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Hydrogeological Assessment Report

Woodstock Wastewater Treatment Plant Biogas Utilization Project

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1.0 Introduction

This Hydrogeological Assessment Report has been prepared in accordance with the guidelines provided by the Ministry of the Environment, Conservation and Parks (MECP) entitled “Chapter 9: Additional reports that may be required as part of an REA application.” This report fulfills part of the requirements for a Renewable Energy Approval (REA) under Ontario Regulation 359/09, which is part of the Environmental Protection Act.

This report has been prepared under the supervision and in conjunction with a professional engineer. This report provides a description of the project geology/hydrogeology and an assessment of site suitability. The majority of information in the following report has been extracted from the “Geotechnical Investigation Woodstock Wastewater Treatment Plant Phase 2” Report prepared by WSP in July of 2023 (Refer to Appendix A). The WSP report was prepared by a licensed Geotechnical Engineer.

1.1 Project Overview

Oxford County (the County) is undertaking a biogas utilization upgrade at the Woodstock Wastewater Treatment Plant (WWTP) as part of the County’s 100% Renewable Energy Plan by implementing a combined heat and power (CHP) system to generate heat and electricity from biogas produced at the WWTP, thereby decreasing the WWTP’s dependence on the energy grid.

The Woodstock WWTP is located at 195 Admiral Street, Woodstock, Ontario. The proposed CHP system will be within the existing footprint of the WWTP.

The basic components of the Woodstock WWTP Biogas Utilization Project will include the following:

- The CHP and biogas conditioning equipment and associated exterior concrete equipment pad
- High voltage grounding transformer and associated exterior concrete equipment pad
- Field control panel and associated exterior concrete equipment pad
- Yard piping, including electrical and communication wires, hydronic heating pipes, digester gas pipes, and condensate drain pipes

2.0 Description of Project Geology / Hydrogeology

The geological and hydrogeological background of the site is described in the WSP Geotechnical Report (Appendix A) and summarized herein.

2.1 Overview of the Local Physiographic and Hydrogeological Setting

The site topography at the Woodstock WWTP is generally flat. The site is occupied primarily by the WWTP and asphalt access road and is bounded by industrial lots on the north and south sides. The west side abuts the Thames River, and the east side is bounded by Tecumseh St.

The overall site composition can be found in the surficial soil mapping from the Ontario Geological Survey (Map M2281, Ministry of Northern Development and Mines) which indicates fine-textured glaciolacustrine outwash gravel and gravelly sand frequently overlain by several feet of sand or silt as well as modern alluvium comprising unsubdivided silt sand and gravel.

Bedrock has been reported at elevations around 250 m and 275 m in the area, based on Map P.0169 (Ministry of Northern Development and Mines). Local bedrock consists of sandstone, dolostone, limestone of the Detroit River Group (Upper Thames River Conservation Authority).

2.2 Key Topographic/Geological Features in the Study Area

The only notable key topographic or geographic feature in the vicinity of the site is Thames River. However, this feature does not fall within the boundaries of the site.

2.3 Details on Soil Materials Present in the Study Area

WSP conducted geotechnical fieldwork, which included two sample boreholes and two test pits (Appendix A).

Cohesionless fill materials were identified below the asphalt (approximately 50 mm thick in asphalt covered locations) and topsoil (between 150 mm and 200 mm thick) at all four explored locations and extended to a minimum depth of 3.0 m below ground surface (bgs). The fills were characterized as sand or sand and gravel with SPT blow counts (N-values) ranging from 2 to over 50 blows per 300 mm of penetration in the ground. This indicated that these materials ranged from very loose to very dense in relative compaction. Trace cobble fragments and trace fines were also reported. These soils were described as brown to dark brown to black and in a moist state. Moisture contents were recorded between 4% and 25%.

A cohesionless native deposit of gravelly sand was encountered at between elevations of 280.2 m and 281.5 m above sea level (asl). The boreholes terminated in the material due to auger refusal. The N-values exceeded 50 blows per 300 mm of ground penetration, indicating very dense relative compaction. This soil was described as brown with a trace of silt and in a moist state. Moisture contents were recorded between 1% and 3%.

2.4 Hydrogeological Features of Local Aquitards and Aquifers Relevant to the Proposed Taking

During the geotechnical fieldwork, boreholes were left open for approximately 30 minutes after drilling. No free-standing water was observed during drilling and after the completion of drilling at either borehole location. The WSP Geotechnical Report recommended a water level of 4 m bgs be used for this Project, which was based on previous investigation findings (from a 2006 Geotechnical Investigation at the WWTP site) and the dry cave noted in the boreholes.

There are no aquitards or aquifers that are relevant to the proposed taking of this project, as project work will take place no deeper than 1.3 m bgs.

2.5 Location of All Water Wells at the Site and Within 300 m of the Project location

There are no water wells at the site or within 300 m of the project location.

2.6 Site Specific Conceptual Hydrogeological Model

The current design for the CHP system includes excavation to an approximate depth of 1.3m, which is above the current expected groundwater table elevation (4m) and the existing wastewater treatment infrastructure on site is constructed to lower maximum depths than the proposed works for this project.

Based on these factors, it was determined that:

- The local hydrogeology regime has no effect on the overall applicability of the site for renewable energy generation activities; and
- The inclusion of the CHP system at the WWTP, and the engineering approaches to mitigate accidental spills and leaks, will not adversely affect the local groundwater.

Given that the construction and operational works for this renewable energy project will not impact groundwater with respect to either flow pathways or groundwater takings, there was no conceptual modelling conducted for this project.

3.0 Assessment of Site Suitability

3.1 Aspects of The Facility Related to Storage of Biomass, Source Separated Organics, Farm Materials, Residual Waste

The proposed Project will not be involved with handling, storage and processing biomass, source separated organics, farm material, or residual waste. The WWTP does dewater digestate material in accordance with the existing ECA, but this operation will not be impacted by the currently CHP system installation or operation.

The Project takes advantage of the existing WWTP to treat, handle, store, and process digestate material that is used in the existing WWTP digesters to create biogas. The proposed CHP system will utilize digester gas produced from the existing WWTP to create renewable energy in the form of heat and electricity. During the operation phase of the Project, the digestate solid waste that is generated from the existing digesters will continue to be managed in accordance with the *Nutrient Management Act* and adhere to O.Reg. 267/03 and follow the existing WWTP's Environmental Compliance Approval (ECA) (ECA#5950-7XQKXS). Process wastewater streams from the CHP system (i.e. the condensate drain) will be redirected to the headworks of the WWTP where it will be treated until it meets the effluent parameters to be discharged to the Thames River, per the existing ECA. This condensate drain represents a new location for the condensate to be collected, not an additional source of wastewater.

The Woodstock WWTP will continue to handle biomass as described in the existing ECA. Raw sludge at the WWTP is all discharged into one common raw sludge header. That total sludge volume must be directed to either one of the two primary digesters. Raw sludge is pumped to one of the primary digesters (Digesters No. 3 or No. 4), alternating on a daily basis. Digested

sludge from Digester Nos. 3 and 4 is pumped to Digester Nos. 1 and 2 before being transferred to the dewatering process. The subsequent steps in sludge handling are dewatering and composting. The Woodstock WWTP dewatering process utilizes two Alpha Laval Centrifuges to produce a dewatered cake capable of being piled and stored at the dedicated offsite storage site, the Biosolids Centralized Storage Facility (BCSF) prior to beneficial reuse on agricultural land.

The use of BCSF prevents the possibility to cause the discharge of contaminants to ground water through normal operation or through accidental spills or leakage (for instance through the use of underground storage tanks). This allows the WWTP to avoid operational scenarios where storage tanks could lead to seepage of stored material or leachate into the groundwater.

3.2 Aspects of the Facility with Potential to Discharge to Groundwater

Spills are possible during the construction, installation and decommissioning phases of the Project. Fuel, lubricant, and coolant will be utilized for the CHP system and various construction equipment, and this may pose as a spill risk. Spill kits and emergency response materials will be made readily available to rectify the accidental discharge. In the event of a spill, all work in the affected area will stop immediately and the spill will be rectified accordingly as outlined in the Emergency Response Plan in the Design and Operation report. Any contaminated material will be safely disposed.

During the operation phase of the Project, spills may result in various processes of the existing WWTP including but not limited to the transfer of the external sludge into the existing sludge receiving building at the WWTP, digester leakage and biogas leakage. The existing operational spill risks of the WWTP are detailed in the existing WWTP's ECA and protocols will be followed accordingly.

Fuel, lubricant and coolant utilized for the CHP system during the operation phase of the Project may pose as a spill risk. The Emergency Response Plan in the Design and Operation Report contains procedures for all spill contingency and the necessary training, notification, clean-up materials and equipment required. As per s.13 of the Environmental Protect Act, all spills that could potentially have an adverse environmental effect that are in excess of the prescribed regulatory levels will be reported to the MECP.

4.0 Report Summary

This Hydrogeological Assessment Report, prepared in support of the Renewable Energy Approval (REA) application for the proposed Class 3 anaerobic digestion facility at the Woodstock Wastewater Treatment Plant (WWTP), has evaluated the site's geology, hydrogeology, and suitability for the intended development. Based on the findings from geotechnical investigations, including boreholes and test pits, as well as a review of relevant historical data, the site is characterized by generally stable soil conditions.

The assessment confirms that the proposed location for the Project is suitable and will not disrupt local groundwater resources. No drinking water wells are located within 300 meters of the project area, further minimizing potential risks to groundwater quality.

The storage of biomass and the management of biosolids will not be impacted by this project. Biomass will continue to be handled as set out in the existing WWTP ECA to mitigate discharge of contaminants to groundwater, with contingency plans in place in the unlikely event of a spill. The Project's design and operations are expected to have no significant adverse effects on the local hydrogeological environment, and the site is deemed suitable for the intended facility.

Closure

This report has been prepared by J.L. Richards & Associates Limited for Oxford County's exclusive use. Its discussions and conclusions are summary in nature and cannot properly be used, interpreted or extended to other purposes without a detailed understanding and discussions with the client as to its mandated purpose, scope and limitations. This report is based on information, drawings, data, or reports provided by the named client, its agents, and certain other suppliers or third parties, as applicable, and relies upon the accuracy and completeness of such information. Any inaccuracy or omissions in information provided, or changes to applications, designs, or materials may have a significant impact on the accuracy, reliability, findings, or conclusions of this report.

This report was prepared for the sole benefit and use of the named client and may not be used or relied on by any other party without the express written consent of J.L. Richards & Associates Limited, and anyone intending to rely upon this report is advised to contact J.L. Richards & Associates Limited in order to obtain permission and to ensure that the report is suitable for their purpose.

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Appendix A

Geotechnical Investigation Woodstock Wastewater Treatment Plant Phase 2 (WSP, 2023)

2 SITE DESCRIPTION AND GEOLOGICAL BACKGROUND

2.1 SITE DESCRIPTION

The site is located at the sewage pumping station in the Woodstock Wastewater Treatment Plant at 145 Admiral Street, located in the City of Woodstock, Ontario. The general site topography is generally flat. The site is occupied by the wastewater treatment plan and asphalt access road and is bounded by industrial lots on the north and south sides. The west side abuts the Thames River, and the east side is bounded by Tecumseh St.

2.2 GEOLOGICAL and GEOTECHNICAL BACKGROUND

Surficial soil mapping from the Ontario Geological Survey (Map M2281, Ministry of Northern Development and Mines) indicate fine-textured glaciolacustrine outwash gravel and gravelly sand frequently overlain by several feet of sand or silt as well as modern alluvium comprising unsubdivided silt sand and gravel.

Bedrock has been reported at elevations around 250 m and 275 m in the area, based on Map P.0169 (Ministry of Northern Development and Mines). Local bedrock consists of sandstone, dolostone, limestone of the Detroit River Group (Upper Thames River Conservation Authority).

WSP reviewed Report #LNGED008426A prepared by Trow Associates Inc for the WWTP Upgrades and dated June 2006. Borehole 1 was drilled in the vicinity of the project area. The elevation of the surface at the borehole location was recorded as 284.8 m. The borehole was drilled to 6.7 m or elevation 278.1 m. Borehole 1 encountered surficial topsoil underlain by a loose, variable silty sand fill with glass, brick and organic pockets extending to 5.1 m below ground surface. Compact native brown Sand underlain by Sand and Gravel till was encountered in the bottom 1.5 m of the borehole. Groundwater was observed at 5.0 m prior to backfilling the borehole.

3 INVESTIGATION PROGRAM

3.1 FIELD WORK

The scope of the geotechnical fieldwork included two (2) sampled boreholes designated, BH23-1 and BH23-2, as well as two (2) test pits, TP-1 and TP-2. Boreholes were advanced to auger refusal at a depth of 5.2 m below ground surface (m bgs) and test pits were excavated to 1.5 m bgs and 2.5 m bgs. The locations of the boreholes and test pits are shown on Figure 2 and their coordinates are shown on the Record of Borehole sheets. Test Pits and Test Pit Photo Log are attached in Appendix A. A summary is provided in Table 3-1.

Table 3-1: Borehole and Test Pit Summary

BH ID	Borehole Coordinates (UTM, NAD83)		Surface Elevation (Geodetic Datum, m asl)	Terminated Depth (m bgs) *
	Easting	Northing		
BH23-1	518598.0	4776062.0	284.5	5.2
BH23-2	518629.0	4776062.0	284.6	5.2
TP-1	518616.0	4776071.0	284.6	2.5
TP-2	518620.0	4776055.0	284.6	1.5

*m bgs – metres below ground surface

The ground surface elevations and co-ordinates at each borehole location were surveyed by WSP with a Trimble R12i and TSC5 unit, using NAD83 horizontal datum and CGVD28:78 (1978) vertical datum.

The drilling program for this investigation was completed on June 30th, 2023. The boreholes were advanced using a track mount 7220 geo-probe machine equipped with 150 mm OD hollow stem augers and conventional soil sampling tools. Soil samples were taken at frequent intervals of depth following the Standard Penetration Test (ASTM D1586) procedure. Test pits were developed using a backhoe with a 60 mm wide bucket.

The field investigation was conducted under the full-time monitoring of WSP's personnel who directed the drilling/excavation, sampling and logging. After completion of the boreholes, the augers were extracted, the boreholes were inspected for standing water and signs of sloughing, then backfilled using bentonite and cutting mixture in accordance with O. Reg. 903. No monitoring wells were installed in accordance with the provisional item of the terms of reference and the dry groundwater conditions observed in the boreholes.

All samples were field logged, placed in airtight containers, and transported to WSP's laboratory for further examination and testing.

Natural moisture content tests were carried out in accordance with ASTM D2216 on all the recovered soil samples. Three selected soil samples were tested for the grain size distribution and Atterberg limits in accordance with ASTM D6913, ASTM D7928 and ASTM D4318. The results are included in Appendix C.

4 SUBSURFACE CONDITIONS

The following is a summary of the subsurface soil conditions encountered during the field investigation as outlined in Section 3.1. The results of geotechnical laboratory testing carried out on selected samples are summarized on the Record of Borehole sheets which are in Appendix A with full details found in Appendix B.

4.1 ASPHALT

A thickness of 50 mm of asphalt was reported at the surface of BH23-2.

4.2 CONCRETE ELEMENTS

Excavation of the test pits revealed previously an unidentified concrete structure that was encountered at both test pit locations at Elevations 283.5 m asl and 283.6 m asl at TP-1 and TP-2, respectively.

4.3 TOPSOIL

Topsoil was encountered at the surface at boreholes BH23-1 and at TP-1 and TP-2, having a thickness between 150 mm and 200 mm. It should be noted that the classification of materials identified in this report as topsoil was based solely on visual and textural evidence. Testing of organic content or other constituents or nutrients, or the topsoil's general suitability as a vegetal growth supporting medium, was not performed. Therefore, the use of materials classified as topsoil in this report cannot be relied upon for supporting growth of landscaped vegetation.

4.4 FILL

Cohesionless fill materials were identified below the asphalt and topsoil at all four explored locations and extended to a minimum depth of 3.0 m bgs. The fills comprised sand and sand and gravel with SPT blow counts (N-values) ranging from 2 to over 50 blows per 300 mm of penetration in the ground. This indicated that these materials were very loose to very dense in relative compaction. Trace cobble fragments and trace fines were also reported. These soils were described as brown to dark brown to black and in a moist state. Moisture contents were recorded between 4% and 25%. Sample SS3 from BH23-1 tested for organic content yielded 12.6%. Table 4.1 below is a summary of gradation analyses of three (3) samples of fill.

Table 4-1: Results of Grain Size Analysis and Soil Classification Tests on Fill Samples

BH	Sample	Depth (m bgs)	Particle Size Distribution (%)		
			Gravel	Sand	Fines (Silt and Clay)
BH23-1	SS4	2.6	46	46	8
BH23-2	SS1	0.5	41	51	8
BH23-2	SS6	4.1	34	55	11

4.5 NATIVE GRAVELLY SAND

A cohesionless native deposit of gravelly sand was encountered at BH23-1 starting at approximately elevation 281.5 m asl and at BH23-2 staring at elevation 280.2 m. The boreholes terminated in this material due to auger refusal after approximately 20 minutes of attempting to advance the auger at each borehole location. The N-values exceeded 50 blows per 300 mm of ground penetration, indicating a very dense relative compaction. This soil was described as brown with a trace of silt and in a moist state. Moisture contents were recorded between 1% and 3%. Sloughing was observed at 280.5 m asl in BH23-1 and 280.2 m in BH23-2.

4.6 GROUNDWATER

Boreholes were left open for approximately 30 minutes after drilling. No free-standing water was observed during drilling and after the completion of drilling at either borehole location. Similarly, no seepage was observed at either test pit location. However, it should be noted that during and after local precipitation events, groundwater that is 'perched' above the long-term levels may accumulate in the fills near the ground surface. In addition, significant amounts of groundwater may be present in any fill materials within any existing utility trenches. Groundwater levels are expected to fluctuate, usually seasonally, but especially after extreme precipitation events or during the thaw of extreme snow accumulations.

A water level of 4 m bgs is recommended to be used for design. This water level is based on the previous investigation findings and the dry cave noted in the boreholes.

5 GROUND CHARACTERIZATION

5.1 FROST PENETRATION DEPTH

In accordance with the Ontario Provisional Standard Drawing (OPSD 3090.101) the design frost depth below the ground surface for the general area is estimated to be 1.3 m bgs. Therefore, a minimum permanent soil cover of 1.3 m or equivalent thermal insulation is required for frost protection where required for externally exposed foundation elements as well as for unheated internal ones. Foundations in heated structures do not need frost protection if the temperature remains above freezing. If this cannot be achieved, then frost protection is recommended as outlined above.

5.2 SEISMICITY

Based on the borehole and in conformance with Section 4.4.3.2 and Table 4.1 (Site Classification for Seismic Site Response) of the 2012 Ontario Building Code, Site Class "D" (Stiff Soil) may be used for design. Site class may be confirmed via geophysical testing to assess the average properties of the uppermost 30 m of the soil. These include shear wave velocity ($V_{s(30)}$), standard penetration resistance (N_{60}) and (if applicable) undrained shear strength (s_u), according to Section 6.5.1.2 of the Canadian Foundation and Engineering Manual (CFEM).

The six values of the spectral acceleration Sa(T), peak ground velocity (PGV), peak ground acceleration (PGA) can be obtained from Geological Survey of Canada on Natural resources Canada website: 'www.earthquakecanada.ca" or Table C-3 (Seismic Design Data for Selected Locations in Canada) in Appendix C, Division B of the National Building Code of Canada (2020) Volume 1.

The corresponding acceleration coefficients associated with a return period of 2,475 years of ground motion are obtained from the National Building Code of Canada seismic hazard values (2020) and summarized in Table 5-1.

Table 5-1: Seismic Design Coefficients (NBCC 2020)

Return Period	Possibility of Exceedance	Coefficient of PGA	Sa(0.2)	Sa(1.0)	Sa(2.0)
2,475	2% in 50 years	0.146	0.25	0.143	0.0675

5.2.1 LIQUEFACTION POTENTIAL

Seismic liquefaction occurs when earthquake vibrations cause an increase in pore water pressures within the soil. The presence of excess pore water pressures reduces the effective stress between particles and the soil's frictional resistance to shearing.

The following conditions are more prone to experiencing seismic liquefaction:

- Coarse grained soils (i.e., more probable for sands than for fills);
- Soils having a loose state of packing; and
- Soils located below the groundwater level.

According to the above and the low seismicity of the Site, the risk to experience soil liquefaction at the Site is negligible.

5.3 CORROSION POTENTIAL

Two (2) soil samples were collected and submitted for analysis of parameters used to assess corrosion potential to steel and degradation to concrete, including analysis of pH value, resistivity, conductivity, sulphate content and chloride content. The results of analytical testing on soil samples are provided in Appendix C. A summary of the results of the corrosivity testing is presented in Table 5.2.

Table 5-2: Analytical Laboratory Testing (Corrosion Potential)

BOREHOLE NO./ SAMPLE ID	SAMPLE DEPTH (m)	pH	CHLORIDE (µg/g)	SULPHATE (µg/g)	ELECTRICAL RESISTIVITY (LABORATORY) (Ω-cm)	ELECTRICAL CONDUCTIVITY (mS/cm)	AVERAGE REDOX POTENTIAL (mV)
BH23-1 / SS3	1.5 to 2.1	7.49	80.3	142	2770	361	341
BH23-2/ SS3	1.5 to 2.1	8.10	418	<20	1180	847	243

The corrosivity test results were compared to the American Water Works Association (AWWA) C-105 (2005) Standard, "Polyethylene Encasement for Ductile-Iron Pipe Systems". Based on the parameters in Table 5.2, the soil samples obtained from BH23-2 SS3 is corrosive (greater than 10 points). Also, the concentration of water-soluble sulphate within the soil sample tested does not exceed the limit of 0.1%, above which CSA A.23 recommends the use of sulphate resistant cement. Therefore, sulphate resistant concrete is not required. General Use cement will be appropriated for the Site.

It should be noted that the in-situ resistivity can vary within much larger ranges than those determined in the laboratory on select samples. Also, variations of the in-situ moisture content due to weathering and/or groundwater fluctuation can contribute to potentially large deviations on the soil electrical characteristics. If the design of buried steel and

concrete elements are sensitive to the range in data, it is recommended that further in-situ testing be completed.

These recommendations are provided as guidance only for preliminary design considerations; the design engineers should review the results of the laboratory testing, the potential for corrosion and the ultimate selection of material into consideration during detailed design.

5.4 TCLP ANALYSIS

One composite sample from the Project Area was submitted for waste classification testing in accordance with *O.Reg. 347/90 – General, Waste Management* ("O.Reg. 347/90"). The sample was prepared as a composite sample by selecting soil aliquots from the excess soil cuttings generated during drilling. The sample was subject to flashpoint determination and analysis of general inorganics, metals, VOC, PCB, organochlorine pesticides and benzo[a]pyrene in accordance with the TCLP. The results of the waste classification testing along with the Schedule 4 leachate quality criteria is provided in Appendix C. The results of the waste classification indicate that the soil would be classified as non-hazardous solid waste if removed from the Project Area.

6 DISCUSSION AND RECOMMENDATIONS

6.1 GENERAL

Based on the site plan provided to WSP by the Client, it is understood that the project consists of the following:

1. A new 10 m x 3 m exterior concrete equipment pad to support a new 250 kWe cogenerated heat and power (CHP) unit will be constructed.
2. A new 4.45 m x 2.6 m exterior concrete equipment pad to support a new filtration and dehumidification unit will be constructed.
3. New gas feed line(s) to the new CHP unit from the Digester 3&4 control building will be installed.
4. New hydronic supply and return lines to CHP unit from the Digester 3&4 control building will be installed.
5. Provisional (Dependent on Preferred Location of CHP System): New granular or asphalt pavement access road will be constructed from the paved area to the south of the dewatering building, across an underground utility corridor (contains the primary 900mm Ø raw sewage line to site and parallel services to the dewatering building).
6. To investigate if the original foundations of the dewatering building were removed or left in place via test pits.

The following sections provide design recommendations in support of these proposed upgrades.

6.2 FOUNDATION RECOMMENDATIONS

6.2.1 SHALLOW FOUNDATIONS

It is recommended to place foundations on competent native soil below the thick fill layer. Unacceptable total and differential settlements could occur if foundations are placed on unapproved, uncontrolled fill.

The geotechnical resistances at Factored Ultimate Limits States (Factored ULS) and Serviceability Limits States (SLS) are provided in Table 6-1 for isolated shallow foundations as well as for strip footings. A geotechnical resistance factor (Φ) 0.5 (Table 8.1, CFEM) was applied to obtain the factored ULS resistances. A factor of safety of three (3) was used to obtain the SLS resistances, at which global and differential settlements are usually limited to 25 mm and 15 mm, respectively. However, a settlement verification should be done

during design using predicted loads to ensure that settlements are within tolerances for the proposed structures.

Table 6-1: Recommended Net Geotechnical Resistances – Shallow Foundations

Borehole/ Location	Footing Type	Minimum Foundation Depth (m bgs)	Maximum Foundation Width, B (m)	*Net Geotechnical Resistance (kPa)	
				ULS	SLS
Borehole 23-1 – Location 1	Isolated/Spread/Strip	3.0	1.5	300	200
Borehole 23-2 – Location 2	Isolated/Spread/Strip	4.5	1.5	250	170

*Net Geotechnical Resistance is the difference between the total resistance of the soil mass and the resistance of the soil mass due its weight.

Where competent native soils are not present at the proposed design elevations, footings can either be lowered or the deleterious material sub excavated and engineered fill used to raise the grade to underside of footing. If engineered fill is used, the base of the excavation will need to extend beyond the footing on all sides at a rate of 1 horizontal: 1 vertical. There may be a benefit of increased capacity at the footing if founded on an engineered pad. WSP would need to review the final design to provided further comment.

The geotechnical pressure values provided are intended to assess the feasibility and sizes of footings and are for vertical loads (no inclination) without load eccentricity. For inclined load factors, reference should be made to the applicable design codes. The ULS values will be less than those stated if inclined or eccentric loading conditions exist. The SLS value provided should correspond to not more than 25 mm of total settlement with 10 mm to 15 mm of differential settlement.

The footing excavation should be reviewed by a qualified geotechnical consultant to confirm that the bearing soil has adequate bearing capacity.

Loose or disturbed material should be removed from the footing excavation prior to the placement of concrete. Hand cleaning may be required to prepare an acceptable bearing surface. The footing subgrade should be always protected from rain, snow, freezing temperatures and the ingress of free water. Concrete should not be placed on frozen soil, nor should the soil beneath the footing be allowed to freeze after construction of the footing.

If footings are stepped up or down, it is recommended that they be stepped at a maximum vertical distance of 0.5 m for each 1.0 m horizontal run of footing (1V: 2H).

6.2.2 SLAB-ON-GRADE

Two exterior concrete equipment pads are planed at the Site as follows:

1. A new 10 m x 3 m exterior concrete equipment pad to support a new 250 kWe cogenerated heat and power (CHP) unit will be constructed either at Borehole Location 23-1 or 23-2. It is understood that weight of the CHP and gas treatment system is 20,100 kilograms. The estimated pressure over the 10 m x 3 m slab is approximately 6.6 kPa.
2. A new 4.45 m x 2.6 m exterior concrete equipment pad to support a new filtration and dehumidification unit will be constructed.

The exterior concrete pads will require excavation of the existing fill to the depth of frost penetration to accommodate a minimum 1.3 m thick pad structure that consists of the concrete slab (assume 300 mm thick), underlain by minimum 200 mm thick layer of OPSS1010 Granular A and in turn underlain by 800 mm thick layer of OPSS1010 Granular B Type II. For placement and compaction refer to Section 7.1.1.

The Geotechnical Engineer should inspect and approve the subgrade or direct the Contractor to remove unsuitable materials and replace it with imported granular materials. See Section 7.1.1.

Subgrade preparation should include complete removal of topsoil layer, cohesive and non-cohesive fill soil, unsuitable loose and soft soil, organic soils and any weak/wet soils. After removal of all unsuitable materials, the cohesionless subgrade should be heavily compacted or densified using a 15-ton smooth roller. The compacting operation should be witnessed by the Geotechnical Engineer. Any soft of unsuitable subgrade areas which deflect significantly should be sub-excavated and replaced with suitable engineered fill material compacted to 100% of SPMDD.

Where construction is undertaken during winter months, concrete slab subgrade, engineered fill mat and / or granular base should be protected from freezing. If the subgrade and/or the granular materials are impacted by frost, the subgrade should be completely thawed, drained, inspected then proof rolled prior to placing concrete.

6.2.3 RECOMMENDED PARAMETERS FOR VERTICAL SOIL DEFORMATION

The following table provides recommended design parameters to be used when modelling or predicting vertical ground deformation induced by soil-structure interactions.

Table 6-2: Recommended Design Parameters for Modelling Vertical Deformation of Soils

Subgrade Soil	Soil Modulus of Subgrade Reaction, $k_{v0.3}$ (MPa/m) [1, 2]	Modulus of Elasticity, Es (MPa)[2, 3]	Poisson's Ratio, ν[3]
Granular A (OPSS 1010) [4]	35 – 40	40 – 50	0.35
Granular B, Type II (OPSS 1010) [4]	35 – 40		
Compact Non-Cohesive Fill Soils as encountered in BH23-1 and 23-2	30	50	

Notes:
1 Normalized values for a base foundation measuring 0.3 m x 0.3 m.
2 Bowles, J.E. Foundation Analysis and Design
3 EPRI, Manual on Estimating Soil Properties for Foundation Design
4 All granular materials should be compacted to at least 98% SPMDD, depending on use. Refer to Section 7.1.1.

Subgrade modulus values for rectangular foundations (having a width, B and a length, L) may be estimated using the following relation:

$$k = \frac{k_{v0.3}\left(1 + 0.5\frac{B}{L}\right)}{1.5}$$

According to this relation, the modulus of subgrade reaction for very long foundations (i.e., L >> B) can be approximated by $k \approx 0.67 k_{v0.3}$.

6.3 DEEP FOUNDATIONS (DRILLED CAISSONS)

Temporary casings will likely be required given the risk of sloughing within the drilled shafts. The geotechnical resistances in compression are given in Table 6-3 for bored caissons with diameters of 0.76 m, 0.9 m and 1.2 m. Axial compression resistances were computed according to Section 18.2.1 of the CFEM. Due to the density of the soils at the pile tip elevations only end-bearing resistance was considered. It is recommended to found the pile tips at an elevation no higher than 280.5 m asl, which is where the very dense cohesionless soils were encountered. The underside of the pile cap should be located at least 1.3 m bgs to ensure frost protection, or equivalent thermal insulation should be used.

It should be mentioned that factored ULS values were obtained by using a geotechnical resistance factor (Φ) of 0.4 (Table 8.1, CFEM). The SLS values provided correspond to allowable capacities, where a factor-of-safety of 3.0 was used.

Table 6-3: Recommended Axial Capacities – Drilled Caissons

Pile Diameter (m)	Minimum Pile Length (m)	Geotechnical Axial Capacity (kN)	
		Factored ULS	SLS
0.76	2.7	500	330
0.90	2.7	700	470
1.20	2.7	1,200	800

6.3.1 SETTLEMENT OF A SINGLE PILE

The SLS axial capacities in compression that are provided in Table 6-3 normally limit global settlements to less than 25 mm, and differential settlement to less than 15 mm. However, once the location of structures and anticipated loads are known, this can be re-evaluated to ensure that the allowable limits are respected. Assuming that the pile tips are bearing in a stratum with SPT N ≥ 50, it is anticipated that most settlement will be due to the elastic deformation of the pile itself after transmitting axial compressive loading.

6.3.2 CAPACITY OF A PILE GROUP

The capacity of a pile group is estimated by the product of the capacity of a single pile, the number of piles comprising the group and a group efficiency factor (η), which is a function of the centre-to-centre spacing (s) of the piles. The pile spacing (s) is a multiple of the pile diameter. Table 7.5 is a summary of suggested group efficiency factors to be used.

Table 6-4: Group Effects – Reduction Factor (Axially Loaded Piles)

Pile Spacing in Direction of Loading, s. (s = D= Pile Diameter)	Efficiency Factor (η)
3s	0.7
4s	0.8
5s	0.9
≥6s	1.0

2.1.1 LATERAL RESISTANCE OF A SINGLE PILE

The lateral capacity of a caisson can best be determined by field tests, horizontal subgrade reaction or numerical modelling using software such as LPILE. The stress-deformation behaviour of caisson under lateral loads can be determined using the horizontal subgrade reaction method.

In the model of pile-soil interaction, the lateral earth resistance of soil can be simulated by a series of linear springs, and the stiffness coefficient of the springs or spring constant (K_{spr}) can be obtained from the calculated values of the modulus of horizontal subgrade reaction (k_h). For a pile with a diameter of d and a segment L used in analysis, the value of K_{spr} can be calculated using:

$$K_{spr} = d \cdot L \cdot k_h$$

The unit of K_{spr} is kN/m, and the unit of L is metre (m).

In non-cohesive soils like the sandy silt encountered within the boreholes, the coefficient of horizontal subgrade reaction and the ultimate lateral resistance P_{ult} may be estimated by the following equations:

$$k_h = n_h z / d$$

$$p_{ult} = 3 \gamma z K_p$$

where: k_h = coefficient of horizontal subgrade reaction (MN/m3)

z = depth (m) below finished grade

d = caisson diameter (m)

n_h = soil coefficient (5 to 10 MPa/m)

γ = total unit weight of soils, kN/m^3

γ' = submerged unit weight of soils, kN/m^3

K_p = Passive Earth Pressure Coefficient (Table 6-5)

L = length of the caisson segment used in the analysis.

6.4 LATERAL EARTH PRESSURE

It is recommended that granular material (e.g., Granular 'A' or Granular 'B' as per OPSS 1010) be used as a backfill behind foundation walls (if any). The granular material will facilitate drainage to a perimeter drainage system to reduce hydrostatic pressures acting on the walls (if below groundwater). Heavy compaction equipment should not be used for wall backfill. Adequate slope of the surface layer should be maintained to drain any runoff away from the buildings to designated locations (e.g., maintenance holes).

6.4.1 STATIC EARTH PRESSURE COEFFICIENTS

Based on a well-compacted and drained backfill soil, the foundation walls should be designed to resist the horizontal pressure acting on the wall. The horizontal pressure 'p', at a depth 'h', may be estimated using the following:

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

where K = lateral earth pressure coefficient (at-rest, passive or active);

γ = unit weight (kN/m^3);

h = depth below final grade (m); and

q = surcharge load (kPa), if present, plus 12 kPa due to compaction equipment

Suggested material properties and parameters for static conditions are presented in Table 6-5.

Table 6-5: Recommended Static Lateral Earth Pressure Parameters

Material	Design Bulk Unit Weight (kN/m^3)	Angle of Internal Friction, ϕ (°)	Active Earth Coefficient (K_a)	Passive Earth Coefficient (K_p)	At Rest Earth Coefficient (K_o)
Granular 'A'	22.0	33 to 35	0.27 to 0.30	3.3 to 3.7	0.43 to 0.46
Granular 'B' Type I	21.0	29 to 32	0.31 to 0.35	2.9 to 3.2	0.47 to 0.52
Granular 'B' Type II	21.0	30 to 33	0.29 to 0.33	3.0 to 3.4	0.46 to 0.50
Native Compact	20	30 to 32	0.31 to 0.33	3.2 to 3.3	0.52 to 0.56

Material	Design Bulk Unit Weight (kN/m^3)	Angle of Internal Friction, ϕ (°)	Active Earth Coefficient (K_a)	Passive Earth Coefficient (K_p)	At Rest Earth Coefficient (K_o)
Gravelly Sand					

*In saturated conditions, the effective unit weight ($\gamma' = \gamma - \gamma_w$) and hydrostatic pressure should be considered.

6.4.2 SEISMIC LATERAL EARTH PRESSURE COEFFICIENTS

Recommended lateral earth pressures for seismic design are presented in Table 6-6, in accordance with Section 6.7.1 of the CFEM. It should be noted that for seismic parameters, an internal angle of friction between a structure and retained soil (δ) was assumed to be two-thirds of the internal angle of friction. In addition, these parameters are for a horizontally sloped and well draining backfill.

For design, the total seismic active thrust (P_{AE}) is taken as:

$$P_{AE} = \frac{1}{2}K_{AE}\gamma H^2(1-k_v)$$

where K_{AE} = seismic lateral earth pressure coefficient;

γ = unit weight (kN/m^3);

H = wall height (m), and

k_v = vertical seismic coefficient (may be neglected for seismic analyses in south-western Ontario)

The total seismic active thrust includes the static component (P_a):

$$P_{AE} = P_a + \Delta P_{AE}$$

The location of this force is then considered to act at a height h (m) from the base of the wall:

$$h = \frac{P_a\left(\frac{H}{3}\right) + \Delta P_{AE}(0.6H)}{P_{AE}}$$

where all parameters are as previously defined.

Similarly, the total passive thrust (P_{PE}) is taken as:

$$P_{PE} = \frac{1}{2}K_{PE}\gamma H^2(1-k_v)$$

where all parameters as previously defined. This total seismic passive thrust also includes the static component as:

$$P_{PE} = P_p + \Delta P_{PE}$$

However conversely to the active case, the dynamic component acts in the opposing direction to the static component, which reduces the available passive resistance.

Table 6-6: Recommended Seismic Lateral Earth Pressure Parameters

Material	Design Bulk Unit Weight (kN/m^3)	Angle of Internal Friction, ϕ (°)	Seismic Active Earth Coefficient (K_{AE})	Seismic Passive Earth Coefficient (K_{PE})
Granular 'A'	22.0	33 to 35	0.37 to 0.40	2.8 to 3.3
Granular 'B' Type I	21.0	29 to 32	0.41 to 0.46	2.1 to 2.6
Granular 'B' Type II	21.0	30 to 33	0.40to 0.44	2.3 to 2.8
Native Compact Gravelly Sand	20	30 to 32	0.41 to 0.44	2.3 to 2.6

*In saturated conditions, the effective unit weight ($\gamma' = \gamma - \gamma_w$) and hydrostatic pressure should be considered.

6.4.3 HYDROSTATIC PRESSURE

Hydrostatic loading should be included in the design of buried structures below the known groundwater table. The highest known water level (5 m bgs based on Trow investigation), should be taken as the design water level, plus 1 m, up to the ground surface, as applicable. A design groundwater level of 4 m bgs is recommended for design. The hydrostatic pressure (p_{hydro}) is to be computed according to:

$$p_{hydro} = \gamma_w h_w$$

where:

γ_w = unit weight of water (9.81 kN/m^3); and

h_w = height of the design water level above the foundation level (m)

No lateral earth pressure coefficients are applied to the hydrostatic pressure.

6.5 SLIDING RESISTANCE

Resistance to sliding parameters are presented in Table 6-7. The following should be used to estimate the coefficient of friction (μ):

$$\mu = \tan(\delta)$$

Where δ is the interaction angle of friction (in degrees) between concrete and earthen materials. It is recommended to use two-thirds of the internal angle of friction of each soil type to estimate δ.

Table 6-7: Recommended Parameters for Estimating Resistance to Sliding

Material	Bulk Unit Weight, γ (kN/m^3)	Angle of Internal Friction, ϕ (°)	Interactive Friction Angle, δ ($\approx \frac{2}{3}\phi$, °)	*Factored ULS Coefficient of Sliding (μ)
Granular 'A'	22	33 to 35	22 to 23	0.32 to 0.34
Granular 'B' Type I	21	29 to 32	19 to 21	0.27 to 0.30
Granular 'B' Type II	21	30 to 33	20 to 22	0.29 to 0.32
Native Compact Gravelly Sand	20	30 to 32	20 to 22	0.29 to 0.31

*A geotechnical resistance factor (Φ) of 0.8 was applied to these values (Table 8.1, CFEM)

A geotechnical resistance factor (Φ) of 0.8 for cohesionless materials (Table 8.1, CFEM) has been applied to ultimate values of coefficient of sliding.

6.6 UPLIFT RESISTANCE

The potential uplift force acting on a foundation or buried service due to groundwater pressure is estimated at the level of the underside of the foundation or at the invert elevation. Safety against buoyancy is estimated by computing the ratio between the self-weight of the structure and overburden fill material (downward weight) versus the upward hydrostatic force. A minimum safety factor of 1.5 is acceptable (Table 8.3, CFEM). Hydrostatic pressure (p_w) is computed according to:

$$p_w = \gamma_w z_{w\,max}$$

where:

γ_w: unit weight of water (9.81 kN/m^3),

$z_{w\,max}$: maximum height of groundwater above the foundation level (i.e., the highest measured groundwater level) and

p_w: hydrostatic pressure at the foundation level, at a depth of $z_{w\,max}$ below the groundwater table.

Additional dead load to ensure that structures have adequate resistance against uplift may be provided as ballast via the following (but not limited to):

- supplemental mass concrete below the target foundation level,
- a thickness of granular material at the base of the structure below the target foundation level,

- a flared base beyond the walls of a structure to mobilize overlying soil.

The choice of ballast system is left to the structural designer's discretion based on the magnitude of additional dead load that is required and cost of materials.

6.7 PAVEMENT DESIGN

Pavement design has been made with the following assumptions:

- CSA S6-14 (or equivalent) with an anticipated load of 80 kN;
- Approximately load frequency is once per week (AADT = 52);
- TF = 3.5;
- Percentage of load being commercial vehicles = 100%

Further design factors are as per the MTO Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions, Final Report, March 2008, and are as follows:

- Initial Serviceability, Pi = 4.5;
- Terminal Serviceability, Pt = 2.5;
- Mean Subgrade Resilient Modulus = 25 MPa;
- Reliability Level, R = 90%;
- Over Standard Deviation, So = 0.49;

Based on the factors listed above, the following table summarizes recommendations for pavement design and structure with a design life of 20 years.

ESALs	AASHTO Design for 20 Years						Recommended HMA		GBE (mm)
	HMA	Gran A	Gran B Type II	Design SN Req'	Selected SN	Total Pavt	HL 3 Surface Course PGAC 58-28	HL 8 (HS) Binder Course PGAC 58-28	
	Thickness (mm)								
~1.6x10^6	140	150	300	120	122	590	40 mm	50+50 mm	730

Pavement and granular structures must be placed on approved subgrade material and verified by a licensed geotechnical engineer at the time of placement. All granular must be compacted to 100% SPMDD as per OPSS Form 1010. Drainage properties of compacted base and sub-base materials should be adequate to accommodate typical surface runoff.

Where the new pavement meets existing pavements, a step joint should be constructed as follows:

- Saw cut and remove existing asphalt full depth a minimum of 300 mm back from the limits of new pavement; and

- Mill surface of existing asphalt within 300 mm of saw cut by 40 mm deep to allow surface course of new pavement to extend over onto existing base courses. Place tack coat on existing asphalt to allow for appropriate bonding between existing and new asphalt.

6.7.1 RIGID PAVEMENT DESIGN OVER 900 MM SEWAGE LINE

It is understood that an access road could be constructed to connect the proposed Location 1 of the CHP system to the dewatering building. The access road will travel across an underground utility corridor that contains a shallow primary 900 mm raw sewage line. In order to protect the shallow 900 mm sewage line, the following rigid pavement concrete structure is recommended:

- Concrete Slab – OPSSMUNI350: 200 mm thick.
- Granular A – OPSSMUNI1010: 300 mm thick, placed in 150 mm lifts and compacted to minimum 98% SPMDD.

Geotextile Terrafix 270R or similar should be installed under the entire concrete pavement structure to ensure separation between the granular and the subgrade.

7 CONSTRUCTION RECOMMENDATIONS

7.1 GENERAL EARTHWORKS

7.1.1 ENGINEERED FILL

If a grade raise is required, engineered fill should be used to raise the subgrade to the desired elevation. Engineered fill should be placed in loose lifts no greater than 300 mm for grade raises and compacted to at least 100% SPMDD for structural fills, under full time monitoring by the Geotechnical Engineer. For grade raises where no support for new structures is required, the fill can be compacted to 98% SPMDD. Engineering fill materials shall be sampled and tested as per OPSS 1010. Erosion and sediment control measures around stockpiles shall be done in accordance with OPSD 219.130.

Engineering fill may be required if soft or loose areas are identified in foundation subgrades, which should be sub-excavated and backfilled properly. Engineered fill may also be required for backfilling in the areas that will support structures (e.g., access roads).

i. Engineered fill can be placed after stripping all the; organic/fill, loose soils, any soils containing excessive debris/organic matter, and otherwise unsuitable or deleterious soils, within an area extending at least 1.0 m plus the depth of engineered fill beyond the perimeter of the footprint of the proposed structure. Engineered fill would then be suitable to support the foundations provided that the following criteria are strictly followed.

ii. The areal extent of engineered fill should be controlled by proper surveying techniques to ensure that the top of the engineered fill extends a minimum of 1.0 m beyond the perimeter of the structure to be supported. The engineered fill should be sloped at a minimum of 1H:1V to the approved subgrade. Care should be taken to compact the full extent of the engineered fill; this will likely require over placement of engineered fill and slope trimming after compaction.

iii. The proposed subgrade footprint should be stripped of; any organic soil, loose soils, organic matters, and other compressible, weak and/or deleterious materials. Spongy, wet or soft/loose spots should be sub excavated to stable subgrade and replaced with compactable approved soil, compatible with subgrade conditions, as directed by the geotechnical engineer.

iv. For foundations, the fill material should be placed in thin layers not exceeding approximately 200 mm when loose. Oversize particles (cobbles and boulders) larger than 120 mm should be discarded.

v. For engineered fill below foundations, each fill layer should be uniformly compacted with heavy compactors, suitable for the type of fill used, to at least 100% SPMDD. Above the foundation level, compaction shall be done to at least 98% SPMDD.

vi. Full-time geotechnical inspection and quality control (by means of frequent field density and laboratory testing) are necessary for the construction of a certifiable engineered fill and compaction procedure and efficiency should be controlled by the geotechnical engineer.

vii. The engineered fill should not be frozen and should be placed at moisture contents within 2% of the optimum value for compaction. The engineered fill should not be placed during winter months when freezing ambient temperatures occur persistently or intermittently.

7.1.2 EXCAVATIONS

Conventional heavy equipment should be capable of excavating the pavement structure, fills and native soils. Excavation into the bedrock, if required, will require the use of heavy equipment outfitted with rock teeth and hoe-ramming equipment.

All excavations should be carried out in accordance with the current Ontario Occupational Health and Safety Act and Regulations for Construction Projects (O. Reg. 213/91, as amended). The soils encountered at site are classified as shown in Table 7-1.

Table 7-1 Soil Classification for Excavations (OHSA)

Soil	Soil Classification
Compact to Loose Fill	Type 3
Compact Non-Cohesive Deposits above the groundwater table	Type 3
Compact Non-Cohesive Deposits below the groundwater table	Type 4

However, consideration should be given to the possibility of re-classifying the soils downward if excavation walls have been exposed to weathering for several days without proper protection. Conditions for Type 4 soils may develop if excavations encounter flowing groundwater. Alternatively, an engineered shoring system may be used, combined with adequate dewatering of the excavation base. Where required, temporary protection systems should be provided in accordance with OPSS.PROV 539.

Where workers must enter excavations advanced deeper than 1.2 m, the trench walls must be suitably sloped and/or braced in accordance with Ontario Regulation 213/91 of the Occupational Health and Safety Act. The regulations stipulate maximum slopes of excavation by soil types as shown in Table 7-2.

Table 7-2 Maximum Slopes of Excavations

Soil Classification	Base of Slope	Maximum Slope Inclination
Type 3	From bottom of trench	1 horizontal to 1 vertical
Type 4	From bottom of trench	3 horizontal to 1 vertical

Stockpiles of excavated materials and vehicular traffic should be kept at least 1.5 m away from the edge of the excavation to prevent slope instability, subject to confirmation by the geotechnical engineer. Care should also be taken to avoid overloading of any underground services/structures by stockpiles.

Some flattening or benching of excavation slopes may be required if saturated soils are encountered. The global slope stability should be conducted when the detailed design of the wingwalls / retaining walls is available.

All surface drainage must be directed away from any open excavations and trenches. Where there is insufficient space for open cut excavations, shoring will be required. Water within excavations should be managed with temporary gravity sumps and pumping as required.

7.1.3 TEMPORARY SHORING AND TRENCHING

Any open excavations will need to avoid undermining existing foundations. It is recommended any excavation do not sub excavate material within an area extending at a rate of 2 horizontal to 1 vertical (2H:1V) below existing footings without the use of shoring designed to support the loads.

Design of temporary support of excavation (SOE) systems are the responsibility of the Contractors and shall be designed by a Professional Engineer licensed in Ontario, in accordance with the CFEM. The temporary shoring design must include appropriate factors of safety, and any possible surcharge loading must be considered. The support system must comply with sections 234 to 239 and 241 of Ontario Regulation 213/91. All shoring shall meet all requirements of the OHSA and Regulations for Construction Projects and the Trench Excavators Protection Act. In addition, for excavations carried out during the installation of services, the use of steel trench-boxes may be considered for temporary SOE.

The soil parameters in Table 6-5 may be used for design of temporary SOE. However, it is up to the contractor to have a qualified and licensed engineering working for the contractor to confirm the suitability of the earth pressure coefficients for the contractor's temporary shoring design.

7.1.4 PIPE BEDDING & COVER

Service pipes require an adequate base to ensure proper pipe connection and that positive flow is maintained post-construction. As such, pipe bedding should be placed in uniform thickness and compactness. The pipe bedding and cover material should conform to OPSD 802.010 and 802.013 specifications for flexible pipes and to OPSD 802.031 to 802.033 with Class “B” bedding for rigid pipes. The pipe bedding material should consist of a minimum thickness of 150 mm Granular “A” (OPSS 1010) below the pipe and extend up the sides to the spring line.

It is recommended that the bedding thickness shall be increased depending on the pipe diameter or if wet or weak localized subgrade conditions are encountered. The additional bedding thickness should be determined after inspection by qualified geotechnical personnel.

The pipe cover material from the spring line should consist of Granular "B" Type I (OPSS 1010) and should extend to a minimum of 300 mm above the crown of the pipe. All granular fill material is to be placed in maximum 200 mm thick loose lifts compacted to a minimum of 98% SPMDD. The bedding material, pipe and cover material should be installed as soon as practically possible after the excavation subgrade is exposed.

7.1.5 REUSE OF EXCAVATED SOILS

Excavated soils are expected to consist of upper variable fills (sands and gravels with debris), and native gravelly sand. In general, existing fill soils found in BH23-1 are not suitable for reuse as engineered fill or backfill for trenches due to the debris (slag, brick, metal) and organic content. The fill represented by sample SS1 in BH23-2 conforms to gradation requirements of Granular B, Type II (OPSS 1010), therefore is suitable for reuse as engineered fill or backfill for trenches.

Any unsuitable soils and other materials such as concrete and steel foundations, encountered during excavations should be removed from the site and disposed of appropriately depending on the environmental condition of the soil. The native soil is considered suitable for reuse as bulk fill, provided it can be properly compacted. The soils must also be at suitable moisture contents for re-compaction. Typically, the optimum moisture content for silty sand/sandy silt soils for re-compaction is about 10%. The moisture contents recorded for the non-cohesive soils encountered varies from 10% to 29%, therefore, some moisture conditioning may be required.

All trench backfills and bulk fills should be placed in maximum 300 mm lifts and compacted to a minimum of 95% Standard Proctor Maximum Dry Density (ASTM D698). For the upper 0.5 m below any pavement structure, the degree of compaction should be increased to at least 98% SPMDD.

7.2 GROUNDWATER CONTROL DURING EXCAVATIONS

Based on the soil and groundwater conditions at the borehole locations and the proposed shallow excavations for exterior concrete pads, if required groundwater inflow into the excavations could be controlled by properly filtered sumps placed a minimum or 0.5 m below the founding grade located around the work area. Care should also be exercised to minimize disturbance to the final subgrade during excavation.

7.3 EARTHWORKS IN WINTER WEATHER

Exposed subgrade should never be allowed to freeze. If this occurs, sub-excavation of frozen materials through the complete frozen depth is required followed by immediate backfilling with competent fill, as directed by the on-site geotechnical engineer. Continuous placement of materials until the desired grade is recommended as achieving compaction targets is difficult if in-situ moisture is allowed to freeze. It is important to note that soils that are placed and allowed to freeze before compaction will subside during thawing periods, potentially affecting structures at the surface. Therefore, coordinated hoarding and heating is recommended if work is to occur during winter weather.

7.4 MANAGING POTENTIAL EFFECTS OF CONSTRUCTION ON EXISTING STRUCTURES

Prior to construction, pre-construction condition surveys of existing structures should be carried out. It should be noted that the existing structures may be affected by the excavation of the exterior concrete pads.

As the construction of the new structures may affect the existing structures (roads/buildings/underground utilities, etc.), a pre-construction and post-construction surveys.

7.5 PROTECTION FOR EXISTING UTILITIES & STRUCTURES

Before any excavation work can begin, private and public utility locates must be completed to identify existing subsurface services. This information will inform construction planning and sequencing with the aim of protecting these services. Hydro-vacuum methods may be used to daylight sensitive utilities in advance of conventional excavation. Exposed services shall be protected and supported by using slings to suspend to maintain approximate invert levels. The frequency of sling locations will depend on the rigid or flexible nature of each service. Any duct banks shall be exposed and protected in accordance with the utility owner's specifications and standards.

Utilities that are not going to be exposed via excavation may be protected from heavy construction traffic by using steel mats or by temporarily adding a thickness of imported granular material to the existing grade, above the sensitive services (see Section 7.1.1). The design of thicknesses will depend on the type of utilities and anticipated traffic. The Contractor shall design temporary utility protection. In addition, some utility owners prescribe specific protection requirements, and it is the Contractor's responsibility to check and ensure the protection is in accordance with their standards and specifications. Utilities should also be monitored for vibrations imparted due to construction activity if high frequency vibrations are anticipated during the works. A monitoring plan should be in place in accordance with the Client's specifications and standards.

Footings at differing elevations should be in such a way that higher footings are outside of a zone of influence from lower footings that can be described by a line grading upward at a rate of 10H:7V, starting at the edge of the underside of the lower foundation. This also applies to existing service excavations.

For a permanent protection of the shallow 900 mm raw sewage line, a rigid concrete pavement structure is recommended,, refer to Section 6.7.

7.6 RETAINING WALLS AND BACKFILL

The lateral earth pressures acting on the permanent walls will depend on the type and method of placement of the backfill materials, on the nature of the soils behind the backfill, on the magnitude of surcharge including construction and traffic loadings, on the freedom of lateral movement of the structure, and on the drainage conditions behind the walls.

The granular backfill behind retaining walls may be placed either in a zone with a width equal to at least 1.5 m behind the back of the wall stem (Case I) or within the wedge-shaped zone defined by a line drawn at 1.5 horizontal to 1 vertical (1.5H:1V) extending up and back from the rear face of the footing (Case II). The coefficients listed in Table 6-5 may be used for the design of the earth-retaining structural elements against lateral loads.

If lateral movements are permitted in design, active (K_a) or passive (K_p) earth pressures (movements away from or into retained earth, respectively) may be used in the design of the structure. Otherwise at-rest earth (K_0) pressures are to be assumed for geotechnical design. The movement threshold at which active or passive pressures develop within the backfill may be taken as follows:

- rotation (i.e., ratio of wall movement to wall height) of approximately 0.002 about the base of a vertical wall;
- horizontal translation (i.e., ratio of lateral displacement to wall height) of 0.001 active earth pressure and 0.015 for passive earth pressure; or
- a combination of both rotation and translation that results in movements that correspond to the minimum threshold ratios as outlined above.

Granular materials shall be placed as per Section 7.1.1. Manual compaction may be used where it is infeasible for machinery to access or where it may cause damage to the wall. Generally, this is within 1.5 m of the wall surface.

Should they be required, drains at the foundation level of retaining walls should consist of a minimum 150 mm diameter fabric wrapped perforated drainage tile surrounded by 19 mm diameter clear stone (OPSS 1004), with a minimum cover of 150 mm on top and sides and 50 mm below the drainage tile. The clear stone gravel should be wrapped in a non-woven geotextile as a separation barrier to prevent fines migration.

The water collected from the weeping tile should be directed away from the structure to appropriate drainage features, either through gravity flow or interior sump pump systems. Any waterproofing requirements are left to the discretion of the designer.

7.7 SITE GRADING & DRAINAGE

The site shall be graded such that positive drainage is promoted away from existing and newly installed structures. Gradients should be at minimum 1% to convey flow away from structures. Surface runoff should also be directed to drainage features and/or sumps to the existing drainage system.

7.8 OBSTRUCTIONS

The test pit portion of the field investigation revealed unidentified concrete structural elements. It appears that they may be abandoned foundations that were left in place. Other potential obstructions include presence of asphalt, organics, concrete and other deleterious materials within the existing fill that should be anticipated, and cobbles and boulders may be encountered within the native soils and accounted for in the Project Contractor's equipment selection. It should be noted that the size, quantity, and exact location of all obstructions cannot be accurately determined by single borehole locations and WSP recommends that the contract documents include a warning to the potential for these obstructions.

7.9 CONSTRUCTION QUALITY CONTROL

It is recommended that the geotechnical aspects of the final design drawings and specifications are reviewed by WSP prior to tendering and construction, to confirm that the intent of this report has been met. It is also recommended that a program of site supervision, inspection, and construction materials testing is implemented during the construction phase of the project to confirm that construction is carried out in accordance with the design and specifications, and to confirm that the subsurface conditions encountered in the excavations are consistent with those encountered in the boreholes.

8 CLOSURE

The limitations of this report, as discussed in detail in Appendix D, constitute an integral part of this report. We recommend the Geotechnical Consultant be retained to review drawings and the intended methods of construction prior to implementation to assure conformance with the geotechnical restrictions and assumptions.

We trust this report is complete within the terms of our reference. However, should questions arise concerning this report, do not hesitate to contact us.

NOTES:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE WSP E&I CANADA LIMITED REPORT No. OGTW2331. ALL LOCATIONS ARE APPROXIMATE.

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REFERENCES:
CANMAP STREETFILES V2008.4.

CLIENT: County of Oxford, 21 REEVE STREET, WOODSTOCK, ONTARIO, N4S 7Y3	Oxford County — Growing stronger together	DWN BY: LMK CHK'D BY: NR DATUM: NAD83 PROJECTION: UTM Zone 17 SCALE: 1:40,000	PROJECT: GEO INV - WOODSTOCK WWTP 195 ADMIRAL STREET WOODSTOCK, ONTARIO	DATE: JULY 2023 PROJECT No: OGTW2331
WSP E&I Canada Limited 900 MAPLE GROVE ROAD, UNIT 10 CAMBRIDGE, ONTARIO, N3H 4R7 519-650-7100	wsp		TITLE: KEY PLAN	REV No: 0 FIGURE No: 1

DATE PLOTTED: 7/12/2023 2:34:33 PM
FILE LOCATION: G:\CCGEM\2023\Geotechnical\Projects\OGTW2331 Oxford WD WWTP\14 CAD\GEO\OGTW2331-R01001.dwg

LEGEND:

BOREHOLE LOCATION

TEST PIT LOCATION

NOTES:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE WSP E&I CANADA LIMITED REPORT No. OGTW2331.

ALL LOCATIONS ARE APPROXIMATE.

ORIGINAL PAPER SIZE: 8 ½ x 11

REFERENCES:
BING IMAGERY AS OF JULY 12, 2023 (IMAGE DATE UNKNOWN), BING IMAGERY USED FOR ILLUSTRATION PURPOSES ONLY AND NOT TO BE USED FOR MEASUREMENTS.

DATE PLOTTED: 7/13/2023 9:50:14 AM
FILE LOCATION: G:\CGEM\2023\Geotechnical\Projects\OGTW2331 Oxford WD WWTP\14 CAD\GEO\OGTW2331-R01001.dwg

CLIENT: County of Oxford 21 REEVE STREET WOODSTOCK, ONTARIO, N4S 7Y3	Oxford County Growing stronger together	DWN BY: LMK CHK'D BY: NR DATUM: NAD83 PROJECTION: UTM Zone 17 SCALE: 1:500	PROJECT: GEO INV - WOODSTOCK WWTP 195 ADMIRAL STREET WOODSTOCK, ONTARIO	DATE: JULY 2023 PROJECT No: OGTW2331
WSP E&I Canada Limited 900 MAPLE GROVE ROAD, UNIT 10 CAMBRIDGE, ONTARIO, N3H 4R7 519-650-7100	wsp		TITLE: BOREHOLE LOCATION PLAN	REV. No: 0 FIGURE No: 2

APPENDIX

A

EXPLANATION OF BOREHOLE LOG

This form describes some of the information provided on the borehole logs, which is based primarily on examination of the recovered samples, and the results of the field and laboratory tests. Additional description of the soil/rock encountered is given in the accompanying geotechnical report.

GENERAL INFORMATION

Project details, borehole number, location coordinates and type of drilling equipment used are given at the top of the borehole log.

SOIL LITHOLOGY

Elevation and Depth

This column gives the elevation and depth of inferred geologic layers. The elevation is referred to the datum shown in the Description column.

Lithology Plot

This column presents a graphic depiction of the soil and rock stratigraphy encountered within the borehole.

Description

This column gives a description of the soil stratums, based on visual and tactile examination of the samples augmented with field and laboratory test results. Each stratum is described according to the *Modified Unified Soil Classification System* (modified slightly so that an inorganic clay of "medium plasticity" is recognized).

The compactness condition of cohesionless soils based on standard penetration testing (SPT) and the consistency of cohesive soils (undrained shear strength) are defined as follows *(Ref. Canadian Foundation Engineering Manual, 4th Edition, 2006)*:

Compactness of Cohesionless Soils	SPT N-Value
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

Consistency of Cohesive Soils	Unconfined Compressive Strength	
	kPa	psf
Very Soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	> 200	> 4000

SOIL SAMPLING

Sample types are abbreviated as follows:

SS	Split Spoon	TW	Thin Walled Open (Pushed)	RC	Rock Core	GS	Grab Sample
AS	Auger Sample	TP	Thin Walled Piston (Pushed)	WS	Washed Sample	AR	Air Return Sample

Additional information provided in this section includes sample numbering, sample recovery (%) and numerical testing results (SPT).

FIELD AND LABORATORY SAMPLING

Results of field testing (e.g., SPT, pocket penetrometer, and vane testing) and laboratory testing (e.g., natural moisture content, and limits) executed on the recovered samples are plotted in this section.

Definitions of Penetration Resistance

Standard penetration resistance 'N' – The number of blows required to advance a standard split spoon sampler 30 cm into the subsoil, driven by means of a 63.5 kg hammer falling freely a distance of 76 cm.

Dynamic penetration resistance – The number of blows required to advance a 50 mm, 60 degree cone, fitted to the end of drill rods, 30 cm into the subsoil, the driving energy being 474.5 Joules per blow.

INSTRUMENTATION INSTALLATION

Instrumentation installations (monitoring wells, piezometers, inclinometers, etc.) are plotted in this section.

WATER LEVEL

Water levels, if measured during fieldwork, are plotted in the depth/elevation column. These water levels may or may not be representative of the static groundwater level depending on the nature of soil stratum where the piezometer tips are located, the time elapsed from installation to reading and other applicable factors. Other information includes the depth of borehole cave-in, if any. This information is also included in the borehole log footer.

COMMENTS

This column is used to describe non-standard situations or notes of interest.

MODIFIED* UNIFIED SOIL CLASSIFICATION SYSTEM

*The soil of each stratum is described using the Unified Soil Classification System (Technical Memorandum 36-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S Army. Vol. 1, March 1953) modified slightly so that an inorganic clay of "medium plasticity" is recognized.

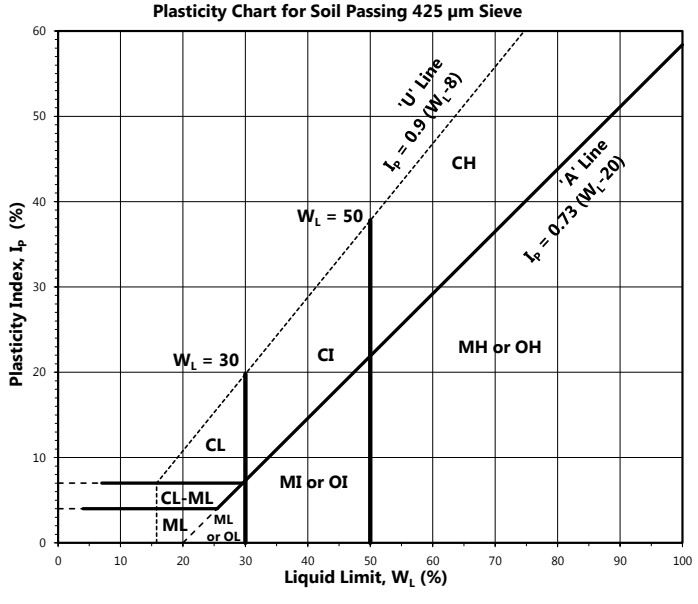
MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR I_P LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE OR I_P MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (TRACE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			SP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR I_P LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE OR I_P MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		W_L > 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 30%	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		30% < W_L < 50%	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		W_L > 50%	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SLTS & CLAYS BELOW "A" LINE	W_L < 50%	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", e.g. SF IS A MIXTURE OF SAND WITH SILT OR CLAY
		W_L > 50%	OH	ORGANIC CLAYS OF HIGH PLASTICITY	
HIGH ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE

SOIL COMPONENTS

FRACTION	U.S STANDARD SIEVE SIZE			DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
		PASSING	RETAINED	PERCENT	DESCRIPTOR
GRAVEL	COARSE	75 mm	19 mm	35 - 50	AND
	FINE	19 mm	4.75 mm	20 - 35	Y/EY
SAND	COARSE	4.75 mm	2.00 mm	10 - 20	SOME
	MEDIUM	2.00 mm	425 µm	1 - 10	TRACE
	FINE	425 µm	75 µm		
FINES (SILT AND CLAY BASED ON PLASTICITY)		75 µm			

OVERSIZED MATERIAL

ROUNDED OR SUBROUNDED:	NOT ROUNDED:
COBBLES 75 mm to 300 mm	ROCK FRAGMENTS > 75 mm
BOULDERS > 300 mm	ROCKS > 0.76 CUBIC METRE IN VOLUME



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Geotechnical Discipline - Ontario Region

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MODIFIED USCS

Note 1: Soils are classified and described according to their engineering properties and behaviour.
Note 2: The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual (4th Edition, Canadian Geotechnical Society, 2006.)

Rev Date: September 22, 2022

RECORD OF BOREHOLE No. BH23-01

Project Number: **OGTW2331**
Project Client: **County of Oxford**
Project Name: **Geo Inv - Woodstock WWTP**
Project Location: **195 Admiral St, Woodstock, ON**
Drilling Location: **N 4776062.0 E 518598.0**

Drilling Method: **200 mm O.D. Hollow Stem Augers**
Drilling Machine: **Track Mounted Drill**
Date Started: **30 Jun 2023** Date Completed: **30 Jun 2023**
Logged by: **RL** Compiled by: **NR**
Reviewed by: **MN** Revision No.: **1**

Geodetic Ground Surface Elevation: 284.5 m

Description	Depth (m)	Elevation (m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value
150 mm TOPSOIL	284.3					
FILL (sand and gravel) brown, trace silt, compact, moist	0.2		SS	1	84	16
	284.0					
FILL (sand) black, trace slag and brick fragments, trace metal debris and organics, very loose to compact, moist	0.5		SS	2	67	13
- some organics, trace glass debris and loose below 1.5 m			SS	3	51	2
	282.2					
FILL (sand and gravel) brown, trace silt, compact, moist	2.3		SS	4	51	13
	281.5					
GRAVELLY SAND brown, trace silt, very dense, moist	3.0		SS	5	57	53
			SS	6	89	50/ 0.13
			SS	7	100	50/ 0.13
	279.3					
END OF BOREHOLE	5.2					

FIELD TESTING: Penetration Testing (SPT, DCPT); MTO Vane* (Intact, Remould); Nilcon Vane* (Intact, Remould); Undrained Shear Strength (kPa) (from P. Penetrometer tests) 20 40 60 80

LAB TESTING: Atterberg Limits (W_P, W, W_L; Plastic, Liquid); Passing 75 um (%); Moisture Content (%); Unit Weight (KN/m3); 20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

Sample SS1B submitted for environmental analysis of PHC F1 to F4, BTEX, PAH and Metals and Inorganics

Sample SS2 submitted for environmental analysis of PHC F1 to F4, BTEX, PAH and Metals and Inorganics

Sample SS3 submitted for corrosion potential analysis
Organic Content on SS3
Ash Content: 87%
Organic Content: 13%

Sample SS4 submitted for environmental analysis of PHC F1 to F4, BTEX, PAH and Metals and Inorganics
Grainsize on SS4
Gravel: 46%
Sand: 46%
Fines: 8%

Augers Grinding below 3 m

Borehole terminated at 5.2 m below ground surface due to Auger refusal.

WSP Environment & Infrastructure Canada Limited

900 Maple Grove Road
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Tel: (519) 650-7100
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No freestanding groundwater observed in open borehole upon completion of drilling.

Cave in measured at a depth of 4.0 m upon completion of drilling.

RECORD OF BOREHOLE No. BH23-02

Project Number: **OGTW2331**
Project Client: **County of Oxford**
Project Name: **Geo Inv - Woodstock WWTP**
Project Location: **195 Admiral St, Woodstock, ON**
Drilling Location: **N 4776062.0 E 518629.0**

Drilling Method: **200 mm O.D. Hollow Stem Augers**
Drilling Machine: **Track Mounted Drill**
Date Started: **30 Jun 2023** Date Completed: **30 Jun 2023**
Logged by: **RL** Compiled by: **NR**
Reviewed by: **MN** Revision No.: **1**

Geodetic Ground Surface Elevation: 284.6 m

Depth (m)	Description	Elevation (m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	Comments & Grain Size Distribution (%)
	50 mm ASPHALT	284.5					
	FILL (sand and gravel) brown, trace silt, loose to compact, moist	284.0	SS	1	64	22	Grainsize on SS1 Gravel: 41% Sand: 51% Fines: 8%
1			SS	2	75	13	Sample SS2 submitted for environmental analysis of PHC F1 to F4, BTEX, PAH and Metals and Inorganics
2		283	SS	3	67	9	Sample SS3 submitted for corrosion potential analysis
3	- dark brown below 3 m	282	SS	4	75	16	Sample SS4 and DUPS-1 submitted for environmental analysis of PHC F1 to F4, BTEX, PAH and Metals and Inorganics
			SS	5	67	20	Augers Grinding below 3 m
		281					
	FILL (gravelly sand) dark brown, some fines, trace brick fragments, very dense, moist	280.9	SS	6	100	56/ 0.2	Grainsize on SS6 Gravel: 34% Sand: 55% Fines: 11%
4	**GRAVELLY SAND** brown, trace silt, very dense, moist	280.2	SS	7	100	50/ 0.05	
5	**END OF BOREHOLE**	279.4					Borehole terminated at 5.2 m below ground surface due to Auger refusal.

Penetration Testing: SPT ○ DCPT ●
MTO Vane*: Intact △ Remould ▲
Nilcon Vane*: Intact ◇ Remould ◆
Undrained Shear Strength (kPa) (from P. Penetrometer tests)

Atterberg Limits: W_P — W — W_L (Plastic — Liquid)
Passing 75 um (%) ✳
Moisture Content (%) ○
Unit Weight (KN/m3) ★

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

■ Cave in measured at a depth of 4.3 m upon completion of drilling.

Borehole details, as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretive assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

TEST PIT STRATIGRAPHY LOG

Project Name: Geo Inv - Woodstock WWTP	Contractor: Cousins & Johnsons Inc.	Test Pit Designation: Test Pit 1
Project No.: OGTW2331		Date Started: June 30, 2023
Client: County of Oxford	Surface Elevation: 284.6	Date Completed: June 30, 2023
Location: Woodstock, ON	Test Pit Method: Excavator	Supervisor: Nitinkumar Ramnani

Depth *(m)*			*Soil Symbol, Primary Component, Secondary Component, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	*Sample No.*
From	*At*	*To*		
	0		Surface: Topsoil	
0		0.2	Topsoil - Dark brown, sandy, silty, rootlets	
0.2		2.53	Sand & Gravel - Brown, trace cobble fragments, trace fines	
	2.53		End of Test pit	

Location (Coordinates):
N 4776069.4, E 518618.2

Photo:

NOTES: Top of Undefined concrete structure found at 1.1 m BGS, Top of Concrete Slab Found at 1.4 m BGS

Seepage depth: Not Applicable
Sidewall Stability: No Cave in
Mix fill, landfill depth-thickness: Not Applicable
Bedrock depth: Not Encountered
Surface water run into excavation: None
Analytical testing sample depth: None
bgs- below ground surface

Completed By: Nitinkumar Ramnani *Date:* *05-Jul-23*

TEST PIT STRATIGRAPHY LOG

Project Name: Geo Inv - Woodstock WWTP	Contractor: Cousins & Johnsons Inc.	Test Pit Designation: Test Pit 2
Project No.: OGTW2331		Date Started: June 30, 2023
Client: County of Oxford	Surface Elevation: 284.6 m	Date Completed: June 30, 2023
Location: Woodstock, ON	Test Pit Method: Excavator	Supervisor: Nitinkumar Ramnani

Depth *(m)*			*Soil Symbol, Primary Component, Secondary Component, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	*Sample No.*
From	*At*	*To*		
	0		Surface: Topsoil	
0		0.2	Topsoil - Dark brown, sandy, silty, rootlets	
0.2		0.5	Sand & Gravel - Dark brown to brown, trace cobble fragments, trace fines	
0.5		1.51	Sand & Gravel - Brown to grey, trace cobble fragments, trace fines	
	1.51		End of Test pit	

Location (Coordinates):
N 4776055.0, E 518621.0

Photo:

NOTES: Top of Undefined concrete structure found at 0.9 m BGS, Top of Concrete Slab Found at 1.2 m BGS

Seepage depth: Not Applicable
Sidewall Stability: No Cave in
Mix fill, landfill depth-thickness: Not Applicable
Bedrock depth: Not Encountered
Surface water run into excavation: None
Analytical testing sample depth: None
bgs- below ground surface

Completed By: Nitinkumar Ramnani *Date:* *05-Jul-23*

Test Pit 1 Photographs:

Photo : 1

Photo : 2

Photo : 3

Photo : 4

Test Pit 2 Photographs:

Photo : 1

Photo : 2

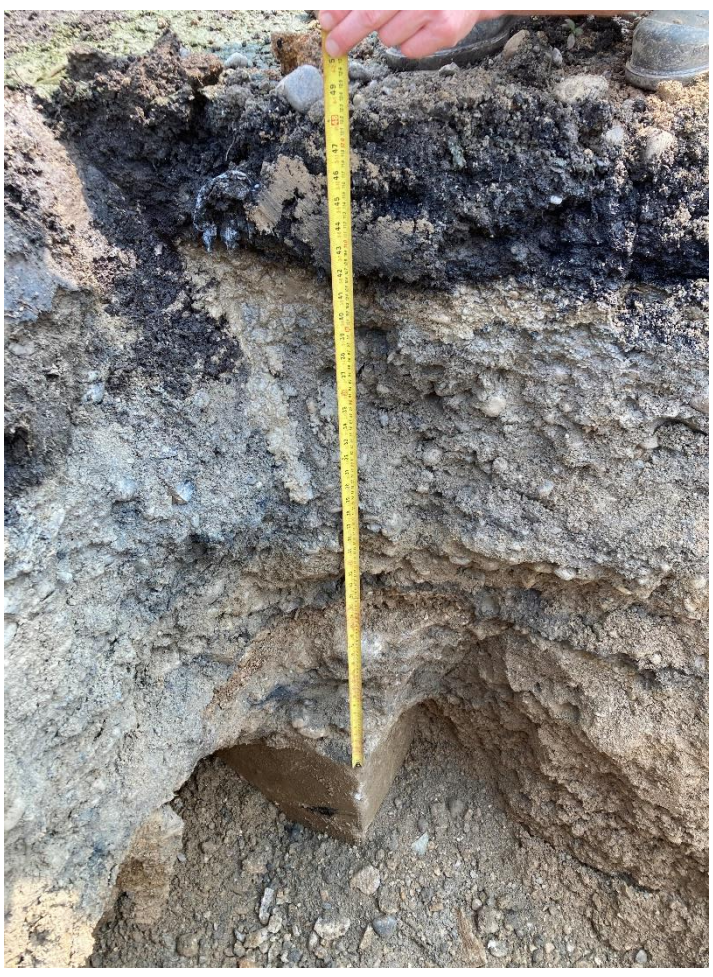


Photo : 3

Photo : 4

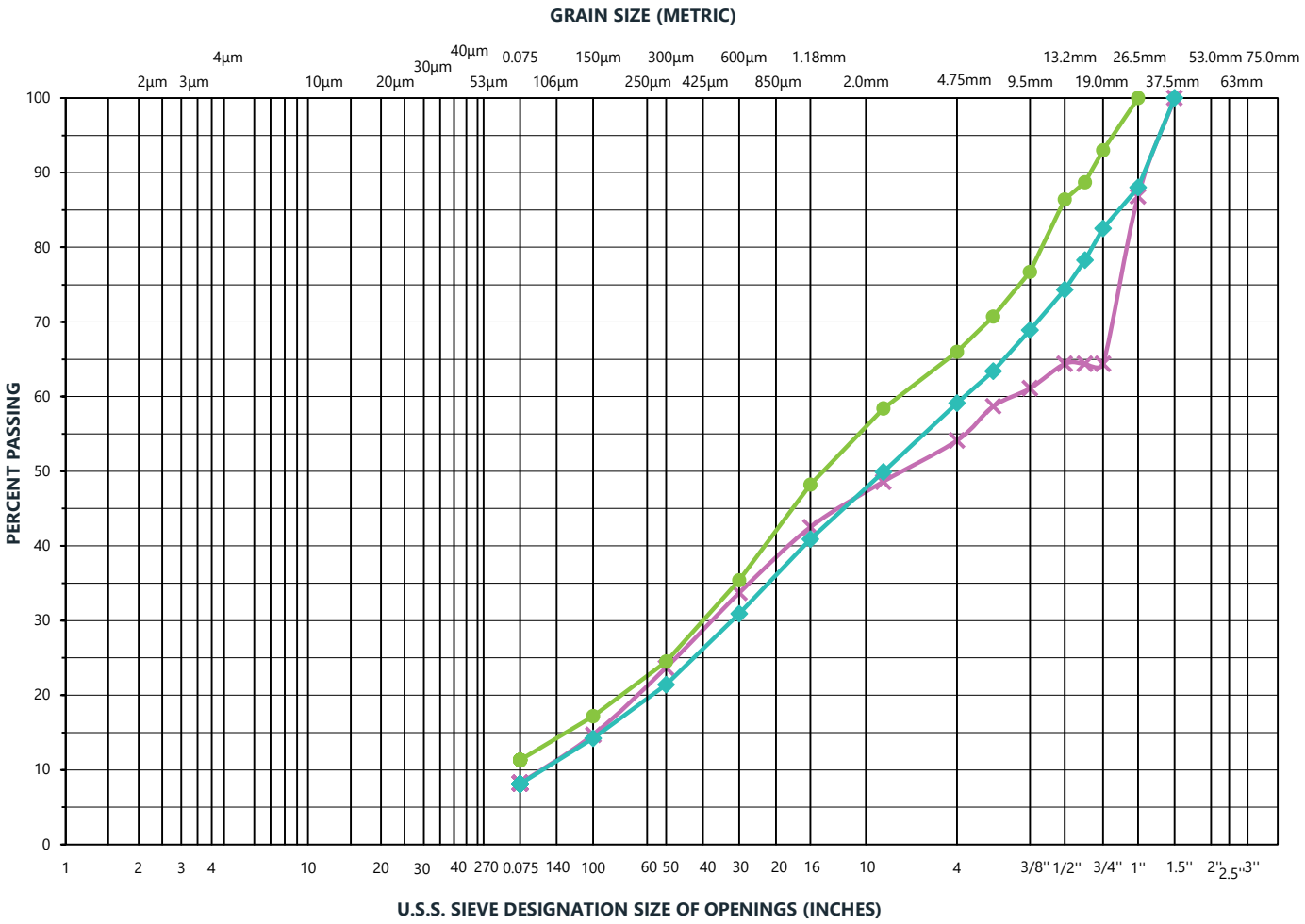
APPENDIX

B

GRAIN SIZE DISTRUBUTION

Oxford WD WWTP Upgrades

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	23-1	SS4	7.5 - 9.5	46	46	8	
◆	23-2	SS1	0.5 - 2.5	41	51	8	
●	23-2	SS6	12.5 - 14.5	34	55	11	

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GRAIN SIZE DISTRIBUTION

FIGURE 1

Project No.:	**OGTW3331**		
Date Rec'd:	**Jul 5, 2023**	**Tested By:**	**K. Gill**
Report Date:	**Jul 10, 2023**		

MOISTURE & ORGANIC CONTENT TEST REPORT

Standard Test Method for Moisture, Ash and Organic Material of Peat and Other Organic Soil ASTM D 2974

CLIENT: County of Oxford
PROJECT NO: OGTW2331
PROJECT: Oxford WD WWTP

LOCATION: Woodstock, ON
SOIL DESCRIPTION: Sand Trace Gravel and Organics

DATE REPORTED: 7-Jul-23
DATE RECEIVED: 5-Jul-23
SAMPLED BY: Nihtin Ramnani
CONTRACTOR:
TESTED BY: Justin Rocha

TEST RESULTS

WATER CONTENT DETERMINATION *(Test Method A)*

SAMPLE #:	3					
BORE HOLE #:	23-1					
STATION:						
DEPTH:	5 - 7'					
TARE & WET SAMPLE *(g):*	97.5					
TARE & DRY SAMPLE *(g):*	84.1					
MOISTURE *(g):*	13.40					
TARE WEIGHT *(g)* :	30.7					
SAMPLE DRY WEIGHT *(g):*	53.40					
WATER CONTENT *(% oven-dried basis):*	**25.1**					
WATER CONTENT *(% as-received basis):*	**20.1**					

ASH CONTENT DETERMINATION *(Test Method A)*

TARE & DRY SAMPLE *(g):*	3069.6					
TARE & ASH *(g):*	3060.8					
ORGANIC MATTER WEIGHT *(g)* :	8.80					
TARE WEIGHT *(g)* :	2999.9					
ASH WEIGHT *(g)* :	60.90					
FURNACE TEMPERATURE *(^{0} C):*	440					
TEST DURATION *(hours)*	1.00					
ASH CONTENT *(%):*	**87.4**					
ORGANIC MATERIAL CONTENT *(%):*	**12.6**					

Note:

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request.

Prepared by:
Reviewed by:

WSP E&I Canada Limited
900 Maple Grove Rd, Unit 10
Cambridge, ON, N3H 4R7

APPENDIX

C

ALS Canada Ltd.

right solutions.
right partner.

CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: **WT2319508**	Page	: 1 of 6
Client	: **WSP E&I Canada Limited**	Laboratory	: ALS Environmental - Waterloo
Contact	: Mauro Cortes	Account Manager	: Gayle Braun
Address	: 900 Maple Grove Road Unit 10 Cambridge ON Canada N3H 4R7	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 519 650 7100	Telephone	: +1 519 886 6910
Project	: OGTW2331.2000.5800.5730-00	Date Samples Received	: 30-Jun-2023 14:45
PO	: ----	Date Analysis Commenced	: 04-Jul-2023
C-O-C number	: ----	Issue Date	: 10-Jul-2023 16:33
Sampler	: ----		
Site	:		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 8		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Centralized Prep, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Inorganics, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Metals, Waterloo, Ontario

Summary of Guideline Breaches by Sample

SampleID/Client ID	Matrix	Analyte	Analyte Summary	Guideline	Category	Result	Limit
DUPS-1	Soil/Solid	Sodium adsorption ratio [SAR]		ON153/04	T2-ICC-C	71.4 -	12 -
	Soil/Solid	Sodium adsorption ratio [SAR]		ON406/20	T2.1-S-ICC	71.4 -	12 -

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guidelines are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Key : LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mS/cm	millisiemens per centimetre
mV	millivolts
ohm cm	ohm centimetres (resistivity)
pH units	pH units

>: greater than.
<: less than.
Red shading is applied where the result or the LOR is greater than the Guideline Upper Limit (or lower than the Guideline Lower Limit, if applicable).
For drinking water samples, Red shading is applied where the result for E.coli, fecal or total coliforms is greater than or equal to the Guideline Upper Limit.

Analytical Results Evaluation

Matrix: **Soil/Solid**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID	DUPS-1	BH23-1 SS3	BH23-2 SS3	----	----	----	----
				Sampling date/time	30-Jun-2023	30-Jun-2023 11:00	30-Jun-2023 08:25	----	----	----	----
				Sub-Matrix	Soil/Solid	Soil/Solid	Soil/Solid	----	----	----	----
					WT2319508-006	WT2319508-007	WT2319508-008	--------	--------	--------	--------
Physical Tests											
Conductivity (1:2 leachate)	----	E100-L/WT			----	361	847	----	----	----	----
Conductivity (1:2 leachate)	----	E100-L/WT	mS/cm		1.26	----	----	----	----	----	----
Moisture	----	E144/WT			5.59	12.0	6.82	----	----	----	----
Oxidation-reduction potential [ORP]	----	E125/WT	mV		----	341	243	----	----	----	----
pH (1:2 soil:CaCl2-aq)	----	E108A/WT			8.29	7.49	8.10	----	----	----	----
Resistivity	----	EC100R/WT	ohm cm		----	2770	1180	----	----	----	----
Cyanides											
Cyanide, weak acid dissociable	----	E336A/WT			<0.050	----	----	----	----	----	----
Inorganics											
Sulfides, acid volatile	----	E396-L/WT	mg/kg		----	0.92	0.47	----	----	----	----
Fixed-Ratio Extractables											
Calcium, soluble ion content	7440-70-2	E484/WT			0.93	----	----	----	----	----	----
Magnesium, soluble ion content	7439-95-4	E484/WT	mg/L		<0.50	----	----	----	----	----	----
Sodium, soluble ion content	17341-25-2	E484/WT			250	----	----	----	----	----	----
Sodium adsorption ratio [SAR]	----	E484/WT	-		71.4	----	----	----	----	----	----
Metals											
Antimony	7440-36-0	E440C/WT			<0.10	----	----	----	----	----	----
Arsenic	7440-38-2	E440C/WT	mg/kg		2.45	----	----	----	----	----	----
Barium	7440-39-3	E440C/WT			16.6	----	----	----	----	----	----
Beryllium	7440-41-7	E440C/WT	mg/kg		0.20	----	----	----	----	----	----
Boron	7440-42-8	E440C/WT			7.6	----	----	----	----	----	----
Boron, hot water soluble	7440-42-8	E487/WT	mg/kg		0.16	----	----	----	----	----	----
Cadmium	7440-43-9	E440C/WT			0.078	----	----	----	----	----	----
Chromium	7440-47-3	E440C/WT	mg/kg		25.6	----	----	----	----	----	----
Cobalt	7440-48-4	E440C/WT			3.26	----	----	----	----	----	----
Copper	7440-50-8	E440C/WT	mg/kg		14.2	----	----	----	----	----	----
Lead	7439-92-1	E440C/WT			6.17	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Soil/Solid**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID	DUPS-1	BH23-1 SS3	BH23-2 SS3	----	----	----	----
				Sampling date/time	30-Jun-2023	30-Jun-2023 11:00	30-Jun-2023 08:25	----	----	----	----
				Sub-Matrix	Soil/Solid	Soil/Solid	Soil/Solid	----	----	----	----
					WT2319508-006	WT2319508-007	WT2319508-008	--------	--------	--------	--------
Metals											
Mercury	7439-97-6	E510C/WT	mg/kg		0.0093	----	----	----	----	----	----
Molybdenum	7439-98-7	E440C/WT			0.87	----	----	----	----	----	----
Nickel	7440-02-0	E440C/WT	mg/kg		13.0	----	----	----	----	----	----
Selenium	7782-49-2	E440C/WT			<0.20	----	----	----	----	----	----
Silver	7440-22-4	E440C/WT	mg/kg		<0.10	----	----	----	----	----	----
Thallium	7440-28-0	E440C/WT			0.064	----	----	----	----	----	----
Uranium	7440-61-1	E440C/WT	mg/kg		0.556	----	----	----	----	----	----
Vanadium	7440-62-2	E440C/WT			16.3	----	----	----	----	----	----
Zinc	7440-66-6	E440C/WT	mg/kg		28.7	----	----	----	----	----	----
Speciated Metals											
Chromium, hexavalent [Cr VI]	18540-29-9	E532/WT			0.11	----	----	----	----	----	----
Leachable Anions & Nutrients											
Chloride, soluble ion content	16887-00-6	E236.Cl/WT	mg/kg		----	80.3	418	----	----	----	----
Sulfate, soluble ion content	14808-79-8	E236.SO4/WT			----	142	<20	----	----	----	----

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Summary of Guideline Limits

Analyte	CAS Number	Unit	ON153/04 T2-ICC-C	ON406/20 T2.1-S-ICC
Physical Tests				
Conductivity (1:2 leachate)	----	µS/cm	**1.4 mS/cm**	**1.4 mS/cm**
Conductivity (1:2 leachate)	----	mS/cm	**1.4 mS/cm**	**1.4 mS/cm**
Moisture	----	%	--	--
Oxidation-reduction potential [ORP]	----	mV	--	--
pH (1:2 soil:CaCl2-aq)	----	pH units	--	--
Resistivity	----	ohm cm	--	--
Cyanides				
Cyanide, weak acid dissociable	----	mg/kg	**0.051 mg/kg**	**0.051 mg/kg**
Inorganics				
Sulfides, acid volatile	----	mg/kg	--	--
Fixed-Ratio Extractables				
Calcium, soluble ion content	7440-70-2	mg/L	--	--
Magnesium, soluble ion content	7439-95-4	mg/L	--	--
Sodium adsorption ratio [SAR]	----	-	**12 -**	**12 -**
Sodium, soluble ion content	17341-25-2	mg/L	--	--
Metals				
Antimony	7440-36-0	mg/kg	**40 mg/kg**	**40 mg/kg**
Arsenic	7440-38-2	mg/kg	**18 mg/kg**	**18 mg/kg**
Barium	7440-39-3	mg/kg	**670 mg/kg**	**670 mg/kg**
Beryllium	7440-41-7	mg/kg	**8 mg/kg**	**8 mg/kg**
Boron, hot water soluble	7440-42-8	mg/kg	**2 mg/kg**	**2 mg/kg**
Boron	7440-42-8	mg/kg	**120 mg/kg**	**120 mg/kg**
Cadmium	7440-43-9	mg/kg	**1.9 mg/kg**	**1.9 mg/kg**
Chromium	7440-47-3	mg/kg	**160 mg/kg**	**160 mg/kg**
Cobalt	7440-48-4	mg/kg	**80 mg/kg**	**80 mg/kg**
Copper	7440-50-8	mg/kg	**230 mg/kg**	**230 mg/kg**
Lead	7439-92-1	mg/kg	**120 mg/kg**	**120 mg/kg**
Mercury	7439-97-6	mg/kg	**3.9 mg/kg**	**0.27 mg/kg**
Molybdenum	7439-98-7	mg/kg	**40 mg/kg**	**40 mg/kg**
Nickel	7440-02-0	mg/kg	**270 mg/kg**	**270 mg/kg**
Selenium	7782-49-2	mg/kg	**5.5 mg/kg**	**5.5 mg/kg**
Silver	7440-22-4	mg/kg	**40 mg/kg**	**40 mg/kg**
Thallium	7440-28-0	mg/kg	**3.3 mg/kg**	**3.3 mg/kg**
Uranium	7440-61-1	mg/kg	**33 mg/kg**	**33 mg/kg**
Vanadium	7440-62-2	mg/kg	**86 mg/kg**	**86 mg/kg**
Zinc	7440-66-6	mg/kg	**340 mg/kg**	**340 mg/kg**
Speciated Metals				

Analyte	CAS Number	Unit	ON153/04 T2-ICC-C	ON406/20 T2.1-S-ICC					
Speciated Metals - Continued									
Chromium, hexavalent [Cr VI]	18540-29-9	mg/kg	**8 mg/kg**	**8 mg/kg**					
Leachable Anions & Nutrients									
Chloride, soluble ion content	16887-00-6	mg/kg	--	--					
Sulfate, soluble ion content	14808-79-8	mg/kg	--	--					

Please refer to the General Comments section for an explanation of any qualifiers detected.

Key:

ON153/04		Ontario Regulation 153/04 - April 15, 2011 Standards (JUL, 2011)
	T2-ICC-C	153 T2-Soil-Ind/Com/Commu Property Use (Coarse)
ON406/20		Ontario Regulation 406/19 - Excess Soils - 17-December-20
	T2.1-S-ICC	406 T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use

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QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2319508**	Page	: 1 of 10
Client	: **WSP E&I Canada Limited**	Laboratory	: ALS Environmental - Waterloo
Contact	: Mauro Cortes	Account Manager	: Gayle Braun
Address	: 900 Maple Grove Road Unit 10 Cambridge ON Canada N3H 4R7	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 519 650 7100	Telephone	: +1 519 886 6910
Project	: OGTW2331.2000.5800.5730-00	Date Samples Received	: 30-Jun-2023 14:45
PO	: ----	Issue Date	: 10-Jul-2023 16:32
C-O-C number	: ----		
Sampler	: ----		
Site	:		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 8		
No. of samples analysed	: 3		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] DUPS-1	E336A	30-Jun-2023	04-Jul-2023	14 days	5 days	✓	05-Jul-2023	14 days	1 days	✓
Fixed-Ratio Extractables : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] DUPS-1	E484	30-Jun-2023	06-Jul-2023	180 days	6 days	✓	06-Jul-2023	180 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] BH23-1 SS3	E396-L	30-Jun-2023	05-Jul-2023	14 days	5 days	✓	05-Jul-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] BH23-2 SS3	E396-L	30-Jun-2023	05-Jul-2023	14 days	5 days	✓	05-Jul-2023	7 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH23-1 SS3	E236.Cl	30-Jun-2023	06-Jul-2023	30 days	6 days	✓	06-Jul-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH23-2 SS3	E236.Cl	30-Jun-2023	06-Jul-2023	30 days	6 days	✓	06-Jul-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH23-1 SS3	E236.SO4	30-Jun-2023	06-Jul-2023	30 days	6 days	✓	06-Jul-2023	28 days	0 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP]										
BH23-2 SS3	E236.SO4	30-Jun-2023	06-Jul-2023	30 days	6 days	✓	06-Jul-2023	28 days	0 days	✓
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP]										
DUPS-1	E487	30-Jun-2023	06-Jul-2023	180 days	6 days	✓	06-Jul-2023	180 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP]										
DUPS-1	E510C	30-Jun-2023	06-Jul-2023	----	----		07-Jul-2023	28 days	8 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP]										
DUPS-1	E440C	30-Jun-2023	06-Jul-2023	----	----		07-Jul-2023	180 days	8 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH23-1 SS3	E100-L	30-Jun-2023	06-Jul-2023	----	----		06-Jul-2023	30 days	6 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP]										
BH23-2 SS3	E100-L	30-Jun-2023	06-Jul-2023	----	----		06-Jul-2023	30 days	6 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP]										
DUPS-1	E100-L	30-Jun-2023	06-Jul-2023	----	----		06-Jul-2023	30 days	6 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP]										
BH23-1 SS3	E144	30-Jun-2023	----	----	----		04-Jul-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP]										
BH23-2 SS3	E144	30-Jun-2023	----	----	----		04-Jul-2023	----	----	

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP]										
DUPS-1	E144	30-Jun-2023	----	----	----		04-Jul-2023	----	----	
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP]										
BH23-1 SS3	E125	30-Jun-2023	05-Jul-2023	----	----		06-Jul-2023	180 days	7 days	✓
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP]										
BH23-2 SS3	E125	30-Jun-2023	05-Jul-2023	----	----		06-Jul-2023	180 days	7 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP]										
BH23-1 SS3	E108A	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	30 days	5 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP]										
BH23-2 SS3	E108A	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	30 days	5 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP]										
DUPS-1	E108A	30-Jun-2023	04-Jul-2023	----	----		04-Jul-2023	30 days	5 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP]										
DUPS-1	E532	30-Jun-2023	04-Jul-2023	30 days	5 days	✓	05-Jul-2023	7 days	1 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1023783	1	8	12.5	4.7	✓
Boron-Hot Water Extractable by ICPOES	E487	1021451	1	9	11.1	5.0	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1021447	1	17	5.8	5.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	1021416	1	16	6.2	5.0	✓
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1021450	1	9	11.1	5.0	✓
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1021449	1	15	6.6	5.0	✓
Moisture Content by Gravimetry	E144	1022107	1	17	5.8	5.0	✓
ORP by Electrode	E125	1024574	1	4	25.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1021417	2	36	5.5	5.0	✓
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1021448	1	15	6.6	5.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	1021415	1	16	6.2	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1024903	1	3	33.3	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1024902	1	3	33.3	5.0	✓
Laboratory Control Samples (LCS)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1023783	1	8	12.5	4.7	✓
Boron-Hot Water Extractable by ICPOES	E487	1021451	2	9	22.2	10.0	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1021447	2	17	11.7	10.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	1021416	2	16	12.5	10.0	✓
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1021450	2	9	22.2	10.0	✓
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1021449	2	15	13.3	10.0	✓
Moisture Content by Gravimetry	E144	1022107	1	17	5.8	5.0	✓
ORP by Electrode	E125	1024574	1	4	25.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1021417	2	36	5.5	5.0	✓
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1021448	2	15	13.3	10.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	1021415	1	16	6.2	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1024903	2	3	66.6	10.0	✓
Water Extractable Sulfate by IC	E236.SO4	1024902	2	3	66.6	10.0	✓
Method Blanks (MB)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1023783	1	8	12.5	4.7	✓
Boron-Hot Water Extractable by ICPOES	E487	1021451	1	9	11.1	5.0	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1021447	1	17	5.8	5.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	1021416	1	16	6.2	5.0	✓
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1021450	1	9	11.1	5.0	✓
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1021449	1	15	6.6	5.0	✓
Moisture Content by Gravimetry	E144	1022107	1	17	5.8	5.0	✓

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Method Blanks (MB) - Continued							
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1021448	1	15	6.6	5.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	1021415	1	16	6.2	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1024903	1	3	33.3	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1024902	1	3	33.3	5.0	✓
Matrix Spikes (MS)							
WAD Cyanide (0.01M NaOH Extraction)	E336A	1021415	1	16	6.2	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L ALS Environmental - Waterloo	Soil/Solid	CSSS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A ALS Environmental - Waterloo	Soil/Solid	MECP E3137A	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode.
ORP by Electrode	E125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Oxidation Redution Potential (ORP) is reported as the oxidation-reduction potential of the platinum metal-reference electrode employed in the analysis, measured in mV.
Moisture Content by Gravimetry	E144 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Water Extractable Chloride by IC	E236.Cl ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Water Extractable Sulfate by IC	E236.SO4 ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
WAD Cyanide (0.01M NaOH Extraction)	E336A ALS Environmental - Waterloo	Soil/Solid	APHA 4500-CN I (mod)	Weak Acid Dissociable (WAD) cyanide is determined after extraction by Continuous Flow Analyzer (CFA) with in-line distillation followed by colourmetric analysis.
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S2J	This analysis is carried out in accordance with the method described in APHA 4500 S2-J. After extraction the Acid Volatile Sulphide is determined colourimetrically.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C ALS Environmental - Waterloo	Soil/Solid	EPA 6020B (mod)	This method is intended to liberate metals that may be environmentally available. Samples are dried, then sieved through a 355 µm sieve, and digested with HNO3 and HCl. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Silicate minerals are not solubilized. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. This method does not adequately recover elemental sulfur, and is unsuitable for assessment of elemental sulfur standards or guidelines. Analysis is by Collision/Reaction Cell ICPMS.
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484 ALS Environmental - Waterloo	Soil/Solid	SW846 6010C	A dried, disaggregated solid sample is extracted with deionized water, the aqueous extract is separated from the solid, acidified and then analyzed using a ICP/OES. The concentrations of Na, Ca and Mg are reported as per CALA requirements for calculated parameters. These individual parameters are not for comparison to any guideline.
Boron-Hot Water Extractable by ICPOES	E487 ALS Environmental - Waterloo	Soil/Solid	HW EXTR, EPA 6010B	A dried solid sample is extracted with calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES. Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C ALS Environmental - Waterloo	Soil/Solid	EPA 200.2/1631 Appendix (mod)	Samples are sieved through a 355 µm sieve, and digested with HNO3 and HCl, followed by CVAAS analysis.
Hexavalent Chromium (Cr VI) by IC	E532 ALS Environmental - Waterloo	Soil/Solid	APHA 3500-CR C	Instrumental analysis is performed by ion chromatography with UV detection.
Resistivity Calculation for Soil Using E100-L	EC100R ALS Environmental - Waterloo	Soil/Solid	APHA 2510 B	Soil Resistivity (calculated) is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 ALS Environmental - Waterloo	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl2 - As Received for pH	EP108A ALS Environmental - Waterloo	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation of ORP by Electrode	EP125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Field-moist sample is extracted in a 1:2 ratio with DI water and then analyzed by ORP meter.
Anions Leach 1:10 Soil:Water (Dry)	EP236 ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	5 grams of dried soil is mixed with 50 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.
Cyanide Extraction for CFA (0.01M NaOH)	EP333A ALS Environmental - Waterloo	Soil/Solid	ON MECP E3015 (mod)	Extraction for various cyanide analysis is by rotary extraction of the soil with 0.01M Sodium Hydroxide.
Distillation for Acid Volatile Sulfide in Soil	EP396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S2J	Acid Volatile Sulfide is determined by colourimetric measurement on a sediment sample that has been treated with hydrochloric acid within a purge and trap system, where the evolved hydrogen sulfide gas is carried into a basic solution by argon gas for analysis.
Digestion for Metals and Mercury (355 µm Sieve)	EP440C ALS Environmental - Waterloo	Soil/Solid	EPA 200.2 (mod)	Samples are sieved through a 355 µm sieve, and digested with HNO_3 and HCl. This method is intended to liberate metals that may be environmentally available.
Boron-Hot Water Extractable	EP487 ALS Environmental - Waterloo	Soil/Solid	HW EXTR, EPA 6010B	A dried solid sample is extracted with weak calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES. Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011)
Preparation of Hexavalent Chromium (Cr VI) for IC	EP532 ALS Environmental - Waterloo	Soil/Solid	EPA 3060A	Field moist samples are digested with a sodium hydroxide/sodium carbonate solution as described in EPA 3060A.
VOCs Methanol Extraction for Headspace Analysis	EP581 ALS Environmental - Waterloo	Soil/Solid	EPA 5035A (mod)	VOCs in samples are extracted with methanol. Extracts are then prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
PHCs and PAHs Hexane-Acetone Tumbler Extraction	EP601 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1 (mod)	Samples are subsampled and Petroleum Hydrocarbons (PHC) and PAHs are extracted with 1:1 hexane:acetone using a rotary extractor.

QUALITY CONTROL REPORT

Work Order	: **WT2319508**	Page	: 1 of 10
Client	: WSP E&I Canada Limited	Laboratory	: ALS Environmental - Waterloo
Contact	: Mauro Cortes	Account Manager	: Gayle Braun
Address	: 900 Maple Grove Road Unit 10 Cambridge ON Canada N3H 4R7	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: +1 519 886 6910
Project	: OGTW2331.2000.5800.5730-00	Date Samples Received	: 30-Jun-2023 14:45
PO	: ----	Date Analysis Commenced	: 04-Jul-2023
C-O-C number	: ----	Issue Date	: 10-Jul-2023 16:31
Sampler	: ---- 519 650 7100		
Site	:		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 8		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Waterloo Centralized Prep, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Waterloo Inorganics, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Waterloo Metals, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 1021417)											
WT2319334-001	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.77	7.81	0.513%	5%	----
Physical Tests (QC Lot: 1021447)											
WT2319507-002	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.241 mS/cm	270	11.4%	20%	----
Physical Tests (QC Lot: 1022107)											
WT2319334-001	Anonymous	Moisture	----	E144	0.25	%	14.2	16.5	14.6%	20%	----
Physical Tests (QC Lot: 1023235)											
WT2319477-012	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	8.06	8.02	0.498%	5%	----
Physical Tests (QC Lot: 1024574)											
WT2319508-007	BH23-1 SS3	Oxidation-reduction potential [ORP]	----	E125	0.10	mV	341	321	6.04%	25%	----
Cyanides (QC Lot: 1021415)											
WT2319334-001	Anonymous	Cyanide, weak acid dissociable	----	E336A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
Inorganics (QC Lot: 1023783)											
WT2318924-005	Anonymous	Sulfides, acid volatile	----	E396-L	0.25	mg/kg	<0.24	<0.25	0.24	Diff <2x LOR	----
Metals (QC Lot: 1021448)											
WT2319507-002	Anonymous	Calcium, soluble ion content	7440-70-2	E484	0.50	mg/L	12.3	14.2	14.3%	30%	----
		Magnesium, soluble ion content	7439-95-4	E484	0.50	mg/L	2.22	2.33	0.11	Diff <2x LOR	----
		Sodium, soluble ion content	17341-25-2	E484	0.50	mg/L	29.3	31.3	6.60%	30%	----
Metals (QC Lot: 1021449)											
WT2319508-002	BH23-1 SS2	Antimony	7440-36-0	E440C	0.10	mg/kg	5.46	5.34	2.17%	30%	----
		Arsenic	7440-38-2	E440C	0.10	mg/kg	7.94	7.77	2.11%	30%	----
		Barium	7440-39-3	E440C	0.50	mg/kg	312	300	3.94%	40%	----
		Beryllium	7440-41-7	E440C	0.10	mg/kg	0.46	0.47	0.006	Diff <2x LOR	----
		Boron	7440-42-8	E440C	5.0	mg/kg	7.7	8.0	0.3	Diff <2x LOR	----
		Cadmium	7440-43-9	E440C	0.020	mg/kg	1.91	1.88	1.71%	30%	----
		Chromium	7440-47-3	E440C	0.50	mg/kg	28.3	27.3	3.88%	30%	----
		Cobalt	7440-48-4	E440C	0.10	mg/kg	4.55	4.56	0.166%	30%	----
		Copper	7440-50-8	E440C	0.50	mg/kg	211	189	11.3%	30%	----
		Lead	7439-92-1	E440C	0.50	mg/kg	506	477	5.81%	40%	----
		Molybdenum	7439-98-7	E440C	0.10	mg/kg	2.00	1.72	15.3%	40%	----
		Nickel	7440-02-0	E440C	0.50	mg/kg	16.1	15.9	1.26%	30%	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Metals (QC Lot: 1021449) - continued											
WT2319508-002	BH23-1 SS2	Selenium	7782-49-2	E440C	0.20	mg/kg	0.54	0.50	0.03	Diff <2x LOR	----
		Silver	7440-22-4	E440C	0.10	mg/kg	0.45	0.47	0.01	Diff <2x LOR	----
		Thallium	7440-28-0	E440C	0.050	mg/kg	0.108	0.107	0.001	Diff <2x LOR	----
		Uranium	7440-61-1	E440C	0.050	mg/kg	0.521	0.502	3.71%	30%	----
		Vanadium	7440-62-2	E440C	0.20	mg/kg	20.0	20.3	1.32%	30%	----
		Zinc	7440-66-6	E440C	2.0	mg/kg	330	339	2.59%	30%	----
Metals (QC Lot: 1021450)											
WT2319508-002	BH23-1 SS2	Mercury	7439-97-6	E510C	0.0375	mg/kg	1.34	1.23	8.89%	40%	----
Metals (QC Lot: 1021451)											
WT2319508-002	BH23-1 SS2	Boron, hot water soluble	7440-42-8	E487	0.10	mg/kg	0.26	0.26	0.00003	Diff <2x LOR	----
Speciated Metals (QC Lot: 1021416)											
WT2319334-001	Anonymous	Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 1024902)											
WT2318924-005	Anonymous	Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	<20	0	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 1024903)											
WT2318924-005	Anonymous	Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg	49.5	49.7	0.428%	30%	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1021447)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Physical Tests (QCLot: 1022107)						
Moisture	----	E144	0.25	%	<0.25	----
Cyanides (QCLot: 1021415)						
Cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	<0.050	----
Inorganics (QCLot: 1023783)						
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	<0.20	----
Metals (QCLot: 1021448)						
Calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	<0.50	----
Magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	<0.50	----
Sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	<0.50	----
Metals (QCLot: 1021449)						
Antimony	7440-36-0	E440C	0.1	mg/kg	<0.10	----
Arsenic	7440-38-2	E440C	0.1	mg/kg	<0.10	----
Barium	7440-39-3	E440C	0.5	mg/kg	<0.50	----
Beryllium	7440-41-7	E440C	0.1	mg/kg	<0.10	----
Boron	7440-42-8	E440C	5	mg/kg	<5.0	----
Cadmium	7440-43-9	E440C	0.02	mg/kg	<0.020	----
Chromium	7440-47-3	E440C	0.5	mg/kg	<0.50	----
Cobalt	7440-48-4	E440C	0.1	mg/kg	<0.10	----
Copper	7440-50-8	E440C	0.5	mg/kg	<0.50	----
Lead	7439-92-1	E440C	0.5	mg/kg	<0.50	----
Molybdenum	7439-98-7	E440C	0.1	mg/kg	<0.10	----
Nickel	7440-02-0	E440C	0.5	mg/kg	<0.50	----
Selenium	7782-49-2	E440C	0.2	mg/kg	<0.20	----
Silver	7440-22-4	E440C	0.1	mg/kg	<0.10	----
Thallium	7440-28-0	E440C	0.05	mg/kg	<0.050	----
Uranium	7440-61-1	E440C	0.05	mg/kg	<0.050	----
Vanadium	7440-62-2	E440C	0.2	mg/kg	<0.20	----
Zinc	7440-66-6	E440C	2	mg/kg	<2.0	----
Metals (QCLot: 1021450)						
Mercury	7439-97-6	E510C	0.005	mg/kg	<0.0050	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 1021451)						
Boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	<0.10	----
Speciated Metals (QCLot: 1021416)						
Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	<0.10	----
Leachable Anions & Nutrients (QCLot: 1024902)						
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	----
Leachable Anions & Nutrients (QCLot: 1024903)						
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	<5.0	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1021417)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 1021447)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1409 µS/cm	99.7	90.0	110	----
Physical Tests (QCLot: 1022107)									
Moisture	----	E144	0.25	%	50 %	99.3	90.0	110	----
Physical Tests (QCLot: 1023235)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Cyanides (QCLot: 1021415)									
Cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	1.25 mg/kg	85.6	80.0	120	----
Inorganics (QCLot: 1023783)									
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	2.376 mg/kg	85.0	70.0	130	----
Metals (QCLot: 1021448)									
Calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	300 mg/L	106	80.0	120	----
Magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	50 mg/L	103	80.0	120	----
Sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	50 mg/L	104	80.0	120	----
Metals (QCLot: 1021449)									
Antimony	7440-36-0	E440C	0.1	mg/kg	100 mg/kg	105	80.0	120	----
Arsenic	7440-38-2	E440C	0.1	mg/kg	100 mg/kg	102	80.0	120	----
Barium	7440-39-3	E440C	0.5	mg/kg	25 mg/kg	97.0	80.0	120	----
Beryllium	7440-41-7	E440C	0.1	mg/kg	10 mg/kg	102	80.0	120	----
Boron	7440-42-8	E440C	5	mg/kg	100 mg/kg	98.3	80.0	120	----
Cadmium	7440-43-9	E440C	0.02	mg/kg	10 mg/kg	98.6	80.0	120	----
Chromium	7440-47-3	E440C	0.5	mg/kg	25 mg/kg	97.8	80.0	120	----
Cobalt	7440-48-4	E440C	0.1	mg/kg	25 mg/kg	97.1	80.0	120	----
Copper	7440-50-8	E440C	0.5	mg/kg	25 mg/kg	94.5	80.0	120	----
Lead	7439-92-1	E440C	0.5	mg/kg	50 mg/kg	96.5	80.0	120	----
Molybdenum	7439-98-7	E440C	0.1	mg/kg	25 mg/kg	99.0	80.0	120	----
Nickel	7440-02-0	E440C	0.5	mg/kg	50 mg/kg	94.9	80.0	120	----
Selenium	7782-49-2	E440C	0.2	mg/kg	100 mg/kg	98.4	80.0	120	----
Silver	7440-22-4	E440C	0.1	mg/kg	10 mg/kg	82.9	80.0	120	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report: Spike Concentration	Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High	Qualifier
Metals (QCLot: 1021449) - continued									
Thallium	7440-28-0	E440C	0.05	mg/kg	100 mg/kg	95.7	80.0	120	----
Uranium	7440-61-1	E440C	0.05	mg/kg	0.5 mg/kg	90.9	80.0	120	----
Vanadium	7440-62-2	E440C	0.2	mg/kg	50 mg/kg	101	80.0	120	----
Zinc	7440-66-6	E440C	2	mg/kg	50 mg/kg	95.6	80.0	120	----
Metals (QCLot: 1021450)									
Mercury	7439-97-6	E510C	0.005	mg/kg	0.1 mg/kg	98.5	80.0	120	----
Metals (QCLot: 1021451)									
Boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	1.33333 mg/kg	106	70.0	130	----
Speciated Metals (QCLot: 1021416)									
Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	0.8 mg/kg	106	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1024902)									
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	5000 mg/kg	101	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1024903)									
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	5000 mg/kg	99.7	80.0	120	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Soil/Solid**

Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Matrix Spike (MS) Report: Spike Concentration	Spike Target	Recovery (%): MS	Recovery Limits (%): Low	Recovery Limits (%): High	Qualifier
Cyanides (QCLot: 1021415)										
WT2319334-001	Anonymous	Cyanide, weak acid dissociable	----	E336A	0.902 mg/kg	1.25 mg/kg	72.9	70.0	130	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

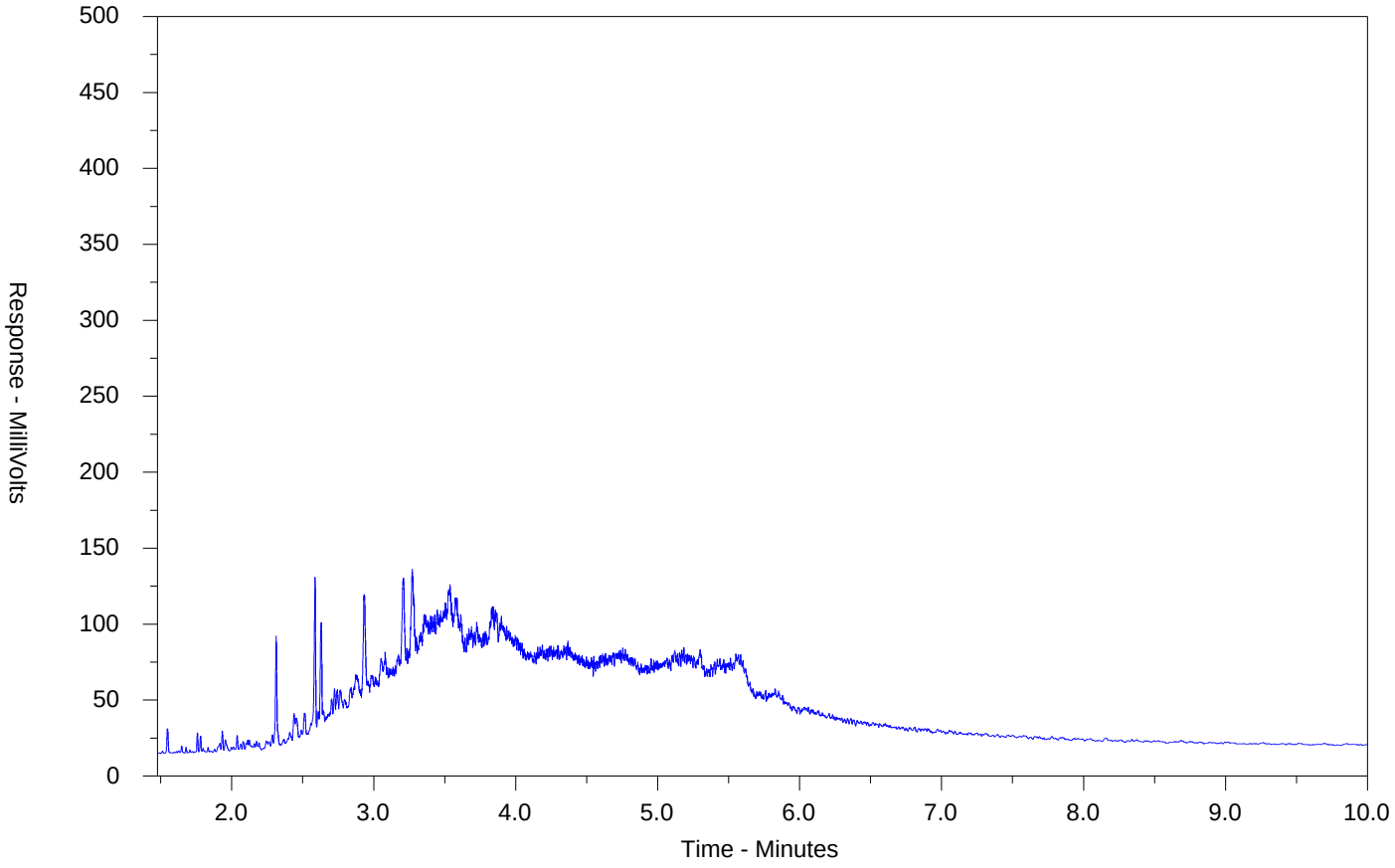
					Reference Material (RM) Report				
					RM Target	Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Concentration	RM	Low	High	Qualifier
Physical Tests (QCLot: 1021447)									
	RM	Conductivity (1:2 leachate)	----	E100-L	2168 µS/cm	89.1	70.0	130	----
Physical Tests (QCLot: 1024574)									
	RM	Oxidation-reduction potential [ORP]	----	E125	475 mV	99.2	90.0	110	----
Metals (QCLot: 1021448)									
	RM	Calcium, soluble ion content	7440-70-2	E484	82.58 mg/L	85.4	70.0	130	----
	RM	Magnesium, soluble ion content	7439-95-4	E484	25.79 mg/L	86.8	70.0	130	----
	RM	Sodium, soluble ion content	17341-25-2	E484	103.41 mg/L	93.5	70.0	130	----
Metals (QCLot: 1021449)									
	RM	Antimony	7440-36-0	E440C	3.99 mg/kg	75.3	70.0	130	----
	RM	Arsenic	7440-38-2	E440C	3.73 mg/kg	95.8	70.0	130	----
	RM	Barium	7440-39-3	E440C	105 mg/kg	94.1	70.0	130	----
	RM	Beryllium	7440-41-7	E440C	0.349 mg/kg	87.1	70.0	130	----
	RM	Boron	7440-42-8	E440C	8.5 mg/kg	89.4	70.0	130	----
	RM	Cadmium	7440-43-9	E440C	0.91 mg/kg	93.7	70.0	130	----
	RM	Chromium	7440-47-3	E440C	101 mg/kg	96.5	70.0	130	----
	RM	Cobalt	7440-48-4	E440C	6.9 mg/kg	97.8	70.0	130	----
	RM	Copper	7440-50-8	E440C	123 mg/kg	99.3	70.0	130	----
	RM	Lead	7439-92-1	E440C	267 mg/kg	82.6	70.0	130	----
	RM	Molybdenum	7439-98-7	E440C	1.03 mg/kg	84.0	70.0	130	----
	RM	Nickel	7440-02-0	E440C	26.7 mg/kg	97.8	70.0	130	----
	RM	Thallium	7440-28-0	E440C	0.0786 mg/kg	75.1	70.0	130	----
	RM	Uranium	7440-61-1	E440C	0.52 mg/kg	75.6	70.0	130	----
	RM	Vanadium	7440-62-2	E440C	32.7 mg/kg	98.6	70.0	130	----
	RM	Zinc	7440-66-6	E440C	297 mg/kg	97.4	70.0	130	----
Metals (QCLot: 1021450)									
	RM	Mercury	7439-97-6	E510C	0.0585 mg/kg	101	70.0	130	----
Metals (QCLot: 1021451)									
	RM	Boron, hot water soluble	7440-42-8	E487	1.971 mg/kg	104	60.0	140	----

Sub-Matrix:

					Reference Material (RM) Report				
					RM Target	Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Concentration	RM	Low	High	Qualifier
Speciated Metals (QCLot: 1021416)									
	RM	Chromium, hexavalent [Cr VI]	18540-29-9	E532	172 mg/kg	99.2	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1024902)									
	RM	Sulfate, soluble ion content	14808-79-8	E236.SO4	1070 mg/kg	100	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1024903)									
	RM	Chloride, soluble ion content	16887-00-6	E236.Cl	432 mg/kg	99.8	70.0	130	----

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: WT2319508-002-E601.SG-L
Client Sample ID: BH23-1 SS2



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
←Diesel/Jet Fuels→			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

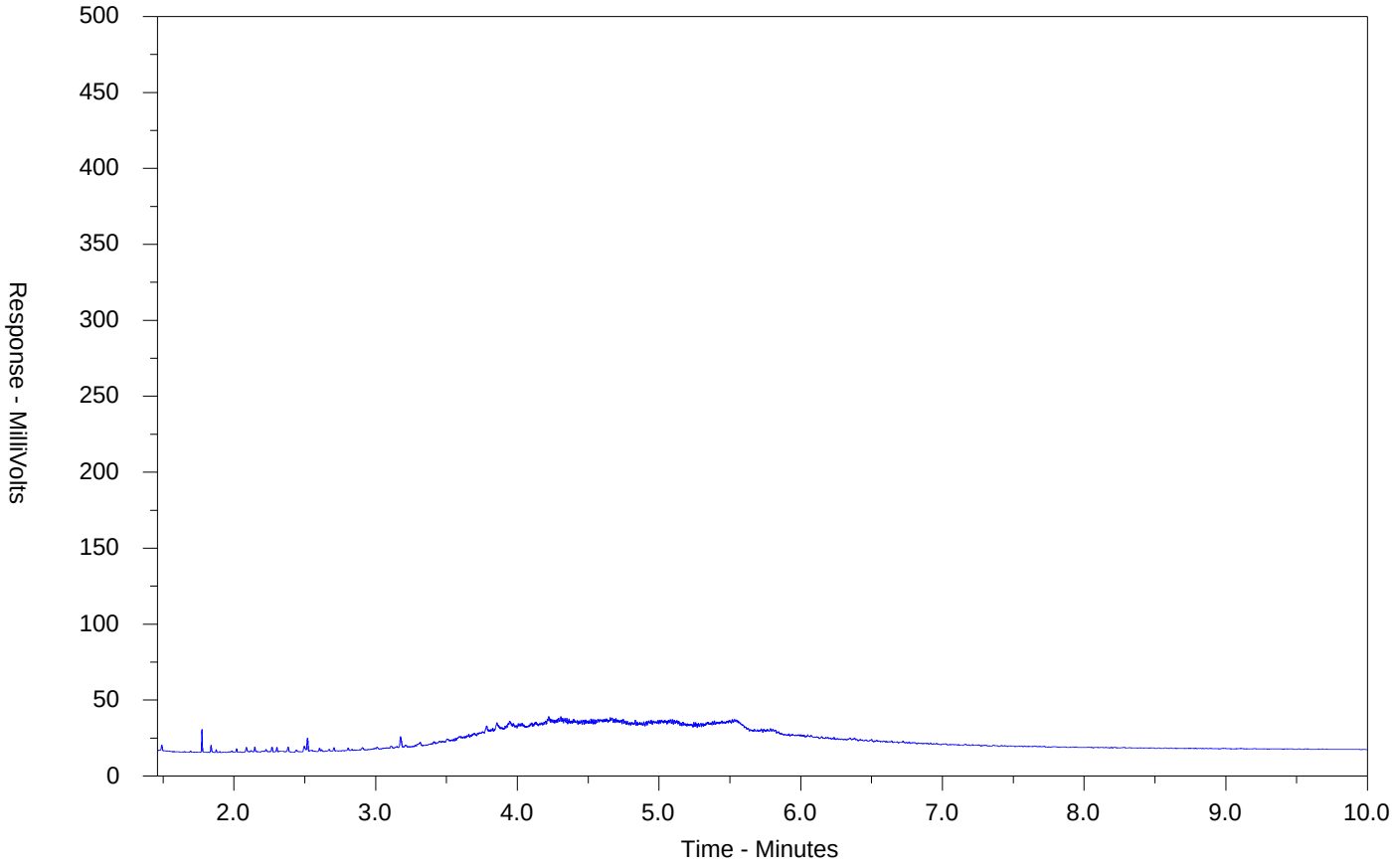
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: WT2319508-004-E601.SG-L
Client Sample ID: BH23-2 SS2



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
←Diesel/Jet Fuels→			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

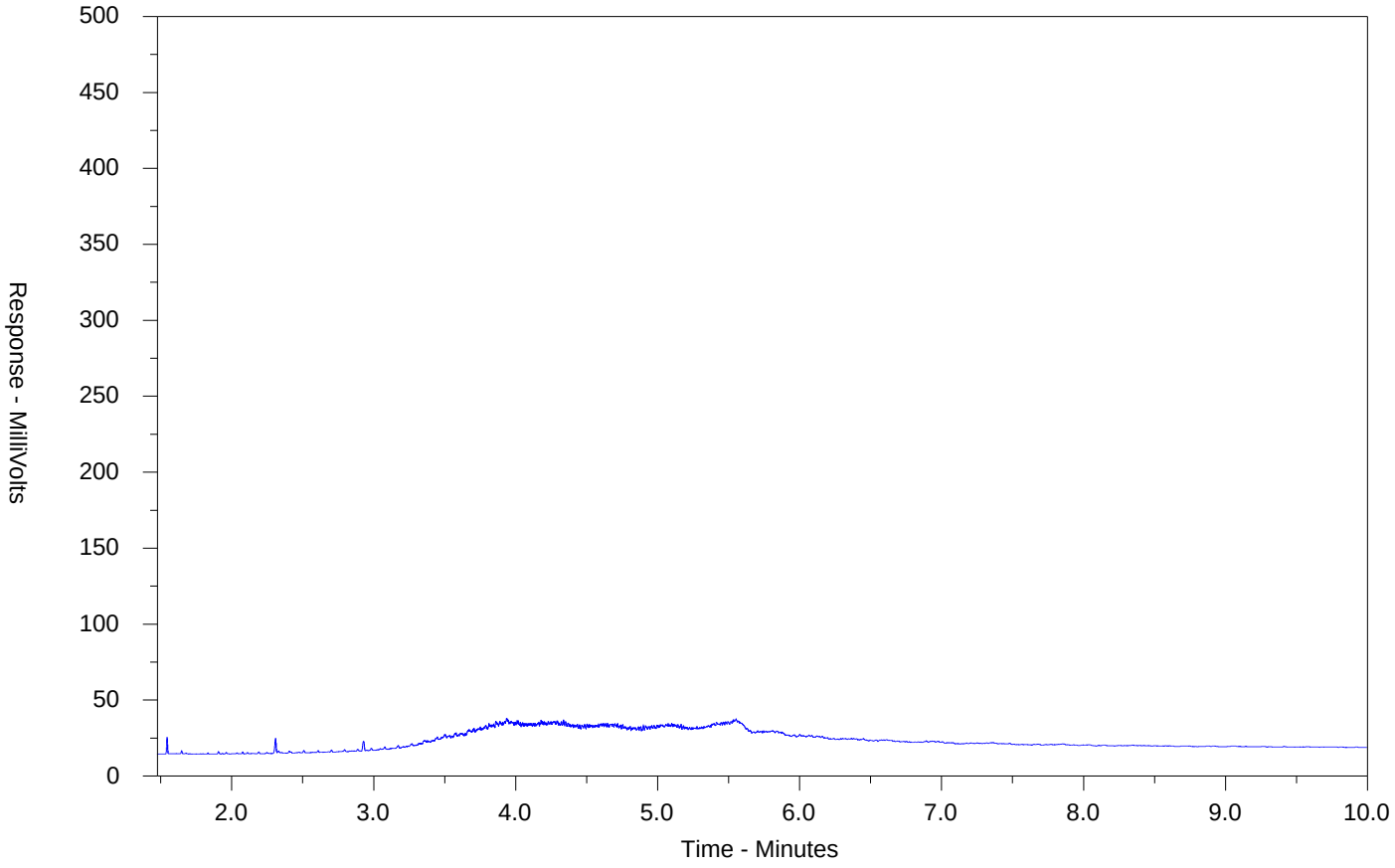
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: WT2319508-005-E601.SG-L
Client Sample ID: BH23-2 SS4



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

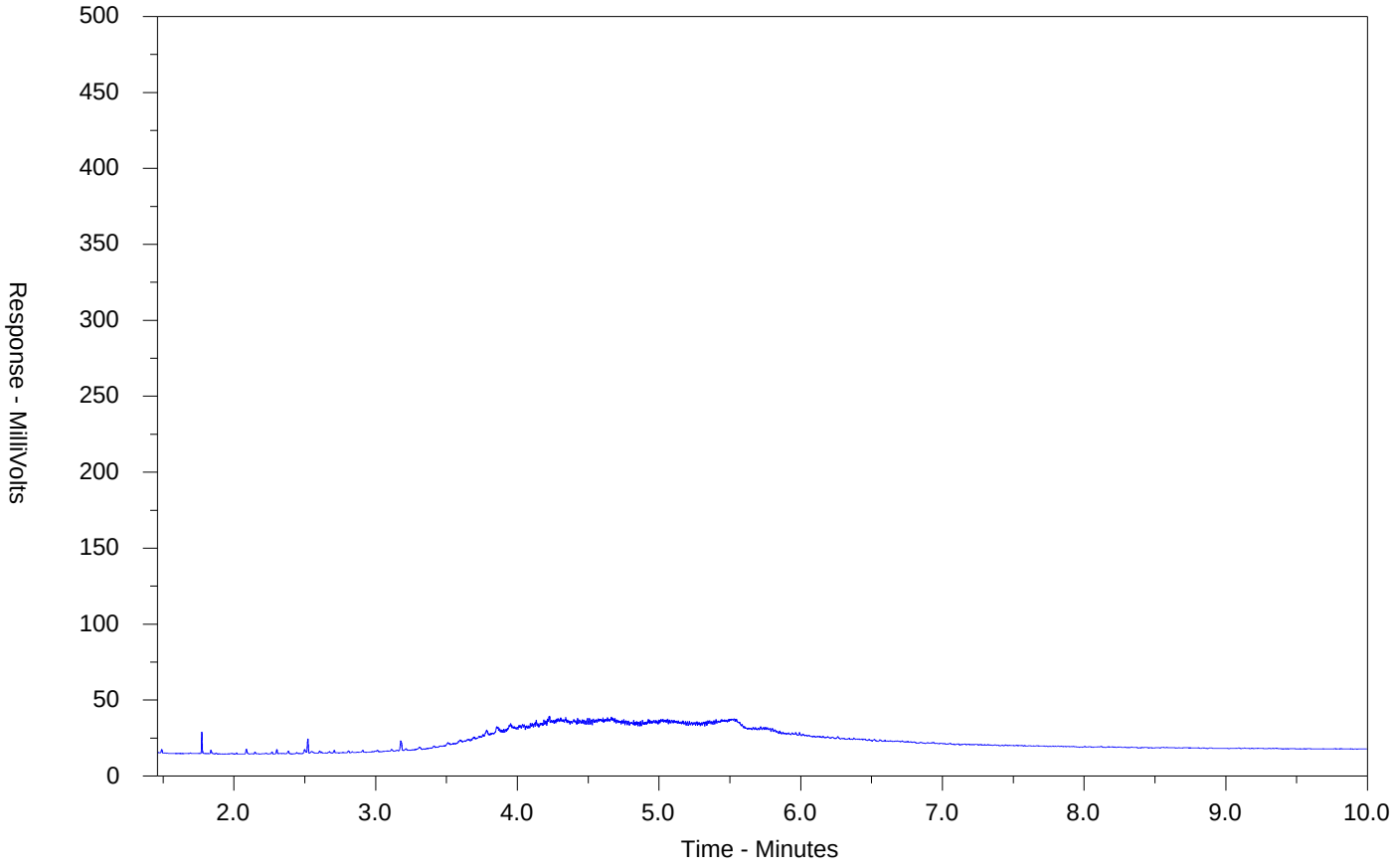
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: WT2319508-006-E601.SG-L
Client Sample ID: DUPS-1



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

COC Number: 17 -

Page 1 of

Report To	Contact and company name below will appear on the final report
Company:	WSP
Contact:	Mauro Cortes
Phone:	519-650-7121
	Company address below will appear on the final report
Street:	900 Maple Grove Road
City/Province:	Cambridge ON
Postal Code:	N3H4R7

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mauro.cortes@wsp.com
Email 2	herman.padham@wsp.com
Email 3	cindy.smith2@wsp.com

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)
- **4 day [P4-20%]** ☐
- **3 day [P3-25%]** ☐
- **2 day [P2-50%]** ☐

EMERGENCY
- **1 Business day [E - 100%]** ☐
- **Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)]** ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	
Contact:	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	apinvoice.canada@woodplc.com
Email 2	herman.padham@wsp.com

Project Information	
ALS Account # / Quote #:	2023 SOA
Job #:	OGTW2331.2000.5800.5730-00
PO / AFE:	
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: GB **Sampler:** RL/ NR

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	PHC F1 to F4	PAH	Metals/Inorganics	BTEX	Corrosivity Package									SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH23-1 SS1B	30-Jun-23	10:40	Soil	4	R	R	R	R										x	
	BH23-1 SS2	30-Jun-23	10:50	Soil	4	R	R	R	R											
	BH23-1 SS4	30-Jun-23	11:00	Soil	4	R	R	R	R										x	
	BH23-2 SS2	30-Jun-23	8:00	Soil	4	R	R	R	R											
	BH23-2 SS4	30-Jun-23	8:30	Soil	4	R	R	R	R											
	DUPS-1	30-Jun-23		Soil	4	R	R	R	R											
	BH23-1 SS3	30-Jun-23	11:00	Soil	1					R										
	BH23-2 SS3	30-Jun-23	8:25	Soil	1					R										

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☑ NO

Are samples for human consumption/ use?
☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Table 2 I/C/C Coarse and Table 2.1, please retain soil for SPLP analysis once bulk testing is complete

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☐ Ice Cubes ☐	Custody seal intact	Yes ☐	No	☐
Cooling Initiated	☐				

INIITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			

SHIPMENT RELEASE (client use)		
Released by: N. Ramnani	Date: Jun 30, 2023	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 -

Page 1 of

Report To	Contact and company name below will appear on the final report
Company:	WSP
Contact:	Mauro Cortes
Phone:	519-650-7121
	Company address below will appear on the final report
Street:	900 Maple Grove Road
City/Province:	Cambridge ON
Postal Code:	N3H4R7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax	mauro.cortes@wsp.com
Email 2	herman.padham@wsp.com
Email 3	cindy.smith2@wsp.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax	apinvoice.canada@woodplc.com
Email 2	herman.padham@wsp.com

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)
- 4 day [P4-20%] ☐
- 3 day [P3-25%] ☐
- 2 day [P2-50%] ☐

EMERGENCY
- 1 Business day [E - 100%] ☐
- Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	2023 SOA
Job #:	OGTW2331.2000.5800.5730-00
PO / AFE:	
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only): WT2319508

ALS Contact: GB Sampler: RL/ NR

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	PHC F1 to F4	PAH	Metals/Inorganics	BTEX	Corrosivity Package	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH23-1 SS1B	30-Jun-23	10:40	Soil	4	R	R	R	R		X	
	BH23-1 SS2	30-Jun-23	10:50	Soil	4	R	R	R	R		X	
	BH23-1 SS4	30-Jun-23	11:00	Soil	4	R	R	R	R		X	
	BH23-2 SS2	30-Jun-23	8:00	Soil	4	R	R	R	R		X	
	BH23-2 SS4	30-Jun-23	8:30	Soil	4	R	R	R	R		X	
	DUPS-1	30-Jun-23		Soil	4	R	R	R	R		X	
	BH23-1 SS3	30-Jun-23	11:00	Soil	1					R	X	
	BH23-2 SS3	30-Jun-23	8:25	Soil	1					R	X	

Environmental Division
Waterloo
Work Order Reference
WT2319508

Telephone : +1 519 886 6910

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Table 2 I/C/C Coarse and Table 2.1, please retain soil for SPLP analysis once bulk testing is complete

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
	14.1

SHIPMENT RELEASE (client use)

Released by: N. Ramnani	Date: Jun 30, 2023	Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:
BB	06/30/23	2:45

SOL-162
CM VS-138

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

ALS Canada Ltd.

right solutions.
right partner.

CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: **WT2319510**	Page	: 1 of 9
Client	: **WSP E&I Canada Limited**	Laboratory	: ALS Environmental - Waterloo
Contact	: Mauro Cortes	Account Manager	: Gayle Braun
Address	: 900 Maple Grove Road Unit 10 Cambridge ON Canada N3H 4R7	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 519 650 7100	Telephone	: +1 519 886 6910
Project	: OGTW2331.2000.5800.5730-00	Date Samples Received	: 30-Jun-2023 14:45
PO	: ----	Date Analysis Commenced	: 04-Jul-2023
C-O-C number	: ----	Issue Date	: 10-Jul-2023 17:05
Sampler	: ----		
Site	: ----		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Centralized Prep, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Inorganics, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Metals, Waterloo, Ontario
Jeremy Gingras	Team Leader - Semi-Volatile Instrumentation	Organics, Waterloo, Ontario
Jocelyn Kennedy	Department Manager - Semi-Volatile Organics	Organics, Waterloo, Ontario
Robert Braun	Soils Team Supervisor	Inorganics, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	VOC, Waterloo, Ontario

No Breaches Found

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guidelines are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Key : LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
°C	degrees celsius
m/sec	metres per second
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mm/sec	millimetres per second
pH units	pH units
sec	seconds

>: greater than.
<: less than.
Red shading is applied where the result or the LOR is greater than the Guideline Upper Limit (or lower than the Guideline Lower Limit, if applicable).
For drinking water samples, Red shading is applied where the result for E.coli, fecal or total coliforms is greater than or equal to the Guideline Upper Limit.

Qualifiers

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Analytical Results Evaluation

Matrix: **Soil/Solid**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID	TCLP-1	----	----	----	----	----	----
				Sampling date/time	30-Jun-2023 13:00	----	----	----	----	----	----
				Sub-Matrix	Soil/Solid	----	----	----	----	----	----
					WT2319510-001	--------	--------	--------	--------	--------	--------
Physical Tests											
Ignitability	----	E209/WT			Negative	----	----	----	----	----	----
Moisture	----	E144/WT	%		10.3	----	----	----	----	----	----
Sample comment	----	E209/WT			BROWN LOAM WITH ROCKS	----	----	----	----	----	----
Time to ignition	----	E209/WT	sec		Not Determined	----	----	----	----	----	----
Burning rate	----	E209/WT			Not Determined	----	----	----	----	----	----
Temperature of test material	----	E209/WT	°C		21.0	----	----	----	----	----	----
Air velocity, fume hood	----	E209/WT			0.44	----	----	----	----	----	----
TCLP Anions & Nutrients											
Nitrate + Nitrite (as N), TCLP	----	EC240.N+N/WT	mg/L		<7.50	----	----	----	----	----	----
TCLP Extractables											
Acenaphthene, TCLP	83-32-9	E644/WT			<0.0050	----	----	----	----	----	----
Acenaphthylene, TCLP	208-96-8	E644/WT	mg/L		<0.0050	----	----	----	----	----	----
Acridine, TCLP	260-94-6	E644/WT			<0.0050	----	----	----	----	----	----
Anthracene, TCLP	120-12-7	E644/WT	mg/L		<0.0050	----	----	----	----	----	----
Benz(a)anthracene, TCLP	56-55-3	E644/WT			<0.0050	----	----	----	----	----	----
Benzo(a)pyrene, TCLP	50-32-8	E644/WT	mg/L		<0.00050	----	----	----	----	----	----
Benzo(b+j)fluoranthene, TCLP	----	E644/WT			<0.0050	----	----	----	----	----	----
Benzo(g,h,i)perylene, TCLP	191-24-2	E644/WT	mg/L		<0.0050	----	----	----	----	----	----
Benzo(k)fluoranthene, TCLP	207-08-9	E644/WT			<0.0050	----	----	----	----	----	----
Chrysene, TCLP	218-01-9	E644/WT	mg/L		<0.0050	----	----	----	----	----	----
Cyanide, weak acid dissociable, TCLP	----	E337A/WT			<0.10	----	----	----	----	----	----
Dibenz(a,h)anthracene, TCLP	53-70-3	E644/WT	mg/L		<0.0050	----	----	----	----	----	----
Fluoranthene, TCLP	206-44-0	E644/WT			<0.0050	----	----	----	----	----	----
Fluorene, TCLP	86-73-7	E644/WT	mg/L		<0.0050	----	----	----	----	----	----
Fluoride, TCLP	16984-48-8	E240.F/WT			<10	----	----	----	----	----	----
Indeno(1,2,3-cd)pyrene, TCLP	193-39-5	E644/WT	mg/L		<0.0050	----	----	----	----	----	----
Naphthalene, TCLP	91-20-3	E644/WT			<0.0050	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Soil/Solid**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID	TCLP-1	----	----	----	----	----	----
				Sampling date/time	30-Jun-2023 13:00	----	----	----	----	----	----
				Sub-Matrix	Soil/Solid	----	----	----	----	----	----
				WT2319510-001	--------	--------	--------	--------	--------	--------	
TCLP Extractables											
Nitrate (as N), TCLP	14797-55-8	E240.NO3/WT	mg/L	<5.0	----	----	----	----	----	----	
Nitrite (as N), TCLP	14797-65-0	E240.NO2/WT		<5.0	----	----	----	----	----	----	
Phenanthrene, TCLP	85-01-8	E644/WT	mg/L	<0.0050	----	----	----	----	----	----	
Pyrene, TCLP	129-00-0	E644/WT		<0.0050	----	----	----	----	----	----	
TCLP Extractables Surrogates											
Chrysene-d12, TCLP	1719-03-5	E644/WT	%	101	----	----	----	----	----	----	
Naphthalene-d8, TCLP	1146-65-2	E644/WT		106	----	----	----	----	----	----	
Phenanthrene-d10, TCLP	1517-22-2	E644/WT	%	108	----	----	----	----	----	----	
TCLP Metals											
Arsenic, TCLP	7440-38-2	E444/WT		<1.0	----	----	----	----	----	----	
Barium, TCLP	7440-39-3	E444/WT	mg/L	<2.5	----	----	----	----	----	----	
Boron, TCLP	7440-42-8	E444/WT		<0.50	----	----	----	----	----	----	
Cadmium, TCLP	7440-43-9	E444/WT	mg/L	<0.050	----	----	----	----	----	----	
Chromium, TCLP	7440-47-3	E444/WT		<0.25	----	----	----	----	----	----	
Lead, TCLP	7439-92-1	E444/WT	mg/L	<0.25	----	----	----	----	----	----	
Mercury, TCLP	7439-97-6	E512/WT		<0.0010	----	----	----	----	----	----	
pH, TCLP 1st preliminary	----	EPP444/WT	pH units	9.25	----	----	----	----	----	----	
pH, TCLP 2nd preliminary	----	EPP444/WT		5.94	----	----	----	----	----	----	
pH, TCLP extraction fluid initial	----	EPP444/WT	pH units	2.91	----	----	----	----	----	----	
pH, TCLP final	----	EPP444/WT		5.66	----	----	----	----	----	----	
Selenium, TCLP	7782-49-2	E444/WT	mg/L	<0.10	----	----	----	----	----	----	
Silver, TCLP	7440-22-4	E444/WT		<0.050	----	----	----	----	----	----	
Uranium, TCLP	7440-61-1	E444/WT	mg/L	<0.20	----	----	----	----	----	----	
TCLP VOCs											
Benzene, TCLP	71-43-2	E615B/WT		<0.0050	----	----	----	----	----	----	
Carbon tetrachloride, TCLP	56-23-5	E615B/WT	mg/L	<0.025	----	----	----	----	----	----	
Chlorobenzene, TCLP	108-90-7	E615B/WT		<0.025	----	----	----	----	----	----	
Chloroform, TCLP	67-66-3	E615B/WT	mg/L	<0.10	----	----	----	----	----	----	

Analytical Results Evaluation

Matrix: **Soil/Solid**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID	TCLP-1	----	----	----	----	----	----
				Sampling date/time	30-Jun-2023 13:00	----	----	----	----	----	----
				Sub-Matrix	Soil/Solid	----	----	----	----	----	----
				WT2319510-001	--------	--------	--------	--------	--------	--------	
TCLP VOCs											
Dichlorobenzene, 1,2-, TCLP	95-50-1	E615B/WT		<0.025	----	----	----	----	----	----	
Dichlorobenzene, 1,4-, TCLP	106-46-7	E615B/WT	mg/L	<0.025	----	----	----	----	----	----	
Dichloroethane, 1,2-, TCLP	107-06-2	E615B/WT		<0.025	----	----	----	----	----	----	
Dichloroethylene, 1,1-, TCLP	75-35-4	E615B/WT	mg/L	<0.025	----	----	----	----	----	----	
Dichloromethane, TCLP	75-09-2	E615B/WT		<0.10	----	----	----	----	----	----	
Methyl ethyl ketone [MEK], TCLP	78-93-3	E615B/WT	mg/L	<0.10	----	----	----	----	----	----	
Tetrachloroethylene, TCLP	127-18-4	E615B/WT		<0.025	----	----	----	----	----	----	
Trichloroethylene, TCLP	79-01-6	E615B/WT	mg/L	<0.025	----	----	----	----	----	----	
Vinyl chloride, TCLP	75-01-4	E615B/WT		<0.050	----	----	----	----	----	----	
TCLP VOCs Surrogates											
Bromofluorobenzene, 4-, TCLP	460-00-4	E615B/WT	%	103	----	----	----	----	----	----	
Difluorobenzene, 1,4-, TCLP	540-36-3	E615B/WT		102	----	----	----	----	----	----	
Polychlorinated Biphenyls											
Aroclor 1016	12674-11-2	E687/WT	mg/kg	<0.011 DLM	----	----	----	----	----	----	
Aroclor 1221	11104-28-2	E687/WT		<0.011 DLM	----	----	----	----	----	----	
Aroclor 1232	11141-16-5	E687/WT	mg/kg	<0.011 DLM	----	----	----	----	----	----	
Aroclor 1242	53469-21-9	E687/WT		<0.020 DLM	----	----	----	----	----	----	
Aroclor 1248	12672-29-6	E687/WT	mg/kg	<0.011 DLM	----	----	----	----	----	----	
Aroclor 1254	11097-69-1	E687/WT		<0.011 DLM	----	----	----	----	----	----	
Aroclor 1260	11096-82-5	E687/WT	mg/kg	0.027 DLM	----	----	----	----	----	----	
Aroclor 1262	37324-23-5	E687/WT		<0.011 DLM	----	----	----	----	----	----	
Aroclor 1268	11100-14-4	E687/WT	mg/kg	<0.011 DLM	----	----	----	----	----	----	
Polychlorinated biphenyls [PCBs], total	----	E687/WT		<0.037	----	----	----	----	----	----	
Polychlorinated Biphenyls Surrogates											
Decachlorobiphenyl	2051-24-3	E687/WT	%	145	----	----	----	----	----	----	
Tetrachloro-m-xylene	877-09-8	E687/WT		99.9	----	----	----	----	----	----	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Summary of Guideline Limits

Analyte	CAS Number	Unit	ONWCR PCBs	ONWCR Sch. 4					
Physical Tests									
Air velocity, fume hood	----	m/sec	--	--					
Burning rate	----	mm/sec	--	--					
Ignitability	----	-	--	--					
Moisture	----	%	--	--					
Sample comment	----	-	--	--					
Temperature of test material	----	°C	--	--					
Time to ignition	----	sec	--	--					
TCLP Anions & Nutrients									
Nitrate + Nitrite (as N), TCLP	----	mg/L	--	**1000 mg/L**					
TCLP Extractables									
Acenaphthene, TCLP	83-32-9	mg/L	--	--					
Acenaphthylene, TCLP	208-96-8	mg/L	--	--					
Acridine, TCLP	260-94-6	mg/L	--	--					
Anthracene, TCLP	120-12-7	mg/L	--	--					
Benz(a)anthracene, TCLP	56-55-3	mg/L	--	--					
Benzo(a)pyrene, TCLP	50-32-8	mg/L	--	**0.001 mg/L**					
Benzo(b+j)fluoranthene, TCLP	----	mg/L	--	--					
Benzo(g,h,i)perylene, TCLP	191-24-2	mg/L	--	--					
Benzo(k)fluoranthene, TCLP	207-08-9	mg/L	--	--					
Chrysene, TCLP	218-01-9	mg/L	--	--					
Cyanide, weak acid dissociable, TCLP	----	mg/L	--	--					
Dibenz(a,h)anthracene, TCLP	53-70-3	mg/L	--	--					
Fluoranthene, TCLP	206-44-0	mg/L	--	--					
Fluorene, TCLP	86-73-7	mg/L	--	--					
Fluoride, TCLP	16984-48-8	mg/L	--	**150 mg/L**					
Indeno(1,2,3-cd)pyrene, TCLP	193-39-5	mg/L	--	--					
Naphthalene, TCLP	91-20-3	mg/L	--	--					
Nitrate (as N), TCLP	14797-55-8	mg/L	--	--					
Nitrite (as N), TCLP	14797-65-0	mg/L	--	--					
Phenanthrene, TCLP	85-01-8	mg/L	--	--					
Pyrene, TCLP	129-00-0	mg/L	--	--					
TCLP Extractables Surrogates									
Chrysene-d12, TCLP	1719-03-5	%							
Naphthalene-d8, TCLP	1146-65-2	%							
Phenanthrene-d10, TCLP	1517-22-2	%							
TCLP Metals									
Arsenic, TCLP	7440-38-2	mg/L	--	**2.5 mg/L**					

Analyte	CAS Number	Unit	ONWCR PCBs	ONWCR Sch. 4					
TCLP Metals - Continued									
Barium, TCLP	7440-39-3	mg/L	--	**100 mg/L**					
Boron, TCLP	7440-42-8	mg/L	--	**500 mg/L**					
Cadmium, TCLP	7440-43-9	mg/L	--	**0.5 mg/L**					
Chromium, TCLP	7440-47-3	mg/L	--	**5 mg/L**					
Lead, TCLP	7439-92-1	mg/L	--	**5 mg/L**					
Mercury, TCLP	7439-97-6	mg/L	--	**0.1 mg/L**					
pH, TCLP 1st preliminary	----	pH units	--	--					
pH, TCLP 2nd preliminary	----	pH units	--	--					
pH, TCLP extraction fluid initial	----	pH units	--	--					
pH, TCLP final	----	pH units	--	--					
Selenium, TCLP	7782-49-2	mg/L	--	**1 mg/L**					
Silver, TCLP	7440-22-4	mg/L	--	**5 mg/L**					
Uranium, TCLP	7440-61-1	mg/L	--	**10 mg/L**					
TCLP VOCs									
Benzene, TCLP	71-43-2	mg/L	--	**0.5 mg/L**					
Carbon tetrachloride, TCLP	56-23-5	mg/L	--	**0.5 mg/L**					
Chlorobenzene, TCLP	108-90-7	mg/L	--	**8 mg/L**					
Chloroform, TCLP	67-66-3	mg/L	--	**10 mg/L**					
Dichlorobenzene, 1,2-, TCLP	95-50-1	mg/L	--	**20 mg/L**					
Dichlorobenzene, 1,4-, TCLP	106-46-7	mg/L	--	**0.5 mg/L**					
Dichloroethane, 1,2-, TCLP	107-06-2	mg/L	--	**0.5 mg/L**					
Dichloroethylene, 1,1-, TCLP	75-35-4	mg/L	--	**1.4 mg/L**					
Dichloromethane, TCLP	75-09-2	mg/L	--	**5 mg/L**					
Methyl ethyl ketone [MEK], TCLP	78-93-3	mg/L	--	**200 mg/L**					
Tetrachloroethylene, TCLP	127-18-4	mg/L	--	**3 mg/L**					
Trichloroethylene, TCLP	79-01-6	mg/L	--	**5 mg/L**					
Vinyl chloride, TCLP	75-01-4	mg/L	--	**0.2 mg/L**					
Bromofluorobenzene, 4-, TCLP	460-00-4	%							
Difluorobenzene, 1,4-, TCLP	540-36-3	%							
Polychlorinated Biphenyls									
Aroclor 1016	12674-11-2	mg/kg	--	--					
Aroclor 1221	11104-28-2	mg/kg	--	--					
Aroclor 1232	11141-16-5	mg/kg	--	--					
Aroclor 1242	53469-21-9	mg/kg	--	--					
Aroclor 1248	12672-29-6	mg/kg	--	--					
Aroclor 1254	11097-69-1	mg/kg	--	--					
Aroclor 1260	11096-82-5	mg/kg	--	--					
Aroclor 1262	37324-23-5	mg/kg	--	--					
Aroclor 1268	11100-14-4	mg/kg	--	--					

Analyte	*CAS Number*	*Unit*	ONWCR PCBs	ONWCR Sch. 4					
Polychlorinated Biphenyls - Continued									
Polychlorinated biphenyls [PCBs], total	----	mg/kg	**50 mg/kg**	**--**					
Decachlorobiphenyl	2051-24-3	%							
Tetrachloro-m-xylene	877-09-8	%							

Please refer to the General Comments section for an explanation of any qualifiers detected.

Key:

ONWCR	Ontario MECP, General Waste Control Regulation No. 347/90,558/00
PCBs	Polychlorinated Biphenyls (PCBs)
Sch. 4	Schedule 4 Leachate Quality Criteria

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QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2319510**	Page	: 1 of 9
Client	: **WSP E&I Canada Limited**	Laboratory	: ALS Environmental - Waterloo
Contact	: Mauro Cortes	Account Manager	: Gayle Braun
Address	: 900 Maple Grove Road Unit 10 Cambridge ON Canada N3H 4R7	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 519 650 7100	Telephone	: +1 519 886 6910
Project	: OGTW2331.2000.5800.5730-00	Date Samples Received	: 30-Jun-2023 14:45
PO	: ----	Issue Date	: 10-Jul-2023 17:05
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- Test sample Surrogate recovery outliers exist for all regular sample matrices - please see following pages for full details.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Regular Sample Surrogates

Sub-Matrix: **Soil/Solid**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Result	Limits	Comment
Samples Submitted							
Polychlorinated Biphenyls Surrogates	WT2319510-001	TCLP-1	Decachlorobiphenyl	2051-24-3	145 %	50.0-140 %	Recovery greater than upper data quality objective

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Ignitability (O. Reg. 347/558)										
Glass soil jar/Teflon lined cap [ON MECP]										
TCLP-1	E209	30-Jun-2023	----	----	----		04-Jul-2023	30 days	4 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP]										
TCLP-1	E144	30-Jun-2023	----	----	----		04-Jul-2023	----	----	
Polychlorinated Biphenyls : PCB Aroclors by GC-MS										
Glass soil jar/Teflon lined cap [ON MECP]										
TCLP-1	E687	30-Jun-2023	05-Jul-2023	----	----		06-Jul-2023	40 days	0 days	✓
TCLP Extractables : Fluoride by IC (TCLP)										
HDPE [ON MECP]										
TCLP-1	E240.F	05-Jul-2023	07-Jul-2023	----	----		07-Jul-2023	28 days	7 days	✓
TCLP Extractables : Nitrate by IC (TCLP)										
HDPE [ON MECP]										
TCLP-1	E240.NO3	05-Jul-2023	07-Jul-2023	----	----		07-Jul-2023	7 days	7 days	✓
TCLP Extractables : Nitrite by IC (TCLP)										
HDPE [ON MECP]										
TCLP-1	E240.NO2	05-Jul-2023	07-Jul-2023	----	----		07-Jul-2023	7 days	7 days	✓
TCLP Extractables : PAHs by GC-MS (TCLP)										
Glass vial (sodium bisulfate)										
TCLP-1	E644	04-Jul-2023	06-Jul-2023	18 days	6 days	✓	07-Jul-2023	40 days	1 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
TCLP Extractables : WAD Cyanide (TCLP)										
HDPE - total (sodium hydroxide)										
TCLP-1	E337A	05-Jul-2023	06-Jul-2023	19 days	6 days	✓	06-Jul-2023	13 days	0 days	✓
TCLP Metals : Mercury by CVAAS (TCLP)										
Glass vial - total (lab preserved)										
TCLP-1	E512	05-Jul-2023	06-Jul-2023	----	----		06-Jul-2023	28 days	6 days	✓
TCLP Metals : Metals by CRC ICPMS (TCLP)										
HDPE - total (lab preserved)										
TCLP-1	E444	05-Jul-2023	06-Jul-2023	----	----		06-Jul-2023	180 days	6 days	✓
TCLP Metals : TCLP Leachate Preparation (Metals, Inorganics, and SVOCs)										
Lab Split - Non-Volatile Leach: 14 day HT (e.g. CN, SVOC, NOx)										
TCLP-1	EPP444	30-Jun-2023	05-Jul-2023	----	----		----	----	----	
TCLP VOCs : VOCs by Headspace GC-MS (TCLP)										
Glass vial (sodium bisulfate)										
TCLP-1	E615B	04-Jul-2023	06-Jul-2023	----	----		06-Jul-2023	14 days	6 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Fluoride by IC (TCLP)	E240.F	1027353	1	6	16.6	5.0	✓
Mercury by CVAAS (TCLP)	E512	1025125	1	4	25.0	5.0	✓
Metals by CRC ICPMS (TCLP)	E444	1025092	1	4	25.0	5.0	✓
Moisture Content by Gravimetry	E144	1022334	1	17	5.8	5.0	✓
Nitrate by IC (TCLP)	E240.NO3	1027354	1	6	16.6	5.0	✓
Nitrite by IC (TCLP)	E240.NO2	1027355	1	6	16.6	5.0	✓
PAHs by GC-MS (TCLP)	E644	1024954	1	3	33.3	5.0	✓
PCB Aroclors by GC-MS	E687	1022750	1	17	5.8	5.0	✓
VOCs by Headspace GC-MS (TCLP)	E615B	1025242	1	5	20.0	5.0	✓
WAD Cyanide (TCLP)	E337A	1025846	1	3	33.3	5.0	✓
Laboratory Control Samples (LCS)							
Fluoride by IC (TCLP)	E240.F	1027353	1	6	16.6	5.0	✓
Mercury by CVAAS (TCLP)	E512	1025125	1	4	25.0	5.0	✓
Metals by CRC ICPMS (TCLP)	E444	1025092	1	4	25.0	5.0	✓
Moisture Content by Gravimetry	E144	1022334	1	17	5.8	5.0	✓
Nitrate by IC (TCLP)	E240.NO3	1027354	1	6	16.6	5.0	✓
Nitrite by IC (TCLP)	E240.NO2	1027355	1	6	16.6	5.0	✓
PAHs by GC-MS (TCLP)	E644	1024954	1	3	33.3	5.0	✓
PCB Aroclors by GC-MS	E687	1022750	1	17	5.8	5.0	✓
VOCs by Headspace GC-MS (TCLP)	E615B	1025242	1	5	20.0	5.0	✓
WAD Cyanide (TCLP)	E337A	1025846	1	3	33.3	5.0	✓
Method Blanks (MB)							
Fluoride by IC (TCLP)	E240.F	1027353	1	6	16.6	5.0	✓
Mercury by CVAAS (TCLP)	E512	1025125	1	4	25.0	5.0	✓
Metals by CRC ICPMS (TCLP)	E444	1025092	1	4	25.0	5.0	✓
Moisture Content by Gravimetry	E144	1022334	1	17	5.8	5.0	✓
Nitrate by IC (TCLP)	E240.NO3	1027354	1	6	16.6	5.0	✓
Nitrite by IC (TCLP)	E240.NO2	1027355	1	6	16.6	5.0	✓
PAHs by GC-MS (TCLP)	E644	1024954	1	3	33.3	5.0	✓
PCB Aroclors by GC-MS	E687	1022750	1	17	5.8	5.0	✓
VOCs by Headspace GC-MS (TCLP)	E615B	1025242	1	5	20.0	5.0	✓
WAD Cyanide (TCLP)	E337A	1025846	1	3	33.3	5.0	✓
Matrix Spikes (MS)							
Fluoride by IC (TCLP)	E240.F	1027353	1	6	16.6	5.0	✓
Mercury by CVAAS (TCLP)	E512	1025125	1	4	25.0	5.0	✓

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Matrix Spikes (MS) - Continued							
Metals by CRC ICPMS (TCLP)	E444	1025092	1	4	25.0	5.0	✓
Nitrate by IC (TCLP)	E240.NO3	1027354	1	6	16.6	5.0	✓
Nitrite by IC (TCLP)	E240.NO2	1027355	1	6	16.6	5.0	✓
PAHs by GC-MS (TCLP)	E644	1024954	1	3	33.3	5.0	✓
PCB Aroclors by GC-MS	E687	1022750	1	17	5.8	5.0	✓
VOCs by Headspace GC-MS (TCLP)	E615B	1025242	1	5	20.0	5.0	✓
WAD Cyanide (TCLP)	E337A	1025846	1	3	33.3	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Moisture Content by Gravimetry	E144 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Ignitability (O. Reg. 347/558)	E209 ALS Environmental - Waterloo	Soil/Solid	EPA 1030 (mod)	Ignitability is determined by placing a sample on a ceramic tile and formed into a test strip. One end of the strip is then heated with a torch. Any burn rate for non-metallic samples that exceeds 2.2 mm/sec is considered to have a positive result. For metals, a burn rate of more than 0.17 mm/sec is considered to have a positive result.
Fluoride by IC (TCLP)	E240.F ALS Environmental - Waterloo	Soil/Solid	EPA 1311/EPA 300.1 (mod)	Inorganic anions are analyzed by obtaining an extract produced by the Toxicity Characteristic Leachate Procedure (TCLP) as per EPA 1311, which is then analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite by IC (TCLP)	E240.NO2 ALS Environmental - Waterloo	Soil/Solid	EPA 1311/EPA 300.1 (mod)	Inorganic anions are analyzed by obtaining an extract produced by the Toxicity Characteristic Leachate Procedure (TCLP) as per EPA 1311, which is then analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate by IC (TCLP)	E240.NO3 ALS Environmental - Waterloo	Soil/Solid	EPA 1311/EPA 300.1 (mod)	Inorganic anions are analyzed by obtaining an extract produced by the Toxicity Characteristic Leachate Procedure (TCLP) as per EPA 1311, which is then analyzed by Ion Chromatography with conductivity and/or UV detection.
WAD Cyanide (TCLP)	E337A ALS Environmental - Waterloo	Soil/Solid	APHA 4500-CN I (mod)	Weak Acid Dissociable (WAD) cyanide is determined after extraction by Continuous Flow Analyzer (CFA) with in-line distillation followed by colourmetric analysis.
Metals by CRC ICPMS (TCLP)	E444 ALS Environmental - Waterloo	Soil/Solid	EPA 1311/6020B (mod)	An extract produced by the Toxicity Characteristic Leachate Procedure (TCLP) as per EPA 1311 is analyzed by Collision/Reaction Cell ICPMS.
Mercury by CVAAS (TCLP)	E512 ALS Environmental - Waterloo	Soil/Solid	SW 846 -1311/245.1 CVAA ON TCLP LEACHATE	An extract produced by the Toxicity Characteristic Leachate Procedure (TCLP) as per EPA 1311 is analyzed by CVAAS.
VOCs by Headspace GC-MS (TCLP)	E615B ALS Environmental - Waterloo	Soil/Solid	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
PAHs by GC-MS (TCLP)	E644 ALS Environmental - Waterloo	Soil/Solid	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are analyzed by GC-MS.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
PCB Aroclors by GC-MS	E687 ALS Environmental - Waterloo	Soil/Solid	EPA 8270E (mod)	PCB Aroclors are analyzed by GC-MS
Nitrate and Nitrite (as N), (TCLP) (Calculation)	EC240.N+N ALS Environmental - Waterloo	Soil/Solid	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
VOCs Preparation for Headspace Analysis (TCLP)	EP582 ALS Environmental - Waterloo	Soil/Solid	EPA 5021A (mod)	Liquid obtained after the TCLP process is prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
PHCs and PAHs Extraction (TCLP)	EP602 ALS Environmental - Waterloo	Soil/Solid	EPA 3511 (mod)	Petroleum Hydrocarbons (PHCs) and Polycyclic Aromatic Hydrocarbons (PAHs) are extracted using a hexane liquid-liquid extraction.
Pesticides, PCB, PAH, and Neutral Extractable Chlorinated Hydrocarbons Extraction	EP660 ALS Environmental - Waterloo	Soil/Solid	EPA 3570 (mod)	A homogenized subsample is extracted with organic solvents using a mechanical shaker.
TCLP Leachate Preparation (Metals, Inorganics, and SVOCs)	EPP444 ALS Environmental - Waterloo	Soil/Solid	EPA 1311	Preparation of a Toxicity Characteristic Leaching Procedure (TCLP) solid sample involves particle size reduction, homogenization, then determination of appropriate extraction fluid. A measured portion of fresh subsample is placed in an extraction bottle with the appropriate extraction fluid then tumbled in a rotary extractor for 18+/- 2 hours at 23 +/- 2 C. The liquid leachate is filtered to separate from solids then bottled and prepared for analytical tests.
TCLP Leachate Preparation (VOCs)	EPP582 ALS Environmental - Waterloo	Soil/Solid	EPA 1311	An extract produced by the Toxicity Characteristic Leaching Procedure (TCLP) as per EPA 1311.

QUALITY CONTROL REPORT

Work Order	: **WT2319510**	Page	: 1 of 12
Client	: WSP E&I Canada Limited	Laboratory	: ALS Environmental - Waterloo
Contact	: Mauro Cortes	Account Manager	: Gayle Braun
Address	: 900 Maple Grove Road Unit 10 Cambridge ON Canada N3H 4R7	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: +1 519 886 6910
Project	: OGTW2331.2000.5800.5730-00	Date Samples Received	: 30-Jun-2023 14:45
PO	: ----	Date Analysis Commenced	: 04-Jul-2023
C-O-C number	: ----	Issue Date	: 10-Jul-2023 17:05
Sampler	: ---- 519 650 7100		
Site	: ----		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Waterloo Centralized Prep, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Waterloo Inorganics, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Waterloo Metals, Waterloo, Ontario
Jeremy Gingras	Team Leader - Semi-Volatile Instrumentation	Waterloo Organics, Waterloo, Ontario
Jocelyn Kennedy	Department Manager - Semi-Volatile Organics	Waterloo Organics, Waterloo, Ontario
Robert Braun	Soils Team Supervisor	Waterloo Inorganics, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	Waterloo VOC, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 1022334)											
WT2319424-001	Anonymous	Moisture	----	E144	0.25	%	11.6	12.2	4.97%	20%	----
TCLP Extractables (QC Lot: 1024954)											
WT2319410-001	Anonymous	Acenaphthene, TCLP	83-32-9	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Acenaphthylene, TCLP	208-96-8	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Acridine, TCLP	260-94-6	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Anthracene, TCLP	120-12-7	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Benz(a)anthracene, TCLP	56-55-3	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Benzo(a)pyrene, TCLP	50-32-8	E644	0.50	µg/L	<0.00050 mg/L	<0.50	0	Diff <2x LOR	----
		Benzo(b+j)fluoranthene, TCLP	----	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Benzo(g,h,i)perylene, TCLP	191-24-2	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Benzo(k)fluoranthene, TCLP	207-08-9	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Chrysene, TCLP	218-01-9	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Dibenz(a,h)anthracene, TCLP	53-70-3	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Fluoranthene, TCLP	206-44-0	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Fluorene, TCLP	86-73-7	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Indeno(1,2,3-cd)pyrene, TCLP	193-39-5	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Naphthalene, TCLP	91-20-3	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Phenanthrene, TCLP	85-01-8	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Pyrene, TCLP	129-00-0	E644	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
TCLP Extractables (QC Lot: 1025846)											
WT2319510-001	TCLP-1	Cyanide, weak acid dissociable, TCLP	----	E337A	0.10	mg/L	<0.10	<0.10	0	Diff <2x LOR	----
TCLP Extractables (QC Lot: 1027353)											
WT2318613-004	Anonymous	Fluoride, TCLP	16984-48-8	E240.F	10	mg/L	<10	<10	0	Diff <2x LOR	----
TCLP Extractables (QC Lot: 1027354)											
WT2318613-004	Anonymous	Nitrate (as N), TCLP	14797-55-8	E240.NO3	5.0	mg/L	<5.0	<5.0	0	Diff <2x LOR	----
TCLP Extractables (QC Lot: 1027355)											
WT2318613-004	Anonymous	Nitrite (as N), TCLP	14797-65-0	E240.NO2	5.0	mg/L	<5.0	<5.0	0	Diff <2x LOR	----
TCLP Metals (QC Lot: 1025092)											
WT2319692-001	Anonymous	Arsenic, TCLP	7440-38-2	E444	1.0	mg/L	<1.0	<1.0	0	Diff <2x LOR	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
TCLP Metals (QC Lot: 1025092) - continued											
WT2319692-001	Anonymous	Barium, TCLP	7440-39-3	E444	2.5	mg/L	<2.5	<2.5	0	Diff <2x LOR	----
		Boron, TCLP	7440-42-8	E444	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Cadmium, TCLP	7440-43-9	E444	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		Chromium, TCLP	7440-47-3	E444	0.25	mg/L	<0.25	<0.25	0	Diff <2x LOR	----
		Lead, TCLP	7439-92-1	E444	0.25	mg/L	1.73	1.74	0.494%	50%	----
		Selenium, TCLP	7782-49-2	E444	0.10	mg/L	<0.10	<0.10	0	Diff <2x LOR	----
		Silver, TCLP	7440-22-4	E444	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		Uranium, TCLP	7440-61-1	E444	0.20	mg/L	<0.20	<0.20	0	Diff <2x LOR	----
TCLP Metals (QC Lot: 1025125)											
WT2319692-001	Anonymous	Mercury, TCLP	7439-97-6	E512	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
TCLP VOCs (QC Lot: 1025242)											
WT2318473-012	Anonymous	Benzene, TCLP	71-43-2	E615B	5.0	µg/L	<0.0050 mg/L	<5.0	0	Diff <2x LOR	----
		Carbon tetrachloride, TCLP	56-23-5	E615B	25	µg/L	<0.025 mg/L	<25	0	Diff <2x LOR	----
		Chlorobenzene, TCLP	108-90-7	E615B	25	µg/L	<0.025 mg/L	<25	0	Diff <2x LOR	----
		Chloroform, TCLP	67-66-3	E615B	100	µg/L	<0.10 mg/L	<100	0	Diff <2x LOR	----
		Dichlorobenzene, 1,2-, TCLP	95-50-1	E615B	25	µg/L	<0.025 mg/L	<25	0	Diff <2x LOR	----
		Dichlorobenzene, 1,4-, TCLP	106-46-7	E615B	25	µg/L	<0.025 mg/L	<25	0	Diff <2x LOR	----
		Dichloroethane, 1,2-, TCLP	107-06-2	E615B	25	µg/L	<0.025 mg/L	<25	0	Diff <2x LOR	----
		Dichloroethylene, 1,1-, TCLP	75-35-4	E615B	25	µg/L	<0.025 mg/L	<25	0	Diff <2x LOR	----
		Dichloromethane, TCLP	75-09-2	E615B	100	µg/L	<0.10 mg/L	<100	0	Diff <2x LOR	----
		Methyl ethyl ketone [MEK], TCLP	78-93-3	E615B	100	µg/L	<0.10 mg/L	<100	0	Diff <2x LOR	----
		Tetrachloroethylene, TCLP	127-18-4	E615B	25	µg/L	<0.025 mg/L	<25	0	Diff <2x LOR	----
		Trichloroethylene, TCLP	79-01-6	E615B	25	µg/L	<0.025 mg/L	<25	0	Diff <2x LOR	----
		Vinyl chloride, TCLP	75-01-4	E615B	50	µg/L	<0.050 mg/L	<50	0	Diff <2x LOR	----
Polychlorinated Biphenyls (QC Lot: 1022750)											
WT2319433-022	Anonymous	Aroclor 1016	12674-11-2	E687	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Aroclor 1221	11104-28-2	E687	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Aroclor 1232	11141-16-5	E687	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Aroclor 1242	53469-21-9	E687	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Aroclor 1248	12672-29-6	E687	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Aroclor 1254	11097-69-1	E687	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Aroclor 1260	11096-82-5	E687	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Aroclor 1262	37324-23-5	E687	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Aroclor 1268	11100-14-4	E687	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1022334)						
Moisture	----	E144	0.25	%	<0.25	----
TCLP Extractables (QCLot: 1024954)						
Acenaphthene, TCLP	83-32-9	E644	5	µg/L	<5.0	----
Acenaphthylene, TCLP	208-96-8	E644	5	µg/L	<5.0	----
Acridine, TCLP	260-94-6	E644	5	µg/L	<5.0	----
Anthracene, TCLP	120-12-7	E644	5	µg/L	<5.0	----
Benz(a)anthracene, TCLP	56-55-3	E644	5	µg/L	<5.0	----
Benzo(a)pyrene, TCLP	50-32-8	E644	0.5	µg/L	<0.50	----
Benzo(b+j)fluoranthene, TCLP	----	E644	5	µg/L	<5.0	----
Benzo(g,h,i)perylene, TCLP	191-24-2	E644	5	µg/L	<5.0	----
Benzo(k)fluoranthene, TCLP	207-08-9	E644	5	µg/L	<5.0	----
Chrysene, TCLP	218-01-9	E644	5	µg/L	<5.0	----
Dibenz(a,h)anthracene, TCLP	53-70-3	E644	5	µg/L	<5.0	----
Fluoranthene, TCLP	206-44-0	E644	5	µg/L	<5.0	----
Fluorene, TCLP	86-73-7	E644	5	µg/L	<5.0	----
Indeno(1,2,3-cd)pyrene, TCLP	193-39-5	E644	5	µg/L	<5.0	----
Naphthalene, TCLP	91-20-3	E644	5	µg/L	<5.0	----
Phenanthrene, TCLP	85-01-8	E644	5	µg/L	<5.0	----
Pyrene, TCLP	129-00-0	E644	5	µg/L	<5.0	----
TCLP Extractables (QCLot: 1025846)						
Cyanide, weak acid dissociable, TCLP	----	E337A	0.1	mg/L	<0.10	----
TCLP Extractables (QCLot: 1027353)						
Fluoride, TCLP	16984-48-8	E240.F	10	mg/L	<10	----
TCLP Extractables (QCLot: 1027354)						
Nitrate (as N), TCLP	14797-55-8	E240.NO3	5	mg/L	<5.0	----
TCLP Extractables (QCLot: 1027355)						
Nitrite (as N), TCLP	14797-65-0	E240.NO2	5	mg/L	<5.0	----
TCLP Metals (QCLot: 1025092)						
Arsenic, TCLP	7440-38-2	E444	1	mg/L	<1.0	----
Barium, TCLP	7440-39-3	E444	2.5	mg/L	<2.5	----
Boron, TCLP	7440-42-8	E444	0.5	mg/L	<0.50	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
TCLP Metals (QCLot: 1025092) - continued						
Cadmium, TCLP	7440-43-9	E444	0.05	mg/L	<0.050	----
Chromium, TCLP	7440-47-3	E444	0.25	mg/L	<0.25	----
Lead, TCLP	7439-92-1	E444	0.25	mg/L	<0.25	----
Selenium, TCLP	7782-49-2	E444	0.1	mg/L	<0.10	----
Silver, TCLP	7440-22-4	E444	0.05	mg/L	<0.050	----
Uranium, TCLP	7440-61-1	E444	0.2	mg/L	<0.20	----
TCLP Metals (QCLot: 1025125)						
Mercury, TCLP	7439-97-6	E512	0.001	mg/L	<0.0010	----
TCLP VOCs (QCLot: 1025242)						
Benzene, TCLP	71-43-2	E615B	5	µg/L	<5.0	----
Carbon tetrachloride, TCLP	56-23-5	E615B	25	µg/L	<25	----
Chlorobenzene, TCLP	108-90-7	E615B	25	µg/L	<25	----
Chloroform, TCLP	67-66-3	E615B	100	µg/L	<100	----
Dichlorobenzene, 1,2-, TCLP	95-50-1	E615B	25	µg/L	<25	----
Dichlorobenzene, 1,4-, TCLP	106-46-7	E615B	25	µg/L	<25	----
Dichloroethane, 1,2-, TCLP	107-06-2	E615B	25	µg/L	<25	----
Dichloroethylene, 1,1-, TCLP	75-35-4	E615B	25	µg/L	<25	----
Dichloromethane, TCLP	75-09-2	E615B	100	µg/L	<100	----
Methyl ethyl ketone [MEK], TCLP	78-93-3	E615B	100	µg/L	<100	----
Tetrachloroethylene, TCLP	127-18-4	E615B	25	µg/L	<25	----
Trichloroethylene, TCLP	79-01-6	E615B	25	µg/L	<25	----
Vinyl chloride, TCLP	75-01-4	E615B	50	µg/L	<50	----
Polychlorinated Biphenyls (QCLot: 1022750)						
Aroclor 1016	12674-11-2	E687	0.01	mg/kg	<0.010	----
Aroclor 1221	11104-28-2	E687	0.01	mg/kg	<0.010	----
Aroclor 1232	11141-16-5	E687	0.01	mg/kg	<0.010	----
Aroclor 1242	53469-21-9	E687	0.01	mg/kg	<0.010	----
Aroclor 1248	12672-29-6	E687	0.01	mg/kg	<0.010	----
Aroclor 1254	11097-69-1	E687	0.01	mg/kg	<0.010	----
Aroclor 1260	11096-82-5	E687	0.01	mg/kg	<0.010	----
Aroclor 1262	37324-23-5	E687	0.01	mg/kg	<0.010	----
Aroclor 1268	11100-14-4	E687	0.01	mg/kg	<0.010	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1022334)									
Moisture	----	E144	0.25	%	50 %	100	90.0	110	----
TCLP Extractables (QCLot: 1024954)									
Acenaphthene, TCLP	83-32-9	E644	5	µg/L	0.5263 µg/L	92.2	50.0	130	----
Acenaphthylene, TCLP	208-96-8	E644	5	µg/L	0.5263 µg/L	98.0	50.0	130	----
Acridine, TCLP	260-94-6	E644	5	µg/L	0.5263 µg/L	79.7	50.0	140	----
Anthracene, TCLP	120-12-7	E644	5	µg/L	0.5263 µg/L	100	50.0	130	----
Benz(a)anthracene, TCLP	56-55-3	E644	5	µg/L	0.5263 µg/L	102	50.0	140	----
Benzo(a)pyrene, TCLP	50-32-8	E644	0.5	µg/L	0.5263 µg/L	102	60.0	140	----
Benzo(b+j)fluoranthene, TCLP	----	E644	5	µg/L	0.5263 µg/L	107	50.0	130	----
Benzo(g,h,i)perylene, TCLP	191-24-2	E644	5	µg/L	0.5263 µg/L	95.1	50.0	140	----
Benzo(k)fluoranthene, TCLP	207-08-9	E644	5	µg/L	0.5263 µg/L	98.7	50.0	150	----
Chrysene, TCLP	218-01-9	E644	5	µg/L	0.5263 µg/L	97.0	50.0	140	----
Dibenz(a,h)anthracene, TCLP	53-70-3	E644	5	µg/L	0.5263 µg/L	95.2	50.0	140	----
Fluoranthene, TCLP	206-44-0	E644	5	µg/L	0.5263 µg/L	101	50.0	130	----
Fluorene, TCLP	86-73-7	E644	5	µg/L	0.5263 µg/L	97.1	50.0	130	----
Indeno(1,2,3-cd)pyrene, TCLP	193-39-5	E644	5	µg/L	0.5263 µg/L	100	50.0	140	----
Naphthalene, TCLP	91-20-3	E644	5	µg/L	0.5263 µg/L	96.7	50.0	130	----
Phenanthrene, TCLP	85-01-8	E644	5	µg/L	0.5263 µg/L	96.8	50.0	130	----
Pyrene, TCLP	129-00-0	E644	5	µg/L	0.5263 µg/L	101	50.0	140	----
TCLP Extractables (QCLot: 1025846)									
Cyanide, weak acid dissociable, TCLP	----	E337A	0.1	mg/L	6.25 mg/L	89.7	70.0	130	----
TCLP Extractables (QCLot: 1027353)									
Fluoride, TCLP	16984-48-8	E240.F	10	mg/L	1 mg/L	94.1	70.0	130	----
TCLP Extractables (QCLot: 1027354)									
Nitrate (as N), TCLP	14797-55-8	E240.NO3	5	mg/L	2.5 mg/L	98.1	70.0	130	----
TCLP Extractables (QCLot: 1027355)									
Nitrite (as N), TCLP	14797-65-0	E240.NO2	5	mg/L	0.5 mg/L	94.8	70.0	130	----
TCLP Metals (QCLot: 1025092)									
Arsenic, TCLP	7440-38-2	E444	1	mg/L	0.05 mg/L	110	70.0	130	----
Barium, TCLP	7440-39-3	E444	2.5	mg/L	0.0125 mg/L	105	70.0	130	----
Boron, TCLP	7440-42-8	E444	0.5	mg/L	0.05 mg/L	95.4	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
TCLP Metals (QCLot: 1025092) - continued									
Cadmium, TCLP	7440-43-9	E444	0.05	mg/L	0.005 mg/L	104	70.0	130	----
Chromium, TCLP	7440-47-3	E444	0.25	mg/L	0.0125 mg/L	103	70.0	130	----
Lead, TCLP	7439-92-1	E444	0.25	mg/L	0.025 mg/L	101	70.0	130	----
Selenium, TCLP	7782-49-2	E444	0.1	mg/L	0.05 mg/L	107	70.0	130	----
Silver, TCLP	7440-22-4	E444	0.05	mg/L	0.005 mg/L	99.2	70.0	130	----
Uranium, TCLP	7440-61-1	E444	0.2	mg/L	0.00025 mg/L	104	70.0	130	----
TCLP Metals (QCLot: 1025125)									
Mercury, TCLP	7439-97-6	E512	0.001	mg/L	0.0001 mg/L	97.7	70.0	130	----
TCLP VOCs (QCLot: 1025242)									
Benzene, TCLP	71-43-2	E615B	5	µg/L	250 µg/L	100	70.0	130	----
Carbon tetrachloride, TCLP	56-23-5	E615B	25	µg/L	250 µg/L	98.3	60.0	140	----
Chlorobenzene, TCLP	108-90-7	E615B	25	µg/L	250 µg/L	104	70.0	130	----
Chloroform, TCLP	67-66-3	E615B	100	µg/L	250 µg/L	113	70.0	130	----
Dichlorobenzene, 1,2-, TCLP	95-50-1	E615B	25	µg/L	250 µg/L	102	70.0	130	----
Dichlorobenzene, 1,4-, TCLP	106-46-7	E615B	25	µg/L	250 µg/L	102	70.0	130	----
Dichloroethane, 1,2-, TCLP	107-06-2	E615B	25	µg/L	250 µg/L	104	70.0	130	----
Dichloroethylene, 1,1-, TCLP	75-35-4	E615B	25	µg/L	250 µg/L	104	70.0	130	----
Dichloromethane, TCLP	75-09-2	E615B	100	µg/L	250 µg/L	116	70.0	130	----
Methyl ethyl ketone [MEK], TCLP	78-93-3	E615B	100	µg/L	250 µg/L	95.6	50.0	150	----
Tetrachloroethylene, TCLP	127-18-4	E615B	25	µg/L	250 µg/L	103	70.0	130	----
Trichloroethylene, TCLP	79-01-6	E615B	25	µg/L	250 µg/L	110	70.0	130	----
Vinyl chloride, TCLP	75-01-4	E615B	50	µg/L	250 µg/L	97.0	60.0	130	----
Polychlorinated Biphenyls (QCLot: 1022750)									
Aroclor 1016	12674-11-2	E687	0.01	mg/kg	0.005 mg/kg	89.7	60.0	140	----
Aroclor 1221	11104-28-2	E687	0.01	mg/kg	0.005 mg/kg	89.7	60.0	140	----
Aroclor 1232	11141-16-5	E687	0.01	mg/kg	0.005 mg/kg	89.7	60.0	140	----
Aroclor 1242	53469-21-9	E687	0.01	mg/kg	0.005 mg/kg	89.7	60.0	140	----
Aroclor 1248	12672-29-6	E687	0.01	mg/kg	0.005 mg/kg	84.3	60.0	140	----
Aroclor 1254	11097-69-1	E687	0.01	mg/kg	0.005 mg/kg	81.2	60.0	140	----
Aroclor 1260	11096-82-5	E687	0.01	mg/kg	0.005 mg/kg	102	60.0	140	----
Aroclor 1262	37324-23-5	E687	0.01	mg/kg	0.005 mg/kg	102	60.0	140	----
Aroclor 1268	11100-14-4	E687	0.01	mg/kg	0.005 mg/kg	102	60.0	140	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
TCLP Extractables (QCLot: 1024954)										
WT2319410-001	Anonymous	Acenaphthene, TCLP	83-32-9	E644	0.5 µg/L	0.5263 µg/L	93.6	50.0	140	----
		Acenaphthylene, TCLP	208-96-8	E644	0.5 µg/L	0.5263 µg/L	97.5	50.0	140	----
		Acridine, TCLP	260-94-6	E644	0.4 µg/L	0.5263 µg/L	73.8	50.0	140	----
		Anthracene, TCLP	120-12-7	E644	0.5 µg/L	0.5263 µg/L	100	50.0	140	----
		Benz(a)anthracene, TCLP	56-55-3	E644	0.5 µg/L	0.5263 µg/L	99.0	50.0	140	----
		Benzo(a)pyrene, TCLP	50-32-8	E644	0.54 µg/L	0.5263 µg/L	103	50.0	140	----
		Benzo(b+j)fluoranthene, TCLP	----	E644	0.6 µg/L	0.5263 µg/L	107	50.0	140	----
		Benzo(g,h,i)perylene, TCLP	191-24-2	E644	0.4 µg/L	0.5263 µg/L	82.8	50.0	140	----
		Benzo(k)fluoranthene, TCLP	207-08-9	E644	0.5 µg/L	0.5263 µg/L	100	50.0	140	----
		Chrysene, TCLP	218-01-9	E644	0.5 µg/L	0.5263 µg/L	95.8	50.0	140	----
		Dibenz(a,h)anthracene, TCLP	53-70-3	E644	0.5 µg/L	0.5263 µg/L	91.6	50.0	140	----
		Fluoranthene, TCLP	206-44-0	E644	0.5 µg/L	0.5263 µg/L	102	50.0	140	----
		Fluorene, TCLP	86-73-7	E644	0.5 µg/L	0.5263 µg/L	96.7	50.0	140	----
		Indeno(1,2,3-cd)pyrene, TCLP	193-39-5	E644	0.5 µg/L	0.5263 µg/L	88.8	50.0	140	----
		Naphthalene, TCLP	91-20-3	E644	0.5 µg/L	0.5263 µg/L	96.7	50.0	140	----
		Phenanthrene, TCLP	85-01-8	E644	0.5 µg/L	0.5263 µg/L	95.8	50.0	140	----
		Pyrene, TCLP	129-00-0	E644	0.5 µg/L	0.5263 µg/L	100	50.0	140	----
TCLP Extractables (QCLot: 1025846)										
WT2319510-001	TCLP-1	Cyanide, weak acid dissociable, TCLP	----	E337A	5.83 mg/L	6.25 mg/L	93.3	50.0	140	----
TCLP Extractables (QCLot: 1027353)										
WT2318613-004	Anonymous	Fluoride, TCLP	16984-48-8	E240.F	18 mg/L	20 mg/L	93.0	50.0	150	----
TCLP Extractables (QCLot: 1027354)										
WT2318613-004	Anonymous	Nitrate (as N), TCLP	14797-55-8	E240.NO3	49.2 mg/L	50 mg/L	98.4	50.0	150	----
TCLP Extractables (QCLot: 1027355)										
WT2318613-004	Anonymous	Nitrite (as N), TCLP	14797-65-0	E240.NO2	9.5 mg/L	10 mg/L	95.4	50.0	150	----
TCLP Metals (QCLot: 1025092)										
WT2319692-001	Anonymous	Arsenic, TCLP	7440-38-2	E444	9.8 mg/L	10 mg/L	97.8	50.0	140	----
		Barium, TCLP	7440-39-3	E444	13.0 mg/L	12.5 mg/L	104	50.0	140	----
		Boron, TCLP	7440-42-8	E444	9.88 mg/L	10 mg/L	98.8	50.0	140	----

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
TCLP Metals (QCLot: 1025092) - continued										
WT2319692-001	Anonymous	Cadmium, TCLP	7440-43-9	E444	10.3 mg/L	10 mg/L	103	50.0	140	----
		Chromium, TCLP	7440-47-3	E444	10.7 mg/L	10 mg/L	107	50.0	140	----
		Lead, TCLP	7439-92-1	E444	10.3 mg/L	10 mg/L	103	50.0	140	----
		Selenium, TCLP	7782-49-2	E444	11.1 mg/L	10 mg/L	111	50.0	140	----
		Silver, TCLP	7440-22-4	E444	0.104 mg/L	0.1 mg/L	104	50.0	140	----
		Uranium, TCLP	7440-61-1	E444	10.4 mg/L	10 mg/L	104	50.0	140	----
TCLP Metals (QCLot: 1025125)										
WT2319692-001	Anonymous	Mercury, TCLP	7439-97-6	E512	0.0029 mg/L	0.003 mg/L	98.1	50.0	140	----
TCLP VOCs (QCLot: 1025242)										
WT2318473-012	Anonymous	Benzene, TCLP	71-43-2	E615B	243 µg/L	250 µg/L	97.3	50.0	140	----
		Carbon tetrachloride, TCLP	56-23-5	E615B	234 µg/L	250 µg/L	93.6	50.0	140	----
		Chlorobenzene, TCLP	108-90-7	E615B	254 µg/L	250 µg/L	102	50.0	140	----
		Chloroform, TCLP	67-66-3	E615B	270 µg/L	250 µg/L	110	50.0	140	----
		Dichlorobenzene, 1,2-, TCLP	95-50-1	E615B	248 µg/L	250 µg/L	99.3	50.0	140	----
		Dichlorobenzene, 1,4-, TCLP	106-46-7	E615B	246 µg/L	250 µg/L	98.6	50.0	140	----
		Dichloroethane, 1,2-, TCLP	107-06-2	E615B	259 µg/L	250 µg/L	104	50.0	140	----
		Dichloroethylene, 1,1-, TCLP	75-35-4	E615B	238 µg/L	250 µg/L	95.2	50.0	140	----
		Dichloromethane, TCLP	75-09-2	E615B	280 µg/L	250 µg/L	110	50.0	140	----
		Methyl ethyl ketone [MEK], TCLP	78-93-3	E615B	240 µg/L	250 µg/L	97.0	50.0	140	----
		Tetrachloroethylene, TCLP	127-18-4	E615B	243 µg/L	250 µg/L	97.2	50.0	140	----
		Trichloroethylene, TCLP	79-01-6	E615B	266 µg/L	250 µg/L	106	50.0	140	----
		Vinyl chloride, TCLP	75-01-4	E615B	215 µg/L	250 µg/L	86.2	50.0	140	----
Polychlorinated Biphenyls (QCLot: 1022750)										
WT2319433-022	Anonymous	Aroclor 1016	12674-11-2	E687	0.009 mg/kg	0.005 mg/kg	87.3	50.0	150	----
		Aroclor 1221	11104-28-2	E687	0.009 mg/kg	0.005 mg/kg	87.3	50.0	150	----
		Aroclor 1232	11141-16-5	E687	0.009 mg/kg	0.005 mg/kg	87.3	50.0	150	----
		Aroclor 1242	53469-21-9	E687	0.007 mg/kg	0.005 mg/kg	68.0	50.0	150	----
		Aroclor 1248	12672-29-6	E687	0.009 mg/kg	0.005 mg/kg	87.3	50.0	150	----
		Aroclor 1254	11097-69-1	E687	0.008 mg/kg	0.005 mg/kg	82.8	50.0	150	----
		Aroclor 1260	11096-82-5	E687	0.013 mg/kg	0.005 mg/kg	133	50.0	150	----
		Aroclor 1262	37324-23-5	E687	0.014 mg/kg	0.005 mg/kg	136	50.0	150	----
		Aroclor 1268	11100-14-4	E687	0.014 mg/kg	0.005 mg/kg	136	50.0	150	----

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 -

MT Pa

Environmental Division Waterloo
Work Order Reference
WT2319510

Telephone : +1 519 886 6910

Report To	Contact and company name below will appear on the final report
Company:	WSP
Contact:	Mauro Cortes
Phone:	519-650-7121
	Company address below will appear on the final report
Street:	900 Maple Grove Road
City/Province:	Cambridge ON
Postal Code:	N3H4R7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mauro.cortes@wsp.com
Email 2	herman.padham@wsp.com
Email 3	cindy.smith2@wsp.com

Invoice Distribution	
Select Invoice Distribution:	☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	apinvoice.canada@woodplc.com
Email 2	herman.padham@wsp.com

Select Service Level Below - Contact your AM to

Regular [R] ☑ Standard TAT if received by 3 pr

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Busines | Same Day | (Laborato

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level s

Analysis

Project Information	
ALS Account # / Quote #:	2023 SOA
Job #:	OGTW2331.2000.5800.5730-00
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only):	WT2319510

Oil and Gas Required Fields (client use)		
AFE/Cost Center:		PO#
Major/Minor Code:		Routing Code:
Requisitioner:		
Location:		
ALS Contact:	GB	Sampler: NR

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	TCLP - VOC	TCLP - PAH	TCLP - metal inogranics	Bulk PCB	Ignitability	SAMPLES ON HOLI	SUSPECTED HAZARD (see Special Instructions)
	TCLP-1	30-Jun-23	13:00	Soil	4	R	R	R	R	R		

Indicate Filtered (F), Preserved (P) or Filtere

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human consumption/ use? ☐ YES ☑ NO	Oreg 347

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☑ | Ice Cubes ☑ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				14.1			

SHIPMENT RELEASE (client use)		
Released by: N. Ramnani	Date: Jun 30, 2023	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: BB	Date: 06/30/23	Time: 2:45

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

SDWA - TWB - 591 EC

APPENDIX

D

LIMITATIONS TO GEOTECHNICAL REPORTS

1. The work performed in the preparation of this report and the conclusions presented herein are subject to the following:

    a) The contract between WSP and the Client, including any subsequent written amendment or Change Order dully signed by the parties (hereinafter together referred as the "Contract");

    b) Any and all time, budgetary, access and/or site disturbance, risk management preferences, constraints or restrictions as described in the contract, in this report, or in any subsequent communication sent by WSP to the Client in connection to the Contract; and

    c) The limitations stated herein.

2. **Standard of care:** WSP has prepared this report in a manner consistent with the level of skill and are ordinarily exercised by reputable members of WSP's profession, practicing in the same or similar locality at the time of performance, and subject to the time limits and physical constraints applicable to the scope of work, and terms and conditions for this assignment. No other warranty, guaranty, or representation, expressed or implied, is made or intended in this report, or in any other communication (oral or written) related to this project. The same are specifically disclaimed, including the implied warranties of merchantability and fitness for a particular purpose.

3. **Limited locations:** The information contained in this report is restricted to the site and structures evaluated by WSP and to the topics specifically discussed in it, and is not applicable to any other aspects, areas or locations.

4. **Information utilized:** The information, conclusions and estimates contained in this report are based exclusively on: i) information available at the time of preparation, ii) the accuracy and completeness of data supplied by the Client or by third parties as instructed by the Client, and iii) the assumptions, conditions and qualifications/limitations set forth in this report.

5. **Accuracy of information:** No attempt has been made to verify the accuracy of any information provided by the Client or third parties, except as specifically stated in this report (hereinafter "Supplied Data"). WSP cannot be held responsible for any loss or damage, of either contractual or extra-contractual nature, resulting from conclusions that are based upon reliance on the Supplied Data.

6. **Report interpretation:** This report must be read and interpreted in its entirety, as some sections could be inaccurately interpreted when taken individually or out-of-context. The contents of this report are based upon the conditions known and information provided as of the date of preparation. The text of the final version of this report supersedes any other previous versions produced by WSP.

7. **No legal representations:** WSP makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

8. **Decrease in property value:** WSP shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.

9. **No third party reliance:** This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or Contract. Any use or reproduction which any third party makes of the report, in whole or in part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. WSP does not represent or warrant the accuracy, completeness, merchantability, fitness for purpose or usefulness of this document, or any information contained in this

document, for use or consideration by any third party. WSP accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on this report or anything set out therein. including without limitation, any indirect, special, incidental, punitive or consequential loss, liability or damage of any kind.

10. **Assumptions**: Where design recommendations are given in this report, they apply only if the project contemplated by the Client is constructed substantially in accordance with the details stated in this report. It is the sole responsibility of the Client to provide to WSP changes made in the project, including but not limited to, details in the design, conditions, engineering or construction that could in any manner whatsoever impact the validity of the recommendations made in the report. WSP shall be entitled to additional compensation from Client to review and assess the effect of such changes to the project.

11. **Time dependence**: If the project contemplated by the Client is not undertaken within a period of 18 months following the submission of this report, or within the time frame understood by WSP to be contemplated by the Client at the commencement of WSP's assignment, and/or, if any changes are made, for example, to the elevation, design or nature of any development on the site, its size and configuration, the location of any development on the site and its orientation, the use of the site, performance criteria and the location of any physical infrastructure, the conclusions and recommendations presented herein should not be considered valid unless the impact of the said changes is evaluated by WSP, and the conclusions of the report are amended or are validated in writing accordingly.
    Advancements in the practice of geotechnical engineering, engineering geology and hydrogeology and changes in applicable regulations, standards, codes or criteria could impact the contents of the report, in which case, a supplementary report may be required. The requirements for such a review remain the sole responsibility of the Client or their agents.
    WSP will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

12. **Limitations of visual inspections:** Where conclusions and recommendations are given based on a visual inspection conducted by WSP, they relate only to the natural or man-made structures, slopes, etc. inspected at the time the site visit was performed. These conclusions cannot and are not extended to include those portions of the site or structures, which were not reasonably available, in WSP's opinion, for direct observation.

13. **Limitations of site investigations**: Site exploration identifies specific subsurface conditions only at those points from which samples have been taken and only at the time of the site investigation. Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions. The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite this investigation, conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.
    Final sub-surface/bore/profile logs are developed by geotechnical engineers based upon their interpretation of field logs and laboratory evaluation of field samples. Customarily, only the final bore/profile logs are included in geotechnical engineering reports.
    Bedrock, soil properties and groundwater conditions can be significantly altered by environmental remediation and/or construction activities such as the use of heavy equipment or machinery, excavation, blasting, pile-driving

or draining or other activities conducted either directly on site or on adjacent terrain. These properties can also be indirectly affected by exposure to unfavorable natural events or weather conditions, including freezing, drought, precipitation and snowmelt.

During construction, excavation is frequently undertaken which exposes the actual subsurface and groundwater conditions between and beyond the test locations, which may differ from those encountered at the test locations. It is recommended practice that WSP be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered at the test locations, that construction work has no negative impact on the geotechnical aspects of the design, to adjust recommendations in accordance with conditions as additional site information is gained and to deal quickly with geotechnical considerations if they arise.

Interpretations and recommendations presented herein may not be valid if an adequate level of review or inspection by WSP is not provided during construction.

14. **Factors that may affect construction methods, costs and scheduling**: The performance of rock and soil materials during construction is greatly influenced by the means and methods of construction. Where comments are made relating to possible methods of construction, construction costs, construction techniques, sequencing, equipment or scheduling, they are intended only for the guidance of the project design professionals, and those responsible for construction monitoring. The number of test holes may not be sufficient to determine the local underground conditions between test locations that may affect construction costs, construction techniques, sequencing, equipment, scheduling, operational planning, etc.

    Any contractors bidding on or undertaking the works should draw their own conclusions as to how the subsurface and groundwater conditions may affect their work, based on their own investigations and interpretations of the factual soil data, groundwater observations, and other factual information.

15. **Groundwater and Dewatering**: WSP will accept no responsibility for the effects of drainage and/or dewatering measures if WSP has not been specifically consulted and involved in the design and monitoring of the drainage and/or dewatering system.

16. **Environmental and Hazardous Materials Aspects**: Unless otherwise stated, the information contained in this report in no way reflects on the environmental aspects of this project, since this aspect is beyond the Scope of Work and the Contract. Unless expressly included in the Scope of Work, this report specifically excludes the identification or interpretation of environmental conditions such as contamination, hazardous materials, wild life conditions, rare plants or archeology conditions that may affect use or design at the site. This report specifically excludes the investigation, detection, prevention or assessment of conditions that can contribute to moisture, mould or other microbial contaminant growth and/or other moisture related deterioration, such as corrosion, decay, rot in buildings or their surroundings. Any statements in this report or on the boring logs regarding odours, colours, and unusual or suspicious items or conditions are strictly for informational purposes

17. **Sample Disposal**: WSP will dispose of all uncontaminated soil and rock samples after 30 days following the release of the final geotechnical report. Should the Client request that the samples be retained for a longer time, the Client will be billed for such storage at an agreed upon rate. Contaminated samples of soil, rock or groundwater are the property of the Client, and the Client will be responsible for the proper disposal of these samples, unless previously arranged for with WSP or a third party.

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