the method had expired.

Sample PYK446 [21-17 SA2] : SPLP VOCs Extraction: Sample extracted past holding time. Analysis was performed past sample holding time. This may increase the variability associated with these results. Reported result in a minimum concentration and is not acceptable for establishing that the waste does not exceed the regulatory level.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Leachate Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS
7441781	o-Terphenyl	2021/07/02	103	60 - 130	101	60 - 130	98	%				
7442303	4-Bromofluorobenzene	2021/07/06	104	60 - 140	103	60 - 140	99	%				
7442303	D10-o-Xylene	2021/07/06	92	60 - 130	113	60 - 130	85	%				
7442303	D4-1,2-Dichloroethane	2021/07/06	97	60 - 140	98	60 - 140	97	%				
7442303	D8-Toluene	2021/07/06	104	60 - 140	104	60 - 140	98	%				
7443259	Decachlorobiphenyl	2021/07/05	92	60 - 130	99	60 - 130	89	%				
7443487	D10-Anthracene	2021/07/05	103	50 - 130	102	50 - 130	105	%				
7443487	D14-Terphenyl (FS)	2021/07/05	99	50 - 130	102	50 - 130	90	%				
7443487	D8-Acenaphthylene	2021/07/05	86	50 - 130	86	50 - 130	73	%				
7443509	D10-Anthracene	2021/07/06	82	50 - 130	88	50 - 130	84	%				
7443509	D14-Terphenyl (FS)	2021/07/06	83	50 - 130	90	50 - 130	82	%				
7443509	D8-Acenaphthylene	2021/07/06	76	50 - 130	90	50 - 130	64	%				
7443540	o-Terphenyl	2021/07/05	88	60 - 130	91	60 - 130	89	%				
7447577	Leachable D10-Anthracene	2021/07/07	93	50 - 130	95	50 - 130	96	%				
7447577	Leachable D14-Terphenyl (FS)	2021/07/07	82	50 - 130	85	50 - 130	82	%				
7447577	Leachable D8-Acenaphthylene	2021/07/07	93	50 - 130	94	50 - 130	93	%				
7448583	Leachable 4-Bromofluorobenzene	2021/07/07	107	70 - 130	111	70 - 130	91	%				
7448583	Leachable D4-1,2-Dichloroethane	2021/07/07	104	70 - 130	103	70 - 130	113	%				
7448583	Leachable D8-Toluene	2021/07/07	107	70 - 130	105	70 - 130	86	%				
7448614	Leachable (SPLP) 4-Bromofluorobenzene	2021/07/07	106	70 - 130	105	70 - 130	93	%				
7448614	Leachable (SPLP) D4-1,2-Dichloroethane	2021/07/07	107	70 - 130	104	70 - 130	112	%				
7448614	Leachable (SPLP) D8-Toluene	2021/07/07	110	70 - 130	111	70 - 130	94	%				
7449697	Leachable (SPLP) 2,4,6-Tribromophenol	2021/07/08			NA (2)	30 - 130	70	%				
7449697	Leachable (SPLP) 2-Fluorobiphenyl	2021/07/08			NA (2)	30 - 130	49	%				
7449697	Leachable (SPLP) D14-Terphenyl (FS)	2021/07/08			NA (2)	30 - 130	67	%				
7449697	Leachable (SPLP) D5-Nitrobenzene	2021/07/08			NA (2)	30 - 130	62	%				
7450443	Leachable (SPLP) 2,4,5,6-Tetrachloro-m-xylene	2021/07/08	70	30 - 130	77	30 - 130	72	%				
7450443	Leachable (SPLP) Decachlorobiphenyl	2021/07/08	78	30 - 130	82	30 - 130	86	%				
7441781	F2 (C10-C16 Hydrocarbons)	2021/07/03	112	50 - 130	109	80 - 120	<10	ug/g	NC	30		
7441781	F3 (C16-C34 Hydrocarbons)	2021/07/03	110	50 - 130	106	80 - 120	<50	ug/g	NC	30		
7441781	F4 (C34-C50 Hydrocarbons)	2021/07/03	114	50 - 130	110	80 - 120	<50	ug/g	NC	30		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Leachate Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS
7441990	Moisture	2021/07/02							1.1	20		
7442303	1,1,1,2-Tetrachloroethane	2021/07/07	95	60 - 140	109	60 - 130	<0.050	ug/g	NC	50		
7442303	1,1,1-Trichloroethane	2021/07/07	97	60 - 140	110	60 - 130	<0.050	ug/g	NC	50		
7442303	1,1,2,2-Tetrachloroethane	2021/07/07	88	60 - 140	101	60 - 130	<0.050	ug/g	NC	50		
7442303	1,1,2-Trichloroethane	2021/07/07	96	60 - 140	110	60 - 130	<0.050	ug/g	NC	50		
7442303	1,1-Dichloroethane	2021/07/07	90	60 - 140	103	60 - 130	<0.050	ug/g	NC	50		
7442303	1,1-Dichloroethylene	2021/07/07	98	60 - 140	112	60 - 130	<0.050	ug/g	NC	50		
7442303	1,2-Dichlorobenzene	2021/07/07	92	60 - 140	109	60 - 130	<0.050	ug/g	NC	50		
7442303	1,2-Dichloroethane	2021/07/07	89	60 - 140	102	60 - 130	<0.050	ug/g	NC	50		
7442303	1,2-Dichloropropane	2021/07/07	88	60 - 140	100	60 - 130	<0.050	ug/g	NC	50		
7442303	1,3-Dichlorobenzene	2021/07/07	93	60 - 140	109	60 - 130	<0.050	ug/g	NC	50		
7442303	1,4-Dichlorobenzene	2021/07/07	108	60 - 140	126	60 - 130	<0.050	ug/g	NC	50		
7442303	Acetone (2-Propanone)	2021/07/07	100	60 - 140	114	60 - 140	<0.50	ug/g	NC	50		
7442303	Benzene	2021/07/07	87	60 - 140	100	60 - 130	<0.020	ug/g	NC	50		
7442303	Bromodichloromethane	2021/07/07	93	60 - 140	106	60 - 130	<0.050	ug/g	NC	50		
7442303	Bromoform	2021/07/07	92	60 - 140	106	60 - 130	<0.050	ug/g	NC	50		
7442303	Bromomethane	2021/07/07	83	60 - 140	93	60 - 140	<0.050	ug/g	NC	50		
7442303	Carbon Tetrachloride	2021/07/07	96	60 - 140	110	60 - 130	<0.050	ug/g	NC	50		
7442303	Chlorobenzene	2021/07/07	96	60 - 140	110	60 - 130	<0.050	ug/g	NC	50		
7442303	Chloroform	2021/07/07	92	60 - 140	105	60 - 130	<0.050	ug/g	NC	50		
7442303	cis-1,2-Dichloroethylene	2021/07/07	95	60 - 140	108	60 - 130	<0.050	ug/g	NC	50		
7442303	cis-1,3-Dichloropropene	2021/07/07	77	60 - 140	86	60 - 130	<0.030	ug/g	NC	50		
7442303	Dibromochloromethane	2021/07/07	92	60 - 140	106	60 - 130	<0.050	ug/g	NC	50		
7442303	Dichlorodifluoromethane (FREON 12)	2021/07/07	85	60 - 140	99	60 - 140	<0.050	ug/g	NC	50		
7442303	Ethylbenzene	2021/07/07	92	60 - 140	105	60 - 130	<0.020	ug/g	NC	50		
7442303	Ethylene Dibromide	2021/07/07	89	60 - 140	102	60 - 130	<0.050	ug/g	NC	50		
7442303	F1 (C6-C10) - BTEX	2021/07/07					<10	ug/g	NC	30		
7442303	F1 (C6-C10)	2021/07/07	92	60 - 140	86	80 - 120	<10	ug/g	NC	30		
7442303	Hexane	2021/07/07	99	60 - 140	111	60 - 130	<0.050	ug/g	NC	50		
7442303	Methyl Ethyl Ketone (2-Butanone)	2021/07/07	100	60 - 140	114	60 - 140	<0.50	ug/g	NC	50		
7442303	Methyl Isobutyl Ketone	2021/07/07	95	60 - 140	110	60 - 130	<0.50	ug/g	NC	50		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Leachate Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS
7442303	Methyl t-butyl ether (MTBE)	2021/07/07	91	60 - 140	104	60 - 130	<0.050	ug/g	NC	50		
7442303	Methylene Chloride(Dichloromethane)	2021/07/07	88	60 - 140	100	60 - 130	<0.050	ug/g	NC	50		
7442303	o-Xylene	2021/07/07	93	60 - 140	107	60 - 130	<0.020	ug/g	NC	50		
7442303	p+m-Xylene	2021/07/07	97	60 - 140	111	60 - 130	<0.020	ug/g	NC	50		
7442303	Styrene	2021/07/07	102	60 - 140	117	60 - 130	<0.050	ug/g	NC	50		
7442303	Tetrachloroethylene	2021/07/07	92	60 - 140	105	60 - 130	<0.050	ug/g	NC	50		
7442303	Toluene	2021/07/07	89	60 - 140	101	60 - 130	<0.020	ug/g	0.37	50		
7442303	Total Xylenes	2021/07/07					<0.020	ug/g	NC	50		
7442303	trans-1,2-Dichloroethylene	2021/07/07	96	60 - 140	109	60 - 130	<0.050	ug/g	NC	50		
7442303	trans-1,3-Dichloropropene	2021/07/07	79	60 - 140	88	60 - 130	<0.040	ug/g	NC	50		
7442303	Trichloroethylene	2021/07/07	100	60 - 140	115	60 - 130	<0.050	ug/g	NC	50		
7442303	Trichlorofluoromethane (FREON 11)	2021/07/07	96	60 - 140	109	60 - 130	<0.050	ug/g	NC	50		
7442303	Vinyl Chloride	2021/07/07	92	60 - 140	105	60 - 130	<0.020	ug/g	NC	50		
7443259	Aroclor 1242	2021/07/05					<0.010	ug/g	NC	50		
7443259	Aroclor 1248	2021/07/05					<0.010	ug/g	NC	50		
7443259	Aroclor 1254	2021/07/05					<0.010	ug/g	NC	50		
7443259	Aroclor 1260	2021/07/05	105	30 - 130	116	30 - 130	<0.010	ug/g	NC	50		
7443259	Total PCB	2021/07/05	105	30 - 130	116	30 - 130	<0.010	ug/g	NC	50		
7443462	WAD Cyanide (Free)	2021/07/05	89	75 - 125	89	80 - 120	<0.01	ug/g	NC	35		
7443483	Conductivity	2021/07/05			100	90 - 110	<2	umho/cm	2.3	10		
7443487	1-Methylnaphthalene	2021/07/05	91	50 - 130	98	50 - 130	<0.0050	ug/g	NC	40		
7443487	2-Methylnaphthalene	2021/07/05	87	50 - 130	91	50 - 130	<0.0050	ug/g	NC	40		
7443487	Acenaphthene	2021/07/05	91	50 - 130	91	50 - 130	<0.0050	ug/g	NC	40		
7443487	Acenaphthylene	2021/07/05	84	50 - 130	86	50 - 130	<0.0050	ug/g	NC	40		
7443487	Anthracene	2021/07/05	95	50 - 130	95	50 - 130	<0.0050	ug/g	NC	40		
7443487	Benzo(a)anthracene	2021/07/05	95	50 - 130	93	50 - 130	<0.0050	ug/g	NC	40		
7443487	Benzo(a)pyrene	2021/07/05	78	50 - 130	83	50 - 130	<0.0050	ug/g	NC	40		
7443487	Benzo(b/j)fluoranthene	2021/07/05	95	50 - 130	95	50 - 130	<0.0050	ug/g	NC	40		
7443487	Benzo(g,h,i)perylene	2021/07/05	96	50 - 130	99	50 - 130	<0.0050	ug/g	NC	40		
7443487	Benzo(k)fluoranthene	2021/07/05	88	50 - 130	102	50 - 130	<0.0050	ug/g	NC	40		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Leachate Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS
7443487	Biphenyl	2021/07/05	92	50 - 130	93	50 - 130	<0.0050	ug/g				
7443487	Chrysene	2021/07/05	94	50 - 130	96	50 - 130	<0.0050	ug/g	NC	40		
7443487	Dibenzo(a,h)anthracene	2021/07/05	93	50 - 130	93	50 - 130	<0.0050	ug/g	NC	40		
7443487	Fluoranthene	2021/07/05	99	50 - 130	107	50 - 130	<0.0050	ug/g	NC	40		
7443487	Fluorene	2021/07/05	92	50 - 130	92	50 - 130	<0.0050	ug/g	NC	40		
7443487	Indeno(1,2,3-cd)pyrene	2021/07/05	94	50 - 130	102	50 - 130	<0.0050	ug/g	NC	40		
7443487	Naphthalene	2021/07/05	80	50 - 130	88	50 - 130	<0.0050	ug/g	NC	40		
7443487	Phenanthrene	2021/07/05	90	50 - 130	92	50 - 130	<0.0050	ug/g	NC	40		
7443487	Pyrene	2021/07/05	98	50 - 130	105	50 - 130	<0.0050	ug/g	NC	40		
7443509	1-Methylnaphthalene	2021/07/06	84	50 - 130	94	50 - 130	<0.0050	ug/g	NC	40		
7443509	2-Methylnaphthalene	2021/07/06	80	50 - 130	86	50 - 130	<0.0050	ug/g	NC	40		
7443509	Acenaphthene	2021/07/06	76	50 - 130	84	50 - 130	<0.0050	ug/g	NC	40		
7443509	Acenaphthylene	2021/07/06	76	50 - 130	88	50 - 130	<0.0050	ug/g	111 (1)	40		
7443509	Anthracene	2021/07/06	83	50 - 130	89	50 - 130	<0.0050	ug/g	114 (1)	40		
7443509	Benzo(a)anthracene	2021/07/06	92	50 - 130	96	50 - 130	<0.0050	ug/g	127 (1)	40		
7443509	Benzo(a)pyrene	2021/07/06	57	50 - 130	84	50 - 130	<0.0050	ug/g	131 (1)	40		
7443509	Benzo(b/j)fluoranthene	2021/07/06	NC	50 - 130	90	50 - 130	<0.0050	ug/g	125 (1)	40		
7443509	Benzo(g,h,i)perylene	2021/07/06	67	50 - 130	88	50 - 130	<0.0050	ug/g	120 (1)	40		
7443509	Benzo(k)fluoranthene	2021/07/06	96	50 - 130	84	50 - 130	<0.0050	ug/g	125 (1)	40		
7443509	Biphenyl	2021/07/06	81	50 - 130	89	50 - 130	<0.0050	ug/g				
7443509	Chrysene	2021/07/06	85	50 - 130	93	50 - 130	<0.0050	ug/g	124 (1)	40		
7443509	Dibenzo(a,h)anthracene	2021/07/06	81	50 - 130	100	50 - 130	<0.0050	ug/g	122 (1)	40		
7443509	Fluoranthene	2021/07/06	127	50 - 130	97	50 - 130	<0.0050	ug/g	105 (1)	40		
7443509	Fluorene	2021/07/06	80	50 - 130	88	50 - 130	<0.0050	ug/g	NC	40		
7443509	Indeno(1,2,3-cd)pyrene	2021/07/06	75	50 - 130	102	50 - 130	<0.0050	ug/g	124 (1)	40		
7443509	Naphthalene	2021/07/06	71	50 - 130	79	50 - 130	<0.0050	ug/g	NC	40		
7443509	Phenanthrene	2021/07/06	97	50 - 130	89	50 - 130	<0.0050	ug/g	140 (1)	40		
7443509	Pyrene	2021/07/06	112	50 - 130	97	50 - 130	<0.0050	ug/g	104 (1)	40		
7443540	F2 (C10-C16 Hydrocarbons)	2021/07/05	94	50 - 130	99	80 - 120	<10	ug/g	NC	30		
7443540	F3 (C16-C34 Hydrocarbons)	2021/07/05	93	50 - 130	98	80 - 120	<50	ug/g	NC	30		
7443540	F4 (C34-C50 Hydrocarbons)	2021/07/05	93	50 - 130	99	80 - 120	<50	ug/g	NC	30		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Leachate Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS
7443554	Chromium (VI)	2021/07/06	72	70 - 130	87	80 - 120	<0.18	ug/g	NC	35		
7443645	Soluble (20:1) Chloride (Cl-)	2021/07/05	NC	70 - 130	105	70 - 130	<20	ug/g	6.6	35		
7443646	Soluble (20:1) Sulphate (SO4)	2021/07/05	NC	70 - 130	107	70 - 130	<20	ug/g	7.0	35		
7443990	Soluble (20:1) Chloride (Cl-)	2021/07/06	NC	70 - 130	103	70 - 130	<20	ug/g	2.1	35		
7444001	Hot Water Ext. Boron (B)	2021/07/06	107	75 - 125	102	75 - 125	<0.050	ug/g	7.3	40		
7444013	Soluble (20:1) Sulphate (SO4)	2021/07/06	NC	70 - 130	104	70 - 130	<20	ug/g	4.8	35		
7444166	Available (CaCl2) pH	2021/07/05			100	97 - 103			0.68	N/A		
7444351	Hot Water Ext. Boron (B)	2021/07/05	94	75 - 125	91	75 - 125	<0.050	ug/g	4.7	40		
7444438	Acid Extractable Antimony (Sb)	2021/07/07	97	75 - 125	105	80 - 120	<0.20	ug/g	NC	30		
7444438	Acid Extractable Arsenic (As)	2021/07/07	98	75 - 125	103	80 - 120	<1.0	ug/g	1.6	30		
7444438	Acid Extractable Barium (Ba)	2021/07/07	110	75 - 125	101	80 - 120	<0.50	ug/g	2.1	30		
7444438	Acid Extractable Beryllium (Be)	2021/07/07	93	75 - 125	95	80 - 120	<0.20	ug/g	NC	30		
7444438	Acid Extractable Boron (B)	2021/07/07	92	75 - 125	97	80 - 120	<5.0	ug/g	NC	30		
7444438	Acid Extractable Cadmium (Cd)	2021/07/07	102	75 - 125	101	80 - 120	<0.10	ug/g	NC	30		
7444438	Acid Extractable Chromium (Cr)	2021/07/07	103	75 - 125	102	80 - 120	<1.0	ug/g	6.1	30		
7444438	Acid Extractable Cobalt (Co)	2021/07/07	98	75 - 125	101	80 - 120	<0.10	ug/g	7.6	30		
7444438	Acid Extractable Copper (Cu)	2021/07/07	96	75 - 125	101	80 - 120	<0.50	ug/g	2.8	30		
7444438	Acid Extractable Lead (Pb)	2021/07/07	98	75 - 125	103	80 - 120	<1.0	ug/g	0.28	30		
7444438	Acid Extractable Mercury (Hg)	2021/07/07	92	75 - 125	101	80 - 120	<0.050	ug/g				
7444438	Acid Extractable Molybdenum (Mo)	2021/07/07	102	75 - 125	102	80 - 120	<0.50	ug/g	NC	30		
7444438	Acid Extractable Nickel (Ni)	2021/07/07	99	75 - 125	101	80 - 120	<0.50	ug/g	7.9	30		
7444438	Acid Extractable Selenium (Se)	2021/07/07	102	75 - 125	104	80 - 120	<0.50	ug/g	NC	30		
7444438	Acid Extractable Silver (Ag)	2021/07/07	99	75 - 125	102	80 - 120	<0.20	ug/g	NC	30		
7444438	Acid Extractable Thallium (Tl)	2021/07/07	97	75 - 125	101	80 - 120	<0.050	ug/g	NC	30		
7444438	Acid Extractable Uranium (U)	2021/07/07	103	75 - 125	105	80 - 120	<0.050	ug/g	1.0	30		
7444438	Acid Extractable Vanadium (V)	2021/07/07	100	75 - 125	103	80 - 120	<5.0	ug/g	13	30		
7444438	Acid Extractable Zinc (Zn)	2021/07/07	100	75 - 125	107	80 - 120	<5.0	ug/g	0.31	30		
7446163	Leachable Arsenic (As)	2021/07/06	101	80 - 120	98	80 - 120	<0.2	mg/L	NC	35	<0.2	mg/L
7446163	Leachable Barium (Ba)	2021/07/06	NC	80 - 120	102	80 - 120	<0.2	mg/L	3.1	35	<0.2	mg/L
7446163	Leachable Boron (B)	2021/07/06	103	80 - 120	105	80 - 120	<0.1	mg/L	2.0	35	<0.1	mg/L
7446163	Leachable Cadmium (Cd)	2021/07/06	103	80 - 120	101	80 - 120	<0.05	mg/L	NC	35	<0.05	mg/L

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Leachate Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS
7446163	Leachable Chromium (Cr)	2021/07/06	100	80 - 120	99	80 - 120	<0.1	mg/L	NC	35	<0.1	mg/L
7446163	Leachable Lead (Pb)	2021/07/06	96	80 - 120	97	80 - 120	<0.1	mg/L	NC	35	<0.1	mg/L
7446163	Leachable Mercury (Hg)	2021/07/06	99	80 - 120	101	80 - 120	<0.001	mg/L	NC	35	<0.001	mg/L
7446163	Leachable Selenium (Se)	2021/07/06	97	80 - 120	100	80 - 120	<0.1	mg/L	NC	35	<0.1	mg/L
7446163	Leachable Silver (Ag)	2021/07/06	104	80 - 120	104	80 - 120	<0.01	mg/L	NC	35	<0.01	mg/L
7446163	Leachable Uranium (U)	2021/07/06	96	80 - 120	95	80 - 120	<0.01	mg/L	NC	35	<0.01	mg/L
7446235	Conductivity	2021/07/06			99	90 - 110	<2	umho/cm	0.92	10		
7446285	Conductivity	2021/07/06			99	90 - 110	<0.002	mS/cm	0	10		
7446441	Leachable Fluoride (F-)	2021/07/06	122 (1)	80 - 120	99	80 - 120	<0.10	mg/L	1.9	25	<0.10	mg/L
7446445	Leachable Nitrate (N)	2021/07/06	99	80 - 120	94	80 - 120	<1.0	mg/L	NC	25	<1.0	mg/L
7446445	Leachable Nitrate + Nitrite (N)	2021/07/06	101	80 - 120	97	80 - 120	<1.0	mg/L	NC	25	<1.0	mg/L
7446445	Leachable Nitrite (N)	2021/07/06	109	80 - 120	105	80 - 120	<0.10	mg/L	NC	25	<0.10	mg/L
7446451	Leachable WAD Cyanide (Free)	2021/07/06	98	80 - 120	97	80 - 120	<0.0020	mg/L	NC	20	<0.010	mg/L
7447577	Leachable Benzo(a)pyrene	2021/07/07	78	50 - 130	80	50 - 130	<0.10	ug/L	NC	40		
7448583	Leachable 1,1-Dichloroethylene	2021/07/07	102	70 - 130	99	70 - 130	<0.020	mg/L	NC	30		
7448583	Leachable 1,2-Dichlorobenzene	2021/07/07	97	70 - 130	90	70 - 130	<0.050	mg/L	NC	30		
7448583	Leachable 1,2-Dichloroethane	2021/07/07	102	70 - 130	99	70 - 130	<0.050	mg/L	NC	30		
7448583	Leachable 1,4-Dichlorobenzene	2021/07/07	115	70 - 130	106	70 - 130	<0.050	mg/L	NC	30		
7448583	Leachable Benzene	2021/07/07	96	70 - 130	93	70 - 130	<0.020	mg/L	NC	30		
7448583	Leachable Carbon Tetrachloride	2021/07/07	110	70 - 130	105	70 - 130	<0.020	mg/L	NC	30		
7448583	Leachable Chlorobenzene	2021/07/07	101	70 - 130	97	70 - 130	<0.020	mg/L	NC	30		
7448583	Leachable Chloroform	2021/07/07	105	70 - 130	101	70 - 130	<0.020	mg/L	NC	30		
7448583	Leachable Methyl Ethyl Ketone (2-Butanone)	2021/07/07	108	60 - 140	107	60 - 140	<1.0	mg/L	NC	30		
7448583	Leachable Methylene Chloride (Dichloromethane)	2021/07/07	103	70 - 130	99	70 - 130	<0.20	mg/L	NC	30		
7448583	Leachable Tetrachloroethylene	2021/07/07	103	70 - 130	97	70 - 130	<0.020	mg/L	NC	30		
7448583	Leachable Trichloroethylene	2021/07/07	111	70 - 130	107	70 - 130	<0.020	mg/L	NC	30		
7448583	Leachable Vinyl Chloride	2021/07/07	104	70 - 130	99	70 - 130	<0.020	mg/L	NC	30		
7448614	Leachable (SPLP) 1,1,1,2-Tetrachloroethane	2021/07/08	95	70 - 130	97	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) 1,1,2,2-Tetrachloroethane	2021/07/08	99	70 - 130	100	70 - 130	<0.40	ug/L	NC	30		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Leachate Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS
7448614	Leachable (SPLP) 1,1,2-Trichloroethane	2021/07/08	106	70 - 130	108	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) 1,1-Dichloroethane	2021/07/08	94	70 - 130	96	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) 1,1-Dichloroethylene	2021/07/08	94	70 - 130	98	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) 1,2-Dichlorobenzene	2021/07/08	89	70 - 130	93	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) 1,2-Dichloroethane	2021/07/08	98	70 - 130	98	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) 1,2-Dichloropropane	2021/07/08	99	70 - 130	101	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) 1,4-Dichlorobenzene	2021/07/08	98	70 - 130	105	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) Bromomethane	2021/07/08	91	60 - 140	91	60 - 140	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) Carbon Tetrachloride	2021/07/08	95	70 - 130	99	70 - 130	<0.19	ug/L	NC	30		
7448614	Leachable (SPLP) Chloroform	2021/07/08	99	70 - 130	100	70 - 130	<1.2	ug/L	NC	30		
7448614	Leachable (SPLP) cis-1,2-Dichloroethylene	2021/07/08	99	70 - 130	101	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) cis-1,3-Dichloropropene	2021/07/08	94	70 - 130	91	70 - 130	<0.30	ug/L	NC	30		
7448614	Leachable (SPLP) Ethylene Dibromide	2021/07/08	99	70 - 130	99	70 - 130	<0.19	ug/L	NC	30		
7448614	Leachable (SPLP) Tetrachloroethylene	2021/07/08	87	70 - 130	91	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) trans-1,2-Dichloroethylene	2021/07/08	94	70 - 130	99	70 - 130	<0.40	ug/L	NC	30		
7448614	Leachable (SPLP) trans-1,3-Dichloropropene	2021/07/08	104	70 - 130	99	70 - 130	<0.30	ug/L	NC	30		
7448614	Leachable (SPLP) Trichloroethylene	2021/07/08	97	70 - 130	100	70 - 130	<0.40	ug/L	NC	30		
7449697	Leachable (SPLP) 2,4,6-Trichlorophenol	2021/07/08			81	10 - 130	<0.70	ug/L	1.4	40		
7449697	Leachable (SPLP) 2,4-Dinitrophenol	2021/07/08			108	10 - 130	<5.0	ug/L	0.87	40		
7449697	Leachable (SPLP) 2,4-Dinitrotoluene	2021/07/08			85	30 - 130	<3.0	ug/L	0.66	40		
7449697	Leachable (SPLP) 2,6-Dinitrotoluene	2021/07/08			77	30 - 130	<3.0	ug/L	0.31	40		
7449697	Leachable (SPLP) 3,3'-Dichlorobenzidine	2021/07/08			86	30 - 130	<0.40	ug/L	1.1	40		
7449697	Leachable (SPLP) Bis(2-chloroethyl)ether	2021/07/08			74	30 - 130	<2.0	ug/L	1.9	40		
7449697	Leachable (SPLP) Bis(2-chloroisopropyl)ether	2021/07/08			67	30 - 130	<2.0	ug/L	0.89	40		
7449697	Leachable (SPLP) Diethyl phthalate	2021/07/08			85	30 - 130	<1.0	ug/L	1.3	40		
7449697	Leachable (SPLP) Dimethyl phthalate	2021/07/08			90	30 - 130	<1.0	ug/L	0.50	40		
7449697	Leachable (SPLP) p-Chloroaniline	2021/07/08			100	30 - 130	<5.0	ug/L	1.5	40		
7449698	Leachable (SPLP) Antimony (Sb)	2021/07/08	98	80 - 120	98	80 - 120	<0.5	ug/L			<0.5	ug/L
7449698	Leachable (SPLP) Arsenic (As)	2021/07/08	97	80 - 120	98	80 - 120	<1	ug/L			<1	ug/L
7449698	Leachable (SPLP) Barium (Ba)	2021/07/08	90	80 - 120	96	80 - 120	<5	ug/L			<5	ug/L
7449698	Leachable (SPLP) Beryllium (Be)	2021/07/08	92	80 - 120	100	80 - 120	<0.5	ug/L			<0.5	ug/L

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Leachate Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS
7449698	Leachable (SPLP) Boron (B)	2021/07/08	91	80 - 120	97	80 - 120	<10	ug/L			<10	ug/L
7449698	Leachable (SPLP) Cadmium (Cd)	2021/07/08	97	80 - 120	98	80 - 120	<0.1	ug/L			<0.1	ug/L
7449698	Leachable (SPLP) Chromium (Cr)	2021/07/08	91	80 - 120	94	80 - 120	<5	ug/L			<5	ug/L
7449698	Leachable (SPLP) Cobalt (Co)	2021/07/08	94	80 - 120	99	80 - 120	<0.5	ug/L			<0.5	ug/L
7449698	Leachable (SPLP) Copper (Cu)	2021/07/08	94	80 - 120	97	80 - 120	<1	ug/L			<1	ug/L
7449698	Leachable (SPLP) Lead (Pb)	2021/07/08	94	80 - 120	100	80 - 120	<0.5	ug/L			<0.5	ug/L
7449698	Leachable (SPLP) Molybdenum (Mo)	2021/07/08	95	80 - 120	95	80 - 120	<1	ug/L			<1	ug/L
7449698	Leachable (SPLP) Nickel (Ni)	2021/07/08	93	80 - 120	97	80 - 120	<1	ug/L			<1	ug/L
7449698	Leachable (SPLP) Selenium (Se)	2021/07/08	100	80 - 120	103	80 - 120	<2	ug/L			<2	ug/L
7449698	Leachable (SPLP) Silver (Ag)	2021/07/08	93	80 - 120	94	80 - 120	<0.1	ug/L			<0.1	ug/L
7449698	Leachable (SPLP) Thallium (Tl)	2021/07/08	92	80 - 120	99	80 - 120	<0.05	ug/L			<0.05	ug/L
7449698	Leachable (SPLP) Uranium (U)	2021/07/08	103	80 - 120	103	80 - 120	<0.1	ug/L			<0.1	ug/L
7449698	Leachable (SPLP) Vanadium (V)	2021/07/08	95	80 - 120	96	80 - 120	<1	ug/L			<1	ug/L
7449698	Leachable (SPLP) Zinc (Zn)	2021/07/08	94	80 - 120	99	80 - 120	<5	ug/L			<5	ug/L
7450443	Leachable (SPLP) Dieldrin	2021/07/08	95	50 - 130	99	50 - 130	<0.006	ug/L	NC	40		
7450443	Leachable (SPLP) Endrin	2021/07/08	87	50 - 130	88	50 - 130	<0.006	ug/L	NC	40		
7450443	Leachable (SPLP) Heptachlor epoxide	2021/07/08	84	50 - 130	87	50 - 130	<0.006	ug/L	NC	40		

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Leachate Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS
7450443	Leachable (SPLP) Heptachlor	2021/07/08	73	50 - 130	77	50 - 130	<0.006	ug/L	NC	40		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Leachate Blank: A blank matrix containing all reagents used in the leaching procedure. Used to determine any process contamination.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(2) Surrogate recovery was not available (NA).The data quality is not affected since all Target Analyte recoveries were within the limits.

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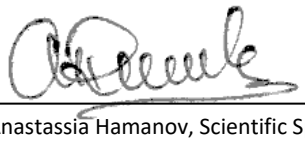
BV Labs Job #: C1H7791
Report Date: 2021/07/10

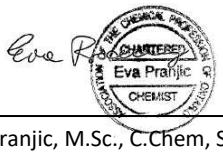
Golder Associates Ltd
Client Project #: 1530382 (7000)
Site Location: QEW/DIXIE
Sampler Initials: AM

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Anastassia Hamanov, Scientific Specialist



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam
A Bureau Veritas Group Company

Maxxam Analytics International Corporation o/a Maxxam Analytics
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-563-6266 Fax:(905) 817-5777 www.maxxam.ca

CHAIN OF CUSTODY RECORD

Page 1 of 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#1326 Golder Associates Ltd	Company Name:		Quotation #:	B80683	Maxxam Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Brad Crowe Katie Nero	P.O. #:			657051
Address:	6925 Century Ave Suite 100 Mississauga ON L5N 7K2	Address:		Project:	~~1668975~~ 1530382/7000	COC #:	Project Manager:
Tel:	(905) 567-4444 x	Tel:	(905) 567-6100 x~~1486~~	Project Name:	QEW/DIXIE	C#657051-10-01	Ema Gitej
Fax:	(905) 567-6561 x	Fax:		Site #:			
Email:	AP_CustomerService@golder.com	Email:	bcrowe@golder.com knero@golder.com	Sampled By:	ATM		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine	☐ CCME ☐ Sanitary Sewer Bylaw	
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ Reg 558 ☐ Storm Sewer Bylaw	
☐ Table 3 ☐ Agri/Other ☐ For RSC	☐ MISA Municipality	
☐ Table ___	☐ PWQO	
	☐ Other	

Include Criteria on Certificate of Analysis (Y/N)? ____

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: _____ Time Required: ____ ☐
Rush Confirmation Number: _____ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	O.Reg 153 Metals & Inorganics Pkg (Soil)	O.Reg 153 VOCs by HS & F1-F4 (Soil)	O.Reg 153 PAHs (Soil)	O.Reg 406 Mtl/VOCs/PAHs/PCBs	Corrosivity Package					# of Bottles	Comments
1		21-23 SA2	2021/6/25	AM	SOIL					X						5	
2		21-27 AS4	2021/6/18	↓	SOIL					X						5	
3		21-39 SA2	2021/6/24		SOIL					X						5	
4		21-40 SA5	2021/6/24		SOIL					X						5	
5		21-42 SA4	2021/6/24	↓	SOIL					X						5	
6		21-33 SA4	2021/6/15	AM	SOIL						X					1	
7		21-27 SA2	2021/6/18	AM	SOIL						X					1	
8		21-40 SA2	2021/6/24	11	11						X					1	
9		21-42 SA3	2021/6/24	AM	SOIL						X					1	
10		21-23 SA3	2021/6/25	AM	SOIL						X					1	

28-Jun-21 09:18
Ema Gitej
C1H7791
ATM ENV-571

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only				
	21/6/28	915AM			09:18		Time Sensitive	Temperature (°C) on Recei 7.1 7.6	Custody Seal Present / Intact	Yes	No ✓

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT HTTP://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIO-COC.PDF.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

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CHAIN OF CUSTODY RECORD — Page 2 of 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#1326 Golder Associates Ltd	Company Name:	→	Quotation #:	B80683	Maxxam Job #:	Bottle Order #: 657051
Attention:	Accounts Payable	Attention:	~~Brad Crowe~~ Katie Nero	P.O. #:			
Address:	6925 Century Ave Suite 100, Mississauga ON L5N 7K2	Address:		Project:	~~1668975~~ 1530382/7000	COC #: C#657051-11-01	Project Manager: Ema Gitej
Tel:	(905) 567-4444 x Fax: (905) 567-6561 x	Tel:	(905) 567-6100 x~~1488~~ Fax:	Project Name:	QEW/DIXIE		
Email:	AP_CustomerService@golder.com	Email:	~~bcrowe@golder.com~~ knero@golder.com	Site #:			
				Sampled By:	AM		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ______ ☐ PWQO ☐ Other ______

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)? ______

ANALYSIS REQUESTED (PLEASE BE SPECIFIC): Field Filtered (please circle): Metals / Hg / Cr VI; O.Reg 153 Metals & Inorganics Pkg (Soil); O.Reg 153 VOCs by HS & F1-F4 (Soil); O.Reg 153 PAHs (Soil); Corrosivity Package; O.Reg 406/19 SPLP; TCLP; O.Reg 406 Metals/VOCs/PHCs/PCBs/PAH

Turnaround Time (TAT) Required: Please provide advance notice for rush projects
Regular (Standard) TAT: ☒ (will be applied if Rush TAT is not specified). Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.
Job Specific Rush TAT (if applies to entire submission): Date Required: ______ Time Required: ______ Rush Confirmation Number: ______ (call lab for #)

#	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered	Metals & Inorganics	VOCs/F1-F4	PAHs	Corrosivity Package	O.Reg 406/19 SPLP	TCLP		O.Reg 406 Metals/VOCs/PHCs/PCBs/PAH			# of Bottles	Comments
1		21-39 SA4	2021/6/24	AM	SOIL					X						*	1	
2		21-27 SA3	2021/6/18	AM	SOIL						X						2	
3		21-40 SA3	2021/6/24	AM	SOIL						X						2	
4		21-42 SA5B	2021/6/24	AM	SOIL						X						2	
5		21-23 SA3	2021/6/25	AM	SOIL						X						2	
6		21-27 SA2	2021/6/18	AM	SOIL							X					2	
7		21-39 SA3	2021/6/24	AM	SOIL							X					2	
8		21-40 SA1	2021/6/24	AM	SOIL							X					2	
9		21-33 SA4	2021/6/15	AM	SOIL									X			5	
10		21-17 SA2	2021/5/12	AM	SOIL						X	~~X~~					2	

RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Time Sensitive	Laboratory Use Only
[signature]	21/6/28	9:15AM	[signature]	2021/06/28	0918			Temperature (°C) on Recei: 7/7/6, 7/7/6; Custody Seal: Yes / No ✓; Present; Intact

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.

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** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT HTTP://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIO-COC.PDF.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

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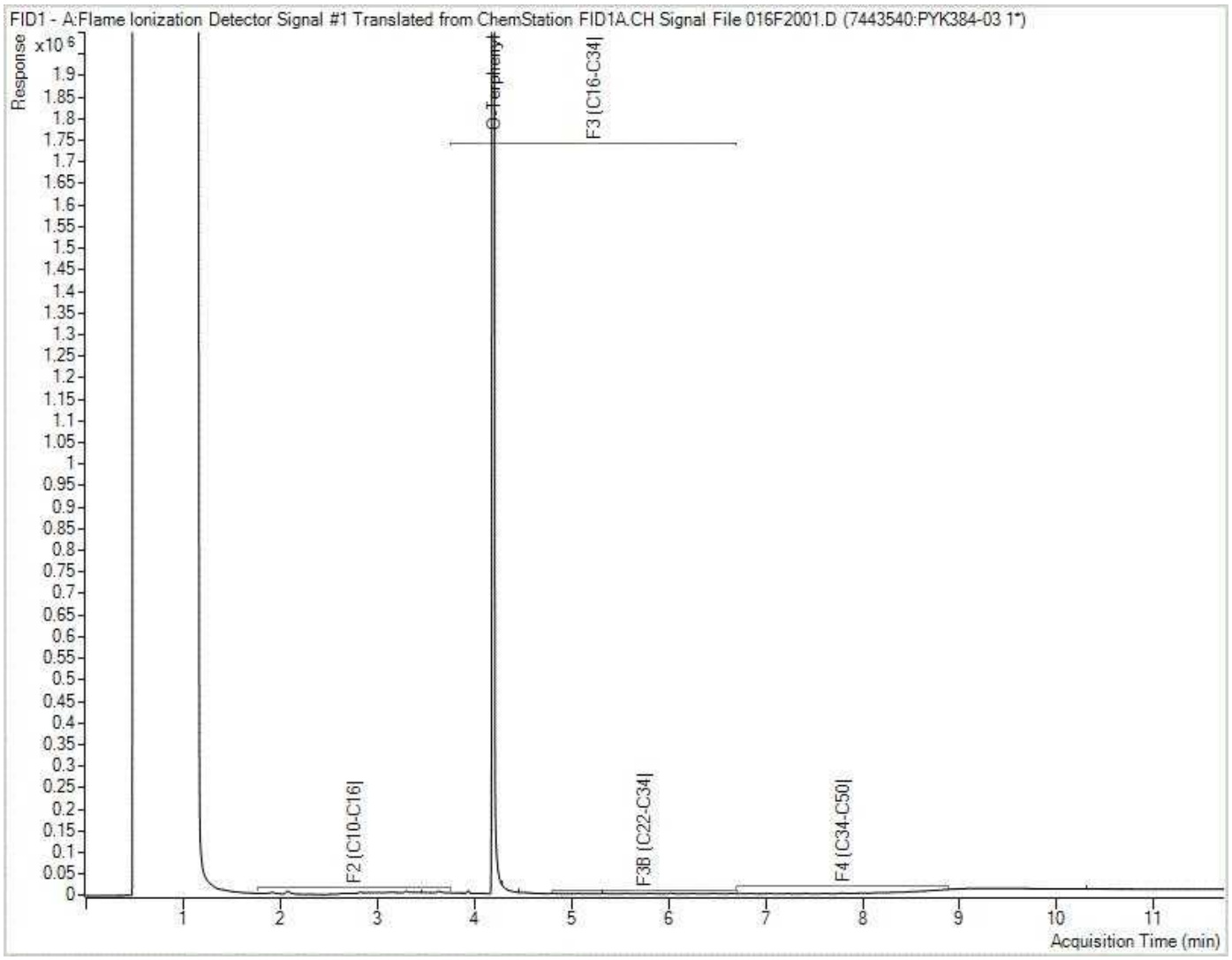
BV Labs Job #: C1H7791
Report Date: 2021/07/10
BV Labs Sample: PYK384

Golder Associates Ltd
Client Project #: 1530382 (7000)
Project name: QEW/DIXIE
Client ID: 21-23 SA2

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

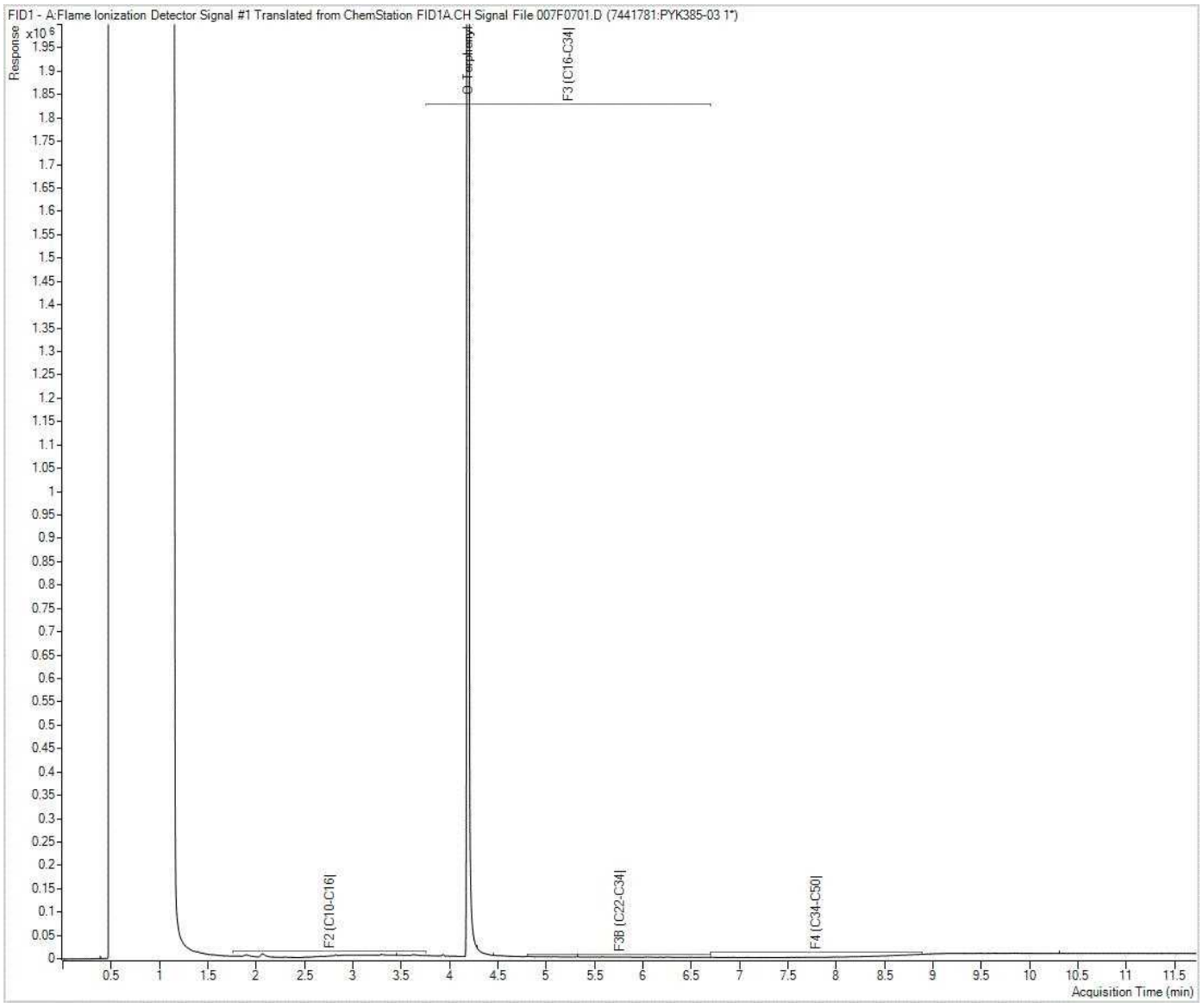


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H7791
Report Date: 2021/07/10
BV Labs Sample: PYK385

Golder Associates Ltd
Client Project #: 1530382 (7000)
Project name: QEW/DIXIE
Client ID: 21-27 AS4

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

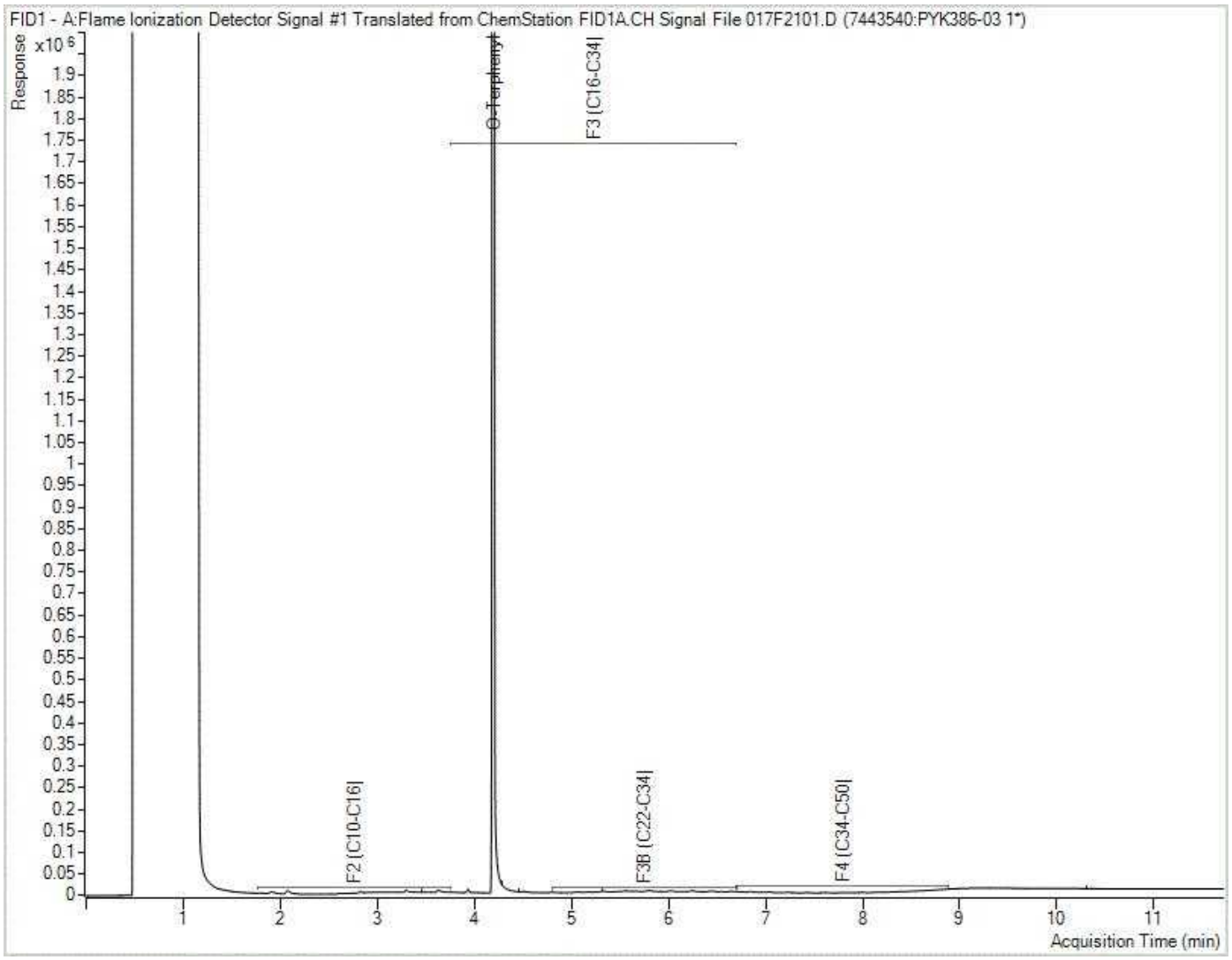


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H7791
Report Date: 2021/07/10
BV Labs Sample: PYK386

Golder Associates Ltd
Client Project #: 1530382 (7000)
Project name: QEW/DIXIE
Client ID: 21-39 SA2

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

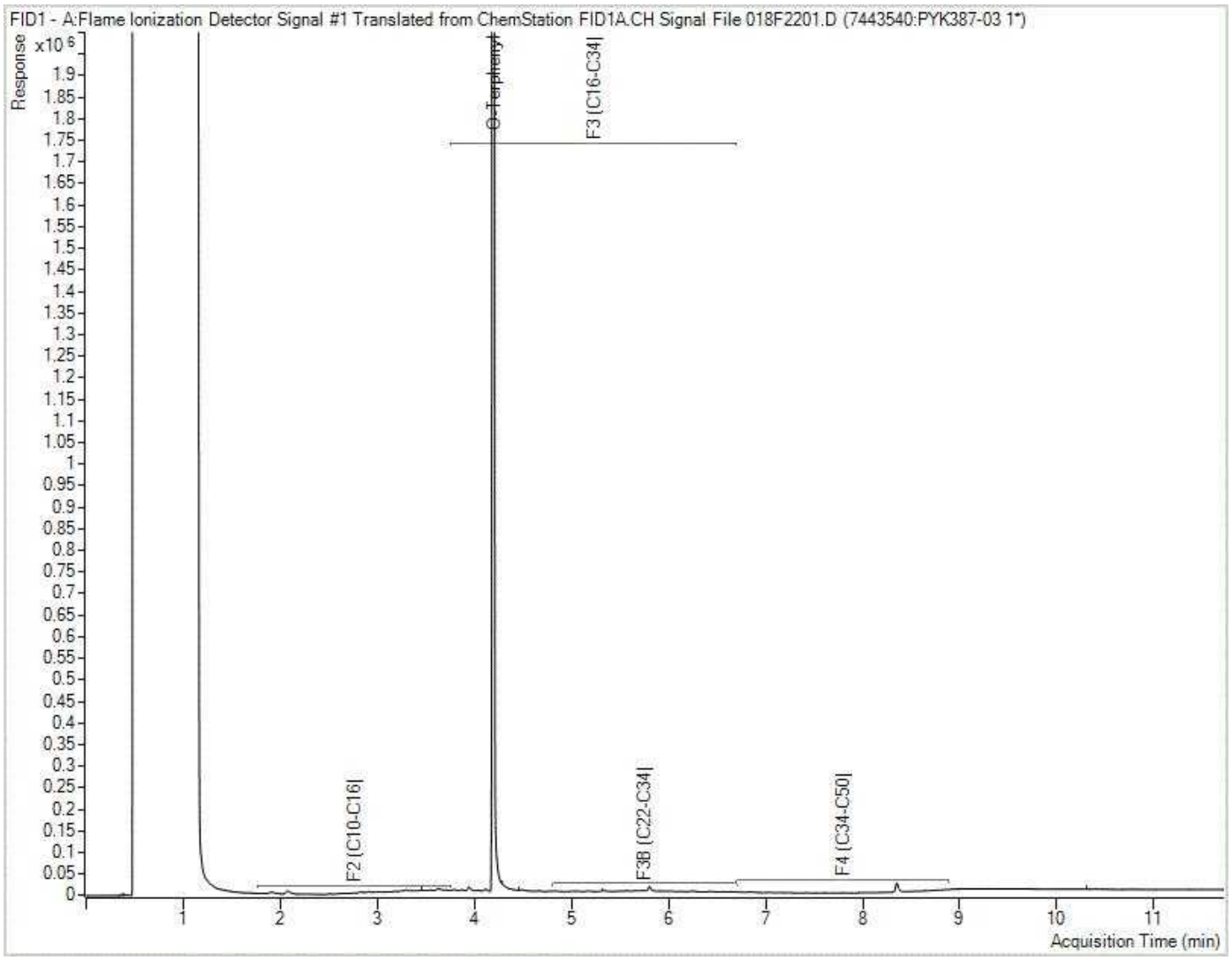


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H7791
Report Date: 2021/07/10
BV Labs Sample: PYK387

Golder Associates Ltd
Client Project #: 1530382 (7000)
Project name: QEW/DIXIE
Client ID: 21-40 SA5

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

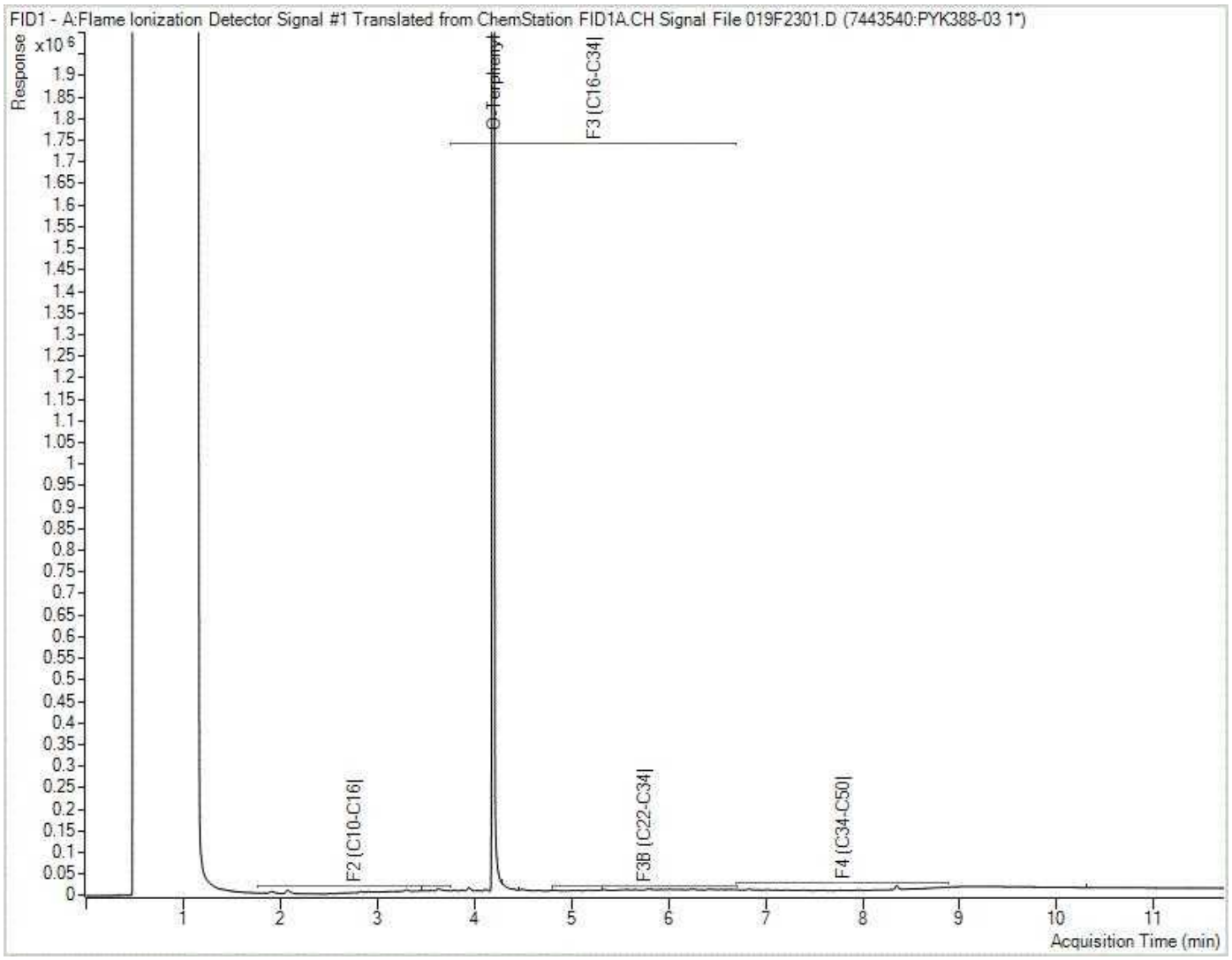


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H7791
Report Date: 2021/07/10
BV Labs Sample: PYK388

Golder Associates Ltd
Client Project #: 1530382 (7000)
Project name: QEW/DIXIE
Client ID: 21-42 SA4

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

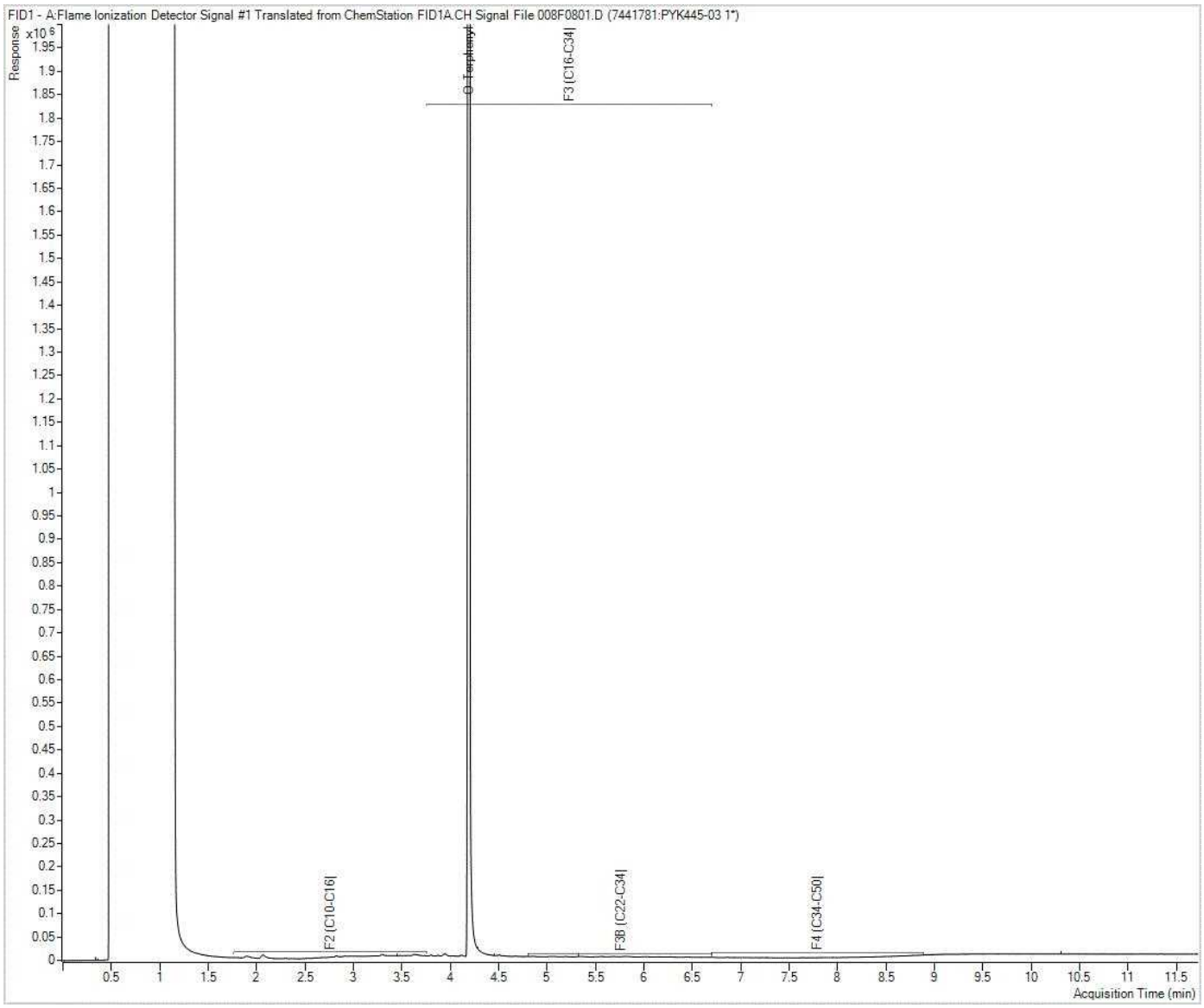


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H7791
Report Date: 2021/07/10
BV Labs Sample: PYK445

Golder Associates Ltd
Client Project #: 1530382 (7000)
Project name: QEW/DIXIE
Client ID: 21-33 SA4

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

APPENDIX D

Non-Standard Special Provisions

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 strip footing foundations if an open-footing replacement is adopted for Culvert CV02/03.

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 thickness of 100 mm and a minimum of 28 day compressive 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 Protection of Founding Bedrock

The surface of the footing founding bedrock shall be exposed by removing all fill, existing concrete and native soil and then cleaned and any loose or fractured parts removed so that sound rock is exposed. The working slab shall be placed on the exposed cleaned sound founding rock surface as specified in the Contract Documents. Any over-excavated portions of the bedrock must be replaced with dental concrete, having the same composition and compressive strength as the concrete used for the foundation construction. If the concrete for the footings cannot be poured within four hours after excavation and inspection, a concrete working slab must be placed in the excavation immediately to protect the integrity of the subgrade.

7.04 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

FILL AND BEDROCK EXCAVATION – Item No.

Special Provision

The existing fill material near the south end of Culvert CV02/03 (as encountered in Borehole CV02/03-3) shall be subexcavated where encountered in the culvert subgrade to reach the surface of the shale bedrock. The subexcavation shall be backfilled with OPSS.PROV 1010 Granular A or Granular B Type II material to the culvert bedding level.

The shale bedrock at the site is weak, and contains interbeds of strong to very strong limestone. Appropriate construction equipment and procedures will be required for excavation into the bedrock. Bedrock excavation shall not disturb or undermine the adjacent culvert structure.

BASIS OF PAYMENT

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

VIBRATION MONITORING - Item No.

Non-Standard Special Provision

TABLE OF CONTENTS

1.0 SCOPE

This special provision describes requirements for vibration monitoring for the following components of the Contract:

Installation of protection systems and bedrock excavation for Applewood Culvert (CV02/03)

2.0 REFERENCES

The subsurface conditions at the site are described in the following Foundation Investigation Report:

1. Foundation Investigation Report, Culvert CV02/03 Replacement, QEW Widening from East of Cawthra Road to the East Mall, Cities of Mississauga and Etobicoke, Ministry of Transportation, Ontario G.W.P. 2102-13-00 & 2432-13-00 (GEOCRES No. 30M11-292).

3.0 DEFINITIONS

For the purposes of this specification, the following definitions apply:

Peak Particle Velocity (PPV) means the maximum component velocity in millimetres per second (mm/sec) that ground particles move as a result of energy released from vibratory construction operations.

Pre-Construction Condition Survey means a detailed record, accompanied by film or video, as necessary, of the condition of private or public property, prior to the commencement of vibratory or vibration-inducing construction operations.

Post-Construction Condition Survey means a detailed record, accompanied by film or video, as necessary, of the condition of private or public property, after completion of vibratory or vibration-inducing construction operations.

4.0 DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor or the Contractor's Engineer shall submit details of the vibration monitoring plan to the Contract Administrator for information purposes. The submittals shall satisfy the specifications and at a minimum contain the following specific information:

a) Equipment and methods used by the Contractor to perform the work that may cause undue vibration.
b) Qualifications of vibration monitoring specialist.
c) Details regarding proposed instrumentation.
d) Proposed location of instruments on or adjacent to the commercial structures, residences, utilities, wells, and/or other potentially vibration-sensitive structures within a 100 m radius from the proposed Culvert CV02/03 works.
e) Proposed frequency of readings.
f) Action plan to be taken to adjust deep foundation installation methods or if readings show vibrations exceeding tolerable levels.

6.0 EQUIPMENT

6.1 Vibration Monitoring Equipment

All vibration monitoring equipment shall be capable of measuring and recording ground vibration PPV up to 200 mm/s in the vertical, transverse, and radial directions. The equipment shall have been calibrated within the last 12 months either by the manufacturer or other qualified agent. Proof of calibration shall be submitted to the Contract Administrator prior to commencement of any monitoring operations.

7.0 CONSTRUCTION

7.1 Pre- and Post-Construction Condition Surveys

A Pre-Construction Condition Survey and Post-Construction Condition Survey shall be prepared for all buildings, utilities, structures, water wells, and facilities within a 100 m radius from this structure site.

7.1.1 Pre-Construction Condition Surveys

The standard inspection procedure shall include the provision of an explanatory letter to the owner or occupant and owner with a formal request for permission to carry out an inspection.

The Pre-Construction Condition Survey, at each structure within a 100 m radius, shall be completed a minimum of two (2) weeks prior to commencement of installation of the protection systems. Only one Pre-

Construction Condition Survey per structure or facility is required to be carried out in advance of deep foundation installation, unless more than six (6) months will elapse between these operations, in which case an interim inspection will be required.

The Pre-Construction Condition Survey shall include, as a minimum, the following information:

a) Type of structure, including type of construction and if possible, the date when built.
b) Identification and description of existing differential settlements, including visible cracks in walls, floors, and ceilings, including a diagram, if applicable, room-by-room. All other apparent structural and cosmetic damage or defects shall also be noted. Defects shall be described, including dimensions, wherever possible.
c) Digital photographs or digital video or both, as necessary, to record areas of significant concern.

Photographs and videos shall be clear and shall accurately represent the condition of the property. Each photograph or video shall be clearly labelled with the location and date taken.

A copy of the Pre-Construction Construction Survey limited to a single residence or property, including copies of any photographs or videos that may form part of the report, shall be provided to the owner of that residence or property, upon request.

7.1.2 Post-Construction Condition Surveys

The standard inspection procedure shall include the provision of an explanatory letter to the owner or occupant and owner with a formal request for permission to carry out an inspection.

A Post-Construction Condition Survey of buildings, utilities, wells and/or other sensitive receptors within a 100 m radius from the site is required within two (2) months of completion of the installation of deep foundations.

The Post-Construction Condition Survey shall include, as a minimum, the following information:

a) Identification and description of existing differential settlements, including visible cracks in walls, floors, and ceilings, including a diagram, if applicable, room-by-room. All other apparent structural and cosmetic damage or defects shall also be noted. Defects shall be described, including dimensions, wherever possible.
b) Digital photographs or digital video or both, as necessary, to record areas of significant concern.
c) Comparison between pre-condition survey documented concerns and post-condition concerns.

Photographs and videos shall be clear and shall accurately represent the condition of the property. Each photograph or video shall be clearly labelled with the location and date taken.

A copy of the Post-Construction Condition Survey limited to a single residence or property, including copies of any photographs or videos that may form part of the report, shall be provided to the owner of that residence or property, upon request. The report shall confirm that there have been no changes to the property between the Pre-Construction Condition Survey and the Post-Construction Condition Survey as a result of the installation of deep foundations.

7.2 Monitoring

The vibration monitoring equipment shall be placed on the ground surface at radial distances of 25 m, 50 m, and 100 m from the site toward the receptors (e.g., buildings, sensitive utilities). The Contractor shall take readings continuously during installation of protection systems and bedrock excavation, and shall immediately notify the Contract Administrator if the vibrations exceed the limits specified herein.

The vibrations measured on private residences shall not exceed 25 mm/s, while those on commercial structures, wells, and utilities, where applicable, shall not exceed 50 mm/s.

If the readings are not within the limits stated above, the Contractor must alter the installation procedures until the vibrations at the various locations are within acceptable levels.

7.3 Records

The Contractor/Contractor's Engineer shall submit details of the vibration monitoring to the Contract Administrator as follows:

a) The time/duration of each reading.
b) Construction operations (i.e. installation of sheet piling) and timing of such relative to the readings.
c) Details of exceedances and modifications to operations.
d) Final report containing all relevant data including vibration monitoring and Pre- and Post-Construction Condition Surveys.

10.0 BASIS OF PAYMENT

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

DEWATERING STRUCTURE EXCAVATIONS - Item No.

Special Provision No. FOUN 0003 March 8, 2018

Amendment to OPSS 902, November 2010

902.02 REFERENCES

Section 902.02 of OPSS 902 is amended by the addition of the following:

Ontario Provincial Standard Specifications, Construction

OPSS 517 Dewatering
OPSS 805 Temporary Erosion and Sediment Control Measures

902.03 DEFINITIONS

Section 903.03 of OPSS 902 is amended by the addition of the following:

Automatic Transfer Switch means as defined in OPSS 517.

Cofferdam means as defined in OPSS 539.

Cut-Off Wall means as defined in OPSS 517.

Design Storm Return Period means as defined in OPSS 517.

Dewatering System means as defined in OPSS 517.

Groundwater Control System means as defined in OPSS 517.

Plug means as defined in OPSS 517.

Sediment means as defined in OPSS 517.

Sediment Control Measure means as defined in OPSS 517.

Temporary Flow Passage System means as defined in OPSS 517.

Unwatering means as defined in OPSS 517.

Vegetated Discharge Area means as defined in OPSS 517.

Waterbody means as defined in OPSS 517.

Watercourse means as defined in OPSS 517.

902.04 DESIGN AND SUBMISSION REQUIREMENTS

902.04.01 Design Requirements

902.04.01.01 Dewatering

Clause 902.04.01.01 of OPSS 902 is deleted in its entirety and replaced with the following:

A dewatering system shall be designed to control water and the flow of water into the excavation, prevent disturbance of the foundation, permit the placing of concrete in the dry, and complete the excavating and backfilling for structures work.

When the system includes temporary flow passage system, the system shall be designed, as a minimum, for a 5-year design storm return period, and groundwater discharge. A longer return period shall be used when determined appropriate for the work.

The dewatering system shall be according to the design requirements specified in OPSS 517.

902.04.02 Submission Requirements

Subsection 902.04.02 of OPSS 902 is deleted in its entirety and replaced with the following:

902.04.02.01 Working Drawings

Working Drawings for the dewatering system shall be according to OPSS 517.

902.04.02.02 Preconstruction Survey

When a groundwater control system by wells or a well point system will be used, a condition survey of property and structures that may be affected by the work shall be carried out. The condition survey shall include the location and condition of adjacent properties, buildings, underground structures, water wells, Utilities, and structures, within a distance of 50 metres from the groundwater control system. In addition, all water wells used as a supply of drinking water and located within this distance shall be tested for compliance with Ontario Drinking Water Quality Standards.

Water wells within the preconstruction survey distance can be located using the website https://www.ontario.ca/environment-and-energy/map-well-records or its successor site.

Copies of the condition survey and water quality test results shall be submitted to the Contract Administrator prior to the operation of the groundwater control system.

902.04.02.03 Milestone Inspections

Clause 902.04.02.03 of OPSS 902 is deleted in its entirety.

902.07 CONSTRUCTION

Subsection 902.07.04 of OPSS 902 is deleted in its entirety and replaced with the following:

902.07.04 Dewatering Structure Excavation

902.07.04.01 General

The dewatering systems shall be constructed and operated according to the Working Drawings.

Activation and deactivation of a temporary flow passage system, if applicable, shall be according to OPSS 517.

The dewatering system shall be continuously operational to control buoyancy forces until such forces can be resisted by backfill and structure self-weight, to keep excavations stable, to avoid erosion impacts from the release of accumulated water, and to keep the work area in the condition required to complete the associated work as specified in the Contract Documents.

When a temporary flow passage system is to remain operational through a seasonal shutdown period, the Contractor shall be responsible for any maintenance or repair costs due to the system during the seasonal shutdown period.

Temporary erosion and sediment control measures, including controlling the discharge of water, shall be according to OPSS 805. Measures not specified in OPSS 805 shall be according to the Working Drawings. Temporary erosion and sediment control measures and cover material to protect exposed soils, as required by the Working Drawings, shall be installed as soon as is practical.

Stranded fish shall be managed as specified in the Contract Documents.

Unwatering shall be carried out as necessary.

Water suspected of being contaminated as indicated by visual or olfactory observations shall be reported to the Contract Administrator.

Dewatering and temporary flow passage systems shall be discontinued in a manner that does not disturb any structure, pipeline, or flow channel. Operation of the dewatering system shall be shut down according to the procedures specified in the Working Drawings, where applicable.

902.07.04.02 Discharge of Water

The discharge of water shall be according to OPSS 517.

902.07.04.03 Monitoring

Monitoring shall be according to OPSS 517.

902.07.04.04 System Amendments

Amendments to stop any displacement, damage, soil loss or erosion due to the operation of the dewatering system shall be according to OPSS 517.

902.07.04.05 Removal

Removal of dewatering system and temporary flow passage system components shall be according to OPSS 517.

NOTES TO DESIGNER:

* Fill in the design storm return period according to MTO Drainage Design Standard TW-1.

** Fill in the preconstruction survey distance as recommended by the foundation engineer.

WARRANT: Include with this standard tender item **only** on the recommendation of a foundation engineer.

CUSTODIAN: Tony Sangiuliano, MERO - Foundation Group.

golder.com