Hamilton Transit

BUS MAINTENANCE & STORAGE FACILITY

Appendix F

Physical Environment

Part 1

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Prepared for

Hamilton

Prepared by

IBI GROUP

HSR - MSF HAMILTON SOILS PROFILE AND DATA COLLECTION

SUPPLEMENTAL INVESTIGATION

CITY OF HAMILTON

DRAFT REPORT (VERSION 2)

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1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by the City of Hamilton to undertake a Phase II Environmental Site Assessment (ESA) for the Future HSR Maintenance Storage Facility (MSF) that will be located on multiple properties in the City of Hamilton. The properties that comprise the HSR Facility include: 2 Hillyard Street, 10 Hillyard Street, 80 Brant Street, and 330 Wentworth Street North. In May 2017, WSP completed a Phase II ESA and soils profile report for the 330 Wentworth Street North and 80 Brant Street on which the majority of the MSF development will cover. In November 2017, WSP completed a Phase II ESA and soils profile report for the 2 Hillyard Street property.

After these investigations were completed, further investigations were required at 35 Brant Street and 10 Hillyard Street. Based on the 2017 investigations, additional boreholes were recommended for the 80 Brant Street and 330 Wentworth Street North properties.

Factual soil profile data and recommendations for the 35 Brant Street/10 Hillyard Street properties are provided in this report based on the information collected as part of the ESA. Supplemental soil information will also be provided for the additional boreholes drilled at the 80 Brant Street and 330 Wentworth Street North properties. This report combines all of the soil data collected from previous investigations on the property to provide one comprehensive report to get soils profile data and recommendations for the entire MSF development.

The site is situated within the former Sherman Inlet and after the inlet was backfilled, the land has been under industrial use since the early 1900s. The proposed development comprises of a 275,000 square foot single storey structure and associated driveways/parking areas.

The purpose of this soils profile and data collection report is to determine the subsurface conditions at the borehole locations and based on the borehole results, to make engineering recommendations for the following:

1. Foundations
2. Floor slabs and permanent drainage
3. Excavations and backfill
4. Seismic Site Classification
5. Pavement Design

This report is provided on the bases of the terms of reference presented above and on the assumption that the design will be in accordance with applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations can be moderated to the changed design.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for The City of Hamilton and their designers. Third party use of this report without the consent of WSP is prohibited.

2 PREVIOUS WORK

In November of 2017, WSP completed a soils profile data and recommendation report for the Future HSR MSF, excluding the area of the development located at 2 Hillyard Street. This report covered data collected from five (5) boreholes, 17-23 through 17-26 (see **Drawing 2**).

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In May of 2017, WSP completed a soils profile data and recommendation report for the Future HSR MSF, excluding the area of the development located at, 80 Brant Street, and 330 Wentworth Street North. This report covered data collected from twenty-two (22) boreholes, 17-01 through 17-22 (see **Drawing 2**).

Subsurface information from an adjacent property is also available from the investigation report titled 'Geotechnical Investigation HSR Garage Terra Cotta Avenue, Hamilton, Ontario' by Trow Ontario Ltd., dated April 24, 1987 (Project: H860243-G). The report included compiled results and recommendations from multiple investigations for a proposed HSR MSF development located on the site immediately adjacent to the south of the site discussed in this report. The compiled investigations included thirty-eight (38) boreholes, eleven (11) test pits, nine (9) auger probes, and seventeen (17) dynamic cone penetration tests (DCPTs). Limits of the buried former Sherman Inlet were delineated from this work and foundation recommendations were given. Pile foundations were recommended for areas of the building located within the Sherman Inlet with fill reaching depths up to 10m. Shallow foundations were recommended for the remainder of the proposed structure.

3 METHOD OF INVESTIGATION

3.1 DRILLING INVESTIGATION WORK AND FIELD TESTING

Borehole locations and depths for this investigation were established by WSP personnel in accordance with the Phase II ESA project requirements.

Two (2) boreholes (BH18-1 and BH18-2) were drilled at the 35 Brant Street property on December 5, 2018 and were advanced to a depth of 6.1m below existing ground surface. Approximate borehole locations are shown on **Drawing 1**.

Six (6) boreholes (BH18-3 to BH18-8) were drilled at the 10 Hillyard Street property between November 29, 2018 and December 4, 2018 and were advanced to depths ranging from 6.1 to 16.8m below existing ground surface. Approximate borehole locations are shown on **Drawing 2**.

Two (2) supplementary boreholes were drilled at the 80 Brant Street and 330 Wentworth Street North properties between December 6, 2018 and December 7, 2018 and were advanced to depths ranging from 13.8 to 18.0m below existing ground surface. Approximate borehole locations are shown on **Drawing 2**.

Drilling was conducted with hollow stem continuous flight auger equipment and mud rotary methods by a drilling sub-contractor under the supervision of WSP personnel. The soil stratigraphy was recorded by observing the quality and changes of augered materials which were withdrawn from the boreholes, and by sampling the soils at regular intervals of depth using a 50mm O.D. split spoon sampler, in accordance with the Standard Penetration Test (ASTM D 1586) method. This sampling method recovers samples from the soil strata, and the number of blows required to drive the sampler 0.3m depth into the undisturbed soil (SPT 'N'-values) gives an indication of the compactness condition or consistency of the sampled soil material. The SPT 'N'-values are indicated on the Borehole Logs in **Appendix A**.

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Table 3-1 - Summary of Borehole Elevations, Depths, and Locations

BOREHOLE	GROUND ELEVATION (M)	DEPTH (M)	PROPOSED CONSTRUCTION AT BOREHOLE LOCATION
BH17-01	78.7	9.0	Pavement
BH17-02	78.8	4.4	Maintenance and Storage Facility
BH17-03	78.5	9.0	Maintenance and Storage Facility
BH17-04	77.8	9.8	Maintenance and Storage Facility
BH17-05	78.0	6.7	Maintenance and Storage Facility
BH17-06	77.2	10.5	Maintenance and Storage Facility
BH17-07	77.4	9.8	Maintenance and Storage Facility
BH17-08	77.9	4.4	Maintenance and Storage Facility
BH17-09	79.6	6.7	Pavement
BH17-10	77.5	5.2	Pavement
BH17-11	77.4	5.2	Pavement
BH17-12	80.2	3.7	Fueling Structure
BH17-13	79.6	5.2	Pavement
BH17-14	79.5	7.5	Maintenance and Storage Facility
BH17-15	79.6	5.9	Maintenance and Storage Facility
BH17-16	79.1	7.5	Maintenance and Storage Facility
BH17-17	79.2	5.9	Maintenance and Storage Facility
BH17-18	79.7	5.2	Pavement
BH17-19	79.5	6.7	Pavement
BH17-20	79.3	6.7	Pavement
BH17-21	80.3	8.2	Parking Structure
BH17-22	81.0	7.6	Parking Structure
BH17-23	79.8	5.9	Maintenance and Storage Facility
BH17-24	80.4	7.9	Fueling
BH17-25	80.4	6.1	Maintenance and Storage Facility
BH17-26	80.0	6.1	CNG
BH17-27	79.8	4.4	Pavement
BH18-1	81.2	6.1	35 Brant Street (no proposed construction)
BH18-2	80.8	6.1	35 Brant Street (no proposed construction)
BH18-3	79.1	16.8	Pavement
BH18-4	80.1	6.1	Pavement
BH18-5	78.8	6.7	Pavement
BH18-6	80.1	9.1	Maintenance and Storage Facility
BH18-7	80.2	6.7	Pavement
BH18-8	78.9	9.1	Maintenance and Storage Facility
BH-1	79.8	13.8	Parking Structure
BH-2	77.8	18.0	Maintenance and Storage Facility

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Upon completion of the fieldwork, the ground surface geodetic elevations at the location of each borehole were surveyed by WSP personnel. The survey was completed suing a differential GPS based on Benchmark Station 0011965U144; the tablet on the west face of the concrete foundation of the three storey school at the northeast corner of Wentworth Street North and Munro Street, in the City of Hamilton. Borehole elevations are indicated in the Borehole Logs in **Appendix A**.

3.2 LABORATORY TESTING

The soil samples were taken to our laboratory where they were re-examined. Representative samples were selected for index testing. The testing programs completed for all investigations as part of this project consisted of the measurement of the natural moisture content of all samples, six (6) grain size distribution tests, six (6) Atterberg Limits tests, and Loss of Ignition (LOI) testing of three (3) selected samples of organic rich soil/peat. The test results are shown on the Borehole Logs and enclosed in **Appendix C**.

4 SUBSURFACE CONDITIONS

4.1 35 BRANT STREET

4.1.1 SITE OVERVIEW

At the time of this report, there were no designs for construction at the 35 Brant Street property. The two (2) boreholes (BH18-1 and BH18-2) from this property are included in this report for factual purposes only.

4.1.2 SUBSOIL CONDITIONS

The two (2) boreholes (BH18-1 and BH18-2) revealed the presence of cohesive and non-cohesive fill deposits overlying sandy silt and silty clay deposits. More specific details on the subsurface conditions at the individual boring locations are given in the Borehole Logs in **Appendix A-1**. The following notes are, therefore, intended only to summarize the data and to amplify some of the general characteristics of the deposits.

FILL

Heterogeneous fill materials were encountered at the surface of both boreholes and extended to a depth of 2.3m. The fill was generally composed of san and gravel or clayey silt, mixed with asphalt pieces. The fill varied in colour from grey to reddish brown. The compactness condition of the fill was very loose to dense, which was inferred based on SPT 'N'-values of 1 to 50 blows per 0.3m penetration, but generally in a very loose to compact compactness condition. The natural moisture content measured in six (6) samples of the fill material ranged from 4 to 27%.

SANDY SILT

Underlying the fill at BH18-1, a deposit of reddish brown sandy silt, trace clay was encountered. The sandy silt extended to a depth of 3.8m below existing ground surface. The compactness condition of the sandy silt was loose to compact, which was inferred based on SPT 'N'-values of 6 to 11 blows per 0.3m penetration. The natural moisture content measured in two (2) samples of the sandy silt ranged from 30 to 31%.

SILTY CLAY

Underlying the fill or sand at both boreholes was native silty clay that extended to the completion of each borehole. The silty clay contained trace sand, was brown to grey in colour, and its consistency was very soft to very stiff which

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was inferred based on SPT 'N'-values of 0 to 9. The natural moisture content measured in seven (7) samples from the silty clay ranged from 26 to 37%.

4.1.3 GROUNDWATER CONDITIONS

A monitoring well was installed in each borehole. Groundwater levels were measured in these wells on December 6 and December 12, 2018 and ranged from 2.3 to 2.9m below ground surface (Elev. 78.9 to 77.9m).

4.2 MAINTENANCE STORAGE FACILITY

4.2.1 SITE OVERVIEW

The HSR MSF building will cover multiple properties including: 2 Hillyard Street, 10 Hillyard Street, 80 Brant Street, and 330 Wentworth Street North. This report compiles soil data collected from May and November 2017 WSP soil data reports to include all relevant soil data pertaining to the proposed structure. A total of thirty-five (35) boreholes were drilled as part of the current investigation and the previous May and November 2017 WSP investigations.

4.2.2 SUBSOIL CONDITIONS

The thirty-five (35) boreholes revealed the presence of concrete, asphalt, or surficial fill at each borehole, which was underlain by silty clay and weathered shale bedrock. Boreholes 18-6 and 18-7 were drilled through the concrete slab of the existing building on the property. More specific details on the subsurface conditions at the individual boring locations are given in the Borehole Logs in **Appendix A-2**. The following notes are, therefore, intended only to summarize the data and to amplify some of the general characteristics of the deposits.

CONCRETE/ASPHALT

Surficial asphalt was encountered at boreholes 17-12, 17-14, 17-15, 17-17 through 17-22, 18-4, 18-5, 18-8m, and BH-1. The asphalt ranged in thickness from 50 to 150mm. Concrete was encountered at the surface of boreholes 18-3, 18-6, and 18-7. The concrete ranged in thickness from 150 to 200mm. The concrete and asphalt was underlain by sand and gravel fill.

FILL

Heterogeneous fill materials were encountered at all thirty-five (35) boreholes and extended to depths of 1.5 to 9.4m. A summary of fill depths and locations is shown in **Table 4-1**. The fill was generally composed of sand and gravel fill overlying clayey silt fill. The fill contained wood pieces, trace slag, and trace bricks pieces. The fill varied in colour from dark brown to grey to black. The compactness condition of the fill was very loose to very dense, which was inferred based on SPT 'N'-values of 0 to in excess of 50 blows per 0.3m penetration, but generally in a very loose to compact compactness condition. The natural moisture content measured in two hundred three (203) samples of the fill material ranged from 3 to 89%.

Table 4-1 - Summary of Fill Depths

BOREHOLE	TOP OF FILL DEPTH (m)	BOTTOM OF FILL DEPTH (m)	UNDERLYING SOIL
BH17-01	0	6.9	Native silty clay
BH17-02	0	3.2	Native silty clay
BH17-03	0	7.8	Peat to 9.0m depth (end of borehole)

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BOREHOLE	TOP OF FILL DEPTH (m)	BOTTOM OF FILL DEPTH (m)	UNDERLYING SOIL
BH17-04	0	9.1	Peat to 9.8m (end of borehole)
BH17-05	0	6.1 including organic fill from 4.6 to 5.3m depth	Native silty clay
BH17-06	0	9.4 including organic fill from 4.6 to 9.4m depth	Peat to 10.5m depth (end of borehole)
BH17-07	0	7.6 including organic fill from 3.8m to 7.6m depth	Organic clayey silt and peat to 9.8m depth (end of borehole)
BH17-08	0	3.8 including organic fill from 2.1 to 3.8m depth	Native silty clay
BH17-09	0	6.7 (end of borehole) including organic fill frim 5.3 to 6.1m depth	Unknown
BH17-10	0	3.8 including organic fill from 2.4 to 3.8m depth	Native silty clay
BH17-11	0	1.5	Native silty clay
BH17-12	0.1	2.4	Native silty clay
BH17-13	0	1.5	Native silty clay
BH17-14	0.2	6.9	Native silty clay
BH17-15	0.1	1.5	Native silty clay
BH17-16	0	6.9	Native silty clay
BH17-17	0.2	3.8	Native silty clay
BH17-18	0.1	2.3	Native silty clay
BH17-19	0.1	6.1	Native silty clay
BH17-20	0.1	6.1	Native silty clay
BH17-21	0.1	4.6	Native silty clay
BH17-22	0.1	2.3	Native silty clay
BH17-23	0	2.3	Native silty clay
BH17-24	0	3.1	Native silty clay
BH17-25	0	3.1	Organic Fill to 5.2m depth
BH17-26	0	6.1 (end of borehole)	Unknown
BH17-27	0	4.1	Native silty clay
BH18-3	0.2	2.3	Native silty clay
BH18-4	0.1	2.3	Native silty clay
BH18-5	0.1	1.5	Native silty clay
BH18-6	0.2	2.3	Native silty clay
BH18-7	0.2	2.3	Native silty clay

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BOREHOLE	TOP OF FILL DEPTH (m)	BOTTOM OF FILL DEPTH (m)	UNDERLYING SOIL
BH18-8	0.1	5.3	Native silty clay
BH-1	0.1	2.3	Native silty clay
BH-2	0	6.9	Organic Silty clay and peat to 11.4m depth
Min Depth = 1.5m, Max Depth = 9.4m			

PEAT AND ORGANIC SOILS

Compressible peat and organic soils were encountered beneath the heterogeneous fill at boreholes 17-03 through 17-10, 17-25, 17-26, and BH-2 at depths ranging from 2.1 m to 8.4 m below grade. The SPT 'N'-values of 1 to 8 indicate the very soft to firm/stiff consistency of the peaty soils. The natural moisture content measured in the test samples from these materials ranged from 32% to 238%. Three (3) Loss of Ignition (LOI) tests were completed on samples from the peat and organic soils encountered in BH-2. The measured organic content in the three (3) samples ranged from 10.8 to 40.8%.

A summary of peat and organic soil depths and locations is shown in **Table 4-2**.

Table 4-2 - Summary of Peat and Organic Soil Depths

BOREHOLE	TOP OF PEAT/ORGANIC SOIL DEPTH (m)	BOTTOM OF PEAT/ORGANIC SOIL DEPTH (m)	SOIL TYPE	UNDERLYING SOIL
BH17-03	7.8	9.0 (end of borehole)	Peat	Unknown
BH17-04	9.1	9.8 (end of borehole)	Peat	Unknown
BH17-05	4.6	5.3	Organic silty clay	Silty clay fill
BH17-06	4.6	10.5 (end of borehole)	Organic silty clay and peat	Unknown
BH17-07	3.8	9.8 (end of borehole)	Organic fill, organic clayey silt, peat	Unknown
BH17-08	2.1	3.8	Organic fill	Native silty clay
BH17-09	5.3	6.1	Organic silty clay	Silty clay fill
BH17-10	2.4	3.8	Organic silty clay	Native silty clay
BH17-25	3.1	5.2	Organic fill	Native silty clay
BH17-26	4.6	6.1 (end of borehole)	Organic fill	Unknown
BH-2	6.9	11.4	Organic silty clay, peat	Native silty clay
Min Depth = 3.8m, Max Depth = 11.4m				

SILTY CLAY

Underlying the fill, organic soils, or peat at all boreholes was native silty clay that extended to the completion of each borehole. Silty clay was not encountered in boreholes 17-03, 17-04, 17-06, 17-07, 17-09, and 17-26 because they were terminated in fill, organic fill, or peat soils. The silty clay contained trace sand, was brown to grey in colour, and its consistency was very soft to very stiff which was inferred based on SPT 'N'-values of 0 to 27. Two (2) field vane tests were completed in the silty clay, at boreholes 17-24 and 17-25 respectively. The field vane tests measured intact shear strength of the silty clay to be 80 to 120kPa with a sensitivity of 2.0 to 2.3. The two field vane tests indicated that the

silty clay at those locations/depths was stiff to very stiff. The natural moisture content measured in one hundred one (101) samples from the silty clay ranged from 16 to 38%.

Grain size distribution and Atterberg Limits Tests were conducted on six (6) samples from the silty clay. The are shown in **Table 4-3** and presented on **Figures B-1 to B-3** enclosed in **Appendix B**. Based on the Modified Soil Classification System (MSCS), the six (6) samples are classified as medium plastic clay (CI).

Table 4-3 - Grain Size Distribution and Atterberg Limits Test Results for Silty Clay

SAMPLE ID	GRAIN SIZE DISTRIBUTION (%)				ATTERBERG LIMITS (%)		
	Gravel	Sand	Silt	Clay	Plastic Limit (PL)	Liquid Limit (LL)	Plasticity Index (PI)
17-01/SS11	1	10	55	33	17	33	16
17-08/SS6	0	4	37	59	21	49	28
17-11/SS5	1	5	42	52	18	42	24
17-15/SS3	1	7	38	54	19	47	28
17-24/SS9	0	2	41	57	19	44	25
17-25/SS8	0	2	39	59	21	44	23
Minimum	0	2	37	33	17	33	16
Maximum	1	10	55	59	21	49	28

CLAYEY SILT

A deposit of clayey silt was encountered underlying the silty clay at borehole BH-1 that extended to a depth of 13.7m below existing ground surface. The clayey silt contained trace sand, trace shale fragments, was grey in colour, and nits consistency was very stiff to hard, which was inferred based on SPT 'N'-values of 22 to in excess of 50 blows per 0.3m of penetration. The natural moisture content measured in two (2) samples from the clayey silt ranged from 22 to 36%.

BEDROCK

Weathered shale bedrock of the Queenston Formation was encountered in boreholes BH-1 and BH-2. The weathered shale was encountered in borehole BH-1 was 13.7m (Elev. 66.0m). The depth of the weathered shale at BH-2 was estimated to be at 15.0m below ground surface (Elev. 62.8m).

Because of the method of drilling, sampling, and variations at the bedrock surface, the surface elevation of the bedrock can differ from what is indicated on the borehole logs. With augering, the auger may penetrate some of the more weathered shale prior to reaching refusal.

4.2.3 GROUNDWATER CONDITIONS

Nineteen (19) monitoring wells have been installed as part of the current and previous WSP investigations. Groundwater level and elevation measurements were collected at each well and the results are shown in **Table 4-4**.

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Table 4-4 – Groundwater Depths and Elevations in Monitoring Wells

BOREHOLE	DATE OF MEASUREMENT	GROUNDWATER DEPTH	GROUNDWATER ELEVATION
BH17-11	April 11, 2017	0.9	76.4
BH17-12	April 11, 2017	DRY	< 77.2
BH17-13	April 11, 2017	2.5	77.1
BH17-15	April 11, 2017	4.9	74.7
BH17-19	April 11, 2017	4.1	75.4
BH17-20	April 11, 2017	3.3	76.0
BH17-21	April 11, 2017	7.0	73.2
BH17-22	April 11, 2017	6.7	74.3
MW101 (by others)	April 11, 2017	1.3	76.3
MW104 (by others)	April 11, 2017	2.8	75.4
MW105 (by others)	April 11, 2017	2.2	76.3
MW106 (by others)	April 11, 2017	2.8	75.9
MW107 (by others)	April 11, 2017	1.6	76.6
MW108 (by others)	April 11, 2017	1.9	76.4
MW107B (by others)	April 11, 2017	1.3	75.8
BH32 (by others)	April 11, 2017	0.5	75.5
DC5 (by others)	April 11, 2017	1.2	75.4
BH17-24	November 8, 2017	6.2	74.2
BH17-25	November 8, 2017	4.0	76.0
BH17-26	November 8, 2017	4.0	75.8
BH18-1	December 12, 2018	2.4	78.8
BH18-2	December 12, 2018	2.4	78.4
BH18-3	December 12, 2018	6.3	72.8
BH18-4	December 12, 2018	5.1	75.0
BH18-5	December 12, 2018	5.7	73.1
BH18-6	December 12, 2018	2.5	77.6
BH18-7	December 12, 2018	5.2	75.0

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BOREHOLE	DATE OF MEASUREMENT	GROUNDWATER DEPTH	GROUNDWATER ELEVATION
BH18-8	December 12, 2018	1.6	77.3

It should be noted that groundwater levels can vary and are subject to seasonal fluctuations and in response to major weather events.

Fill soil at the site is highly variable in composition and, as such, the hydraulic conductivity of this unit can vary significantly. The fill consists of sand and gravel with some silt and it is anticipated that the hydraulic conductivity of this would be on the order of 10^{-3} to 10^{-4} m/s. The native soil encountered consists of a silty clay and is of much lower permeability. This unit would generally act as a confining layer to groundwater flow. The hydraulic conductivity of this unit would be on the order of 10^{-8} to 10^{-9} m/s.

5 SOIL PROFILE INTERPRETATION AND RECOMMENDATIONS

5.1 PROJECT OVERVIEW

We understand that the proposed HSR MSF building will be a single storey structure without a basement. The site development is to include the maintenance and storage facility, a separate parking structure, a two-storey office, and associated asphalt/concrete pavements and driveways.

The proposed finish floor elevation is not known at the time of this report. The HSR MSF building will cover multiple properties including: 2 Hillyard Street, 10 Hillyard Street, 80 Brant Street, and 330 Wentworth Street North. This report compiles soil data collected from May and November 2017 WSP soil data reports to include all relevant soil data pertaining to the proposed structure.

At the time of this report, there were no designs for construction at the 35 Brant Street property. The two (2) boreholes (BH18-1 and BH18-2) from this property are included in this report for factual information only.

The construction methods described in this report must not be misconstrued as being specifications or direct recommendations to contractors, or as being the only suitable methods. Prospective contractors should evaluate all of the factual information, obtain additional subsurface information as they might deem necessary and should select their construction methods, sequence, and equipment based on their own experience in similar ground conditions. Readers of this report are also reminded that the conditions are known only at borehole locations and in view of the generally wide spacing of the boreholes; conditions may vary significantly between boreholes.

5.2 SHALLOW FOUNDATIONS

As discussed in **Section 4** of this report and previous reports, generally very loose to loose heterogeneous fill material with various amounts of organic content is present at the majority of boreholes up to depths of 9.4m.

The fill is underlain by organic silty clay or peat, and/or stiff to very stiff silty clay. Shallow foundations are not suitable for the proposed structure due to the existing fill conditions at this site, unless the fill is removed and replaced or it is improved by other methods.

Sub-excavating the fill and backfilling with engineered fill is likely not a cost effective solution for the proposed structure's foundation design. Shallow competent bearing soil was not encountered in all of the boreholes with the exception of borehole 17-23, where locally shallow foundations could be founded on stiff to very stiff silty clay. All footings must have at least 1.2m of earth cover for frost protection.

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The parking structure, as shown on **Drawing 2**, can be supported by conventional spread and strip footings founded on the undisturbed stiff to very stiff native silty clay. Footing widths are not to exceed 2m. Footings can be designed for bearing capacities at the Serviceability Limit State (SLS) and factored geotechnical resistance at Ultimate Limit State (ULS) at the borehole locations and depths shown in **Table 5-1**.

Table 5-1 - Bearing Capacity Values and Founding Levels of Spread Footings on Native Soils

BOREHOLE	MATERIAL	BEARING CAPACITY AT SLS (kPa)	FACTORED GEOTECHNICAL RESISTANCE AT ULS (kPa)	FOUNDING DEPTH AT OR BELOW EXISTING GRADE (m)*	AT OR BELOW FOUNDING ELEVATION (m)*
BH17-12	Silty clay	100	150	2.4	77.8
BH17-20	Silty clay	100	150	6.1	73.2
BH17-21	Silty clay	200	300	4.6	75.7
BH17-22	Silty clay	150	225	2.3	78.7
BH-1	Silty clay	200	300	2.3	77.5

Once designs of the parking structure become available, they should be sent to WSP for further review of the feasibility of shallow foundations. It may be required to drill additional boreholes at the parking structure once the finished floor elevation and founding elevations are known.

Foundations designed to the specified bearing capacity at the Serviceability Limit States (SLS) are expected to settle less than 25 mm total and 19 mm differential.

All footings exposed to seasonal freezing conditions must have at least 1.2 metres of soil cover for frost protection.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

It should be noted that the recommended bearing capacities have been calculated by WSP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by WSP to validate the information for use during the construction stage. All foundation bases must be inspected by WSP prior to the placement of concrete.

5.3 DEEP FOUDNATIONS

Where shallow foundations are not feasible, consideration can be given to deep foundations: caissons, continuous flight auger piles, or driven piles.

5.3.1 CAISSONS

Drilled caissons, 1m in diameter, founded at Elev. 65.8 to 62.8m in weathered shale encountered in boreholes BH-1 and BH-2 can be designed for a bearing capacity of 1000 kPa at SLS (Serviceability Limit States), and for a factored geotechnical resistance of 1500 kPa at ULS (Ultimate Limit States), provided that the caisson bases are proven to be clean.

The bearing values and the corresponding depth for caissons at the borehole locations are summarized on **Table 5-2**.

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Table 5-2 - Bearing Values and Founding Levels of 1m Diameter Caissons

BH NO.	MATERIAL	BEARING CAPACITY AT SLS (kPa)	BEARING CAPACITY AT ULS (kPa)	MINIMUM DEPTH BELOW EXISTING GRADE (m)	CAISSON BASE ELEVATION (m)
BH-1	Weathered shale	1000	1500	15.0	64.8
BH-2	Weathered shale	1000	1500	16.0	61.8

For vertical capacity, the group reduction factor can be taken as 1 if caisson centre spacing is not less than 2.5D, where D is the pile diameter.

For design purposes, the recommended horizontal capacities for 1m diameter caisson with 1% reinforcement are as follows:

- Factored Horizontal Geotechnical Resistance at ULS = 165 kN/pile
- Horizontal Geotechnical Reaction at SLS = 110 kN/pile

For horizontal capacity, the group reduction factor can be taken as 1, 0.7, 0.4 and 0.25 for caisson centre spacing of 8D, 6D, 4D, and 3D respectively in the direction of loading; and caisson spacing normal to direction of load has no influence, provided it is not less than 2.5D.

It is recommended that minimum one pile load test must be carried out prior to finalizing the design and number of caissons. The number of caisson will depend upon geotechnical capacity of piles, confirmed by static load test.

The presence of groundwater in the upper sandy (cohesionless) deposits will make the construction of the caissons difficult. An oversize temporary caisson liner will be required which must be sealed in the underlying clay soils. All caisson bases must be inspected by this office on a full-time basis.

5.3.2 CONTINUOUS FLIGHT AUGER PILES (CFA PILES)

CFA piles can be used to support the proposed fourteen storey building. When using CFA piles, positive dewatering will be required in the area of deep excavations such as sumps and elevator pits.

CFA piles are typically installed with diameters ranging from 0.3m to 0.9m (12 to 36 inches). The most common locally available diameters are 0.51m to 0.61m (20 to 24 inches) and installed lengths of up to about 24m. The preferred length of CFA pile is in the range of 15 to 20m and typical adopted diameter is 500mm. The steel reinforcement is often limited to the upper 8 to 10m of the pile for ease of installation and also due to the fact that in many cases, relatively low bending stresses are transferred below these depths. In some cases, full-length reinforcement is used. CFA piles can be constructed as single piles and also as a part of a pile group in a manner similar to that of driven pile foundations. Similar to driven piles, the top of a group of CFA piles is terminated with a cap.

Auger cast piling constructed for use in supporting the proposed building structure should have a minimum diameter of 500 mm and toed into the weathered shale (Approximate Elev. 65.3 to 62.3m). Considering skin friction and end bearing resistance, a typical CFA pile having 500mm diameter and embedded length of at least 14.5m (i.e. Elev. 65.3m) to 15.5m (i.e. Elev. 62.3m) into weathered shale can support a geotechnical reaction of 700 kN/pile in compression at the Serviceability Limit States (SLS) and a factored geotechnical resistance of 1125 kN/pile at the Ultimate Limit States (ULS), provided it is confirmed by the pile load test. Prior to construction of production piles, the CFA pile will need to be tested at least 2.0 times the required factored design loads in compression at ULS/pile, as outlined in the Canadian Foundation Engineering Manual (4th Edition) Table 8.1. The load testing procedures must be conforming to the requirements of the latest edition of ASTM (i.e. ASTM D1143) to prove the capacity of pile in compression. The test load must be monitored a minimum for 12 hours.

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It is recommended that pile load test must be carried out prior to finalizing the design and number of CFA piles. The number of CFA piles will depend upon geotechnical capacity of piles, confirmed by static load test.

After confirmation of the load carrying capacity of the CFA pile via a successful full static load test, a series of dynamic testing, known as pile integrity testing will need to be carried out on the production piles following ASTM D5882 – Low Strain Impact Integrity Testing of Deep Foundations. WSP recommends the following integrity testing regimen:

- First 20 piles: 5 piles (i.e. 25%) will be tested as directed by the Geotechnical Consultant
- Remainder of the piles: 5% to 10% of piles as directed by the Geotechnical Consultant

Depending on the results of the initial testing, the frequency of integrity testing can be increased.

For design purposes, the recommended horizontal capacities for CFA piles with 1% reinforcement are as follows:

- Factored Horizontal Geotechnical Resistance at ULS = 40 kN/pile
- Horizontal Geotechnical Reaction at SLS = 27.5 kN/pile

The group reduction factors for vertical and horizontal capacities of CFA are the same as recommended for the caisson as discussed in **Section 5.3.1**.

The subject referenced capacities are based on the following assumptions:

- Well compacted granular material shall be placed around the pile cap, extending at least 3 times its size laterally and of thickness equal to that of the pile cap, and be placed at least flush with the top of the pile cap.
- Thickness of pile cap should not be less than 750 mm and the top of the pile cap must be below the design frost depth.

To assess the performance of production CFA piles, it is prudent that one pile be selected by a qualified geotechnical professional after installation of some or all CFA piles and be tested in compression to at least equal to the required factored design load in compression at ULS/pile. If a test pile fails to meet the performance criteria as outlined in the latest edition of ASTM, the Contractor shall modify his installation procedures so as to achieve the required capacities and repeat the test at his own cost. He shall also undertake, at his own expense, all additional work necessary to allow piles already installed to carry safely their specified design loads. Proposed modifications to installed piles are subject to the approval of the Consultant and his representatives.

Piles subjected to uplift and lateral loads should be properly reinforced. Reinforcement for steel-reinforced CFA piles is placed into the hole filled with fluid concrete/grout immediately after withdrawal of the auger. We further recommend that piling be installed at a minimum centre to centre spacing of three times the pile diameter. Note, during the installation of CFA piles, full time monitoring will be required to confirm the depth of piles and monitor grouting pressure as per the work method statement submitted by the Contractor prior to initiate CFA piles, to avoid discontinuities in the concrete. The success of the CFA piles foundation is dependent on the installation techniques and experience of the contractor.

5.3.3 DRIVEN PILES

The proposed building can be supported by driven piles founded on competent bedrock.

For design purposes, the ultimate axial bearing capacity of the piles driven to practical refusal in bedrock below 13.8 to 15.0m (Elev. 66.0 to 62.8m) can be taken as:

HP 310x110 piles:

Factored geotechnical resistance at ULS	= 1500 kN/pile
Bearing capacity at SLS:	= 1000 kN/pile

The factored horizontal resistance at ULS can be taken as 85kN/pile and SLS horizontal resistance can be taken as 55kN/pile. Pile driving refusal can be assumed to be within 2 m below the bedrock surface. The actual required depth of the piles must be determined by field PDA testing, which may be shorter or longer than the design depth. The

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bearing capacity of the piles must be proven by field PDA testing by PDA Consultant. The measured ultimate capacity (Ru) of the pile from the PDA testing should be at least two times the ULS capacity, i.e. minimum Ru = 3000 kN/pile.

The group reduction factors for vertical and horizontal capacities of driven piles are the same as recommended for the caisson as discussed in **Section 5.3.1**.

The bearing capacity of the piles and the driving criteria for practical refusal in bedrock must be determined by field pile diving analyzer (PDA) tests. All piles should be designed and installed in accordance with OPSS 903. Rock points are required for the piles.

Based on the depths/elevations of the bedrock at the borehole locations provided, bedrock was not cored to confirm its quality during this phase of investigation as it was not part of the scope of work. Additional boreholes with bedrock coring will be required prior to the final design of the proposed buildings. Due to potentially variable bedrock depths, the actual pile tip elevation will vary. The contractor should allow for some variation in pile lengths and this aspect should be taken into consideration when ordering the piles. The tips of the piles may need to be stiffened to minimize damage to the piles. Care must be taken to avoid overdriving and damaging the pile tip, i.e. the structural capacity of the piles should not be exceeded.

It is recommended that prior to the final design of the foundations, a total of 4 test piles be installed across the site to confirm the available bearing capacity and the required depth of the piles by PDA consultant. The bearing capacity and depth of these 4 test piles must be determined by field pile tests using the Pile Driving Analyzer (PDA). The depth of the piles will be economized from the results of this initial stage PDA testing.

Pile PDA testing will also be required for 10% to 20% of the production piles.

The pile driving should be observed, on a full-time basis, by an experienced soil technician, who will record penetration resistance, pile toe elevation, etc. The technician must be supervised by a professional engineer experienced in this type of work.

In order to avoid group effect on the bearing capacity of the piles, the horizontal spacing of adjacent piles should be at least 3 times its dimension/diameter.

All foundations/pile caps exposed to seasonal freezing conditions must have at least 1.2m of soil cover for frost protection.

It should be noted that the recommended bearing resistances have been calculated by WSP Canada Inc. from the borehole information for the preliminary design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by WSP to validate the information for use during the construction stage.

5.4 GROUND IMPROVEMENT

As an alternative to deep foundations, the use of an aggregate pier system could be considered at this site to improve the bearing capacity and settlement control of the existing soil to support the proposed structures without removing the existing fill. The aggregate pier system is constructed by installing compacted layers of aggregate into a predrilled hole or with a displacement mandrel creating a stiff aggregate pier which increases the lateral stress within the matrix soil. The combination of increased lateral stress and stiff aggregate pier increases shear strength and decreases compressibility of the soil, resulting in improved bearing capacities. Specialty contractors are to be retained for design and to consult on ground improvement systems. The designed aggregate pier system must be reviewed by this office.

5.5 FLOOR SLABS AND PERMANENT DRAINAGE

The type of floor slab for the proposed structure will depend on the site preparation and foundation design.

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If a shallow foundation design is used, a floor slab can be supported on grade provided the topsoil and organics are stripped and surficial disturbed and wet soils are removed and the subgrade proof rolled with a heavy roller. Any soft spots detected and revealed by proof-rolling must be removed and replaced with select fill material.

If ground improvement methods are used, the slab-on-grade will need to be designed by the specialty ground improvement contractor. Ground improvement designs allow for reduced total and differential settlement and can increase the subgrade reaction coefficient noted above. Refer to **Section 5.4** for the discussion on ground improvement.

If deep foundations are selected, a structural slab will be required.

Any backfill required to raise the grade can consist of inorganic soil, placed in shallow lifts and compacted to 98% of its Standard Proctor Maximum Dry Density (SPMDD).

A moisture barrier consisting of at least 200mm of 19mm clear crushed stone should be installed under the floor slab.

A perimeter and underfloor drainage system will be required around the exterior basement walls. Typical drainage and backfill recommendations are illustrated on **Drawing 3**.

5.6 SITE SERVICING/EXCAVATIONS

5.6.1 EXCAVATIONS AND BACKFILL

Excavations can be carried out with heavy hydraulic backhoes. Complications due to groundwater can be anticipated for excavations to various depths throughout the site. Measured groundwater levels ranged from 1.6 to 7.6m below existing ground level (Elev. 78.9 to 71.5m). Positive dewatering will be required before any excavation below the groundwater table. The groundwater must be lowered to at least 1.0m below the lowest level of the excavation.

It should be noted that the native soils may contain boulders. Large obstructions such as concrete blocks in the fill material are anticipated. Provisions must be made in the excavation contract for the removal of boulders in the native and large obstructions in the fill material.

All excavations must be carried out in accordance with the moist recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the existing fill is classified as Type 3 to Type 4 soil and the firm to very stiff silty clay is classified as Type 2 to Type 3 soil.

Select inorganic fill and native soils free from topsoil and organics can be used as general construction backfill where it can be suitably compacted, provided its moisture content is within 2 percent of its optimum. The majority of the excavated soils will be too wet to compact and will require significant aeration prior to its use. Loose lifts of soil, which are to be compacted, should not exceed 200mm.

The excavated native soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as OPSS Granular ‘B’ should be used.

It should be noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should be compacted at the surface of be covered with tarpaulins to minimize moisture uptake.

5.6.2 PIPE SUPPORT AND BEDDING

Properly constructed engineered fill, dense fill, and native stiff silty clay will provide adequate support for site servicing utilities. Soft/very loose to firm/loose fill soils will potentially not provide adequate support. Areas of soft/very loose to firm/loose fill should be subexcavated and replaced by compacted Granular ‘A’ material compacted to 98% of its Standard Proctor Maximum Dry Density (SPMDD). Alternatively, consideration can be given to “punch” 50 mm crusher limestone into the soft to firm subgrade. The thickness of the crusher limestone pad should not be less than 300 mm. Then a geo-web pipe support system as shown in **Drawing 4** should be placed on the crusher limestone

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pad. Use of the geo-web system must be approved by the geotechnical engineer and the Client. The subgrade condition must be inspected and approved by geotechnical personnel.

The bedding material and its minimum thickness for the pipes should be in accordance with the current revision of OPSD (Ontario Provincial Standard Drawing).

Class 'B' type bedding material is recommended for pipe bedding. The recommended minimum thickness of the granular bedding below the invert of the pipes is 150mm. However, the thickness of the bedding may have to be increased depending on the pipe diameter or if weak subgrade conditions are encountered. The bedding should consist of well-graded OPSS Granular 'A' material compacted to 98% Standard Proctor Maximum Dry Density (SPMDD). The dimensions of bedding material should conform to the City's current standards. This bedding and granular cover should extend to about 0.3m above the obvert of the pipe. Since the performance of the pipe is dependent on good compaction of the bedding material, the compaction at the bottom of the pipe and adjacent to the pipe must be stringently carried out.

5.6.3 TRENCH BACKFILL

Based on visual and tactile examination, the select on-site excavated organic free fill and native silty clay can generally be re-used as backfill in the service trenches provided their moisture contents at the time of construction are at or near optimum. Some of the soil will be very high in moisture content and they will need to be dried to optimum moisture content prior to use as backfill.

The silty clay is likely to be excavated in cohesive chunks or blocks and will be difficult to compact in confined areas. For use as backfill, the clayey material will have to pulverized and placed in thin layers. The clayey soils will have to be compacted using heavy equipment suitable for these soils which may be difficult to operate in the narrow confines of the trenches. Unless the clayey materials are properly pulverized and compacted in sufficiently thin lifts post-construction settlements could occur.

The backfill should be placed in maximum 200mm thick layers at or near (±2%) their optimum moisture content, and each layer should be compacted to at least 95% SPMDD. In the upper 1.5 m below the final grade, the degree of compaction should be increased to 100% SPMDD. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling.

The on-site excavated soils and especially the clayey soils should not be used in confined areas (e.g. around catch basins and laterals under roadways) where heavy compaction equipment cannot be operated. The use of imported granular fill together with an appropriate frost taper would be preferable in confined areas and around structures, such as catch basins.

5.7 LATERAL EARTH PRESSURES

The lateral earth and water pressure acting at any depth on foundation and retaining walls can be calculated as follows:

Above the groundwater table: $p = K(\gamma z + q)$

Below the groundwater table: $p = K\{\gamma h_1 + \gamma_1(z - h_1) + q\} + p_w$

where p = Lateral earth and water pressure in kPa acting at depth z;

z = Depth below ground surface, in metres;

K = earth pressure coefficient at rest, K = 0.56

γ = Unit weight of soil above groundwater table, assuming $\gamma = 20$ kN/m^3

γ = Submerged unit weight of soil below water table; γ -= 10 kN/m^3

h_1	=	Thickness of soil above groundwater table, in metres, assumed 1m higher than the measured groundwater level from nearby monitoring wells;
q	=	Value of surcharge in kPa;
p_w	=	Hydrostatic water pressure.

5.8 SEISMIC SITE CLASSIFICATION

Based on the borehole information and according to Table 4.1.8.4.A of OBC 2012, the subject site for the proposed building with slab on grade structure founded on undisturbed native soils can be classified as 'Class E' for seismic site response.

6 GENERAL COMMENTS

WSP should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, WSP Canada Inc. will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes and test pits required to determine the localized underground conditions between boreholes and test pits affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole and test pit results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

7 LIMITATIONS OF REPORT

7.1 LIMITED USE

This Report was prepared for the Client, solely for their exclusive use to provide an Assessment of current environmental/geotechnical conditions in association with the Site. WSP will not be responsible for any use of this report by any other party, for any decisions to be made based on it, or for the consequences thereof, unless written reliance is granted by WSP. Unless otherwise agreed in writing by WSP, it shall not be used to express or imply warranty as to the suitability of the property for a particular purpose. WSP disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

7.2 EXCERPTS

The Report is intended to be used in its entirety. No excerpts may be taken to be representative of the findings in the assessment.

7.3 INFO BY OTHERS

In evaluating the Site, WSP has relied in good faith on information provided by others, as noted in the Report. WSP has assumed that the information provided is correct and WSP assumes no responsibility for the accuracy, completeness or workmanship of any such information.

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7.4 STANDARD OF CARE

This project has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by WSP and other engineering/scientific practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The conclusions presented in this Report are based on Work undertaken by trained professional and technical staff and the reasonable and professional interpretation using accepted engineering and scientific practices current at the time the work was performed. Conclusions presented in this report should not be construed as legal advice. WSP makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in the Report, including, but not limited to, ownership of any property, or the application of any law to the findings of the Assessment.

7.5 LIMITED SCOPE

The Report summarizes WSP's review of available data in accordance with the principal components of the stated regulations, standards and guidelines and the scope, terms and conditions of the contract or proposal to which the Assignment was conducted. No other warranties are either expressed or implied with respect to the professional services provided under the terms of the contract or proposal and represented in this Report. Conditions may exist which were not detected given the nature of the inquiry WSP was retained to undertake with respect to the Site. Additional environmental studies and actions may be recommended.

7.6 CHANGES OVER TIME

The Report is based on data and information collected at the time of this Assessment, as stated in the Report. Site use or conditions change and the information and conclusions in the Report may no longer apply following the date of this Report. If any conditions become apparent that differ significantly from that presented in this Report, we request that we be notified to reassess the conclusions and recommendations provided herein. WSP disclaims any obligation to update this Report for conditions that may be identified after the date of this Report; however, WSP reserves the right to amend or supplement this report based on additional information, documentation or evidence.

7.7 VARIABILITY BETWEEN TEST LOCATIONS

Conclusions are based on the Site conditions observed by WSP at the time the work was performed and may include information obtained at specific testing and/or sampling locations. It is recognized that overall conditions can only be extrapolated to an undefined limited area around these testing and sampling locations. The conditions that WSP interprets to exist between testing and sampling points may differ from those that actually exist. The accuracy of any extrapolation and interpretation beyond the sampling locations will depend on natural conditions, the history of Site development and changes through construction and other activities. In addition, analysis has been carried out for the identified chemical and physical parameters only, and it should not be inferred that other chemical species or physical conditions are not present. WSP cannot warrant against undiscovered environmental liabilities or adverse impacts off-Site.

7.8 SURVEYING

Benchmark and elevations used in this report are primarily to establish relative elevation differences between the specific testing and/or sampling locations and should not be used for other purposes, such as grading, excavating, construction, planning, development, etc.

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7.9 USE FOR DESIGN AND CONSTRUCTION

Design recommendations given in this report are applicable only to the project and areas as described in the text and then only if constructed in accordance with the details stated in this report. The comments made in this report on potential construction issues and possible methods are intended only for the guidance of the designer. The number of testing and/or sampling locations may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. Contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

Yours very truly,

WSP CANADA INC.

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APPENDIX

DRAWINGS

DRAWING 1 – BOREHOLE LOCATION PLAN (35 BRANT STREET)
DRAWING 2 – BOREHOLE LOCATION PLAN (MAINTENANCE STORAGE FACILITY)
DRAWING 3 – DRAINAGE AND BACKFILL RECOMMENDATIONS
DRAWING 4 – GEO-WEB PIPE SUPPORT SYSTEM

LEGEND

- Borehole Location (March and October 2017)
- Monitoring Well Location (March and October 2017)
- Existing Monitoring Well Location
- Borehole Location (November and December 2018)
- Monitoring Well Location (November and December 2018)

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CLIENT: CITY OF HAMILTON		PROJECT NO: 161-17781-05	DRAWING NO: 1
TITLE: BOREHOLE LOCATION PLAN		DRAWN BY: CC	CHECKED BY: LC
PROJECT: SOILS PROFILE AND DATA COLLECTION - HSR MSF FACILITY		DATE: FEB 1, 2019	SCALE: AS SHOWN
		ORIGINAL SIZE: LETTER	REV. # N/A

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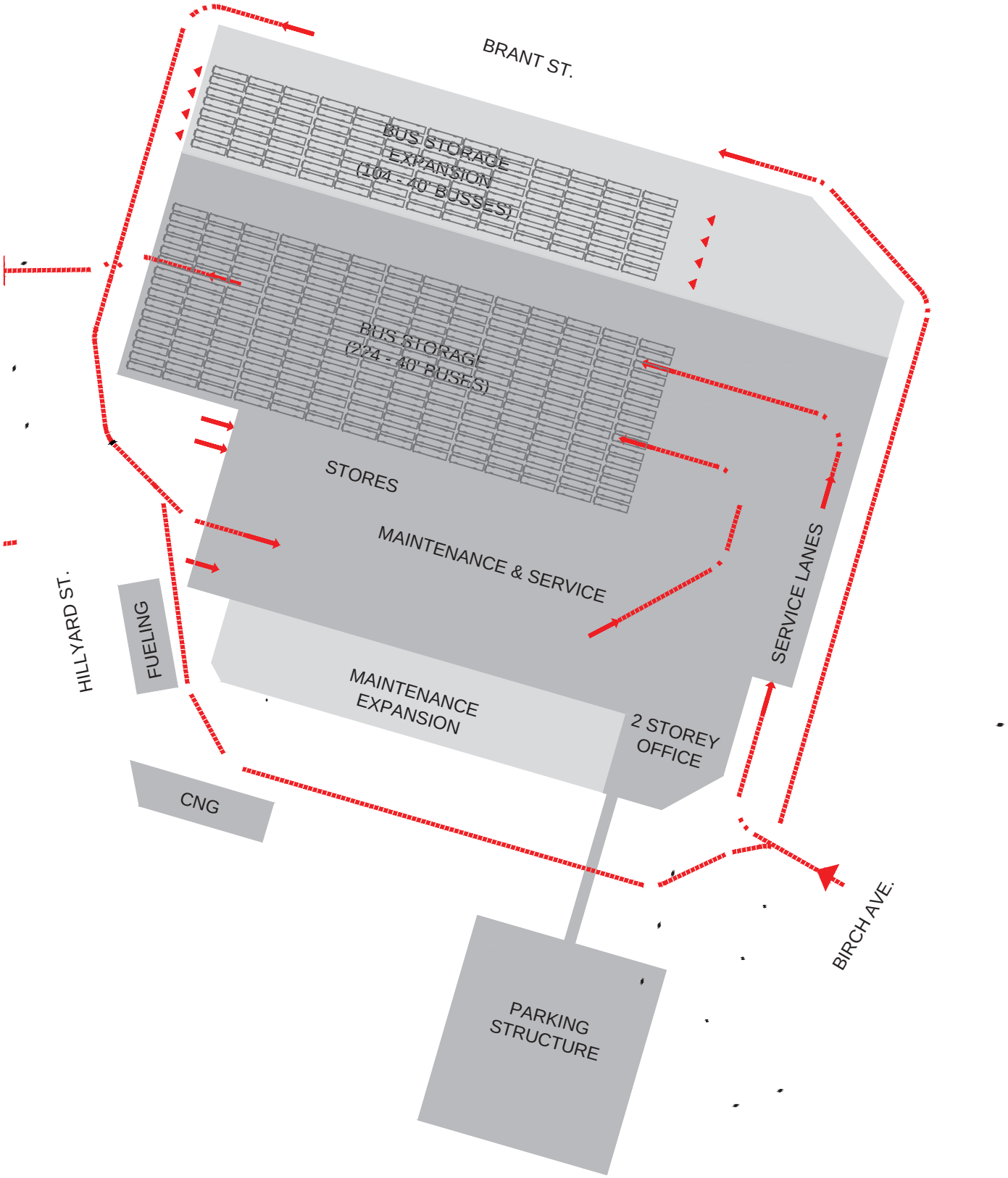
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(104 - 40' BUSSES)
BUS STORAGE
(224 - 40' BUSES)
STORES
MAINTENANCE & SERVICE
SERVICE LANES
HILLYARD ST.
FUELING
MAINTENANCE
EXPANSION
2 STOREY
OFFICE
CNG
PARKING
STRUCTURE
BIRCH AVE.

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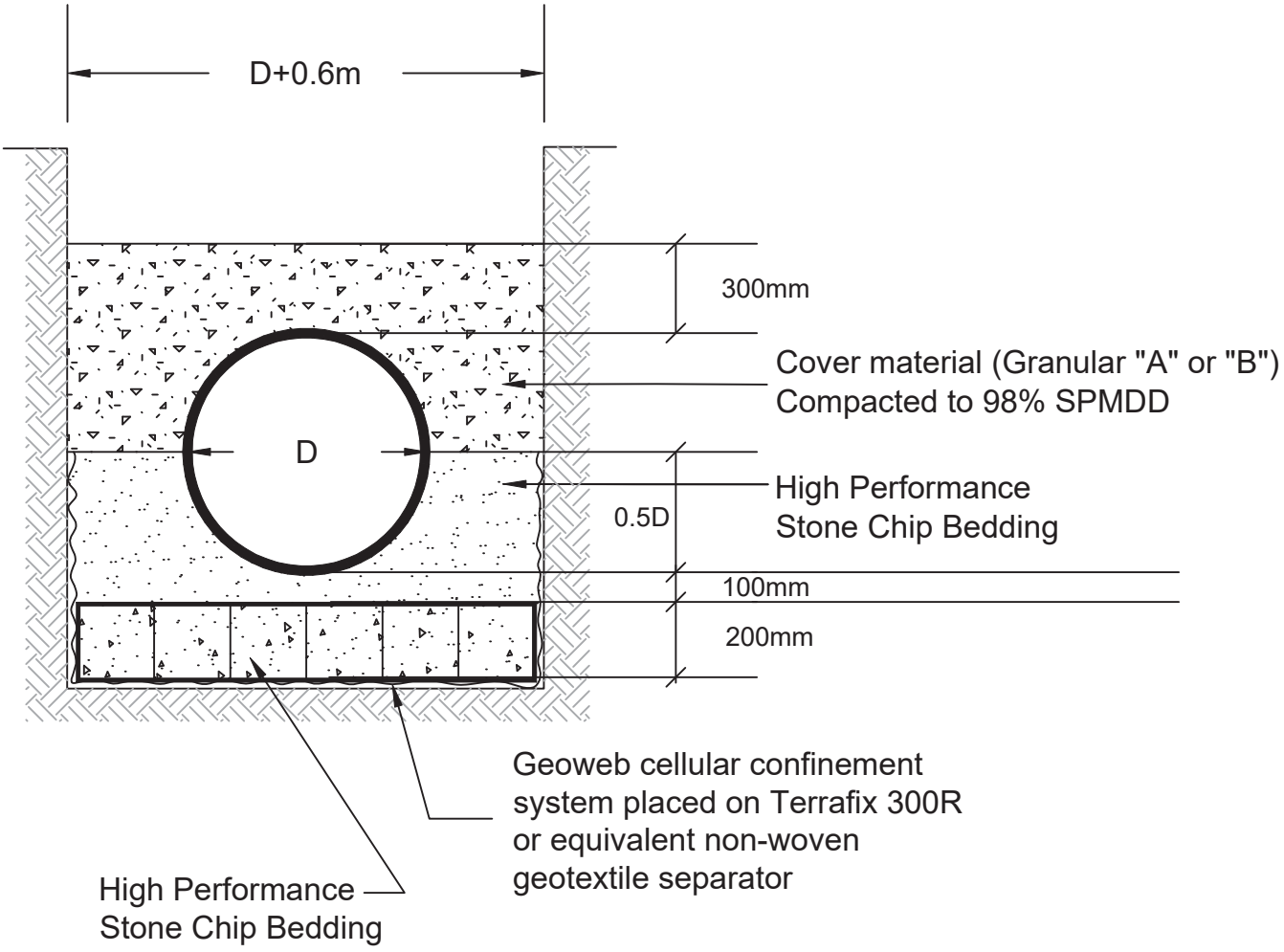

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CLIENT: CITY OF HAMILTON		PROJECT NO: 161-17781-05	DRAWING NO: 4
TITLE: GEO-WEB PIPE BEDDING		DRAWN BY: TJ	CHECKED BY: LC
PROJECT: SOILS PROFILE AND DATA COLLECTION - 350 WENTWORTH STREET NORTH		DATE: NOVEMBER 2017	SCALE: N.T.S
		ORIGINAL SIZE: LETTER	REV. # N/A

APPENDIX

A

EXPLANATION OF TERMS USED IN BOREHOLE LOGS
LOGS OF BOREHOLES

Explanation of Terms Used in the Record of Borehole

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
NR	No recovery
RC	Rock core
SC	Soil core
SS	Spoon sample
SH	Shelby tube sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

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

WH – Samples sinks under "weight of hammer"

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

Textural Classification of Soils (ASTM D2487-10)

Classification	Particle Size
Boulders	> 300 mm
Cobbles	75 mm - 300 mm
Gravel	4.75 mm - 75 mm
Sand	0.075 mm - 4.75 mm
Silt	0.002 mm - 0.075 mm
Clay	<0.002 mm(*)

(*) Canadian Foundation Engineering Manual (4th Edition)

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	> 35%

Soil Description

a) Cohesive Soils(*)

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

(*) Hierarchy of Shear Strength prediction
1. Lab triaxial test
2. Field vane shear test
3. Lab. vane shear test
4. SPT "N" value
5. Pocket penetrometer

b) Cohesionless Soils

Density Index (Relative Density)	SPT "N" Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_p	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
U	Unconsolidated Undrained Triaxial Test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

APPENDIX

A-1 *35 BRANT STREET BOREHOLE LOGS*

LOG OF BOREHOLE BH18-1

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 35 Brant Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790998 E 594029

Method: Hollow Stem Auger
Diameter: 150 mm
Date: Dec/05/2018

REF. NO.: 161-17781-05
ENCL NO.: 1
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
81.2	Ground Surface											
0.0	**FILL:** sand and gravel, trace fines, grey, compact, moist		1	SS	30		81				0	SS1: M&I, BNAEs
1			2	SS	24		80				0	
2			3	SS	19		79				0	
78.9						W. L. 78.9 m Dec 06, 2018 Dec 12, 2018						
2.3	**SANDY SILT:** trace clay, reddish brown, saturated, loose to compact		4	SS	11					25	0	SS4: PHCs, VOCs
3			5	SS	6		78			25	0	
77.4												
3.8	**SILTY CLAY:** trace sand, APL to WTPL, very soft to soft		6	SS	4		77			25	0	
4			7	SS	2					0	0	SS7: Grain Size, pH
5							76					
75.1			8	SS	1					0	0	
6.1	**END OF BOREHOLE**											

NOTES:
1. Borehole dry upon removal of augers.
2. 50mm monitoring well installed.
3. No. 10 screen installed.
4. Water Level Measurements

Date	Depth (mBGS)
Dec 6, 2018	2.26
Dec 12, 2018	2.36

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL LOG V002 2018FW PROJ SPECIFIC - 161-17781-05 ALL BOREHOLES RECOVERY CURRENT.GPJ 12/4/19

LOG OF BOREHOLE BH18-2

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 35 Brant Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790984 E 594079

Method: Hollow Stem Auger
Diameter: 150 mm
Date: Dec/05/2018

REF. NO.: 161-17781-05
ENCL NO.: 2
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
80.8	Ground Surface											
0.0	**FILL:** sand and gravel, grey, moist, compact		1	SS	30						0	
1	- clayey silt, some sand, trace asphalt pieces, reddish brown, moist, soft to firm		2	SS	5		80				0	SS2: M&I, BNAEs
2			3	SS	4		79				0	SS3 PHCs, VOCs
78.5												
2.3	**SILTY CLAY:** trace sand, greyish brown, APL, stiff		4	SS	9	W. L. 78.4 m Dec 12, 2018	78			75	0	
3	- WTPL, very soft to firm below 3.0m		5	SS	3	W. L. 77.9 m Dec 06, 2018	77			0	0	
4			6	SS	2					0	0	
5			7	SS	6		76			0	0	
6			8	SS	0		75			0	0	
74.7												
6.1	**END OF BOREHOLE**											

NOTES:
1. Borehole dry upon removal of augers.
2. 50mm monitoring well installed.
3. No. 10 screen installed.
4. Water Level Measurements

Date	Depth (mBGS)
Dec 6, 2018	2.88
Dec 12, 2018	2.35

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL (ICP).GMAV 29.GPJ GLB
WSP-SOIL LOGS V2020 2019FINAL.SPEDFIC - BH-17781-09 ALL BOREHOLES RECOVERY CURRENT.GPJ 1/24/19

APPENDIX

A-2 *MAINTENANCE STORAGE FACILITY BOREHOLES*

LOG OF BOREHOLE BH17-01

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 3
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/14/2017
COMPILED BY CC
BH LOCATION: N 4790745 E 594092
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.7	Ground Surface											
0.0	**FILL:** Silty sand, some gravel, brown, dry, compact		1	SS	18							
77.8							78					
1 0.9	Silty clay, trace sand and gravel, dark brown to black, trace debris, moist, firm to very stiff		2	SS	27							SS2: VOCs, M&I, PAHs, PHCs
	Grey-brown, trace sand, becoming firm		3	SS	8		77					
2												
	Red and brown, trace sand, gravel and debris		4	SS	7		76					
3 75.6												
3.1	Clayey silt and sand, red-brown and black, moist, firm		5	SS	6							
74.9							75					
4 3.8	Silty sand and clay, brown, moist, very loose/very soft to compact/stiff		6	SS	4							
			7	SS	2		74					SS7: VOCs, M&I, PAHs, PHCs, PCBs
5	Black staining, odour											
			8	SS	3		73					
6												
	Stiff		9	SS	10							
71.8							72					
7 6.9	**SILTY CLAY:** Some sand, trace gravel, brown and grey, moist, stiff to very stiff		10	SS	15					100		SS10: VOCs, M&I, PAHs, PHCs
							71					
8			11	SS	12					188		1 10 55 33
			12	SS	11		70			88		
69.7												
9.0	**END OF BOREHOLE** **NOTE:** 1) Borehole dry and open to 7.6 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL (ICV).GAV - 29 SEP 17 - 15:8
WSP-SOIL LOG - V2021 2016 PW1 PROJ SPECIFIC - 161-17781-09 ALL BOREHOLES RECOVERY CURRENT.GPJ - 12/4/19

LOG OF BOREHOLE BH17-02

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790739 E 594142

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Mar/14/2017

REF. NO.: 161-17781-01
ENCL NO.: 4
ORIGINATED BY ER
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.8	Ground Surface											
0.0 / 77.9	**FILL:** Sand, some gravel, black and brown, moist, compact		1	SS	13		78					SS1: VOCs, M&I, PAHs, PHCs
0.9 / 75.6	Sandy silt, red, moist, compact		2	SS	10							
			3	SS	11		77					
			4	SS	10		76					
3.2 / 74.4	**SILTY CLAY:** some sand, trace gravel, grey and brown, moist, stiff		5	SS	10					175		
			6	SS	12		75			175		SS6: VOCs, M&I, PAHs, PHCs
4.4	**END OF BOREHOLE** **NOTE:** 1) Borehole open and dry to 4.3 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL LOG V4.GPJ 29 3/17 GLB
WSP-SOIL LOG V4.GDT 3/29/17 PROJ SPECIFIC - 161-17781-09 ALL BOREHOLES RECOVERY CURRENT.GPJ 3/24/17

LOG OF BOREHOLE BH17-03

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790776 E 594192

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Mar/14/2017

REF. NO.: 161-17781-01
ENCL NO.: 5
ORIGINATED BY ER
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (w_P w w_L) WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.5	Ground Surface							50 100 150 200 250	10 20 30			
0.0	**FILL:** Sand and gravel, some debris, grey and black, dry, very dense		1	SS	64/ 101mm		78					
77.7												
0.8	Sand, some silt, trace gravel and debris, black and brown, moist, dense		2	SS	40		77					SS2: M&I, PAHs
77.0												
1.5	Silty sand, trace gravel, brick pieces, black and red, moist, compact to very loose		3	SS	25							
			4	SS	2		76					SS4: VOCs, PHCs, PCBs
75.2	----------											
3.3	Some clay and black staining		5	SS	4		75					
74.8	Clayey silt, trace sand, grey and black, wet, soft											
3.7	Peaty silty sand, black, some plant debris, moist, loose		6	SS	6	▽ W. L. 74.7 m on completion	74					
	---------- Becoming dark grey											
	---------- Becoming wet		7	SS	5							
73.5												
5.0	Silty sand, black, PHC odour, wet, very loose		8	SS	2		73					
72.2												
6.3	Organic silty sand, dark brown, moist, very loose		9	SS	2		72			64		
			10	SS	2							SS10: VOCs, M&I, PAHs, PHCs
70.7							71					
7.8	**PEAT:** Some sand and silt, brown to black, moist, very soft		11	SS	2					53		
			12	SS	4		70			41		
69.5												
9.0	**END OF BOREHOLE** **NOTE:** 1) Borehole open to 6.4 m on completion 2) Water level measured at 3.8 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL (ICV).GAV - 29 SEP 17 - GLB
WSP SOIL LOG - V1.GDT - 20/9/17 - PROJ_SPECIFIC - 161-17781-09 ALL BOREHOLES RECOVERY CURRENT.GPJ - 12/4/19

LOG OF BOREHOLE BH17-04

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 6
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/16/2017
COMPILED BY CC
BH LOCATION: N 4790788 E 594276
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.8	Ground Surface							50 100 150 200 250	10 20 30			
0.0	**FILL:** Gravelly sand, grey and brown, dry, very dense		1	SS	50/ 127mm							
1			2	SS	40		77					SS2: VOCs, M&I, PAHs, PHCs
	---------- Black staining, dense											
76.3												
1.5	Clayey silt mixed with sand and gravel, brown, black staining, moist, firm to very stiff		3	SS	17		76					
2			4	SS	4		75					
74.7						▽						
3.1	Gravelly sand, some debris, mixed with organic material, dark grey, wet, very loose		5	SS	4		W. L. 74.7 m on completion					SS5: VOCs, M&I, PAHs, PHCs
4			6	SS	2		74					
			7	SS	3		73					
5			8	SS	2		72					
6			9	SS	2		71					
7			10	SS	1		70					
	---------- Some clay		11	SS	2							
8												
69.4												
8.4	Organic sandy silt, black, PHC odour, wet, very loose		12	SS	0		69					
9												
68.7												
9.1	**PEAT:** Trace clay and organics, brown, moist, very soft		13	SS	4							
68.0												
9.8	**END OF BOREHOLE** **NOTE:** 1) Borehole open to 6.1 m on completion 2) Water level measured at 3.1 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL (ICP).GAV 29 377 GUI
WSP SOIL LOG - V.GDT 2/28/19 PROJ_SPECIFIC - 161-17781-09 ALL BOREHOLES RECOVER CURRENT.GPJ 1/24/19

LOG OF BOREHOLE BH17-05

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 7
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/15/2017
COMPILED BY CC
BH LOCATION: N 4790831 E 594276
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.0	Ground Surface											
0.0	**FILL:** Gravelly sand, brown, moist, dense		1	SS	40							
77.3												
0.8	Silty clay mixed with sand, some gravel, dark brown, orange and grey sand, moist, firm		2	SS	6		77					
			3	SS	6		76					
75.7												
2.3	Clay mixed with sand, red-brown, black staining, moist, soft --- wet --- Some debris, very soft		4	SS	5		75					
			5	SS	3							
			6	SS	2		74					SS6: VOCs, M&I, PAHs, PHCs
73.4						▽						
4.6	Organic silty clay, sandy, dark brown, black staining, moist, very soft		7	SS	1		W. L. 73.4 m on completion 73			80		
72.7												
5.3	Silty clay and sand, trace gravel, some organics, grey, moist, firm		8	SS	5							
71.9							72					
6.1	**SILTY CLAY:** brown to grey, moist, stiff		9	SS	12					225		
71.3												
6.7	**END OF BOREHOLE** **NOTE:** 1) Borehole open to 6.7 m on completion 2) Water level measured at 4.6 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL (ICV).GMW 29.0T1.GLB
WSP-SOIL LOG - VOC 2016 PA1.GPJ SPEDRIC 08-17781-09 ALL BOREHOLES RECOVERY CURRENT.GPJ 1/24/19

LOG OF BOREHOLE BH17-06

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790806 E 594354

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Mar/22/2017

REF. NO.: 161-17781-01
ENCL NO.: 8
ORIGINATED BY ER
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (w_P / w / w_L) WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.2	Ground Surface											
0.0	**FILL:** Sand, some silt, trace gravel, grey, moist, compact to very dense		1	SS	28		77					
			2	SS	38		76					
	Black, wet		3	SS	64		75					SS3: VOCs, M&I, PAHs, PHCs
	Some clay, wood pieces, loose		4	SS	7		74					
	Some debris, compact		5	SS	7		73					
72.6			6	SS	11							
4.6	Silty clay mixed with sand and organic material, grey, wet, very soft to firm		7	SS	4		72					
			8	SS	3		71					
			9	SS	2		70					
			10	SS	3		69					
			11	SS	4		68					SS13: VOCs, M&I, PAHs, PHCs
68.8			12	SS	1		67					
8.4	Organic silty clay, very soft to firm, black, moist		13	SS	6							
67.8			14	SS	6							
9.4	**PEAT:** trace clay and organics, brown to black, firm, moist											
66.7												
10.5	**END OF BOREHOLE**											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH17-07

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790767 E 594324

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Mar/16/2017

REF. NO.: 161-17781-01
ENCL NO.: 9
ORIGINATED BY ER
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.4	Ground Surface											
0.0	**FILL:** Sand and gravel mixed with silt, clay, and organics, brown and grey, moist, dense		1	SS	47		77					
1	Black staining, organics, very dense		2	SS	50/ 152mm							
2	Some debris, compact		3	SS	18		76					SS3: VOCs, M&I, PAHs, PHCs
3	Becoming wet, loose		4	SS	7		75					
73.6	Some red clay		5	SS	8		74					
3.8	sand and gravel mixed with organic material, some debris, moist, very loose to loose		6	SS	1	▽	W. L. 73.2 m on completion		49			
5	Black, saturated, loose		7	SS	7				53			
6	Moist, very loose		8	SS	3		72		71			
7	Loose		9	SS	4		71					
69.8			10	SS	4				50			
7.6	**ORGANIC CLAYEY SILT:** Dark brown, black staining, moist, very soft to soft		11	SS	2		70					
9			12	SS	3		69		79			
68.3												
9.1	**PEAT:** some silt and clay, trace organics, brown, moist, very soft		13	SS	2		68		60			
67.7												
9.8	**END OF BOREHOLE** **NOTE:** 1) Borehole open to 5.8 m on completion 2) Water level measured at 4.3 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL LOG_VOCs_ANALYSIS_29 SEP 17.GLB
WSP-SOIL LOG_VOCs_2016FINAL.GPJ WSPGPJ_GB-17781-09 ALL BOREHOLES RECOVERY CURRENT.GPJ 1/24/19

LOG OF BOREHOLE BH17-08

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 10
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/15/2017
COMPILED BY CC
BH LOCATION: N 4790716 E 594290
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.9	Ground Surface											
0.0	**FILL:** Silty clay, dark brown, some black sand, moist, stiff		1	SS	10							SS1: VOCs, M&I, PAHs, PHCs
77.2												
0.8	Silty sand, organics, black and orange, saturated, very loose		2	SS	2		77					
1			3	SS	2		76					
75.8												
2.1	Organic sandy silt, dark brown and grey, black staining, wet, very loose		4	SS	3	▽	W. L. 75.5 m on completion					
	---------- Black and brown, some silt						75					
3			5	SS	2							
74.1												
3.8	**SILTY CLAY:** Trace sand, red-brown, trace mottling, moist, stiff		6	SS	13		74					0 4 37 59
4												
73.5												
4.4	**END OF BOREHOLE** **NOTE:** 1) Borehole open to 3.1 m on completion 2) Water level measured at 2.4 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3$, $\times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH17-09

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 11
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/15/2017
COMPILED BY CC
BH LOCATION: N 4790700 E 594357
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.6	Ground Surface							50 100 150 200 250	10 20 30			
0.0	**FILL:** Sand and gravel, brown, some red and black coarse sand, moist, loose		1	SS	7		79					
78.8												
0.8	Sand and gravel, brown to black, trace organics, moist, very loose		2	SS	2							SS2: VOCs, M&I, PAHs, PHCs
78.1							78					
1.5	Silty sand, red, moist, very loose to compact		3	SS	3							
			4	SS	10		77					
	Black staining											
	Dark brown with grey mottling, trace silt		5	SS	9		76					
			6	SS	2							
	Becoming clayey, grey, wet		7	SS	1	▽ W. L. 75.0 m on completion						SS7: VOCs, M&I, PAHs, PHCs
74.3							74		83			
5.3	Organic silty clay, dark brown and black, wet, stiff		8	SS	8							
73.5												
6.1	Silty clay, sandy, trace organics, grey and brown, wet, very soft		9	SS	1		73					
72.9												
6.7	**END OF BOREHOLE** **NOTE:** 1) Borehole open to 5.2 m on completion 2) Water level measured at 4.6 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH17-10

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 12
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/16/2017
COMPILED BY CC
BH LOCATION: N 4790749 E 594405
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.5	Ground Surface							50 100 150 200 250	10 20 30			
0.0	**FILL:** Sand and gravel, brown and black, moist, compact		1	SS	18		77					
76.7												
0.8	Silty sand, black, moist, compact		2	SS	12		76					
	becoming wet		3	SS	21	▽	W. L. 76.0 m on completion					SS3: VOCs, M&I, PAHs, PHCs, PCBs
75.1												
2.4	Organic silty clay, grey, moist, soft		4	SS	3		75		47			
	Some sand, black staining, some roots, wood pieces		5	SS	3		74		47			
73.7												
3.8	**SILTY CLAY:** trace organics, grey, moist, stiff		6	SS	10					225		
							73					
			7	SS	10					225		
72.3												
5.2	**END OF BOREHOLE** **NOTE:** 1) Borehole open to 2.4 m on completion 2) Water level measured at 1.5 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

WSP-SOIL LOG V4.GDT 29-3-17 GJI
WSP SOIL LOG V4.GDT 2017-01-11 ALL BOREHOLES RECOVERY CURRENT.GPJ 3/24/19

LOG OF BOREHOLE BH17-11

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 13
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/22/2017
COMPILED BY CC
BH LOCATION: N 4790768 E 594420
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.4	Ground Surface							50 100 150 200 250	10 20 30			
0.0 / 76.6	**FILL:** Sand and gravel, brown, moist, very dense		1	SS	58/ 178mm		77					SS1: VOCs, M&I, PAHs, PHCs
0.8 / 75.8	Silty clay and sand, dark brown, moist, firm		2	SS	7	W. L. 76.4 m Apr 11, 2017			○			
1.5	**SILTY CLAY:** Trace sand, trace gravel, dark brown, moist, stiff		3	SS	10	W. L. 76.0 m Mar 30, 2017			○	225		
	Grey/brown		4	SS	14		75		○	225		SS4: VOCs, M&I, PAHs, PHCs
			5	SS	13		74		○ 42	225		1 5 42 52
			6	SS	14				○	225		
							73					
72.2			7	SS	12				○	225		
5.2	**END OF BOREHOLE**											

NOTE:
1) Borehole open and dry on completion
2) 50 mm dia. monitoring well installed in the borehole upon completion of drilling
3) Water level measurements in monitoring well:

Date	W.L. Depth (m)
March 30, 2017	1.3
April 11, 2017	0.9

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

WSP-SOIL LOG V4.GDT 29.3.17 DJI
WSP SOIL LOG V4.GDT 2016-11-04 PROJ_SPECIFIC - 161-17781-00 ALL BOREHOLES RECOVERY CURRENT.GPJ 3/24/19

LOG OF BOREHOLE BH17-12

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 14
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/17/2017
COMPILED BY CC
BH LOCATION: N 4790536 E 594282
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (w_P, w, w_L) WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
80.2	Ground Surface											
80.0	**ASPHALTIC CONCRETE:** 130mm											
0.1	**FILL:** Sand and gravel, brick/debris, brown, moist, compact		1	SS	20		80					
1			2	SS	18		79					
	---------- Some silt, black staining, loose		3	SS	7							SS3: VOCs, M&I, PAHs, PHCs
2							78					
77.8												
2.4	**SILTY CLAY:** Trace organics, brown, moist, stiff to very stiff		4	SS	13					175		
3												
			5	SS	19		77			225		SS5: VOCs, M&I, PAHs, PHCs
76.6												
3.7	**END OF BOREHOLE**											

NOTE:
1) Borehole open and dry on completion
2) 50 mm dia. monitoring well installed in the borehole upon completion of drilling
3) Water level measurements in monitoring well:

Date	W.L. Depth (m)
March 30, 2017	DRY
April 11, 2017	DRY

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL LOG V4.GDT 29.377.GLB
WSP-SOIL LOG V4.GDT 2016-04-PROJ SPECIFIC - 161-17781-00 ALL BOREHOLES RECOVERY CURRENT.GPJ 3/24/19

LOG OF BOREHOLE BH17-13

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 15
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/21/2017
COMPILED BY CC
BH LOCATION: N 4790624 E 594191
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.6	Ground Surface							50 100 150 200 250	10 20 30			
0.0	**FILL:** Sand, some gravel, brown, moist, dense to very dense		1	SS	45		79					
1			2	SS	70							SS2: VOCs, M&I, PAHs, PHCs
78.1												
1.5	**SILTY CLAY:** Trace sand, grey and brown, mottled, moist, very stiff		3	SS	19		78			225		
2			4	SS	19	▽	W. L. 77.1 m Apr 11, 2017			225		
3			5	SS	16	▽	W. L. 76.2 m Mar 30, 2017			225		SS5: VOCs, M&I, PAHs, PHCs
4			6	SS	17					225		
			7	SS	15		75			225		
5												
74.4												
5.2	**END OF BOREHOLE** **NOTE:** 1) Borehole open and dry on completion 2) 50 mm dia. monitoring well installed in the borehole upon completion of drilling 3) Water level measurements in monitoring well: Date — W.L. Depth (m) March 30, 2017 — 3.4 April 11, 2017 — 2.5											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL LOG-VAN01-29-377-GLB
WSP-SOIL LOG - VOCs 2016 V1 PROJ SPECIFIC - 161-17781-09 ALL BOREHOLES RECOVERY CURRENT.GPJ 2/24/19

LOG OF BOREHOLE BH17-14

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790665 E 594201

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Mar/21/2017

REF. NO.: 161-17781-01
ENCL NO.: 16
ORIGINATED BY ER
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.5	Ground Surface											
79.3	**ASPHALTIC CONCRETE:** 150mm											
0.2	**FILL:** Sand and gravel, grey and black, damp, very loose to compact		1	SS	22		79					SS1: VOCs, M&I, PAHs, PHCs
1	Some silt, bricks, and stones		2	SS	8							
	Some clay and debris, becoming loose		3	SS	3		78					
2	Black staining, PHC odour		4	SS	3		77					
3	Becoming wet		5	SS	2		76					
75.5 4	Sandy silty clay, grey, black staining, moist, soft to stiff		6	SS	9					188		
			7	SS	2		75			175		
5	Some silt, trace sand and organics, soft, slight PHC odour		8	SS	2		74			75		
73.4 6	Organic silty clay, soft, trace black staining, wet		9	SS	3		73			44 25		
72.6 7	**SILTY CLAY:** Grey and brown, wet, very stiff		10	SS	16					225		SS10: VOCs, M&I, PAHs, PHCs
72.0 7.5	**END OF BOREHOLE** **NOTE:** 1) Borehole dry and open to 7.6 m on completion						72					

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL LOG V1(X).MAN 29 SEP 16 GLB
WSP SOIL LOG V1(X) 2016 FINAL.SPJ SPJ/PIC - 161-17781-09 ALL BOREHOLES RECOVER CURRENT.GPJ 1/24/19

LOG OF BOREHOLE BH17-15

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790687 E 594257

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Mar/20/2017

REF. NO.: 161-17781-01
ENCL NO.: 17
ORIGINATED BY ER
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.6	Ground Surface											
79.6 / 0.0	**ASPHALTIC CONCRETE:** 100mm											
79.5 / 0.1	**FILL:** Sand and gravel, trace stones, grey and brown, dry, compact to dense		1	SS	35		79					
1			2	SS	14							SS2: VOCs, M&I, PAHs, PHCs
78.1	Some silt, black staining											
1.5	**SILTY CLAY:** Trace sand, trace gravel, grey and brown, trace mottling, moist, stiff to very stiff		3	SS	9		78		47	225		1 7 38 54
2			4	SS	15		77			225		SS4: VOCs, M&I, PAHs, PHCs
3			5	SS	13		76			225		
4			6	SS	8					225		
			7	SS	11		75			188		
5							W. L. 74.7 m Apr 11, 2017					
73.7			8	SS	9		74			163		
5.9	**END OF BOREHOLE** **NOTE:** 1) Borehole open and dry on completion 2) 50 mm dia. monitoring well installed in the borehole upon completion of drilling 3) Water level measurements in monitoring well: Date — W.L. Depth (m) April 11, 2017 — 4.9											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH17-16

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 18
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/20/2017
COMPILED BY CC
BH LOCATION: N 4790688 E 594323
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.1	Ground Surface							50 100 150 200 250	10 20 30			
0.0	**FILL:** Silty sand mixed with clay, some gravel, trace debris, brown, moist, loose to compact		1	SS	6		79					
1	Some stones and black staining		2	SS	25		78					
2	Increasing silt content		3	SS	11		77					
			4	SS	13							SS4: VOCs, M&I, PAHs, PHCs
3	Black staining		5	SS	9		76					
75.3												
3.8	Silty clay, some sand, trace organics and debris, brown, moist, soft		6	SS	2		75					
4	Black staining		7	SS	3		74					
5	Decreased black staining, some organics		8	SS	3							SS8: VOCs, M&I, PAHs, PHCs
6	Some sand, trace black staining		9	SS	3	▽	73					
72.3								W. L. 72.6 m on completion				
6.9	**SILTY CLAY:** trace to some sand, grey, moist, very stiff		10	SS	17		72			225		
7 71.6												
7.5	**END OF BOREHOLE** **NOTE:** 1) Borehole open to 6.7 m on completion 2) Water level measured at 6.6 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

WSP-SOIL (ICV).MAN 29 SEP 2017 GLB
WSP-SOIL LOG - V1QC 2016FW PROJ SPECIFIC - BH-17781-09 ALL BOREHOLES RECOVERY CURRENT.GPJ 12/4/19

LOG OF BOREHOLE BH17-17

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 19
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/20/2017
COMPILED BY CC
BH LOCATION: N 4790644 E 594296
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.2	Ground Surface											
79.0	**ASPHALTIC CONCRETE:** 150mm											
0.2	**FILL:** Sand and gravel, some stones, grey and brown, moist, compact		1	SS	19		79					SS1: VOCs, M&I, PAHs, PHCs
78.5												
0.8	Silty sand, some gravel, grey and brown, moist, loose		2	SS	9		78					
1												
	Some pieces of concrete and brick		3	SS	9							
2												
76.9												
2.3	Sand and gravel, black and grey, moist, compact to dense		4	SS	32		77					SS4: VOCs, M&I, PAHs, PHCs
3												
			5	SS	14		76					
75.4												
3.8	**SILTY CLAY:** grey-brown, moist, firm to very stiff		6	SS	23		75			225		
4												
	Shale fragments		7	SS	13					225		
5							74					
			8	SS	7					125		
73.3												
5.9	**END OF BOREHOLE** **NOTE:** 1) Borehole open and dry to 5.9 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL LOG V4.GPJ 29 3/17 GJI
WSP SOIL LOG V4.GDT 3/29/17 PROJ_SPECIFIC - 161-17781-00 ALL BOREHOLES RECOVERY CURRENT.GPJ 3/24/17

LOG OF BOREHOLE BH17-18

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 20
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/17/2017
COMPILED BY CC
BH LOCATION: N 4790620 E 594242
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.7	Ground Surface											
79.6 / 0.1	**ASPHALTIC CONCRETE:** 70mm		1	SS	50/ 50mm							SS1: VOCs, M&I, PAHs, PHCs, PCBs
	FILL: Sand and gravel, grey and black, damp, compact to very dense											
1 78.7			2	SS	10		79					
1.1	Silty clay mixed with sand, moist, stiff											
2 77.5			3	SS	9		78					
2.3	**SILTY CLAY:** Trace sand, brown, moist, stiff		4	SS	13					225		
	Trace mottling						77					
3			5	SS	14					225		
							76					
4			6	SS	13					225		
			7	SS	11		75			175		SS7: VOCs, M&I, PAHs, PHCs
5 74.6												
5.2	**END OF BOREHOLE** **NOTE:** 1) Borehole open and dry to 5.2 m on completion											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH17-19

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790608 E 594305

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Mar/21/2017

REF. NO.: 161-17781-01
ENCL NO.: 21
ORIGINATED BY ER
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.5	Ground Surface											
79.0	**ASPHALTIC CONCRETE:** 130mm											
0.1	**FILL:** Sand and gravel, grey and brown, damp, compact to very dense		1	SS	74		79					SS1: VOCs, M&I, PAHs, PHCs
			2	SS	24		78					
77.9												
1.5	Silty clay mixed with sand, trace gravel, brown, moist, firm to very stiff		3	SS	13							
			4	SS	12		77					
			5	SS	16		76					
			6	SS	9			W. L. 75.4 m Apr 11, 2017				
			7	SS	6		75					
								W. L. 74.4 m Mar 30, 2017				
	Black staining, PHC odour		8	SS	5		74					SS8: VOCs, M&I, PAHs, PHCs
73.4												
6.1	**SILTY CLAY:** Trace organics, some sand, grey, moist, stiff		9	SS	12		73			225		
72.8												
6.7	**END OF BOREHOLE**											

NOTE:
1) Borehole open and dry on completion
2) 50 mm dia. monitoring well installed in the borehole upon completion of drilling
3) Water level measurements in monitoring well:

Date	W.L. Depth (m)
March 30, 2017	5.1
April 11, 2017	4.1

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL LOG V1(X).MAN 29 SEP 17 GLB
WSP SOIL LOG V1(X) 2016 PROJ SPECIFIC - 08-17781-09 ALL BOREHOLES RECOVERY CURRENT.GPJ 1/24/19

LOG OF BOREHOLE BH17-20

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790587 E 594296

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Mar/21/2017

REF. NO.: 161-17781-01
ENCL NO.: 22
ORIGINATED BY ER
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.3	Ground Surface											
79.0	**ASPHALTIC CONCRETE:** 130mm											
0.1	**FILL:** Sand and gravel, trace silt, brown and grey, moist, compact to very dense		1	SS	50/ 152mm		79					
1			2	SS	31		78					
2			3	SS	20		77					
3 76.3			4	SS	16							
3.1	Sandy silt and clay, trace gravel, dark brown, trace black staining, very moist, firm		5	SS	6		76					
75.5								W. L. 75.9 m Mar 24, 2017				
3.8 4	Silty clay, some sand, dark brown, black staining, very moist, PHC odour, firm to stiff		6	SS	4		75					
5			7	SS	7							SS7: VOCs, PHCs
	Becoming grey		8	SS	9		74					
6 73.2												
6.1	**SILTY CLAY:** Some sand, grey, moist, stiff		9	SS	11		73			225		SS9: VOCs, PHCs
72.6												
6.7	**END OF BOREHOLE**											

NOTE:
1) Borehole open and dry on completion
2) 50 mm dia. monitoring well installed in the borehole upon completion of drilling
3) Water level measurements in monitoring well:

Date	W.L. Depth (m)
March 30, 2017	3.4
April 11, 2017	3.3

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH17-21

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 23
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/31/2017
COMPILED BY CC
BH LOCATION: N 4790510 E 594275
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
80.3	Ground Surface											
80.2 / 0.1	**ASPHALTIC CONCRETE:** 50mm											
	FILL: Sand and gravel, mixed with organics, brown, moist, compact		1	SS	13		80			42		
79.5 / 0.8	Silty sand, some clay, trace gravel, pieces of brick, brown, moist, loose		2	SS	8		79					
78.6 / 1.7	Sand, some gravel, black and red, moist, loose		3	SS	9							SS3: VOCs, M&I, PAHs, PHCs
	Some silt and clay, very loose		4	SS	3		78					
			5	SS	3		77					SS5: VOCs, M&I, PAHs, PHCs
	compact		6	SS	10		76					
75.7 / 4.6	**SILTY CLAY:** Grey and brown, moist, very stiff		7	SS	21					225		
			8	SS	19		75			225		
			9	SS	22		74			225		
			10	SS	16	W. L. 73.2 m Apr 11, 2017				175		
			11	SS	20					175		
72.0 / 8.2	**END OF BOREHOLE**											

NOTE:
1) Auger refusal at 7.9 m after retrieving SS11
2) Borehole open and dry on completion
3) 50 mm dia. monitoring well installed in the borehole upon completion of drilling to augered depth
4) Water level measurements in monitoring well:

Date	W.L. Depth (m)
April 11, 2017	7.0

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL LOG-VAN01-29 377.GLB
WSP-SOIL LOG - VOC 2016 PHC1-3 SPECIFIC - 161-17781-09 ALL BOREHOLES RECOVERY CURRENT.GPJ 1/24/19

LOG OF BOREHOLE BH17-22

PROJECT: Phase II ESA
REF. NO.: 161-17781-01
CLIENT: City of Hamilton
Method: Hollow Stem Auger
ENCL NO.: 24
PROJECT LOCATION: 330 Wentworth St N, 80 Brant St, Hamilton, ON
Diameter: 108 mm
ORIGINATED BY ER
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
Date: Mar/31/2017
COMPILED BY CC
BH LOCATION: N 4790524 E 594211
CHECKED BY REB

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT — WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
81.0	Ground Surface											
80.9 / 0.1	**ASPHALTIC CONCRETE:** 70mm											
	FILL: Sand and gravel, trace clay, grey and brown, damp, compact		1	SS	14							
80.3 / 0.8	Sandy silt and clay, trace gravel and debris, brown, moist, compact		2	SS	10		80					SS2: VOCs, M&I, PAHs, PHCs
			3	SS	13		79					
78.7 / 2.3	**SILTY CLAY:** Trace to some sand, brown, moist, very stiff		4	SS	15					225		SS4: VOCs, M&I, PHCs
	Becoming grey, trace black staining		5	SS	20		78			225		
			6	SS	18		77			225		
			7	SS	15		76			225		
			8	SS	20							
	stiff		9	SS	9		75			175		
	firm		10	SS	6		74			100		
73.4 / 7.6	**END OF BOREHOLE**											

W. L. 74.3 m Apr 11, 2017

NOTE:
1) Borehole open and dry on completion
2) 50 mm dia. monitoring well installed in the borehole upon completion of drilling
3) Water level measurements in monitoring well:

Date	W.L. Depth (m)
April 11, 2017	6.7

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL LOG V1(X).GDT - 29.3.17 - CLE
WSP-SOIL LOG - V1(X) - 2016 PW-PROJ SPECIFIC - 161-17781-09 ALL BOREHOLES RECOVER CURRENT.GPJ - 2/24/19

LOG OF BOREHOLE BH17-23

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 2 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790715 E 594137

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Oct/23/2017

REF. NO.: 161-17781-02
ENCL NO.: 25
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.8	Ground Surface											
0.0	**FILL:** sand some gravel, and silt, trace clay, brick pieces, slag, debris, brown to dark brown, moist, loose to compact		1	SS	24							
			2	SS	6		79					SS2: M&I, PAHs
			3	SS	7		78					SS3: VOCs, PHCs
77.5												
2.3	**SILTY CLAY:** trace sand, mottled, brown/grey, moist, stiff to very stiff		4	SS	16		77			225		
			5	SS	18					200		SS5: VOCs, M&I, PAHs, PHCs
			6	SS	16		76			200		
			7	SS	12		75			175		
			8	SS	9		74			175		
73.8												
5.9	**END OF BOREHOLE** **NOTES:** 1) Borehole open and dry upon completion of drilling											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL LOG V4.GDT 29.3.17 DJI
WSP-SOIL LOG V4.GDT 2017-11-23 P:\PROJ\SPECIFIC 161-17781-00 ALL BOREHOLES RECOVERY CURRENT.GPJ 12/4/19

LOG OF BOREHOLE BH17-24

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 2 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790689 E 594119

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Oct/23/2017

REF. NO.: 161-17781-02
ENCL NO.: 26
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
80.4	Ground Surface											
0.0	**FILL:** sand some gravel and silt, brick pieces, slag, debris, brown to dark brown, moist, loose to very dense		1	SS	36		80					
			2	SS	7		79					
			3	SS	5							
			4	SS	50/ 50mm		78					SS4: M&I, PAHs
77.4												
3.1	**SILTY CLAY:** trace sand, mottled, brown/grey, moist, stiff to very stiff		5	SS	10		77			225		SS5: VOCs, PHCs
			6	SS	9		76			100		
			7	SS	8					175		
			8	SS	10		75			50		
			9	SS	9	▽	W. L. 74.3 m Nov 08, 2017		44	75		0 2 41 57
	grey		10	SS	5		73			225		Field Vane = 80 kPa Sensitivity = 2.3
72.5			1	VANE								
7.9	**END OF BOREHOLE**											

NOTES:
1) Borehole open and dry upon completion of drilling
2) 50mm dia. monitoring well was installed upon completion

Date	W.L. Depth (m)
Nov 8, 2017	6.2

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL LOG_V-MAY-29-2017.GLB
WSP-SOIL LOG_V-2017-29-MAY.PRJ_SPECIFIC_BH-17781-09_ALL BOREHOLES RECOVER CURRENT.GPJ_2/24/19

LOG OF BOREHOLE BH17-25

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 2 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790693 E 594140

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Oct/23/2017

REF. NO.: 161-17781-02
ENCL NO.: 27
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
80.4	Ground Surface											GR SA SI CL
0.0	**FILL:** sand, some gravel and silt, trace clay, brick pieces, debris, slag, concrete, brown to dark brown, moist, loose to compact		1	SS	13		80					SS2: PCBs
1			2	SS	4		79					SS3: M&I, PAHs
2			3	SS	4		78					
3 77.3			4	SS	3							
3.1	**ORGANIC FILL:** silty clay mixed with sand, some gravel, slag, dark brown to black, strong solvent odour, moist, very soft		5	SS	3		77	740	42			SS5: VOCs, PHCs
4			6	SS	1	W. L. 76.4 m Nov 08, 2017	76					
5 75.2			7	SS	1							SS7: VOCs, M&I, PAHs, PHCs
5.2	**SILTY CLAY:** trace sand, mottled, brown/grey, moist, very stiff		1	VANE								Field Vane = 120 kPa Sensitivity = 2
			8	SS	17		75		44 175			0 2 39 59
6 74.3												
6.1	**END OF BOREHOLE** **NOTES:** 1) Water level measured at 6.1m below ground surface updon removal of augers 2) 50mm dia. monitoring well was installed upon completion Date W.L. Depth (m) Nov 8, 2017 4.0						W. L. 74.3 m on completion					

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH17-26

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 2 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790641 E 594124

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Oct/23/2017

REF. NO.: 161-17781-02
ENCL NO.: 28
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
80.0	Ground Surface											
0.0	**FILL:** sand, some gravel, and silt, trace clay, brick pieces, slag, brown to dark brown, moist, very loose to compact		1	SS	17							SS1: M&I, PAHs
			2	SS	9		79					
			3	SS	2		78					
			4	SS	9							
			5	SS	1		77					
			6	SS	1							
	---------- black, saturated, organics, shells		7	SS	2		75					SS7: VOCs, PHCs, PCBs
			8	SS	2							
73.9							74					
6.1	**END OF BOREHOLE**											

W. L. 76.0 m Nov 08, 2017

W. L. 75.5 m on completion

NOTES:
1) Water level measured at 4.5m below ground surface upon removal of augers
2) 50mm dia. monitoring well was installed upon completion

Date	W.L. Depth (m)
Nov 8, 2017	4.0

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

LOG OF BOREHOLE BH17-27

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 2 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790648 E 594162

Method: Hollow Stem Auger
Diameter: 108 mm
Date: Oct/23/2017

REF. NO.: 161-17781-02
ENCL NO.: 29
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY REB

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (w_P, w, w_L) WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.8	Ground Surface							50 100 150 200 250	10 20 30			
0.0	**FILL:** sand, some gravel and silt, trace clay, brick pieces, slag, brown to dark brown, moist, loose to very dense		1	SS	50/ 125mm							
			2	SS	8		79					
			3	SS	7		78					
			4	SS	7							
							77					
			5	SS	6							SS5: M&I, PAHs
							76					
75.7			6	SS	4					150		SS6: VOCs, PHCs
4.1 75.4	**SILTY CLAY:** trace sand, grey, moist, firm											
4.4	**END OF BOREHOLE** **NOTES:** 1) Borehole open and dry upon completion of drilling											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL LOG V002 2016 PRELIMINARY.GPJ GLB

LOG OF BOREHOLE BH18-3

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 10 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790923 E 594125

Method: Hollow Stem Auger
Diameter: 150 mm
Date: Nov/29/2018 to Nov/30/2018

REF. NO.: 161-17781-05
ENCL NO.: 30
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.1	Ground Surface											
79.0	**CONCRETE:** 150mm											
0.2	**FILL:** sand and gravel, grey, moist, very dense		1	SS	77/ 280mm						0	
	- clayey silt mixed with sand, reddish brown, moist, hard to very soft		2	SS	50/ 50mm						0	SS2: BNAEs
			3	SS	4						0	SS3: M&I, VOCs, PHCs, PCBs
76.8												
2.3	**SILTY CLAY:** trace sand, greyish brown, APL, soft to very stiff		4	SS	13					100	0	
			5	SS	16					0	0	
			6	SS	8					150	0	
			7	SS	4					0	0	
	- grey, WTPL, very soft below 5.3m		8	SS	2					25	0	
			9	SS	2	W. L. 72.8 m Dec 12, 2018				25	0	
			10	SS	2	W. L. 71.5 m Dec 06, 2018				0	0	
			11	SS	2					0	0	

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH18-3

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 10 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790923 E 594125

Method: Hollow Stem Auger
Diameter: 150 mm
Date: Nov/29/2018 to Nov/30/2018

REF. NO.: 161-17781-05
ENCL NO.: 30
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
11	**SILTY CLAY:** trace sand, greyish brown, APL, soft to very stiff(Continued)		12	SS	2		68		○	0	0	
12			13	SS	0		67		○	0	0	
13							66					
14			14	SS	1		65		○	0	0	
15							64					
16			15	SS	2		63		○	0	0	
62.3												
16.8	**END OF BOREHOLE** **NOTES:** 1. Borehole dry upon removal of augers. 2. 50mm monitoring well installed. 3. No. 10 screen installed. 4. Water Level Measurements Date / Depth (mBGS) Dec 6, 2018 7.59 Dec 12, 2018 6.28											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3$, $\times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

WSP-SOIL (ICP).GAV 29-377.GLB
WSP-SOIL LOG V1X2 2018 FINAL.SPJ SPJ2PRJ - 161-17781-05 ALL BOREHOLES RECOVERY CURRENT.GPJ 1/24/19

LOG OF BOREHOLE BH18-4

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 10 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790870 E 594089

Method: Hollow Stem Auger
Diameter: 150 mm
Date: Dec/04/2018

REF. NO.: 161-17781-05
ENCL NO.: 31
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
80.1	Ground Surface											
80.0 / 0.1	**ASPHALT:** 75mm						80					
	FILL: sand and gravel, grey, moist, compact		1	SS	22						0	SS1: M&I, BNAEs
1	- sandy silt, reddish brown, moist, compact		2	SS	9		79				0	SS2: PCBs
			3	SS	11						3	SS3: VOCs, PHCs
2 / 77.8							78					
2.3	**SILTY CLAY:** trace sand, grey, APL, soft		4	SS	4					25	0	
3	- WTPL, grey, soft to very soft below 3.0m		5	SS	4		77			0	0	
4			6	SS	2		76			0	0	
			7	SS	2	▽				0	0	
5							W. L. 75.0 m Dec 12, 2018					
			8	SS	2	▽	W. L. 74.6 m Dec 06, 2018			0	0	
6 / 74.0							74					
6.1	**END OF BOREHOLE**											

NOTES:
1. Borehole dry upon removal of augers.
2. 50mm monitoring well installed.
3. No. 10 screen installed.
4. Water Level Measurements

Date	Depth (mBGS)
Dec 6, 2018	5.48
Dec 12, 2018	5.07

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP GDL (ICV).GAV 29 3/17 GLB
WSP SOIL LOG - V2021 2019 PA01.SPEDRC - 161-17781-05 ALL BOREHOLES RECOVERY CURRENT.GPJ 12/4/19

LOG OF BOREHOLE BH18-5

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 10 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790805 E 594084

Method: Hollow Stem Auger
Diameter: 150 mm
Date: Dec/04/2018

REF. NO.: 161-17781-05
ENCL NO.: 32
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.8	Ground Surface											
78.7 / 0.1	**ASPHALT:** 75mm											
	FILL: sand and gravel, brown, moist, compact		1	SS	25						0	SS1: PCBs
1			2	SS	13		78				0	SS2: M&I, BNAEs
77.3 / 1.5	**SILTY CLAY:** trace sand, greyish brown, DTPL, firm to very stiff		3	SS	15		77			125	0	
2			4	SS	15					75	0	
3			5	SS	16		76			175	0	
4			6	SS	7		75			50	0	SS6: VOCs, PHCs
	- WTPL, grey, soft below 4.6m		7	SS	5		74			50	0	
5			8	SS	4					25	0	
6						W. L. 73.1 m Dec 12, 2018						
72.1 / 6.7	**END OF BOREHOLE**											

NOTES:
1. Borehole dry upon removal of augers.
2. 50mm monitoring well installed.
3. No. 10 screen installed.
4. Water Level Measurements

Date	Depth (mBGS)
Dec 6, 2018	DRY
Dec 12, 2018	5.67

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL LOG V-XXV-2018 PROJ SPECIFIC - BH-17781-05 ALL BOREHOLES RECOVERY CURRENT.GPJ 12/4/19

LOG OF BOREHOLE BH18-6

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 10 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: approximate coordinates N 4790889 E 594204

Method: Hollow Stem Auger
Diameter: 150 mm
Date: Nov/28/2018 to Nov/29/2018

REF. NO.: 161-17781-05
ENCL NO.: 33
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (WATER CONTENT %)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
80.1	Ground Surface											
79.9 0.0	**CONCRETE:** 200mm						80					
0.2	**FILL:** sand and gravel, grey, moist, compact to very dense		1	SS	70						0	SS1: BNAEs
1			2	SS	33		79				10	SS2: VOCs, PHCs
			3	SS	18						0	SS3: M&I
2 77.8							78					
2.3	**SILTY CLAY:** trace sand, dark grey, APL, soft to very stiff, PHC odour		4	SS	4					50	0	
3			5	SS	16		77			125	0	SS5: Grain, pH
4	- brown, DTPL to APL below 3.8m		6	SS	18		76			225	0	
5			7	SS	15					175	0	
			8	SS	9		75			100	0	
6			9	SS	22		74			100	0	
7			10	SS	10		73			75	0	
	- WTPL, grey, soft below 7.6m		11	ss	5					25	0	
8							72					
9 71.0							71					
9.1	**END OF BOREHOLE**											

W. L. 77.7 m Dec 05, 2018

NOTES:
1. 50mm monitoring well installed.
2. No. 10 screen installed.
3. Water Level Measurements

Date	Depth (mBGS)
Dec 5, 2018	2.45
Dec 12, 2018	2.46

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL (ICP).GMAV 29.GTT GLB
WSP SOIL LOG - V2021 2019 V1 PROJ SPECIFIC - 08-17781-05 ALL BOREHOLES RECOVER CURRENT.GPJ 1/24/19

LOG OF BOREHOLE BH18-7

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 10 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: approximate coordinates N 4790869 E 594115

Method: Hollow Stem Auger
Diameter: 150 mm
Date: Nov/29/2018

REF. NO.: 161-17781-05
ENCL NO.: 34
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm) 50 100 150 200 250	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
80.2	Ground Surface											
80.0	**CONCRETE:** 150mm											
0.2	**FILL:** sand and gravel, grey, moist, compact - sandy silt, reddish brown, black seam, wet, loose		1	SS	14		80				0	SS1: M&I
1			2	SS	6		79				0	SS2: BNAEs
2			3	SS	4					25	0	
77.9							78					
2.3	**SILTY CLAY:** trace sand, greyish brown, reddish brown silt seams, APL, soft		4	SS	4					75	0	
3			5	SS	5		77			25	0	SS5: VOCs, PHCs
4							76					
5			6	SS	4					25	0	
6							75					
	- WTPL, grey, soft below 6.1m		7	SS	3		74			0	0	
73.5												
6.7	**END OF BOREHOLE**											

W. L. 74.9 m Dec 12, 2018
W. L. 74.5 m Dec 05, 2018

NOTES:
1. Borehole dry upon removal of augers.
2. 50mm monitoring well installed.
3. No. 10 screen installed.
4. Water Level Measurements

Date	Depth (mBGS)
Dec 5, 2018	5.72
Dec 12, 2018	5.23

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

WSP-SOIL (ICP).GMAV 29.3[7].GLB
WSP-SOIL LOGS V2020 2020FW1 PROJ SPECIFIC (161-17781-05 ALL BOREHOLES RECOVERY CURRENT.GPJ 1/24/19

LOG OF BOREHOLE BH18-8

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 10 Hillyard Street, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: approximate coordinates N 4790883 E 594244

Method: Hollow Stem Auger
Diameter: 150 mm
Date: Nov/28/2018

REF. NO.: 161-17781-05
ENCL NO.: 35
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (WATER CONTENT %)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.9	Ground Surface											
78.8 / 0.1	**ASPHALT:** 50mm											
	FILL: sand and gravel, grey, moist, compact		1	SS	10						0	
78.2												
78.1 / 0.8	**ASPHALT:** 50mm											
	FILL: sand mixed with clay, black, trace brick pieces, slag, loose		2	SS	5		78				0	
			3	SS	4	W. L. 77.4 m Dec 05, 2018	77				0	SS3: BNAEs
	- silty sand, brownish black, very loose		4	SS	2						0	SS4: M&I
	- wood pieces, trace slag		5	SS	4		76				0	
	- silty clay, brownish black, soft		6	SS	4		75				0	
	- silty sand, brownish grey, PHC odour		7	SS	4		74			41	0	SS7: VOCs, PHCs
73.6												
5.3	**SILTY CLAY:** trace sand, brownish grey, APL, very stiff		8	SS	17					175	0	
	- faint PHC odour		9	SS	21		73			150	0	
							72					
			10	SS	18		71			75	35	
							70					
69.8												
9.1	**END OF BOREHOLE**											

NOTES:
1. Water level measured at 2.7 bgl upon removal of augers.
2. 50mm monitoring well installed.
3. No. 10 screen installed.
4. Water Level Measurements

Date	Depth (mBGS)
Dec 5, 2018	1.56
Dec 12, 2018	1.57

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

WSP-SOIL (ICP).GMAV 29.3(7).GLB
WSP-SOIL LOG - VOC 2018 PHASE I.SPEDFIC - 161-17781-05 ALL BOREHOLES RECOVERY CURRENT.GPJ 12/4/19

LOG OF BOREHOLE BH-1

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 330 Wentworth St N, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790576 E 594238

Method: Mud Rotary/Tricone
Diameter: 150 mm
Date: Dec/06/2018

REF. NO.: 161-17781-05
ENCL NO.: 36
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (w_P / w / w_L) WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.8	Ground Surface							50 100 150 200 250	10 20 30			
79.7 / 0.1	**ASPHALT:** 75mm											
	FILL: sand and gravel, brown to black, trace asphalt pieces, dense to very dense		1	SS	50/150mm		79				0	
1			2	SS	45						0	
			3	SS	36		78				0	
2 / 77.5												
2.3	**SILTY CLAY:** trace sand, greyish brown, DTPL, very stiff		4	SS	27		77			200	0	
3			5	SS	23					200	0	
	- APL below 3.8m		6	SS	24		76			200	0	
4			7	SS	25		75			200	0	
5	- stiff below 5.3m		8	SS	12		74			125	0	
6			9	SS	10					150	0	
7	- WTPL, grey, soft below 6.9m		10	SS	5		73			0	0	
8							72					
9 / 70.6							71					
9.1	**CLAYEY SILT:** trace sand, trace shale fragments, DTPL, very stiff to hard		11	SS	22					0	0	
10							70					

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL (ICP).GAV 29 377 GLB
WSP SOIL LOG V102 2018 PROJ SPECIFIC 161-17781-05 ALL BOREHOLES RECOVER CURRENT.GPJ 12/4/19

LOG OF BOREHOLE BH-1

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 330 Wentworth St N, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790576 E 594238

Method: Mud Rotary/Tricone
Diameter: 150 mm
Date: Dec/06/2018

REF. NO.: 161-17781-05
ENCL NO.: 36
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (w_P w w_L) WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued							50 100 150 200 250	10 20 30			
11	**CLAYEY SILT:** trace sand, trace shale fragments, DTPL, very stiff to hard(Continued)											
12			12	SS	50/ 150mm initial		68			200	0	
13							67					
66.0												
~~66.0~~ 13.8	~~**WEATHERED SHALE:**~~ Queenston Formation, reddish grey, hard, **END OF BOREHOLE ON ASSUMED BEDROCK** **NOTES:**		13	SS	50/ 150mm initial		66			125	0	

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

WSP-SOIL LOG VANAV 29 377 GLB
WSP SOIL LOG V2021 2019 PA1 SPECPIC - 08-17781-05 ALL BOREHOLES RECOVERY CURRENT.GPJ 3/24/19

LOG OF BOREHOLE BH-2

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 80 Brant St, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790772 E 594261

Method: Mud Rotary/Tricone
Diameter: 150 mm
Date: Dec/07/2018

REF. NO.: 161-17781-05
ENCL NO.: 37
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.8	Ground Surface											
0.0	**FILL:** silty clay, gravel, dark brown, moist, very stiff to hard		1	SS	50/ 100mm initial						0	
			2	SS	29		77				0	
	- wood pieces		3	SS	41		76				0	
			4	SS	62		75				0	
			5	SS	50/ 100mm						0	
			6	SS	56		74				0	
73.2												
4.6	**FILL:** sandy silt, some gravel, black, wet to saturated, very loose to compact		7	SS	17		73				0	
			8	SS	1		72				0	
			9	SS	3		71				0	
70.9												
6.9	**ORGANIC SILTY CLAY:** black, WTPL, soft		10	SS	3					25	0	SS10: LOI=10.8%
			11	SS	3		70			0	0	
69.4												
8.4	**PEAT:** black, wet, very soft to soft		12	SS	3		69			50	0	SS12: LOI=40.8%
			13	SS	3					25	0	
			14	SS	2		68			25	0	SS14: LOI=14.6%

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH-2

PROJECT: Phase II ESA
CLIENT: City of Hamilton
PROJECT LOCATION: 80 Brant St, Hamilton, ON
DATUM: Geodetic, NAD83 UTM Zone 17T, mASL
BH LOCATION: N 4790772 E 594261

Method: Mud Rotary/Tricone
Diameter: 150 mm
Date: Dec/07/2018

REF. NO.: 161-17781-05
ENCL NO.: 37
ORIGINATED BY SM
COMPILED BY CC
CHECKED BY DM

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	Head Space Combustible Vapor Reading (ppm)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	TOTAL ORGANIC VAPORS (ppm)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
11	**PEAT:** black, wet, very soft to soft(Continued)		15	SS	2		67			25	0	
66.4												
11.4	**SILTY CLAY:** trace sand, grey, APL, soft		16	SS	3		66			50	0	
12												
13							65					
14							64					
15 62.8							63					
15.0	**WEATHERED SHALE:** Queenston Formation, reddish grey, hard, approximate interface		17	SS	98					50	0	
16							62					
17							61					
18 59.8							60					
18.0	**TRICONE REFUSAL ON BEDROCK**		18	SS	50/ 50mm initial					225	0	

NOTES:

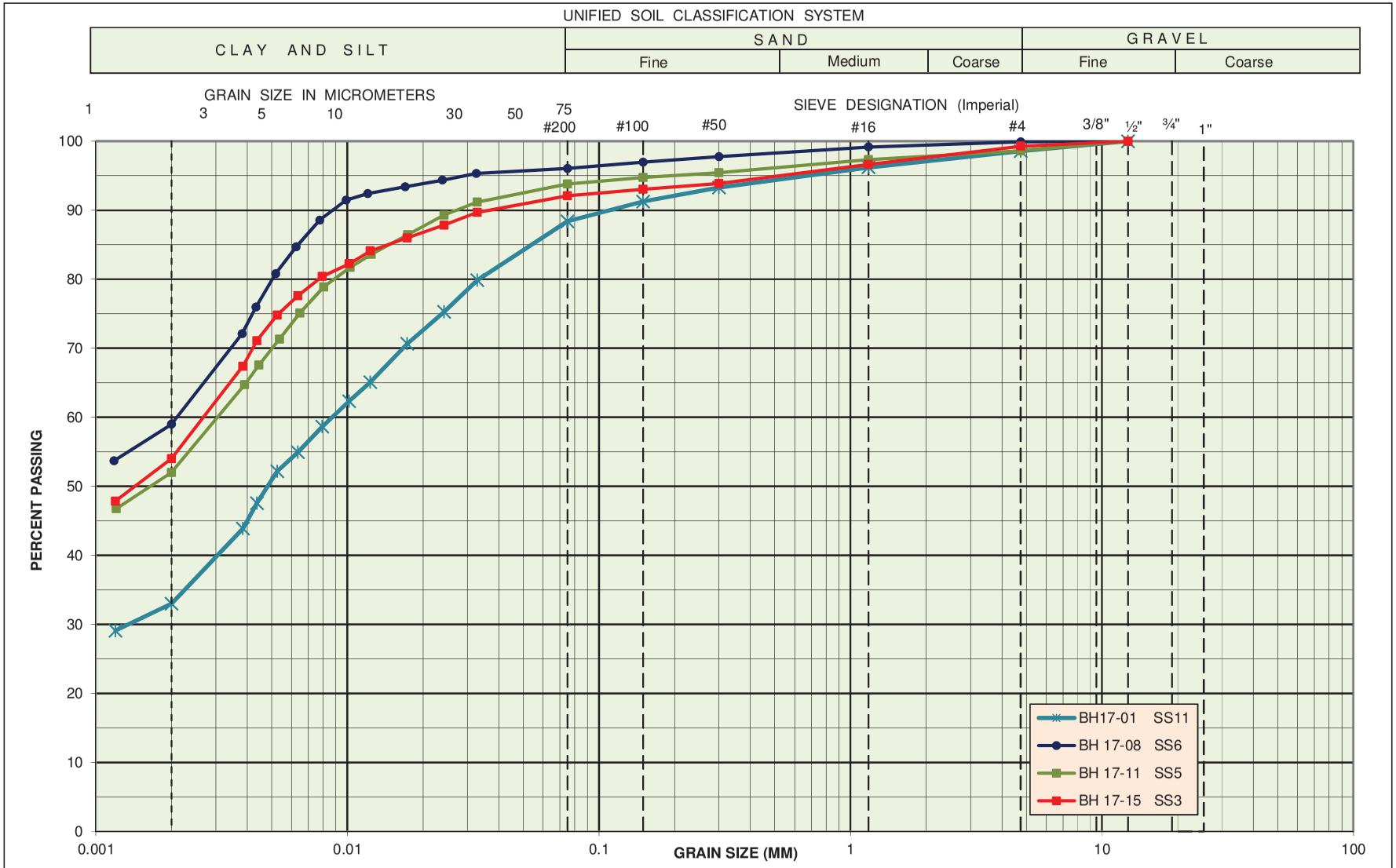
GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

APPENDIX

B

GRAIN SIZE DISTRIBUTION CURVES (FIGURES B-1 TO B-3)
PLASTICITY CHARTS (FIGURES B-4 AND B-5)



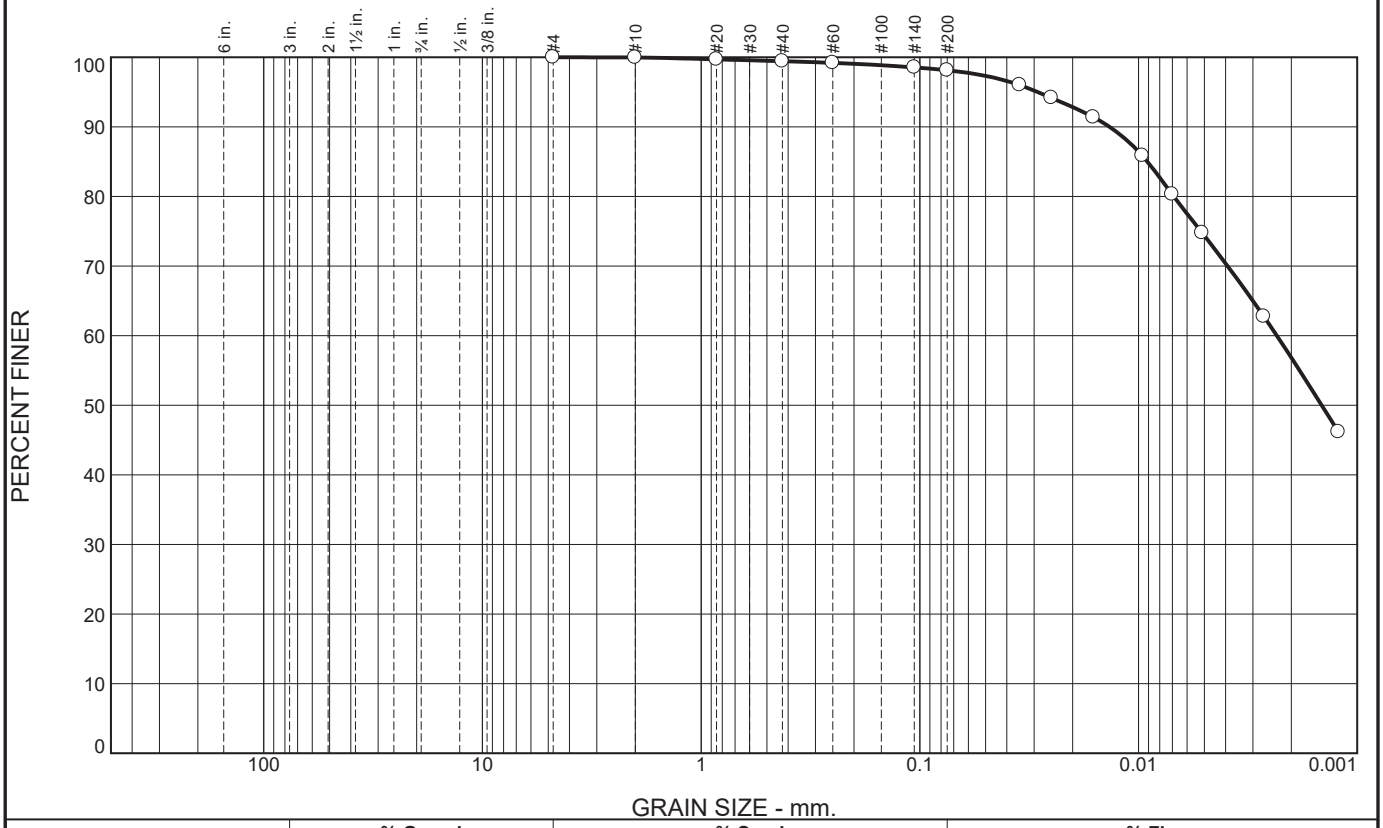
WSP

GRAIN SIZE DISTRIBUTION

Silty Clay

Project No:	161-17781-00		Figure No: B-1
Project Name:	HSR-MSF Hamilton		Client: City of Hamilton
Sampling Date:	March 2017	Lab Testing Date:	April 10, 2017

Particle Size Distribution Report



% +75mm	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	1.3	41.3	56.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4.75mm	100.0		
2.00mm	100.0		
.850mm	99.7		
.425mm	99.4		
.250mm	99.2		
.106mm	98.5		
.075mm	98.1		
0.0350 mm.	96.0		
0.0250 mm.	94.2		
0.0161 mm.	91.4		
0.0096 mm.	85.9		
0.0070 mm.	80.3		
0.0051 mm.	74.8		
0.0027 mm.	62.8		
0.0012 mm.	46.2		

* (no specification provided)

Soil Description

Silty Clay, trace sand

Atterberg Limits

PL= 19 LL= 44 PI= 25

Coefficients

D_{90}= 0.0136 D_{85}= 0.0091 D_{60}= 0.0023
D_{50}= 0.0015 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(26)

Remarks

Lab No: 314-17

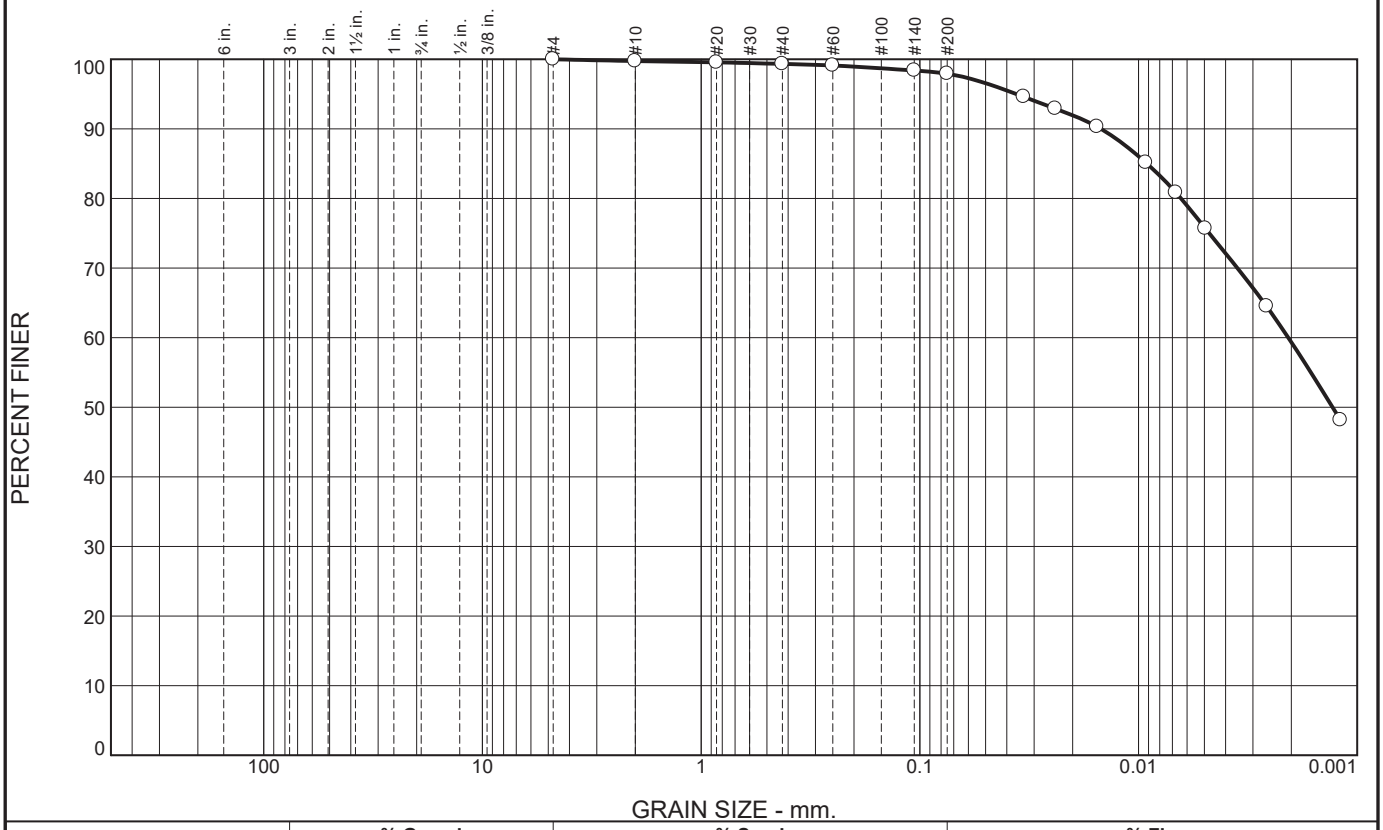
Sample Number: 17-24/SS9

Date: Nov 13, 2017

Client: City of Hamilton
Project: HSR-MSF Facility

Project No: 161-17781-00 Task 04 **Figure** B-2

Particle Size Distribution Report



% +75mm	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	0.4	1.4	38.6	59.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4.75mm	100.0		
2.00mm	99.7		
.850mm	99.6		
.425mm	99.3		
.250mm	99.1		
.106mm	98.4		
.075mm	97.9		
0.0335 mm.	94.6		
0.0240 mm.	92.9		
0.0155 mm.	90.3		
0.0093 mm.	85.2		
0.0067 mm.	80.9		
0.0049 mm.	75.7		
0.0026 mm.	64.5		
0.0012 mm.	48.2		

* (no specification provided)

Soil Description

Silty Clay, trace sand

Atterberg Limits

PL= 21 LL= 44 PI= 23

Coefficients

D_{90}= 0.0148 D_{85}= 0.0091 D_{60}= 0.0021
D_{50}= 0.0013 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(25)

Remarks

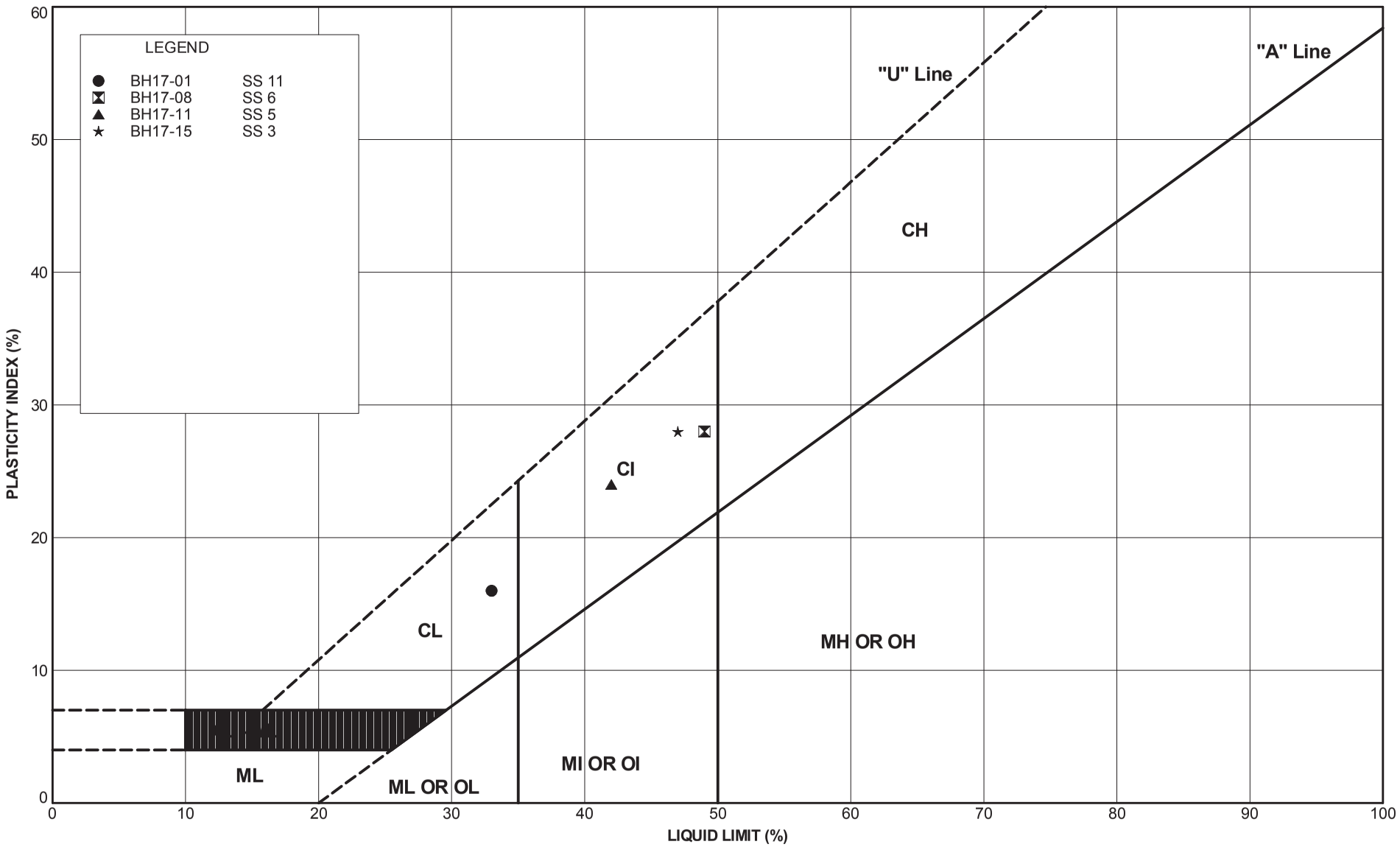
Lab No: 314-17

Sample Number: 17-25/SS8

Date: Nov 13, 2017

Client: City of Hamilton
Project: HSR-MSF Facility

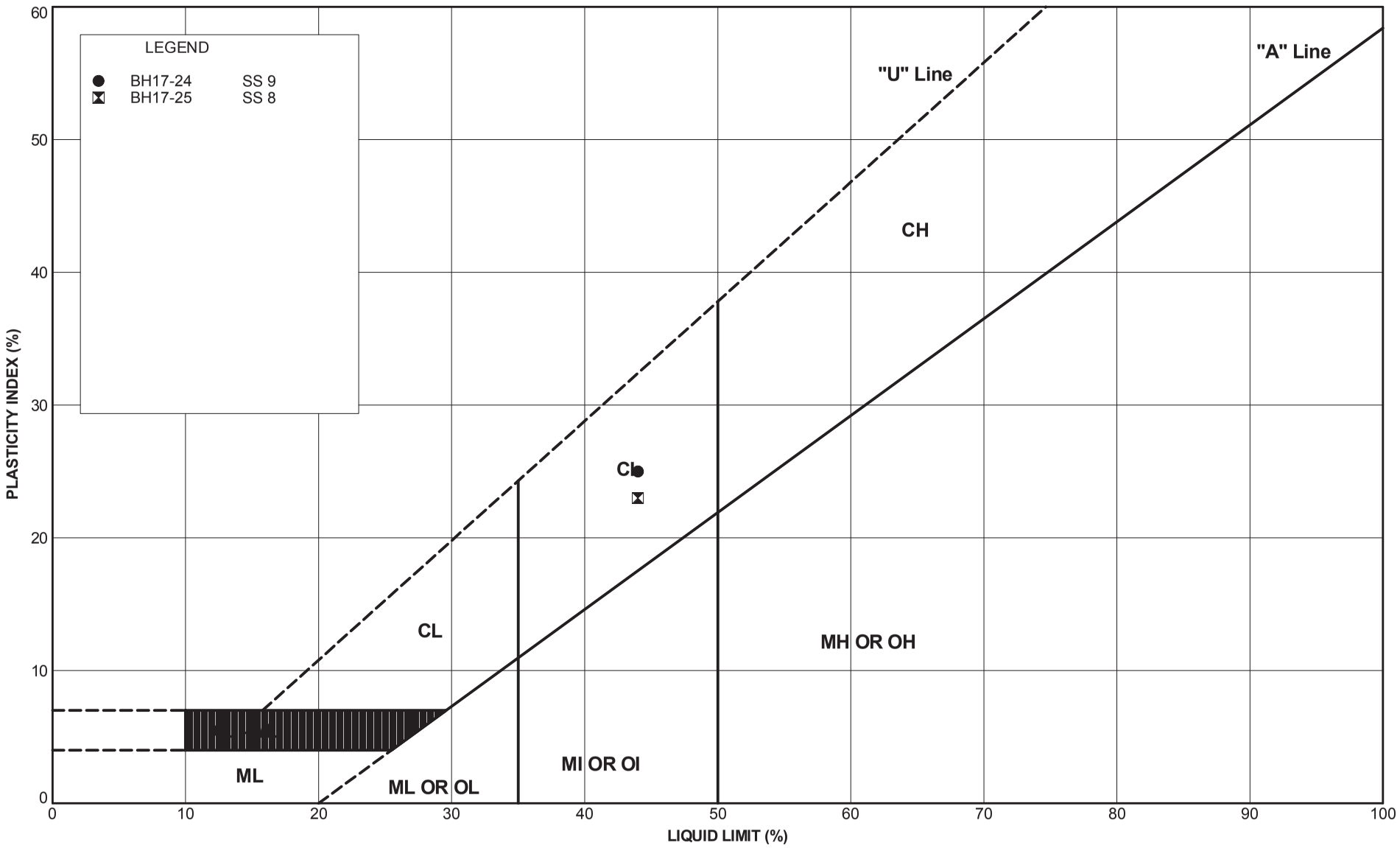
Project No: 161-17781-00 Task 04 **Figure** B-3



WSP

PLASTICITY CHART

FIGURE NO.	B-
JOB NO.	161-17781-00
DATE	April 10, 2017



PLASTICITY CHART

FIGURE NO.	B-
JOB NO.	161-17781-00
DATE	November 13, 2017

APPENDIX

C

LOSS OF IGNITION TEST RESULTS

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: WSP CANADA INC.
180 SHEARSON CRESCENT, UNIT 5
CAMBRIDGE, ON N1T1P4
(519) 740-0065

ATTENTION TO: Cameron Cluett

PROJECT: 161-17781-04

AGAT WORK ORDER: 19T433090

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Supervisor

DATE REPORTED: Feb 06, 2019

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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Results relate only to the items tested. Results apply to samples as received.
All reportable information as specified by ISO 17025:2017 is available from AGAT Laboratories upon request

AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 19T433090

PROJECT: 161-17781-04

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Cameron Cluett

SAMPLING SITE:

SAMPLED BY:

Organic Matter (Soil)

DATE RECEIVED: 2019-01-30

DATE REPORTED: 2019-02-06

		SAMPLE DESCRIPTION:		BH2 SS10	BH2 SS14	BH2 SS12
		SAMPLE TYPE:		Water	Water	Water
		DATE SAMPLED:		2018-12-07	2018-12-07	2018-12-07
Parameter	Unit	G / S	RDL	9870316	9870317	9870318
Organic Matter/LOI @ 440	%		0.005	10.8	14.6	40.8

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9870316-9870318 Analysis was performed at 440°C by AGAT 5623 McAdam.

Certified By:

Amanjot Bhela

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
AMANJOT BHELA
CHEMIST

Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 19T433090

PROJECT: 161-17781-04

ATTENTION TO: Cameron Cluett

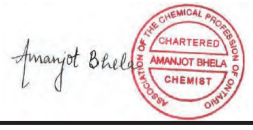
SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Feb 06, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Organic Matter (Soil)															
Organic Matter/LOI @ 440	9870316	9870316	10.8	10.8	0.0%	< 0.01									

Certified By:



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Results relate only to the items tested. Results apply to samples as received.

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FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 19T433090

PROJECT: 161-17781-04

ATTENTION TO: Cameron Cluett

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Organic Matter/LOI @ 440		McKeague 3.81	FURNACE

Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only

Work Order #: 19T433090

Cooler Quantity:

Arrival Temperatures: 7.2 | 7.7 | 4.6
4.3 | 4.1 | 3.7

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes:

Report Information:

Company: WSP Canada Inc.
Contact: Cameron Cluett
Address: 180 Shearson Cres., Unit 3
Cambridge, ON N1T 1P4
Phone: 519.740.0065 Fax: 519.740.0045
Reports to be sent to:
1. Email: Cameron.Cluett@WSP.com
2. Email:

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Sewer Use
☐ Sanitary ☐ Storm
Region (Indicate One) ☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 161-17781-04
Site Location:
Sampled By: S. Morris
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	Metals and Inorganics	O. Reg 153: All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)	ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr6+ ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	Loss on Ignition
BH2 SS10	DEC 7/18	12:00	1	Soil																	/
BH2 SS14	"	"	1	"																	/
BH2 SS12	"	"	1	"																	/

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
				30/11/18	5:00
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
				30/11/18	6:30
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page 1 of 1

N°: T 080019

Document ID: DW 78 1511 015

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Date Revised: Nov 26 2018

CITY OF HAMILTON

PHASE I ENVIRONMENTAL SITE ASSESSMENT

FUTURE HSR STORAGE AND MAINTENANCE FACILITY

MAY 11, 2017

WSP

PHASE I ENVIRONMENTAL SITE ASSESSMENT

FUTURE HSR STORAGE AND MAINTENANCE FACILITY

City of Hamilton

Project nº : 161-17781-00-01-01

May 11, 2017

Distribution:
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www.wspgroup.com

May 11, 2017

Ms. Shaba Shringi
Project Manager, Facilities
City of Hamilton
Facilities Management & Capital Programs Division
Corporate Assets & Strategic Planning, Public Works Department
28 James Street North, 5th Floor
Hamilton, Ontario
L8R 2K1

Subject : **Phase I Environmental Site Assessment**
Future HSR Storage and Maintenance Facility
Hamilton, Ontario
WSP Project No. 161-17781-00-01

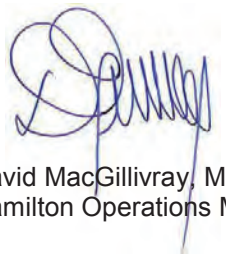
Dear Ms. Shringi,

WSP Canada Inc. is pleased to provide our report documenting the findings of the Phase I Environmental Site Assessment (ESA) completed at the above-noted site.

The report summarizes the relevant background information, methods utilized, scope of work undertaken, and provides conclusions for your consideration. It is understood that the ESA is not required for filing a Record of Site Condition for the site at this time.

We trust that the information provided herein is sufficient for your needs. Please contact the undersigned if you have any questions or comments or require additional information.

Yours truly,
WSP Canada Inc.



David MacGillivray, M.A.Sc., P.Geo., P.Eng., $QP_{ESA,RA}$
Hamilton Operations Manager, Environment

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EXECUTIVE SUMMARY

WSP Canada Inc. (WSP) was retained by the City of Hamilton (City) to conduct a Phase I Environmental Site Assessment (ESA) for the site of a proposed Hamilton Street Railway (HSR) Storage and Maintenance Facility, herein referred to as the Site. The Site includes 2 Hillyard St, 80 Brant St, the former CP Rail tracks between Hillyard St and Birch Ave, and the fleet yard at 330 Wentworth St N. The 7.9 hectare industrial Site is irregular in shape and lies within a predominantly industrial land use area.

It is our understanding that the Phase I ESA is required for due diligence purposes prior to demolition and construction activities at the Site. There is no plan to change the land use at the Site. Given this, the Phase I ESA has been completed using the Canadian Standards Association (CSA) Standard Z768-01 Phase I Environmental Site Assessment and Ontario Regulation 153/04 as general guides. This report has not been prepared to support a Record of Site Condition application for the Site.

The objective of the Phase I ESA was to assess the Site for actual and/or potential environmental concerns associated with the Site through a review of available historical records, Site reconnaissance, and interviews.

Based on information obtained as part of the Phase I ESA records search, Site reconnaissance and interview process, the following findings are presented:

- The Site is situated within the former Sherman Inlet. In the early twentieth century fill was imported from off-Site sources to fill in the Sherman Inlet and associated wetlands. The fill is reportedly variable in nature and comprised of sands, clay, ash, cinders, gravel, glass, wood, cobbles, brick, metal debris, slag, concrete, and foundry sand. The depth of fill ranges from approximately 1 to 10 m across the Site.
- The Site has been under industrial use since the early 1900s. Former occupants of the Site include TH&B Railway (several track lines), W.A. Freeman Co Ltd Fertilizer Works, Canadian Oil Companies Ltd, City of Hamilton Sewage Disposal Works, Duro Aluminium Ltd, Sheridan Warehousing, Niagara Paint & Chemical Company, GSW Heating Products Inc, Hamilton Specialty Bar (scrap metal yard), and Welco Castings Inc.
- At the time of the Site reconnaissance in 2017, the 330 Wentworth St N portion of the Site was in use as a fleet yard for municipal vehicles; the 2 Hillyard St property was in use by Duke Electric Ltd, Petrie Truck Supply Ltd, and The Hamilton Brewery; the 80 Brant St property was undeveloped and vacant; and, the former TH&B Railway tracks were overgrown and no longer in use.
- Shallow groundwater flow at the Site is estimated to be highly influenced by the presence of fill materials associated with the infilling of the former Sherman Inlet. Groundwater flow patterns are inferred to follow the branches of the former Sherman Inlet, with overall flow directed to the north towards Hamilton Harbour.

→ The hydraulic conductivity of the fill materials is estimated to be high, while the hydraulic conductivity of the underlying native clayey silt to silty clay soils is estimated to be low.

The results of the Phase I ESA identified the following 16 Potentially Contaminating Activities (PCAs) on the Site:

2. Adhesives and Resins Manufacturing, Processing and Bulk Storage
14. Crude Oil Refining, Processing and Bulk Storage
22. Fertilizer Manufacturing, Processing and Bulk Storage
28. Gasoline and Associated Products Storage in Fixed Tanks
30. Importation of Fill Material of Unknown Quality
33. Metal Treatment, Coating, Plating and Finishing
34. Metal Fabrication
35. Mining, Smelting and Refining; Ore Processing; Tailings Storage
39. Paints Manufacturing, Processing and Bulk Storage
46. Rail Yards, Tracks and Spurs
48. Salt Manufacturing, Processing and Bulk Storage
49. Salvage Yard, including automobile wrecking
51. Solvent Manufacturing, Processing and Bulk Storage
55. Transformer Manufacturing, Processing and Use
56. Treatment of Sewage equal to or greater than 10,000 litres per day
58. Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners

The Site is situated within a predominantly industrial land use area. The following PCAs were identified off-Site within the Phase I Study Area:

2. Adhesives and Resins Manufacturing, Processing and Bulk Storage
5. Asphalt and Bitumen Manufacturing
8. Chemical Manufacturing, Processing and Bulk Storage
10. Commercial Autobody Shops
11. Commercial Trucking and Container Terminals
14. Crude Oil Refining, Processing and Bulk Storage
16. Drum and Barrel and Tank Reconditioning and Recycling
18. Electricity Generation, Transformation and Power Stations
27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles
28. Gasoline and Associated Products Storage in Fixed Tanks
30. Importation of Fill Material of Unknown Quality
32. Iron and Steel Manufacturing and Processing
33. Metal Treatment, Coating, Plating and Finishing
34. Metal Fabrication
39. Paints Manufacturing, Processing and Bulk Storage
43. Plastics (including Fibreglass) Manufacturing and Processing

46. Rail Yards, Tracks and Spurs
49. Salvage Yard, including automobile wrecking
52. Storage, maintenance, fuelling and repair of equipment, vehicles, and material used to maintain transportation systems
55. Transformer Manufacturing, Processing and Use
57. Vehicles and Associated Parts Manufacturing
58. Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners

The PCAs listed above are considered to be contributing to 16 Areas of Potential Environmental Concern (APECs) on the Site, as described in the following table (refer to Table 6-3 for PCA details):

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs (PCA Numbers indicated)	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
1	Southeast portion of fleet yard on the 330 Wentworth St N property	A 3,000-L spill of hydraulic oil occurred in 1997 at GSW Heating Products Co. (34)	On-Site	PHCs BTEX	Soil and Groundwater
2	Northwest edge of Site on the 80 Brant St property	10, 28, 32, 33, 39, 46, 49, 55, 57, and 58	Off-Site to the northwest	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater
3	Entire Site	30	On-Site	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater
4	West portion of Site on the 2 Hillyard St property	2, 28, 35, 39, 51, and 55	On-Site	M&I PHCs VOCs PCBs	Soil and Groundwater
5	Southwest corner of Site on the 2 Hillyard and 330 Wentworth St N properties	2, 5, 8, 11, 27, 28, 32, 33, 49, 52, and 55	Off-Site to the southwest	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater
6	Northwest corner on the 2 Hillyard and 80 Brant St properties	8, 10, 11, 28, 32, 33, 34, 43, 46, and 58	Off-Site to the west	M&I PAHs PHCs VOCs	Soil and Groundwater

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs (PCA Numbers indicated)	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
7	South portion of Site on the 330 Wentworth St N property	14	On-Site and Off-Site to the south	PHCs VOCs	Soil and Groundwater
8	Three existing or former lines on the Site	46	On-Site	M&I PAHs PHCs VOCs	Soil and Groundwater
9	Two areas on the 80 Brant St and 330 Wentworth St N properties	28	On-Site	PHCs VOCs	Soil and Groundwater
10	West portion of the 2 Hillyard St property	56	On-Site	M&I VOCs PHCs	Soil and Groundwater
11	Southcentral portion of Site on the 330 Wentworth St N property	22, 33, 34, and 55	On-Site	M&I PHCs VOCs PCBs	Soil and Groundwater
12	East edge of Site on the 330 Wentworth St N and 80 Brant St properties	8, 18, 28, 32, 34, 46, 55, and 57	Off-Site to the east	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater
13	North portion of Site on the 80 Brant St property	49 and 58	On-Site	M&I PHCs VOCs	Soil and Groundwater
14	Centre of Site on the 330 Wentworth St N property	48	On-Site	Inorganics	Soil and Groundwater
15	North and East portions of 330 Wentworth St N property	58	On-Site	M&I PAHs PHCs VOCs	Soil and Groundwater

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs (PCA Numbers indicated)	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
16	South portion of 330 Wentworth St N property	The oil-water separator for the floor drains of the off-Site 330 Wentworth St N Operations Center building is located on the Site (52)	On-Site	M&I PHCs VOCs	Soil and Groundwater

Based on the results of the investigation, the possibility exists that one or more contaminants may have affected land or water on, in or under the Site. A Phase II ESA is recommended to investigate the 16 APECs identified in this Phase I ESA.

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1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by the City of Hamilton (City) to conduct a Phase I Environmental Site Assessment (ESA) for the site of a proposed Hamilton Street Railway (HSR) Storage and Maintenance Facility, herein referred to as the Site. A Site Location Map is provided as Figure 1. The Site includes 2 Hillyard St, 80 Brant St, the former CP Rail tracks between Hillyard St and Birch Ave, and the fleet yard at 330 Wentworth St N, as shown on the Site Plan in Figure 2.

The 7.9-hectare industrial Site is irregular in shape and lies within a predominantly industrial land use area with some residential and commercial use. The Site is bounded to the north by Brant St and to the east by a hydro corridor along the west side of Birch Ave. Adjacent lands to the south are occupied by the City Operations Centre and Birch Avenue Dog Park, while Hillyard St and a scrap metal and waste company, Hotz Ferrous Inc., bound the Site to the west.

It is our understanding that the Phase I ESA is required for due diligence purposes prior to demolition and construction activities at the Site. There is no plan to change the land use at the Site. Given this, the Phase I ESA has been completed using the Canadian Standards Association (CSA) Standard Z768-01 Phase I Environmental Site Assessment and Ontario Regulation 153/04 as general guides. This report has not been prepared to support a Record of Site Condition application for the Site.

This report outlines the objectives and scope of the undertaking, summarizes the findings of the records review, interviews, and site reconnaissance, and provides conclusions and recommendations.

1.1 PROPERTY INFORMATION

Property information for the Site is provided in the table below.

Table 1-1 Property Information

CRITERIA	PHASE I PROPERTY INFORMATION
Current Site Owner	City of Hamilton
Site Representative	Shaba Shringi Project Manager, Facilities Corporate Assets and Strategic Planning Facilities Management & Capital Programs (FMCP) Public Works City of Hamilton 28 James Street North, 5th Floor Hamilton, ON L8R 2K1 Tel: 905-546-2424 ext. 3142 Email: shaba.shringi@hamilton.ca
Municipal Addresses	2 Hillyard St 80 Brant St part of 330 Wentworth St N (formerly 281 Birch Ave) railway lands (formerly Toronto Hamilton & Buffalo Railway Company)

CRITERIA	PHASE I PROPERTY INFORMATION
Property Identification Numbers (PINs)	17193-0018 (LT) 17193-0023 (LT) 17193-0034 (LT) 17193-0037 (LT) Part of 17193-0043 (LT)
Legal Descriptions	PT LT 10, CON 1 BARTON, AS IN NS129802 & NS260283; EXCEPT NS260284; HAMILTON PT LTS 9 & 10, CON 1 BARTON; PT LT WATER IN SHERMAN INLET, CON 1 BARTON, AS IN AB276680; HAMILTON PT LT 10, CON 1 BARTON, AS IN HA62174 EXCEPT PT 1, 62R6346; PT 1, 62R7445; PTS 1 & 6, 62R7479; BL1142; BL1200; NS68542; NS129802, NS260283; AB276680; & EXCEPT ALL LANDS DESCRIBED THEREIN LYING W OF HILLYARD ST AS ESTABLISHED BY BL1200 & BL1142 & ALL LYING W OF THE SLY PRODUCTION OF IT'S WLY LIMIT; S/T HA62174; HAMILTON PT LTS 9 & 10, CON 1 BARTON, AS IN HA71701; HAMILTON PART OF: CONSOLIDATION OF VARIOUS PROPERTIES: FIRSTLY: PT LTS 9 AND 10 CON 1 BARTON, PART 2 ON 62R8119; PT LT 9 CON 1 BARTON, PARTS 3, 4, 5, 6 AND 7 ON 62R8119; PT LT 10 CON 1 BARTON, PARTS 1, 2, 3, 4, 5, 6, AND 10 ON 62R7479 (PART 4 ON 62R7479 AKA ROSEMARY AVE) TERRA COTTA AVE (AS CLOSED BY CD431120) PT LT 10 CON 1 BARTON, PART 10 ON 62R8119; PT LT 10 CON 1 BARTON, PART 1 ON 62R7726; PT LT 10 CON 1 BARTON, PARTS 5 AND 6 ON 62R8613; S/T AND T/W CD304610 (EXCEPT THE EASEMENT THEREIN OVER PARTS 6 AND 7 ON 62R7479) S/T AND T/W CD416010; T/W HL321270, AB382978 AND VM52951: SECONDLY: PT LTS 9 AND 10 CON 1 BARTON, PART 1 ON 62R7445; EXCEPT PART 1 ON 62R7726; T/W CD308412 EXCEPT THE EASEMENT THEREIN OVER PART 2 ON 62R7445; HAMILTON

2 SCOPE OF ASSESSMENT

The Phase I ESA was performed in accordance with our offer of work presented in our proposal (number P16-11148-98) dated December 8, 2016, and approved by the City on December 12, 2016.

The primary purpose of the Phase I ESA was to:

- Assess whether current and/or former activities/operations at the Site and/or adjacent properties have adversely affected the Site from an environmental perspective;
- Identify issues of actual and/or potential environmental concerns, if any, related to historical and current land use; and,
- Provide a basis for subsequent investigation of the property based on the Phase I ESA findings, if required.

The Phase I ESA was conducted in general accordance with CSA Standard Z768-01 Phase I Environmental Site Assessment (2001) and Ontario Regulation 153/04 and included the following tasks:

- Records Review
- Interviews (& Correspondence)
- Site Reconnaissance
- Review and Evaluation of Information

3 RECORDS REVIEW

Below is a summary of the records review undertaken by WSP as part of this Phase I ESA.

3.1 GENERAL

The records review provides Site information regarding the physical setting, history of development, and land use in connection with the Site and adjacent properties. Information sources are summarized in the following table. An EcoLOG ERIS report was obtained for the Site and lands within a 250-m radius around the Site. A copy of the EcoLOG ERIS report is provided in Appendix B.

Table 3-1 Summary of General Records Review

SOURCE	RECORDS REVIEW RESULT
Phase I Study Area Determination	The Phase I Study Area for this undertaking included properties wholly, or partly, within 250 m of the Site boundary. Properties wholly beyond 250 m of the Site boundary were not added to the study area due to their distance from the Site. The Site and Phase I Study Area are shown in Figure 3.1.
Fire Insurance Plans (FIPs)	An Enviroscan report was requested through Opta. The report identified two sets of FIPs from 1916 and 1962, having partial coverage of the Site and the Phase I Study Area. The 1911 FIPs were available online through McMaster University Digital Archive. The FIPs are provided in Appendix E and potentially contaminating activities (PCAs) and other significant features identified on the FIPs are listed below. **1911 FIPs** • The Site is shown on the index map and map sheet 109. The majority of the Site is occupied by Sherman Inlet, which had not yet been infilled. • The Toronto Hamilton & Buffalo (TH&B) Railway Co line is shown running through the Site and across a bridge over one arm of Sherman Inlet. • The City Sewage Disposal Works with three settling tanks is shown on the south side of the TH&B railway tracks on the 2 Hillyard St property. • WA Freeman & Co Ltd Fertilizer Works is shown on the east side of the Site. Five iron oil tanks are shown on the property. • Canadian Oil Companies Ltd is shown on the southeast corner of the Site. Eighteen storage tanks are shown on the property. • Canadian Westinghouse Company Ltd is shown in the south portion of the Phase I Study Area. Buildings on the property include an oil house, an auto garage, a foundry, several machine shops, and a transformer house. Fuel is listed as coal and oil. A 149,000-gallon underground oil reservoir tank is shown.

SOURCE	RECORDS REVIEW RESULT
	• Burlington Steel Company is shown in the west portion of the Phase I Study Area. **1916 FIPs** • The Site is not covered by the available FIPs. • Railway lines owned to the TH&B Railway Co are shown to the south, west, and east of the Site. • Railway lines owned by the Grand Trunk Railway are shown to the north of the Site. **1962 FIPs** • The Niagara Paint and Chemical Co is shown on the Site at 2 Hillyard St. Three fuel oil tanks are shown on the north side of the building. One tank containing naphtha and one containing mineral spirits are shown on the south side of the building. • Railway lines owned by the TH&B Railway Co are shown crossing through the Site. • Railway lines owned by the Canadian National Railway are shown to the north of the Site. • A fuel tank is shown approximately 190 m west of the Site at Wilkinson-Kompass Ltd Hardware and Steel Mill Supplies. • Two fuel tanks are shown at a garage approximately 250 m north of the Site. • Two 10,000-gal (40,000-L) oil tanks are shown approximately 190 m north of the Site. • A fuel tank is shown approximately 60 m north of the Site • An auto body shop is shown at 66 Brant St, approximately 50 m northwest of the Site. • Allbright Platers Ltd (metal plating) is shown approximately 100 m northwest of the Site. • A tank of bunker oil is shown approximately 70 m east of the Site on the north side of the TH&B railway tracks. • Burlington Steel Co is located approximately 50 m east of the Site. Railway siding tracks and oil tanks are associated with these operations. • Brown Boggs Foundry & Machine Co is located approximately 200 m east of the Site. • Nasco Products Ltd, manufacturers of automotive clutches and plates, is shown approximately 170 m east of the Site.
Site Inspection Reports / Insurance Reports	Four inspection reports and/or site plan reports were identified for the Site through the Opta Enviroscan report. The reports are provided in Appendix E and are summarized as follows: → 1986 Site Plan Report for Niagara Paint & Chemical Company at 2 Hillyard St ▪ Two buildings are shown on the property: ▪ The east building is used for manufacturing, dispensing, storage, offices and a laboratory. Two 13,650-L above ground storage tanks (ASTs) containing resin are shown in the storage area, two alkyd resin ASTs and two 6,825-L open paint mixing tanks are shown in the manufacturing area. ▪ The west building is used for storage of resins and raw products. Three 27,300-L vertical ASTs containing alkyd resin are shown. ▪ Outside, to the north of the east building, there are seven underground storage tanks (USTs) shown, as follows: ▪ One 4,546-L UST containing reclaimed solvents

SOURCE	RECORDS REVIEW RESULT
	▪ One 4,546-L UST containing an unidentified liquid (appears to be labeled MEX) ▪ One 4,546-L UST containing oil ▪ One 27,300-L UST containing naphtha ▪ One 27,300-L UST containing mineral spirits ▪ One 27,300-L UST containing xylene ▪ One 36,3700-L UST containing toluene ■ Outside, to the south of the east building, there are five storage tanks shown, as follows: ▪ Three vertical ASTs containing linseed oil ▪ Two USTs containing naphtha and mineral spirits → 1989 Insurance Inspection Report for Niagara Paint & Chemical Company at 2 Hillyard St ■ Property is used for manufacture of paints, enamels and blending of varnish and shellac (no cooking of varnish) with retail and wholesale outlet. Mainly industrial and highway marking paints are manufactured. ■ A new underground tank farm has been built at the north side of the yard. The old tanks have been removed. Nine USTs are described on the property, as follows: ▪ 25,003 L of naphtha ▪ 25,003 L of varsol ▪ 27,300 L of xylene ▪ 35,004.2 L of toluene ▪ 15,911 L of "Solvesso 100" ▪ 15,911 L of isopropyl alcohol ▪ 15,911 L of reclaimed solvent ▪ 13,650 L of gasoline ▪ 13,650 L of fuel oil ■ Naphtha, mineral spirits (varsol), xylene and toluene are pumped from the USTs in the north yard and dispensed in the mixing area in the east building. ■ Transformers on the property are listed as PCB-filled. ■ Approximately fifty (50) 204.8-L drums of various flammable liquids and solvents including methyl isobutyl ketone and methyl ethyl ketone are stored at the south end of the west building. ■ Large quantities of in-process paints are stored in open vats (227.5 L to 2,275 L). ■ One hundred (100) 4.6-L closed metal containers of low flash point flammable liquids and solvents are stored in the laboratory. ■ Approximately 45,500 L of finished paint in sealed metal containers ranging from 1.1 L to 22.7 L are stored in the east building warehouse areas. ■ One hundred (100) 204.8-L drums of paint are stored outdoors awaiting shipment. ■ Three 27,300-L vertical ASTs of alkyd resin having a toluene solvent are kept in the west warehouse building.

SOURCE | **RECORDS REVIEW RESULT**

- Two 13,650-L resin tanks (mineral spirit solvent) are kept in the manufacturing area in the east building.
- The storage area of the east building has two 11,355-L tanks of resin.

→ 1990 COPE Report for Niagara Paint & Chemical Company at 2 Hillyard St

- This report does not contain any new information regarding potential environmental concerns related to the property.

→ 1993 Inspection Report for Niagara Paint & Chemical Company at 2 Hillyard St

- This report identifies the same items as the 1989 Inspection Report with a few minor changes to storage tank volumes reported.

Chain of Title

Historical chain of title reports for 80 Brant St, 2 Hillyard St, and 330 Wentworth St N were ordered through Domson's Title Search Inc. Electronic chain of title reports were ordered for the two railway parcels. The reports are provided as Appendix E. Owners of the properties dating back to 1875 are summarized as follows:

80 Brant St

TIME PERIOD	SITE OWNER
pre-1875	Sheriff of Wentworth
1875-1895	Individual owners (J.L. Englehart, F. Rowlin, W.A. Freeman, J. Plant)
1895-1912	The W.A. Freeman Company Ltd.
1912-1917	Toronto Dwellings Ltd.
1917-1933	Toronto Niagara and Western Railway Co.
1933-1947	Canadian National Realties Ltd.
1947-1958	Samuel Lax, Samuel Lax & Sheridan Lax
1958-2000	Sheridan Warehousing Ltd.
2000-2008	Slater Industries Inc., Slater Steel Inc.
2008	Hamilton Specialty Bar Inc.
2008-2015	ZBX Hamilton Lands Inc.
2015-present	City of Hamilton

2 Hillyard St

TIME PERIOD	SITE OWNER
pre-1875	Sheriff of Wentworth
1875-1895	Individual owners (J.L. Englehart, F. Rowlin, W.A. Freeman, J. Plant)
1895-1924 (part 1) 1895-1945 (part 2)	The W.A. Freeman Company Ltd.
1924-1947 (part 1)	Corporation of the City of Hamilton
1945-1955 (part 2)	Duro Aluminium Ltd
1947-2002 (part 1) 1955-2002 (part 2)	Niagara Paint and Chemical Company Ltd.
2002-present	1521020 Ontario Inc.

SOURCE	RECORDS REVIEW RESULT

330 Wentworth St N (formerly 281 Birch Ave)

TIME PERIOD	SITE OWNER
pre-1875	Sheriff of Wentworth
1875-1895	Individual owners (J.L. Englehart, F. Rowlin, W.A. Freeman, J. Plant & R. Gage)
1895-1945	The W.A. Freeman Company Ltd.
1945-1985	Duro Aluminium Limited
1985-1998	GSW Inc
1998-present	Regional Municipality of Hamilton-Wentworth

Environmental Reports

Six previous reports pertaining to the Site were provided to WSP by the City of Hamilton.

The reports were reviewed by WSP and the salient points are provided below.

Report Title:	Environmental Site Characterization, GSW Heating Products Company, 281 Birch Avenue, Hamilton, Ontario
Date:	August 1998
Author:	Conestoga Rovers & Associates (CRA)
Report completed for:	GSW Heating Products Company

Relevant findings:

The report was prepared for the property owner prior to selling the property. The investigation consisted of a review of historical site assessment information, an assessment of potential areas of concern, risk analysis and discussion of mitigative measures. Based on their review, CRA identified ten areas of concern on the Site, as follows:

- Area 1 – PAH and metal contaminated fill was used to infill the former Sherman Inlet of Hamilton Harbour
- Area 2 – Elevated concentrations of zinc in soil from former galvanizing operations
- Area 3 – Former drum storage area for paints and chemicals
- Area 4 – Elevated metals concentrations in soil along the western property edge
- Area 5 – Free product and PHC impacted area in southeast corner of property
- Area 6 – Possible impacts to soil and/or groundwater in the vicinity of an existing AST
- Area 7 – Possible impacts to soil and/or groundwater in the vicinity of two former USTs
- Area 8 – Former railway spur line
- Area 9 – TCE impacts to groundwater were observed near the southwest property boundary
- Area 10 – Elevated metals concentrations in soil beneath the former plant building footprint

Report Title:	Free Product Investigation – Area 5, 330 Wentworth St N, Hamilton (formerly 281 Birch Ave)
Date:	April 2006
Author:	Dillon Consulting Limited
Report completed for:	City of Hamilton

SOURCE	RECORDS REVIEW RESULT

Relevant findings:

The environmental subsurface investigation was carried out in the fleet yard area (designated Area 5) of the Hamilton Operations Centre at 330 Wentworth St N. The municipal address of this area was formerly 281 Birch Ave. The purpose was to further define the extent of light non-aqueous phase liquid (LNAPL) product, which had been observed in the shallow groundwater wells during previous investigations at the site. The source of LNAPL is not confirmed but is believed to be from oil contaminated fill and peat, which was used to fill in Sherman Inlet, now the site, in the early 1900s.

Eleven monitoring wells were used to measure groundwater and LNAPL levels. Free product thickness ranged from none measured to just over 1 m. LNAPL was detected in the majority of the wells including the perimeter wells. The LNAPL thickness in the majority of perimeter wells and all down-gradient wells was less than 1 cm. The approximate centre of the plume is in the vicinity of BH32, located on the east property line. The known extent of the LNAPL covers an area of approximately 2,800 m^2, however the limits of the LNAPL plume have not been delineated. Off-site impacts to the adjacent Hydro One corridor lands and Birch Ave are anticipated. The estimated volume of LNAPL in the subsurface is 3,000 L.

It was recommended that the LNAPL be remediated using a combination of soil excavation and installation of recovery trenches that could be skimmed periodically. Following remediation, a risk assessment approach was recommended to confirm that the residual petroleum contamination does not represent a concern for human health and the environment.

Note: Although not referenced in Dillon Consulting's report, there is an Ontario Spill record from 1997 that states approximately 3,000 L of hydraulic oil was spilled to the asphalt at GSW Heating Products Company at 281 Birch Ave. This could be the source of the LNAPL observed at the Site. The spill record is included in Section 3.2.

Report Title:	Draft Phase I Environmental Site Assessment, Slater Steel Inc. – Hamilton Specialty Bar, 319 Sherman Avenue North, Hamilton, Ontario
Date:	December 2003
Author:	Conestoga Rovers & Associates (CRA)
Report completed for:	Slater Steel Inc.

Relevant findings:

The report was prepared for the Hamilton Specialty Bar facility, which was comprised of five parcels, as follows: Central parcel, Kennametal parcel, Brown Boggs parcel, Bowser parcel, and Scrap Yard parcel. The Scrap Yard parcel is located at 80 Brant St, on the Site. The other four parcels are located east of the Site within the Phase I Study Area. The Phase I ESA was conducted for refinancing purposes.

The report describes several ASTs, USTs, spills, and releases on the four off-Site parcels. It also notes that previous investigations on the Brown Boggs parcel identified metals, PAHs, chlorinated solvent (TCE), and petroleum hydrocarbon contamination in the soil.

The Scrap Metal parcel is described as being used for receiving, sorting, and maintaining an inventory of scrap metal for the melting operations. Approximately ten defined and sorted piles of scrap metal were present on the Site in 2003. Oil staining was observed on the ground surface around the piles of scrap metal. One active 500-gal diesel AST was present on the western portion of the Scrap Yard parcel.

Report Title:	Draft Phase I Environmental Site Assessment, 80 Brant Street, Hamilton, Ontario

SOURCE	RECORDS REVIEW RESULT
	Date: January 22, 2015 Author: G2S Environmental Consulting Inc. Report completed for: Rosenbaum & Frank LLP Relevant findings: The Phase I ESA was conducted for due diligence purposes. The property was owned by ZBX Hamilton Lands Inc. It is described as a former scrap metal yard that has been vacant since 2013. An inactive rail spur runs from the southeast corner to a scale located in the south central portion of the property. The property was formerly part of the Sherman Inlet, which was infilled in the 1920s. The report recommended a Phase II ESA be conducted to investigate the following APECs: → Historical use as a scrap metal yard including the presence of a 2,200-L diesel AST and a rail spur on the property. → The adjacent property to the north was previously occupied by Transport Oil Ltd and Myers Fuel Oils and included four oil tanks on the south side of the property. Currently used by Hotz Environmental for latex paint recycling. → The adjacent property to the south at 330 Wentworth St N was in use by City of Hamilton Fleet Services and included five USTs. The property was formerly used by a metal fabrication facility including nine storage tanks. Prior to that a fertilizer manufacturer operated on the property. → The adjacent property to the south at 2 Hillyard St was occupied by the Niagara Paint and Chemical Company. → The property at 3 Hillyard St (approximately 40 m southwest) was used for metal fabrication, waste processing and a commercial trucking facility including a UST. → The property at 6 Hillyard St (approximately 40 m west) was used for an auto repair shop, a commercial trucking facility and a cleaning products company. → The property at 319 Sherman St (approximately 65 m southeast) was used for an iron and steel manufacturing and processing facility, PCB storage site and hazardous waste generator. → The property at 350 Wentworth St (approximately 100 m southwest) was used for a coal tar distillation plant, a commercial auto body shop, metal fabrication, and a commercial trucking facility. Report Title: Draft Phase II Environmental Site Assessment, 80 Brant Street, Hamilton, Ontario Date: February 6, 2015 Author: G2S Environmental Consulting Inc. Report completed for: Rosenbaum & Frank LLP Relevant findings: The Phase II ESA was conducted for due diligence purposes following the recommendation of the Phase I ESA. Nine boreholes were advanced on the property, six of which were completed as groundwater monitoring wells. Fill materials consisting of concrete, slag, wood, and foundry sand were encountered in all of the boreholes. The fill extended to depths ranging from 2.4 m on the west side of the property to greater than 9.6 m in the central/north section of the

SOURCE	RECORDS REVIEW RESULT

property. Native soil beneath the fill consisted of clayey silt to silty clay with organic material. Shallow groundwater was observed between 1.78 and 4.68 mbgs.

Soil and groundwater quality were compared to the MOECC Table 3 Site Condition Standards (SCS) for Industrial/Commercial/Community Property Use with coarse textured soils. The following exceedances were noted:

- → Soil samples from five of the boreholes and groundwater samples from six of the monitoring wells contained concentrations of PHC F2 and/or PHC F3 exceeding the MOECC Table 3 SCS.
- → Soil samples from eight of the boreholes contained metals at concentrations exceeding the MOECC Table 3 SCS including arsenic, cadmium, chromium, copper, lead, molybdenum, nickel, vanadium, and zinc.
- → Soil samples from three of the boreholes and groundwater samples from two of the monitoring wells contained PAHs at concentrations exceeding the MOECC Table 3 SCS.

Concentrations of PCBs and VOCs in the submitted soil and groundwater samples met the MOECC Table 3 SCS. Concentrations of metals parameters in the groundwater samples met the MOECC Table 3 SCS.

Report Title:	Stage 1 Archaeological Assessment Background Study and Property Inspection, Hamilton RT B-Line Maintenance and Storage Facility and Associated Spur Line Corridor, Class Environmental Assessment Study, Former Township of Barton, Wentworth County, City of Hamilton, Ontario
Date:	February 5, 2013
Author:	Archaeological Services Inc.
Report completed for:	Hatch Mott MacDonald
Relevant findings:	

The Stage 1 archeological assessment was conducted as part of an environmental assessment for the proposed HSR storage and maintenance facility. The study area for the assessment included the Site and adjacent lands to the west and south. The results of the assessment found that the study area did not retain archaeological potential and no further assessment was recommended.

The archeological assessment report includes a detailed history of the Site and settlement in the area. The report describes Sherman Inlet in the late 1800s as a space for recreation as well as habitats for plant and animal life. In the 1920s, swimming areas were closed due to extensive pollution in Hamilton Harbour and its inlets caused by the industry located along and in close proximity to the waterfront. During this period large-scale landfill projects in Hamilton Harbour and Sherman Inlet were approved.

City Directories

Hamilton, Ontario is listed from 1888/89 to 2011 within the City Directory Archives. The Vernon's Hamilton, Ontario, City Directory listings were reviewed at 5-year intervals as part of this assessment. The following listings were provided for the Site:

2 Hillyard St

TIME PERIOD	LISTING
2011	CES Engineering Services

SOURCE	RECORDS REVIEW RESULT	
		Pioneer Waterproofing Dynasty Chiropractic Equipment Corporation Pioneer Home Improvements
	2005/06	Carriere Innovation
	2000/01	Welco Castings Inc
	1975-1995/96	Niagara Paint & Chemical Company
	1961-1970	Niagara Paint & Chemical Company Barber Die Casting Co Ltd
	1904-1955	Address not listed

80 Brant St

TIME PERIOD	LISTING
2011	Brant Hill Recycling
1980-1995/96	Address not listed
1980-1985	Lax Iron & Steel Ltd Sheridan Warehousing Ltd Lax Machine Ltd Bal Harbour Developments Grand Valley Steel Ltd
1975	Lax Iron & Steel Ltd Sheridan Warehousing Ltd Lax Machine Ltd Bal Harbour Developments
1966-1970	Lax Iron & Steel Ltd Sheridan Warehousing Ltd Lax Machine Ltd
1955-1961	Lax Iron & Steel Ltd Sheridan Warehousing Ltd
1950	Lax Iron & Steel Ltd
1904-1945	Address not listed

330 Wentworth St N

TIME PERIOD	LISTING
2011	Darts
2005/06	City of Hamilton Fleet Services
1995/96-2000/01	Hamilton Street Railway Company Safety Service & Adjusters Ltd
1990	Hamilton Street Railway Company Safety Service & Adjusters Ltd Hamilton Wentworth Transit Committee Canada Coach Lines Limited The Fun Trek Tours & Charters
1985	Posner Metals Ltd Specalum Metals Ltd
1970-1980	National Sewer Pipe Ltd Canadian Construction Materials Ltd

SOURCE	RECORDS REVIEW RESULT	
	1955-1965	National Sewer Pipe Ltd
	1882/83-1950	Address not listed

281 Birch Ave (previously known at Terra Cotta Ave (c. 1901-1940s), now part of 330 Wentworth St N)

TIME PERIOD	LISTING
2000/01-2011	vacant
1990-1996/97	GSW Heating Products Company
1985	GSW Building Products Company
1975-1981	GSW Metalwares Division
1931-1971	Duro Alum Ltd, Duro Metalwares Ltd
1911-1946	Canadian Oil Companies Ltd
1901-1906	Sun Oil Works
1901-1926	Freeman Works / Freeman Fertil-Zers
1901-1921	Hamilton & Toronto Sewer Pipe Co
1901-1911	Stroud's Cattle Sheds
1901	Lawry & Son, Pork Packers
1894/95	Street not listed

The following listings of potential environmental concern were identified within the Phase I Study Area. The corresponding PCA number is provided in parentheses.

ADDRESS	TIME PERIOD	LISTING (PCA No.)
410 Birch Ave	1955-1965	Vervack, Vic, Garage (27)
58 Brant St	1955-1961	Allbright Platers Ltd (33)
62 Brant St	1950-1995/96	Veterans Salvage (49)
66 Brant St	1966	Empire Auto Body (10)
	1985	Ed's Autobody (10)
70 Brant St	1975-1995/96	Pettinos George Ltd (32)
71 Brant St	1945	Morrison Ice & Fuel (28)
74 Brant St	1961	Myers Fuel Oil (28)
77 Brant St	1961-1975	Moody Fuels Ltd (28)
171 Brant St	1965	Consteel Setting Co. (34)
	1965	J Harris & Son Ltd (34)
	1965-1970	Ellis, Geo, Cartage Co Ltd (11)
	1970-1985	Payload Carriers Ltd (11)
	1975-1980	Thompson Bill Transport Ltd (11)
	1985	Ryder Truck Lines (11)
	1975	W & L Welding & Fabricating Ltd (34)
	1990	Philip Enterprises Inc (49, 58)
	2011	Hotz Ferrous Inc (58)
237 Brant St	1985	Philip Enterprises Inc (49, 58)
601 Burlington St E	1960-1980	International Harvester Co Ltd (34)
	1985	Bay City International Trucks (parts & serv.) (27)
	1995/96	Smith Fuels (28)
	2005/06	Sunoco Inc (28)
95 Earl St	1980-2011	Rudy's Auto Service (27)
1 Gerrard St	1970-2005/06	D'Angelo Auto Body & Painting (10)
250 Gibson Ave	1970-1980	Cottone Collision Service (10)
	1985-2011	Maple Collision (10)

SOURCE	RECORDS REVIEW RESULT		
	252 Gibson Ave	1955-1970, 1990-2000/01	Can Desmond-Stephan Manufacturing Co Ltd (34)
	3 Hillyard St	1970-1980	Automatic Cutting & Finishing Limited (33, 34)
		2000/01-2011	Plaza Integrated Environments Ltd (58)
		2005/06-2011	T M Steel Fabrication (34)
		1961	Hanover Transport Ltd (11)
		1966	Argosy Carriers Ltd (11)
		1990	Raybo Cutting Inc. (34)
	5 Hillyard St	1990-2011	R C Auto Collision (10)
	6 Hillyard St	2011	Hotz Environmental Services (58)
	9 Hillyard St	2000/01-2005/06	Amcan Castings Limited (57)
	10 Hillyard St	1980-2005/06	Amcan Castings Limited (57)
	17 Hillyard St	1966-1970	Mosseley Cartage Ltd (11)
	55 Hillyard St	1980-2005/06	Whitfield Welding & Fabricating (34)
		2000/01-2011	Gary's Auto Repair (27)
		2011	Dal Bello Auto Service (27)
		1985-1995/96	Hoffman Cartage (11)
	66 Hillyard St	1961-2011	Benny Haulage Limited (11)
		1985-2011	Hamilton Bulk Transport Ltd (11)
	15 McKinstry St	1975	Sportsmen Autobody (10)
	30 Milton Ave	1980-1990	Westinghouse Canada Inc (Plant Entrance) (19)
		1995/96-2011	Siemens Westinghouse Inc (Turbine Facility) (19)
	44 Munroe St	2000/01	IMCO Industrial & Marine Coating Inc (8)
		2005/06	JMC & B Technologies Inc (8)
	46 Munroe St	2005/06-2011	RRD Welding & Fabrication (34)
	54 Munroe St	1950-2011	John Kenyon Ltd (33)
	64 Munroe St	1965	Julius Auto Body (10)
		1970	Rapid Auto Body (10)
		1975	Munro Auto Body (10)
		1980	Alpine Auto Collision (10)
	34 Niagara St	1975	Rapid Auto Collision (10)
		1961-1970	Moselet Cartage Ltd (11)
	42 Niagara St	1975	Metal Textile of Canada (34)
		1980-1995/96	Gencab of Canada (34)
		2011	JBS Manufacturing Ltd (34)
		2011	Ontario Orthotic Lab Inc (43)
	275 Sherman St N	1955-1995/96	Brown Boggs Foundry & Machine Co Ltd (32, 34)
		2000/01-2005/06	Metcan Industrial Corp (8)
		2011	Tube City Ims Canada Ltd (32)
	319 Sherman St N	1955-1980	Burlington Steel Co Ltd (32)
		1985-2005/06	Slater Steels Corp (32)
		2011	Hamilton Specialty Bar (32)
	371 Sherman St N	1945-1975	Kennametal Tools & Manufacturing Co. (33,34)
		1980	Burlington Steel Co (32)
		1985	Slater Steels Corp (32)
		2011	Hamilton Specialty Bar (32)
	340 Wentworth St N	2011	Travale Tires & Service (27)
	350 Wentworth St N	1980-1995/96	Currie Products Ltd (5)
		1985, 1995/96	St Lawrence Resin Products Ltd (2)
		1985-1990	Marshall Refractories Canada (32)
		1995/96	Hepworth Refractories (Canada) Ltd (32)
		2000/01	Brander Trucking (11)
		2005/06	IMCO Technologies Inc (8)
		2005/06	Cristiano Transport Inc (11)
		2005/06-2011	Tirecraft Auto Centre (27)

SOURCE	RECORDS REVIEW RESULT		
		2005/06	Travale Tires & Service (27)
		2000/01-2005/06	Protective Barriers Inc (5)
	360 Wentworth St N	2011	Anuradha Singh Trucking Co (11)
	400 Wentworth St N	2000/01	Advantage Steel (34)
		2005/06-2011	Pointe-Claire Steel (34)
		2011	Stoney Creek Mould Ltd (43)
	404 Wentworth St N	1995/96	Raybo Cutting Inc (34)
		2011	Nicayne Metal Processing Ltd (34)
	466 Wentworth St N	1995/96-2011	Wentworth Truck Repair & Alignment (27)
	468 Wentworth St N	1980	Quality Transmission & Repairs (27)
		1980-1985	Mel's Auto Body / M & R Auto Body (10)

3.2 ENVIRONMENTAL SOURCE INFORMATION

Table 3-2 Summary of Environmental Records

SOURCE	RECORDS REVIEW RESULT
City of Hamilton	A request was sent to the City of Hamilton Public Works Department on January 18, 2017 for copies of any geotechnical and geo-environmental reports pertaining to the Site or lands located within 250 m of the Site. The City responded on February 13, 2017, that they had eight geotechnical reports and four environmental reports located in whole or in part within our area of interest. Copies of the reports were provided to WSP for review and the salient points are summarized as follows: → The geotechnical investigations were completed within the Phase I Study Area between 1963 and 1997. → The geotechnical borehole logs identify mixed fill including brick, wood, tins, cinders, ashes, and glass, overlying a peat layer in some areas. The native soil is generally described as silty clay. → Phase 1 and Phase 2 environmental investigations were completed for a section of Burlington St E. An oil warehouse, drum cleaning facility, USTs and a former scrapyard were identified on the south side of Burlington St E between McKinstry St and Birch Ave. This area was also identified as a former landfill site. The property is now occupied by Air Liquide Canada Inc at 680 Burlington St E. → Phase 1 and Phase 2 Environmental Site Assessments were conducted at 460 Wentworth St N, approximately 200 m west of the Site. Soil and groundwater samples were submitted for analysis of metals, PAHs, VOCs, and PHCs. All of the samples met the applicable 2004 site condition standards.
EcoLOG ERIS Complete Database Report	WSP obtained an EcoLOG Environmental Risk Information Service (ERIS) Standard Report for the Phase I Study Area. The ERIS report tabulates the results of a search of provincial, federal, and private source databases which are considered relevant in the identification of potential environmental risks associated with the Site. The ERIS report identified 29 records for the Site and 541 records within the Phase I Study Area. A copy of the ERIS report is included in Appendix B and the results are summarized in the sections below.
National Pollutant Release Inventory (NPRI)	The ERIS report identified eight NPRI records on the Site and 54 NPRI records within the Phase I Study Area. The records identify the following compounds potentially being released into the environment: **On-Site**

SOURCE	RECORDS REVIEW RESULT
	→ Xylenes, toluene, isopropyl alcohol, n-Butyl alcohol, chromium, and lead at 2 Hillyard St (Niagara Paint Inc). → Xylenes at 281 Birch Ave (GSW Heating Products Company). **Within the Phase I Study Area** → Copper, lead, manganese, nickel, zinc, iron, tin, sulphuric acid, sulphur dioxide, carbon monoxide, carbon dioxide, ferric oxide, methane, VOCs, nitrogen oxides, PM10, PM2.5, and HFC-134a at 10 Hillyard St, 50 m northwest of the Site (Amcan Castings Ltd). → Chromium, PM10, and PM2.5 at 70 Brant St, adjacent to the west of the Site (SunOpta and Stake Technology Ltd). → Manganese at 44 Munroe St, 100 m west of the Site (Russel Metals). → Carbon monoxide, methane, sulphur dioxide, calcium fluoride, acenaphthylene, nitrogen oxides, hexachlorobenzene, ethylene glycol, aluminum oxide, phosphorus, molybdenum trioxide, arsenic, zinc, cadmium, chromium, copper, cobalt, lead, manganese, nickel, mercury, vanadium, dioxins and furans, HFC-134a, PM10, PM2.5, and VOCs at 319 Sherman Ave N, 40 m east of the Site (Slater Steels and Hamilton Specialty Bar). → Chromium, nickel, iron, methyl isobutyl ketone, methyl ethyl ketone, toluene, xylenes, methane, HFC-134a, aluminum oxide, nitrogen oxides, carbon dioxide, carbon monoxide, sulphur dioxide, MSG#1 - Heavy alkylate naphtha, PM10, PM2.5, and VOCs at 30 Milton Ave, 130 m south of the Site (Siemens Westinghouse).
PCB Inventories	The ERIS report identified seven National PCB Inventory (NPCB) records for the Site and 26 NPCB or OPCB (Inventory of PCB Storage Sites) records within the Phase I Study Area. The records are summarized as follows: **On-Site** → Three askarel-containing capacitors are listed as in-use by the Niagara Paint and Chemical Co, located at 2 Hillyard St. → Twleve askarel or pyranol-containing capacitors are listed as in-use by the GSW Heating Products Company, located at 281 Birch Ave. **Within the Phase I Study Area** → Five transformers, three barrels of mineral oil, and 27 capacitors are listed as being stored for disposal by the Hamilton Street Railroad, located at 330 Wentworth St N, adjacent to the south of the Site. → One drum of PCB-containing ballasts and eight capacitors are listed as being stored for disposal by Amcan Castings Ltd, located at 10 Hillyard St, adjacent to the west of the Site. → In the 1990s and early 2000s, over 1,200 drums, transformers, and capacitors containing PCBs are listed as being either in-use or stored for disposal by Siemens Westinghouse, located at 30 Milton Ave, 130 m south of the Site. The PCB-containing materials are described as contaminated soils, ballasts, askarel, mineral oils, or inerteen, which was the Westinghouse trade name for an askarel consisting of approximately 60% PCB (Aroclor 1260) and 40% trichlorobenzene.
Certificates of Approval (CA), Environmental Compliance Approvals (ECA), Environmental Activity and Sector	The ERIS report identified one CA record for the Site and one EASR, four ECA and 23 CA records within the Phase I Study Area. No PTTW or CPU records were identified within the Phase I Study Area. The CA record registered to the Site was issued in May 2000 to Welco Castings Inc, located at 2 Hillyard St. The approval is for installation of a fume and dust control system discharging emissions to atmosphere from a lead smelting operation. Production equipment at this facility

SOURCE	RECORDS REVIEW RESULT
Registry (EASR), Permits To Take Water (PTTW) and Certificates of Property Use (CPU)	comprises metal smelting furnaces complete with ingot molds and auxiliaries, an extruding machine and a finished product bake oven. The EASR, ECA and CA records within the Phase I Study Area pertain to operations and activities that were identified previously through other information sources. No new PCAs were identified through a review of these records.
Inventory of Coal Gasification Plants and Coal Tar Sites	The ERIS report identified one Coal Tar Site record within the Phase I Study Area. The record pertains to Currie Products Ltd, which operated a coal tar distillation plant from 1978 to the late 1990s at 350 Wentworth St N, approximately 90 m west of the Site. The record notes that tar tank storage and distilling/processing facilities are located at the rear (east) of the building.
Records of Environmental Incidents, Orders, Offences, Spills, Discharges of Contaminants or Inspections	The ERIS report identified one TSSA Incident record and one Ontario Spills record on the Site, as follows: → TSSA conducted an inspection following an explosion at 80 Brant St involving cutting torches being used with propane and oxygen. No further details were provided. → In 1997, approximately 3,000 L of hydraulic oil was spilled to the asphalt at GSW Heating Products Company at 281 Birch Ave. The ERIS report identified one TSSA Incident record, one TSSA Pipeline Incident record, two Orders, and 29 Ontario Spills records within the Phase I Study Area. The TSSA records pertain to strikes on natural gas pipelines at 350 Wentworth St N and at 5 Hillyard St. The Orders were issued in 2010 and 2013 under the Environmental Protection Act. The Orders, issued to 350 Wentworth St N, are for preventative measures and for removal of waste and restoration of the property. The Ontario Spills records were reviewed and the following spills were deemed to have the potential to impact soil and/or water within the Phase I Study Area: → Latex sludge was spilled to ground surface at 6 Hillyard St in 2012 → Barium-containing hazardous waste was spilled to ground surface at the corner of Birch Ave and Brant St in 2004 → 220 L of hydraulic oil was spilled to ground surface at 3 Hillyard St in 2004 → A 50-lb cylinder of hydrogen chloride gas leaked in 2008 at 330 Wentworth St N → 250 L of hydraulic oil was leaked to ground at 330 Wentworth St N in 1988 → 250 L of hydraulic oil was leaked to ground at 77 Brant St in 1991 → 181 L of diesel fuel was spilled to ground at 171 Brant St in 1991 and 1992 → 8,000 L of molten aluminum was spilled to ground at 9 Hillyard St in 2007 → 20 L of nitric acid was spilled to ground at 10 Hillyard St in 1997 → 80 L of gasoline was spilled to the storm sewer at 680 Burlington St E in 1991 → 25 L of gasoline was spilled to ground at 33 Princess St in 1991 → 250 L of diesel fuel was spilled to ground at 350 Wentworth St N in 1988 → 4,000 L of tar was spilled to ground at 350 Wentworth St N in 2004 → 135 L of hydraulic oil was spilled to ground at Brant St off Sherman Ave N in 1993

SOURCE	RECORDS REVIEW RESULT
	→ 23 L of hydraulic oil was spilled to ground at 237 Brant St in 1991 → 150 L of diesel fuel was spilled to ground at 237 Brant St in 2006 → 40 L of hydraulic oil was spilled to ground at the intersection of Princess St and Milton St in 1998 → 2 tonnes of calcium hydroxide was spilled to ground at Burlington St E and Birch Ave in 1989 → An unspecified amount of diesel fuel was spilled to ground at Burlington St E and Birch Ave in 1993 → 50 L of unspecified solvent was spilled to ground surface at the Westinghouse Plant on Myler St in 1989 → 45 L of lubricating oil was spilled to the road surface at 30 Milton Ave in 1995 Freedom of Information (FOI) requests were submitted to the Ministry of the Environment and Climate Change (MOECC), requesting information pertaining to environmental incidents, orders, offences, spills, discharges of contaminants, or inspections at the following addresses: 2 Hillyard St, 330 Wentworth St N, 80 Brant St and 281 Birch Ave. At this time, records have been provided by the MOECC for the 2 Hillyard St, 80 Brant St, and 281 Birch Ave properties. The records include O. Reg. 347 Waste Generator registration details, ECAs, Material Safety Data Sheets (MSDS) for chemicals used at 281 Birch Ave, and previous environmental investigation reports for 281 Birch Ave, which had already been provided to WSP by the City. The records provided by MOECC have not identified any new potentially contaminating activities or environmental concerns at the Site, however the records pertaining to 330 Wentworth St N have not yet been received. If the outstanding records identify any new environmental concerns at the Site, then WSP will provide this information to the City. Copies of the MOECC's responses are provided in Appendix D or maintained on file.
O. Reg. 347 Waste Generators and Receivers Summary Records	The ERIS report identified 17 waste generator records for the Site and 178 records within the Phase I Study Area. The Site records pertain to activities and operations that have been previously identified through other sources. No new PCAs were identified on the Site as a result of the waste generator records. The records identified the following PCAs within the Phase I Study Area (PCA number indicated in parentheses), which had not been previously identified through other sources: → Canadian Waste Services Inc and Philip Enterprises Inc operated a waste transfer facility at 77 Brant St (58) → Westglen Truck Systems operated a commercial trucking company at 171 Brant St (11) → LEC Steel & Wire Inc operated a wire mesh manufacturing company at 44 Munroe St (34) → Modern Elevator Innovations Inc operated an elevator manufacturing company at 410 Wentworth St N (34) → Dennis Alfred Rodgers Salvage operated at 61 Princess St (49) → AZZ Blenkhorn & Sawle Ltd operate a metal coating and treatment company at 20 Myler St (33) The ERIS report identified 22 waste receiver records within the Phase I Study Area. The records refer to the waste transfer facilities that operated at 6 Hillyard St, 77 Brant St, and 237 Brant St. One waste receiver record was also identified for the 330 Wentworth St N property on the Site.

SOURCE	RECORDS REVIEW RESULT
Ministry of the Environment and Climate Change Waste Disposal Inventory	The ERIS report identified one record of a waste disposal site record on the Site and 15 records within the Phase I Study Area. The record pertaining to the Site indicates that from 1915 to 1942 the East End Dump, also referred to as the Brant St Dump, operated on the Site. The 1927 air photo, provided as Figure C1, Appendix C, appears to confirm that the 80 Brant St property was a landfill. The records within the Phase I Study Area identify waste transfer stations at 6 Hillyard, 3 Hillyard St, 77 Brant St, and 237 Brant St and a closed waste disposal site at Birch Ave and Burlington St.
Records of Fuel Storage	The ERIS report identified 11 records of TSSA Expired Facilities and 20 records of current or historic fuel storage tanks within the Phase I Study Area. The TSSA Expired Facilities records pertain to the following properties: → Philip Enterprises Inc at 171 Brant St → Boggs Foundry & Machine Co Ltd at 275 Sherman Ave N → Carter Welding Supplies at 605 Burlington St E (listed as a former propane refill outlet) The fuel storage tank records pertain to the following properties: → Boiler Pump & Marina Works Ltd at 3 Hillyard St - private gasoline outlet with a 9,092-L single-walled steel underground storage tank (UST) installed in 1981, listed as active in 2008 → Philip Enterprises Inc at 171 Brant St – private fuel outlet with two or three 45,460-L single-walled steel USTs installed in 1989, listed as active in 2008 → Air Liquide Canada Inc at 680 Burlington St E – private fuel outlet with one 45,460-L single-walled fibreglass-reinforced polymer (FRP) diesel UST and one 9,096-L single-walled FRP gasoline UST, listed as active in 2008 → City of Hamilton Fleet Services at 330 Wentworth St N – private fuel outlet with four 50,000-L diesel USTs and one 25,000-L gasoline UST, USTs are single-walled and were installed in 1988, listed as active in 2008 → Rudy's Auto Service at 95 Earl St → General Cable Corporation at 42 Niagara St – listed one abandoned UST An information request was submitted to the TSSA for any records of existing or historical fuel tanks at the Site and select properties within the Phase I Study Area. The TSSA had the following records on file: → 171 Brant St - 1 active liquid fuel tank → 680 Burlington St E - 2 active liquid fuel tanks → 330 Wentworth St N - 5 active liquid fuel tanks
Environmental Registry	The ERIS report identified two Environmental Registry (EBR) records for the Site and 21 records within the Phase I Study Area. The records pertaining to the Site are summarized as follows: → Welco Castings Inc at 2 Hillyard St, for approval of discharge to air related to lead smelting operations → ZBX Hamilton Inc and Dreher Investments Inc at 80 Brant St, for approval of discharge to air from welding fumes related to operations at a scrap metal recycling facility

SOURCE	RECORDS REVIEW RESULT
	The Environmental Registry records within the Phase I Study Area identified the following PCAs (PCA number indicated in parentheses), which had not been previously identified through other sources: → Triple Crown Enterprises at 20 Myler St (34) → Ontario Galvanizing Inc at 350 Wentworth St N (33) → Newalta Corporation at 237 Brant St (58)
Scott's Manufacturing Directory Records, Automobile Wrecking & Supplies Records	The ERIS report identified the following Scott's Manufacturing Directory records and Automobile Wrecking & Supplies records pertaining to the Site: → Welco Castings operated at 2 Hillyard St → Niagara Paint & Chemical Company operated at 2 Hillyard St → Brant Hill Recycling operated a scrap metal yard at 80 Brant St The ERIS report also identified 52 Scott's Manufacturing Directory records and four Automobile Wrecking & Supplies Records within the Phase I Study Area. The records identified the following PCAs (PCA number indicated in parentheses), which had not been previously identified through other sources: → Pierce Pacific CTEC Inc operated at 46 Munroe St (34) → HT Scrap Metals World operated at 350 Wentworth St N (49)
Water Well Information System (WWIS)	The ERIS report identified two WWIS records on the Site and 20 records within the Phase I Study Area. The Site records are for an overburden observation well installed in 2005 in the fleet yard area and a monitoring well cluster installed at 80 Brant St in 2015. Soils in the fleet yard were described as brown silt with clay and sand. The maximum drilling depth was 7 m below ground surface (mbgs). The records within the Phase I Study Area describe mostly monitoring and observation wells installed in either the overburden or shale bedrock. The records indicate that native soils in the area generally consist of clayey silt underlain by red shale bedrock. Fill materials are present at surface in many of the drilling locations. Bedrock was encountered between 2.4 and 21 mbgs. The following four WWIS records describe supply wells within the Phase I Study Area: → A domestic supply well installed in 1960 at 680 Burlington St E. The well is installed in bedrock at a depth of 7.3 m. → A domestic supply well installed in 1961 at 371 Sherman St N. The well is installed in in bedrock at a depth of 13.1 m. → An industrial water supply well installed in 1957 at 371 Sherman St N. The well is installed in bedrock at a depth of 47.2 m. → A cooling system supply well installed in 1955 at 55 Brant St. The well is installed in bedrock at a depth of 47.2 m.
Areas of Natural and Scientific Interest (ANSIs)	The ERIS report did not identify any ANSIs on the Site or within the Phase I Study Area.

3.3 PHYSICAL SETTING SOURCES

Table 3-3 Summary of Physical Setting Sources

SOURCE	RECORDS REVIEW RESULT
Aerial Photographs – National Air Photo Library and City of Hamilton (online)	Aerial photographs from 1927, 1934, 1950, 1959, 1973, 1990, 1999, 2002, 2005, 2007, 2010, 2012, 2014 and 2015 were reviewed for this assessment. Copies of the 1927 to 1990 photographs are provided in Appendix C. The 1999 through 2015 photographs were reviewed online using the City of Hamilton's interactive mapping tools. Significant information depicted from the photographs, where possible, is summarized below: **1927** → The Toronto Hamilton & Buffalo Railway line runs east-west through the centre of the Site. → The north half of the Site (80 Brant St) is undeveloped. These lands were formerly submerged as part of the Sherman Inlet. In the photo it appears that they are in the process of being filled in. → More than 20 buildings are visible on the south half of the Site. The buildings belong to the WA Freeman Co Ltd Fertilizer Works and Canadian Oil Companies Ltd. → The Burlington Steel Company factory is visible to the east of the Site. → Several railway lines are visible within the Phase I Study Area including adjacent to the Site on the east and northwest sides. → Industrial and/or commercial lands are visible to the south of the Site including the Hamilton & Toronto Sewer Pipe Co and Armour & Co Pork and Beef Packers. → Residential areas are visible near the periphery of the Phase I Study Area to the northeast, northwest and south of the Site. → The Westinghouse plant is visible at the south edge of the Phase I Study Area. **1934** → The Site and Phase I Study Area appear similar to the 1927 air photo. **1950** → The following new buildings are visible on the Site: ▪ One rectangular building, presumably owned by the Niagara Paint and Chemical Co, at 2 Hillyard St; ▪ A large industrial building and several smaller outbuildings, presumably owned by Duro Aluminum & Metalwares Ltd, at 281 Birch Ave; ▪ A storage building, presumably owned by Frank Bros. Ltd Scrap Iron, at the south edge of the Site; and, ▪ Ten rectangular buildings, presumably owned by Sheridan Warehousing Ltd, at 80 Brant St. → The Phase I Study Area appears similar to the 1934 air photo except that many of the commercial/industrial buildings immediately south of the Site have been demolished and removed. **1959** → The Site appears similar to the 1950 air photo except that approximately 15 rectangular warehouse buildings are now visible at 80 Brant St.

SOURCE	RECORDS REVIEW RESULT
	→ The Phase I Study Area appears similar to the 1950 air photo except that warehouses owned by George Pettinos Canada Ltd (foundry supplies, bentonite clays etc.) are visible on the adjacent property to the northwest. **1966** → The Site appears similar to the 1959 air photo except that the southeast corner of the Site, formerly occupied by the Frank Bros. Ltd Scrap Iron warehouse building, has been converted into a paved parking lot. Also, an addition has been built on to the east side of the Niagara Paint and Chemical Co building at 2 Hillyard St. → The Phase I Study Area appears similar to the 1959 air photo. Most properties are developed for industrial or commercial uses. **1973** → The Site appears similar to the 1966 air photo except that there are only nine warehouses at 80 Brant St, and a second rectangular building has been constructed at 2 Hillyard St. → The Phase I Study Area appears similar to the 1966 air photo. A new transformer is visible to the north of the Burlington Steel Co plant, to the east of the Site. **1990** → The warehouses at 80 Brant St have been demolished and removed. → The building at 281 Birch Ave is now owned by GSW Heating Products Co but appears similar to previous air photos. → The City of Hamilton Operations Centre building is visible adjacent to the southwest of the Site. → The land to the south of the Site has been converted from a parking lot into the Birch Avenue Dog Park. → The Phase I Study Area appears similar to the 1973 air photo, with most properties developed for industrial or commercial uses. **1999** → 80 Brant St appears to be in-use for scrap metal recycling activities. → The buildings at 281 Birch Ave have been demolished and removed. The area now consists of a vacant gravel lot. → The Phase I Study Area appears similar to the 1990 air photo, with most properties developed for industrial or commercial uses. **2002** → 281 Birch Ave is occupied by fleet vehicles and a salt storage shed. **2005** → No significant changes from 2002 air photo. **2007** → 80 Brant St appears to not be in active use. There are no piles of scrap metal visible. **2010, 2012** → 80 Brant St appears to be in-use as a scrap metal recycling facility. **2014, 2015** → 80 Brant St appears to not be in active use. There are no piles of scrap metal visible.

SOURCE	RECORDS REVIEW RESULT
Topography, Hydrology, Geology and Hydrogeology	The fleet yard area of the Site at 330 Wentworth St N is relatively flat. From the yard area, the ground surface slopes down to the east towards the hydro corridor and Birch Ave. The ground surface also slopes down to the north to 80 Brant St. The north portion of the Site at 80 Brant St is relatively flat. The 2 Hillyard St property generally slopes down towards Hillyard St to the west and to the railway tracks to the north. Within the Phase I Study Area, the ground surface slopes gently down to the north. Hamilton Harbour lies approximately 650 m north of the Site. The Site is located in the Iroquois Plain physiographic region of Southern Ontario (Chapman and Putnam, 1984), which stretches along the eastern and the northern shores of western Lake Ontario. The Iroquois Plain was created about 12,500 years ago along the shores of glacial Lake Iroquois. It is comprised of outwash sand deposits with more recent stream deposits of sand, gravel, silt, and clay. The Site is located within the former Sherman Inlet. In the early twentieth century fill was imported from off-Site sources to fill in the Sherman Inlet and associated wetlands. Up to approximately 10 m of fill is present on the Site from this infilling. In some of the former wetland areas of the Site, organic peat material is estimated to be present beneath the fill. The native clayey silt to silty clay soil underlies the peat and fill. Bedrock mapping shows the overburden thickness to be approximately 30 m in the vicinity of the Site. The underlying bedrock consists of red shale of the Queenston Formation. Monitoring wells installed at the Site during previous subsurface investigations indicate that the shallow groundwater table lies between approximately 1 and 6 metres below ground surface within the fill. Shallow groundwater flow at the Site is estimated to be highly influenced by the presence of fill materials associated with the infilling of the former Sherman Inlet. Based on previous subsurface investigations at the Site, groundwater flow patterns were inferred to follow the branches of the former Sherman Inlet, with overall flow directed to the north towards Hamilton Harbour. The hydraulic conductivity of the fill materials is estimated to be high, while the hydraulic conductivity of the underlying native clayey silt to silty clay soils is estimated to be low.
Fill Materials	Historically, much of the Site consisted of wetlands and submerged areas of the Sherman Inlet of Hamilton Harbour. Sherman Inlet was infilled in the early twentieth century. Previous subsurface investigations have identified fill materials across the entire Site. The fill extends to depths ranging from approximately 1 to 10 m. The fill is reportedly variable in nature and comprised of sands, clay, ash, cinders, gravel, cobbles, brick, metal debris, slag, concrete, and foundry sand.
Water Bodies and Areas of Natural Significance	Water bodies and areas of natural significance were not identified on the Site or within the Phase I Study Area.
Well Records	The ERIS report identified two WWIS records at the Site and 20 records within the Phase I Study Area. The records were described previously in Section 3.2. In addition to the WWIS records, 18 monitoring wells were installed on the 281 Birch Ave property and six were installed on the 80 Brant St property during previous subsurface investigations conducted on the Site between 1996 and 2015. These records were reviewed previously in Section 3.1. Information regarding soil stratigraphy, groundwater levels, and groundwater chemistry was obtained from the well records. This information was used in previous sections of this report to

SOURCE	RECORDS REVIEW RESULT
	describe the geology, hydrogeology and groundwater quality at the Site and within the Phase I Study Area.

4 INTERVIEWS

Interviews were conducted in-person by Ms. Rachel Bryan of WSP during the Site visits to 330 Wentworth St N on January 20, 2017 and to 2 Hillyard St on February 9, 2017. A summary of the interviews is provided below.

Table 4-1 Details of Interviews with Mr. Brad Merritt and Mr. Steve Aglor

REQUIRED INFORMATION	SPECIFICS
Reason for selecting interviewee	Mr. Merritt holds the position of Supervisor, Facilities Management at the Hamilton Operations Centre at 330 Wentworth St N. He has held this position for approximately one year. Mr. Aglor is the Building Maintenance Coordinator for the City of Hamilton and his office is located in the Hamilton Operations Centre at 330 Wentworth St N. He has held this position since 1990.
Relevant information concerning potentially contaminating activity and areas of potential environmental concern noted by the interviewer.	Messrs. Merritt and Aglor were familiar with the portion of the Site that is presently part of 330 Wentworth St N (formerly 281 Birch Ave). They provided the following information regarding this portion of the Site: → The Site includes a paved parking lot at the corner of Birch Ave and a large fleet yard with a salt storage building used for municipal fleet vehicles. → ASTs located adjacent to the salt storage building contain brine. → Storm water catch basins located in the fleet yard discharge to Birch Ave. → The floor drains for the 330 Wentworth St N building are directed through an oil interceptor prior to being discharged to the sanitary sewer. The oil interceptor is located at the south end of the Site, on the south side of the paved parking lot. The oil interceptor is cleaned out as needed by a licenced contractor. → There are several monitoring wells located on the east side of the fleet yard and along Birch Ave, which were installed several years ago by a consultant. They were uncertain of the reason for the wells or whether there were any environmental reports regarding the wells. Messrs. Merritt and Aglor were not aware of any past or present potentially contaminating activities such as fuel storage and handling, fires, spills, waste disposal, or industrial operations at the Site.
Reliability	The information provided by Messrs. Merritt and Aglor in the interview was compared to the records obtained as part of the records review and the observations made during the Site reconnaissance. The information provided by Messrs. Merritt and Aglor was corroborated by other sources.

Table 4-2 Details of Interview with Mr. Jon Raab

REQUIRED INFORMATION	SPECIFICS
Reason for selecting interviewee	Mr. Raab works for Duke Electric Ltd at 2 Hillyard St and is the son of the property owner. Mr. Raab has been familiar with the 2 Hillyard St property since his family purchased it in 2002.
Relevant information concerning potentially contaminating activity and areas of potential environmental concern noted by the interviewer.	Ms. Raab provided the following information concerning the 2 Hillyard St property: → The current tenants at 2 Hillyard St are Duke Electric Ltd, Petrie Truck Supply Ltd, and The Hamilton Brewery. → The property was purchased in 2002 from Welco Castings Inc. The Niagara Paint and Chemical Company had owned the property before Welco Castings Inc. → PCBs and fuels are not handled or stored at the Site. → The steel drums and diesel AST observed in the yard area are empty and not in use. → All of the transformers stored in the warehouse building are dry. → A due diligence Phase I and Phase II ESA were completed for the property in 2002 prior to the purchase. Mr. Raab has copies of these reports and is willing to provide them if requested by the City. He stated that the investigations did not identify any contamination on the property. → Mr. Raab could not recall if there had been any USTs removed from the north or south yard areas at the Site but stated that prior to purchase of the property, the north yard had been excavated and backfilled and he presumes that any USTs that might have been present were removed at that time.
Reliability	The information provided by Mr. Raab in the interview was compared to the records obtained as part of the records review and the observations made during the Site reconnaissance. The information provided by Mr. Raab was corroborated by other sources.

5 SITE RECONNAISSANCE

5.1 GENERAL REQUIREMENTS

Four site visits were conducted by Ms. Rachel Bryan of WSP as summarized in the following table:

Table 5-1 Site Visits

DATE	TIME	CONDITIONS	AREAS VISITED
20-Jan-17	10:00-12:00	overcast, 2ºC, ground conditions clear and dry	330 Wentworth St N
24-Jan-17	10:00-11:00	overcast, -1ºC, ground conditions clear and dry	80 Brant St
9-Feb-17	9:30-11:00	clear, -10ºC, ground conditions clear and dry	2 Hillyard St, CP Rail parcels
6-Mar-17	11:30-13:00	cloudy, 5ºC, ground conditions clear and dry	330 Wentworth St N

The areas visited are shown on the Site Plan provided as Figure 2.

The Site reconnaissance included an inspection of the interior and exterior areas of the Site as well as a visual inspection of adjacent properties and surrounding properties located wholly or partly within the Phase I Study Area. The visual inspection of adjacent properties was conducted from publicly accessible areas to identify any potentially contaminating activities, water bodies and areas of natural significance.

Select photographs taken during the Site reconnaissance are provided in Appendix A.

5.2 SPECIFIC OBSERVATIONS AT PHASE I PROPERTY

The following table summarizes the specific Site reconnaissance observations.

Table 5-2 Site Reconnaissance Observations

IDENTIFIABLE FEATURES	SPECIFIC OBSERVATIONS
General	
Subject Site Structures and Improvements including Underground Structures	There were three buildings present on the Site including a salt storage shed on the 330 Wentworth St N property and two industrial buildings on the 2 Hillyard St property. There were no structures on the 80 Brant St property. The salt storage shed was constructed in 2001 and consists of a wood frame slab on grade structure with steel roof and wall cladding. At the time of the Site reconnaissance the structure was full of salt for winter de-icing activities. The main industrial building on the 2 Hillyard St property was constructed in 1948 with three additions in 1955, 1960, and 1965. The building is a one and two storey structure with no basement and a footprint of 1,363 m^2. The 1948 and 1955 portions of the building are concrete block wood joist construction. The 1960 and 1965 portions of the building are all metal construction with fibreglass interior insulation walls and ceilings in a thin plastic vinyl sheathing. There were two sumps observed in the concrete floor of the building and some minor cracks in the concrete floor. At the time of the Site reconnaissance there were three tenants in the building including Duke Electric Ltd, an electrical equipment service and repair company, Petrie Truck Supply Ltd, a supplier and distributor of truck parts, and The Hamilton Brewery. The second building on the 2 Hillyard St property consists of a wood frame slab on grade structure built in 1970. The building footprint is approximately 637 m^2. At the time of the Site reconnaissance it was in use by Duke Electric as a warehouse for storage of dry transformers and other equipment. There were no sumps or floor drains observed. A few cracks were observed in the concrete floor.

IDENTIFIABLE FEATURES	SPECIFIC OBSERVATIONS
Storage Tanks	Seven vertical ASTs containing brine solution were observed on the south side of the salt storage structure in the fleet yard of the 330 Wentworth St N property. The ASTs were contained within a concrete secondary containment structure. Three manhole covers from an underground oil-water separator were also observed on the 330 Wentworth St N property at the southeast corner of the Site. Wastewater collected from the floor drains of the 330 Wentworth St N Operation Centre is directed through the three-stage oil-water separator prior to being discharged to the sanitary sewer at Birch Ave. Fire insurance inspection reports from the 1980s indicate that up to 12 ASTs and nine USTs were in active use at the 2 Hillyard St property by the Niagara Paint and Chemical Company. During the Site reconnaissance one empty diesel AST was observed at the 2 Hillyard St property. The steel AST was approximately 1,200 L in volume and was not in use. Mr. Raab, the site representative, believed that the seven USTs which had been located in the north yard had been removed prior to the sale of the property. He was not aware of any records or details regarding the tanks and was not aware of the two USTs that were reportedly located in the south yard. During the site reconnaissance two cut-off steel pipes were observed protruding through the concrete at the southwest corner of the 1960 addition (see Appendix A, Photo 23). Site plans from the 1980s indicate that these pipes were most likely the solvent dispensing lines, which ran from the USTs to the solvent dispensers located in the mixing room. There were no USTs or ASTs or evidence of USTs such as soil depressions, fill pipes or vent pipes observed on the 80 Brant St or former CP Rail parcels.
Potable Water Source	Potable water at the Site is supplied by the City of Hamilton from the Woodward Water Treatment Plant, whose intake is approximately 6.3 km east of the Site in Lake Ontario.
Underground Utilities and Corridors	The 2 Hillyard St and 330 Wentworth St N portions of the Site are serviced by overhead and underground hydro, underground municipal water, sanitary sewer, storm sewer, natural gas and telecom. The 80 Brant St property is serviced by overhead and underground hydro. The largest underground corridor at the Site is that which was created by the infilling of Sherman Inlet in the early twentieth century. The imported fill used to reclaim the inlet provides a continuous corridor of high hydraulic conductivity soil extending north from the Site out to Hamilton Harbour along the former channel of the Sherman Inlet.
Site Features	

IDENTIFIABLE FEATURES	SPECIFIC OBSERVATIONS
Wells	Three monitoring wells (MW107B, BH32 and DC5) installed during previous environmental investigations between 1996 and 2005 were located along the east edge of the Site and observed to be in poor condition (Appendix A, Photo 6). A 0.86-m thick layer of LNAPL was measured in BH32 on March 6, 2017. MW107B and DC5 did not contain measurable free product. The six monitoring wells installed in 2015 on the 80 Brant St property were all present and appeared to be in good condition. Wells were not observed on the 2 Hillyard St property or former CP Rail parcels.
Sewage Works	The 2 Hillyard St property is serviced by municipal storm and sanitary sewers. Storm water catch basins are located along Hillyard St. The fleet yard of 330 Wentworth St N is serviced by municipal storm water sewers. Several catch basins are located in the fleet yard and southeast parking lot on the Site. Storm water is directed to Birch Ave. The 80 Brant St and CP Rail properties are not serviced with storm water or sanitary sewers. There are storm water catch basins located along Brant St and Birch Ave.
Ground Surface	The 80 Brant St and former railway parcels of the Site are unpaved with the exception of two concrete pads and a scale located on the 80 Brant St property. The ground surface is vegetated bare gravel/fill materials in some areas and overgrown with vegetation in other areas. The ground surface on the 2 Hillyard St and 330 Wentworth St N properties consists of a combination of asphalt paved and gravel surfaced areas.
Railway Lines and Spurs	A rail line runs across the centre of the Site from Hillyard St to Birch Ave. The line has been inactive for many years and is overgrown with vegetation and littered with refuse. A spur line is also present on the 80 Brant St property. The line runs from the southwest corner of 80 Brant St to the west central portion of the Site.
Stained Soil, Vegetation or Pavement	Areas of stained soil, pavement or vegetation were not observed during the Site reconnaissance.
Stressed Vegetation	Stressed vegetation was not observed during the Site reconnaissance; however, the Site reconnaissance was conducted during the winter.
Fill Materials	The Site is known to contain significant quantities of fill, which were used to fill in the Sherman Inlet in in the early twentieth century. Previous subsurface investigations have identified fill materials across the entire Site, extending to depths of approximately 1 m to 10 m. During the Site reconnaissance, the areas of bare ground observed at the 80 Brant St property appeared to consist of mixed sand silt and gravel fill with plastic and metal debris.

IDENTIFIABLE FEATURES	SPECIFIC OBSERVATIONS
Potentially Contaminating Activity (PCA)	The following PCAs and corresponding PCA Numbers, as described in O. Reg. 153/04, Schedule D, Table 2, were observed at the Site during the Site reconnaissance: → 30 - Importation of Fill Material of Unknown Quality → 46 - Rail Yards, Tracks and Spurs → 48 - Salt Manufacturing, Processing and Bulk Storage
Unidentified Substances	Approximately 30 containers ranging in size from 5 L to 200 L were observed on the Site in the northeast corner of the fleet yard at 330 Wentworth St N (see Appendix A, Photo 4). Among the containers were paint cans, oil jugs, and pails of grease. Many of the containers appeared in poor condition and were not labeled.
Additional Potential Environmental Concerns	
PCB Materials and Equipment	Fluorescent light ballasts were observed in the Site buildings at 2 Hillyard St. There were also three pole-mounted transformers in the north yard and two transformers observed in the building at 2 Hillyard St. The possible presence of PCBs in the ballasts and transformers is not considered a significant environmental concern for the property. Any ballasts or transformers removed from the Site should be regarded as PCB waste, unless they are identified as non-PCB-containing, and managed accordingly.
Lead Containing Materials (LCMs)	Given the age of the Site buildings on the 2 Hillyard St property, lead-based solder and/or paint may be present.
Asbestos Containing Materials (ACMs)	Given the age of the Site buildings on the 2 Hillyard St property, asbestos may be found in the building materials used at the Site.
Urea Formaldehyde Foam Insulation (UFFI)	UFFI was banned in Canada in 1980. Given the age of the Site buildings on the 2 Hillyard St property, UFFI could be present. UFFI was not observed during the Site reconnaissance; however, spaces behind walls and above ceilings, where UFFI would most likely be found, were not inspected.
Ozone Depleting Substances (ODSs)	Refrigerator, freezers, air conditioning units and fire extinguishers in the 2 Hillyard St buildings may contain ODSs. ODS-containing appliances are not considered to be of potential environmental concern for the Site.
Herbicides and Pesticides	At the time of the Site reconnaissance, there was no evidence of unacceptable use or storage of herbicides and pesticides.
Existing and Former Heating Systems	The buildings on the 2 Hillyard St property were heated by a combination of ceiling-suspended natural gas-fired unit heaters, natural gas-fired furnaces, and roof mounted natural gas-fired air make-up units. Evidence of former heating fuel oil use, such as tanks, vent pipes or fill pipes, was not observed during the Site reconnaissance.

IDENTIFIABLE FEATURES	SPECIFIC OBSERVATIONS
Existing and Former Cooling Systems	The office areas in the 2 Hillyard St building have central air conditioning. The remaining 90% of the building is not air conditioned.
Pits and Lagoons	A concrete pit, which was full of pooled water, was observed on the 80 Brant St property. The former purpose of the pit is not known. Lagoons were not observed during the Site reconnaissance.
Air Emissions	Air emissions or possible sources of air emissions were not observed at the Site during the Site reconnaissance.

5.3 OBSERVATIONS WITHIN PHASE I STUDY AREA

As part of the Site reconnaissance a visual inspection of adjacent properties and properties located within the Phase I Study Area was conducted from the boundary of the Site and from publicly accessible areas to identify any PCAs. At the time of the Site reconnaissance, land use within the Phase I Study Area was primarily industrial and commercial consisting of the following:

Table 5-3 Phase I Study Area Reconnaissance Observations

IDENTIFIABLE FEATURES	SPECIFIC OBSERVATIONS
Immediately Adjacent Properties	
Adjacent Land Uses	Adjacent land uses at the time of the Site reconnaissance are illustrated on Figure 3.1 and were noted as follows: **North:** Brant St followed by Hotz Ferrous Inc, a scrap metal and waste facility, at 171 Brant St **Northwest:** Hotz Environmental Services, a paint recycling facility, at 6 Hillyard St **West:** Hillyard St followed by RC's Auto and Truck Collision at 5 Hillyard St **Southwest:** Hillyard St followed by Tomlinson Tires at 1 Hillyard St **South:** City of Hamilton Operations Centre at 330 Wentworth St N and the Birch Avenue Dog Park **East:** Hydro corridor followed by Birch Ave followed by Hamilton Specialty Bar, a steel manufacturing plant, at 319 and 371 Sherman St N
Phase I Study Area Properties	
Water Bodies	Water bodies were not observed within the Phase I Study Area during the Site reconnaissance.
Areas of Natural Significance	Areas of natural significance were not identified with the Phase I Study Area during the Site reconnaissance.

6 REVIEW AND EVALUATION OF INFORMATION

6.1 CURRENT AND PAST USES

The following table summarizes the current and historical property uses of the Site:

Table 6-1 Summary of Current and Historical Property Uses

APPROIXMATE DATE	LAND USE
pre-1890s	→ Site was mostly submerged areas and wetland areas of the Sherman Inlet. → Above-water areas were presumably undeveloped.
1890s – early 1900s	→ The TH&B Railway was constructed through the central portion of the Site. The tracks crossed a bridge over the Sherman Inlet.
early 1900s – 1930s/40s	→ The W.A. Freeman Co Ltd Fertilizer Works operated on the 330 Wentworth St N portion of the Site. → Canadian Oil Companies Ltd operated on the southeast corner of the Site. → A siding track from the Grand Trunk Railway ran along the east side of the Site. → A City Sewage Disposal Works with settling tanks operated on the 2 Hillyard St portion of the property. → Sherman Inlet was infilled during this period.
1930s/40s – 1980s	→ Duro Aluminum Ltd operated on the 330 Wentworth St N portion of the Site. → The 80 Brant St property was used for warehousing. → Niagara Paint & Chemical Company operated on the 2 Hillyard St property.
1980s – late 1990s / early 2000s	→ GSW Heating Products Company operated on the 330 Wentworth St N portion of the Site. → The 80 Brant St property was used as scrap metal yard.
late 1990s / early 2000s – 2013	→ The 330 Wentworth St N portion of the Site was used as a fleet yard. → The 80 Brant St property was used as scrap metal yard. → Various industrial tenants operated at the 2 Hillyard St property.
2013 – present	→ The 330 Wentworth St N portion of the Site was used as a fleet yard. → The 80 Brant St property was not in use. → Various industrial tenants operated at the 2 Hillyard St property.

6.2 POTENTIALLY CONTAMINATING ACTIVITY

Potentially Contaminating Activities (PCAs) on the Site or within the Phase I Study Area are summarized in the table below. All PCAs, including the number and location (if known) of USTs are illustrated on Figure 3.1.

Refer to O. Reg. 153/04, Schedule D, Table 2 for a complete list of PCAs.

Table 6-2 Summary of PCAs

<table>
<tr><th>PCA</th><th>OBSERVATIONS</th></tr>
<tr><td>2. Adhesives and Resins Manufacturing, Processing and Bulk Storage</td><td><u>On-Site:</u> The Niagara Paint and Chemical Company paint manufacturing facility operated on the 2 Hillyard St property between 1948 and 2002. Seven ASTs containing alkyd resin were located in the indoor storage and manufacturing areas.

<u>Off-Site:</u> St. Lawrence Resin Products Ltd operated in the 1980s and 90s at 350 Wentworth St N.</td></tr>
<tr><td>5. Asphalt and Bitumen Manufacturing</td><td><u>Off-Site:</u> Currie Products Ltd operated a coal tar distillation plant between 1978 and the late 1990s at 350 Wentworth St N, approximately 90 m west of the Site. There was a spill of 250 L of diesel fuel to the ground at this property in 1988 and a spill of 4,000 L of tar to the ground in 2004.</td></tr>
<tr><td>8. Chemical Manufacturing, Processing and Bulk Storage</td><td><u>Off-Site:</u> IMCO Industrial & Marine Coating Inc and JMC & B Technologies Inc operated at 44 Munroe St in the 2000s. IMCO Technologies operated at 350 Wentworth St N in the 2000s. Metcan Industrial Corp, a manufacturer of custom-blended synthetic slag, operated at 275 Sherman Ave N in the 2000s.</td></tr>
<tr><td>10. Commercial Autobody Shops</td><td><u>Off-Site:</u> Historical or existing commercial autobody shops were identified at the following locations within the Phase I Study Area:

<table>
<tr><th>Address</th><th>Distance from Site</th><th>Direction</th><th>Hydraulic Position Relative to Site</th></tr>
<tr><td>66 Brant St</td><td>50 m</td><td>NW</td><td>up-gradient</td></tr>
<tr><td>1 Gerrard St</td><td>130 m</td><td>NE</td><td>down-gradient</td></tr>
<tr><td>250 Gibson St</td><td>180 m</td><td>S</td><td>up-gradient</td></tr>
<tr><td>5 Hillyard St</td><td>20 m</td><td>W</td><td>up-gradient</td></tr>
<tr><td>15 McKinstry St</td><td>120 m</td><td>N</td><td>down-gradient</td></tr>
<tr><td>64 Munroe St</td><td>45 m</td><td>NW</td><td>up-gradient</td></tr>
<tr><td>34 Niagara St</td><td>170 m</td><td>NW</td><td>cross-gradient</td></tr>
<tr><td>468 Wentworth St N</td><td>250 m</td><td>NW</td><td>cross-gradient</td></tr>
</table></td></tr>
<tr><td>11. Commercial Trucking and Container Terminals</td><td><u>Off-Site:</u> Historical or existing commercial tucking companies were identified at the following locations within the Phase I Study Area:

<table>
<tr><th>Address</th><th>Distance from Site</th><th>Direction</th><th>Hydraulic Position Relative to Site</th></tr>
<tr><td>171 Brant St</td><td>20 m</td><td>N</td><td>down-gradient</td></tr>
<tr><td>3 Hillyard St</td><td>20 m</td><td>W</td><td>up-gradient</td></tr>
<tr><td>17 Hillyard St</td><td>130 m</td><td>NW</td><td>cross-gradient</td></tr>
<tr><td>55 Hillyard St</td><td>220 m</td><td>NW</td><td>cross-gradient</td></tr>
<tr><td>66 Hillyard St</td><td>230 m</td><td>NW</td><td>cross-gradient</td></tr>
<tr><td>34 Niagara St</td><td>170 m</td><td>NW</td><td>cross-gradient</td></tr>
<tr><td>360 Wentworth St N</td><td>200 m</td><td>W</td><td>up-gradient</td></tr>
<tr><td>350 Wentworth St N</td><td>90 m</td><td>W</td><td>up-gradient</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>PCA</th><th>OBSERVATIONS</th></tr>
<tr><td>14. Crude Oil Refining, Processing and Bulk Storage</td><td><u>On-Site and Off-Site:</u> The oil refinery company, Canadian Oil Companies Ltd, operated between the early 1900s until approximately 1946 on what is now the parking lot in the southeast corner of the Site and the adjacent area to the south, now occupied by the Birch Avenue Dog Park. The 1911 FIP shows approximately 20 oil storage tanks on the property. An oil warehouse was formerly located at 680 Burlington St E.</td></tr>
<tr><td>16. Drum and Barrel and Tank Reconditioning and Recycling</td><td><u>Off-Site:</u> A former drum cleaning facility operated at 680 Burlington St E.</td></tr>
<tr><td>18. Electricity Generation, Transformation and Power Stations</td><td><u>Off-Site:</u> Canadian Westinghouse Company Ltd operated a gas turbine manufacturing plant approximately 180 m southwest of the Site, a transformer house was included as part of their operations. A transformer station is also located on the 371 Sherman Ave N property, approximately 50 m east of the Site.</td></tr>
<tr><td>22. Fertilizer Manufacturing, Processing and Bulk Storage</td><td><u>On-Site:</u> The W.A. Freeman Co Ltd Fertilizer Works operated on what is now the fleet yard of the 330 Wentworth St N property between the 1890s and late 1920s.</td></tr>
<tr><td>27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles</td><td><u>Off-Site:</u> Historical or existing garages were identified at the following locations within the Phase I Study Area:
<table>
<tr><th>Address</th><th>Distance from Site</th><th>Direction</th><th>Hydraulic Position Relative to Site</th></tr>
<tr><td>30 Milton Ave</td><td>130 m</td><td>S</td><td>up-gradient</td></tr>
<tr><td>410 Birch Ave</td><td>190 m</td><td>NE</td><td>down-gradient</td></tr>
<tr><td>601 Burlington St E</td><td>250 m</td><td>N</td><td>down-gradient</td></tr>
<tr><td>95 Earl St</td><td>240 m</td><td>SE</td><td>up-gradient</td></tr>
<tr><td>55 Hillyard St</td><td>220 m</td><td>NW</td><td>cross-gradient</td></tr>
<tr><td>468 Wentworth St N</td><td>250 m</td><td>NW</td><td>cross-gradient</td></tr>
<tr><td>466 Wentworth St N</td><td>230 m</td><td>NW</td><td>cross-gradient</td></tr>
<tr><td>340 Wentworth St N</td><td>170 m</td><td>W</td><td>up-gradient</td></tr>
<tr><td>350 Wentworth St N</td><td>90 m</td><td>W</td><td>up-gradient</td></tr>
</table></td></tr>
</table>

PCA	OBSERVATIONS
28. Gasoline and Associated Products Storage in Fixed Tanks	**On-Site:** The Niagara Paint and Chemical Company paint manufacturing facility operated on the 2 Hillyard St property between 1948 and 2002. Two USTs containing oil and one UST containing gasoline were located in the north yard of the property. GSW Heating Products Company manufactured water heaters between approximately 1975 and 1998 on what is now the fleet yard of the 330 Wentworth St N property. Two USTs containing fuel oil were located on the southcentral portion of the site. The tanks were removed in 1993. The removal was documented and environmental testing was completed. The 80 Brant St property was used as a scrap metal storage and recycling yard from the 1980s until 2013. One 2,200-L diesel AST was located on the western portion of the 80 Brant St property. **Off-Site:** Canadian Westinghouse Company Ltd operated a gas turbine manufacturing plant approximately 180 m southwest of the Site in the inferred up-gradient groundwater flow direction. The facility included a 149,000-gallon underground oil reservoir. In addition, the following 17 properties with either historical or existing USTs were identified within the Phase I Study Area:
30. Importation of Fill Material of Unknown Quality	**On-Site and Off-Site:** The Site and surrounding areas are known to contain significant quantities of fill, which were used to fill in the Sherman Inlet in in the early twentieth century. Previous subsurface investigations have identified fill materials across the entire Site. The fill extends to depths ranging from approximately 1 to 10 m. The fill is reportedly variable in nature and comprised of sands, clay, ash, cinders, gravel, glass, wood, cobbles, brick, metal debris, slag, concrete, and foundry sand.

Address	# of USTs	Distance from Site	Direction	Hydraulic Position Relative to Site
44 Munroe St	1	70 m	W	up-gradient
601 Burlington St E	U	250 m	N	down-gradient
650 Burlington St E	2	140 m	N	down-gradient
680 Burlington St E	2	130 m	N	down-gradient
3 Hillyard St*	1	20 m	W	up-gradient
66 Hillyard St	2	230 m	NW	cross-gradient
8 McKinstry St	1	60 m	N	down-gradient
275 Sherman Ave N	U	80 m	SE	up-gradient
319 Sherman Ave N	4	40 m	E	up-gradient
371 Sherman Ave N	1	40 m	E	up-gradient
330 Wentworth St N	5	adjacent	S	up-gradient
71 Brant St	U	20 m	N	cross-gradient
74 Brant St	4	adjacent	N	up-gradient
77 Brant St**	U	20 m	N	down-gradient
171 Brant St***	3	20 m	N	down-gradient
95 Earl St	U	240 m	SE	up-gradient
42 Niagara St	1	150 m	NW	cross-gradient

* 220 L of hydraulic oil was spilled to ground at this facility in 2004

** 250 L of hydraulic oil was leaked to ground at this site in 1991

*** 181 L of diesel fuel was spilled to ground at this facility in 1991 and 1992

U = unknown

PCA	OBSERVATIONS
32. Iron and Steel Manufacturing and Processing	**Off-Site:** Canadian Westinghouse Company Ltd operated a gas turbine manufacturing plant approximately 180 m southwest of the Site, a foundry and several machine shops were included as part of their operations. The Hamilton Specialty Bar steel plant (formerly Burlington Steel) and Brown Boggs Foundry are located approximately 50 m east of the Site at 275, 319 and 371 Sherman Ave N. The plants have been in operation since the early 1900s. George Pettinos Ltd operated at 70 Brant St from the 1970s to 1990s. Marshall Refractories Canada and Hepworth Refractories Canada operated at 350 Wentworth St N in the 1980s and 1990s. Russell Metals operated at 44 Munroe St, 100 m west of the Site. In 2004, there was a spill of an unspecified amount of barium to ground surface at the corner of Brant St and Birch Ave. Barium is used in steel manufacturing and is a hazardous material.
33. Metal Treatment, Coating, Plating and Finishing	**On-Site:** GSW Heating Products Company manufactured water heaters between approximately 1975 and 1998 on what is now the fleet yard of the 330 Wentworth St N property. The operations included galvanizing treatment. **Off-Site:** Allbright Platers Ltd operated in the 1950s and 1960s at 58 Brant St. Automatic Cutting & Finishing Ltd operated at 3 Hillyard St in the 1970s and 80s. John Kenyon Ltd, a metal roofing and siding company, have operated at 54 Munroe St since the 1950s. Kennametal Tools & Manufacturing Company operated at 371 Sherman St N from the 1940s to 1970s. AZZ Blenkhorn & Sawle Ltd operated a metal coating and treatment company at 20 Myler St. Ontario Galvanizing Inc operated at 350 Wentworth St N.

PCA	OBSERVATIONS
34. Metal Fabrication	**On-Site:** Duro Aluminum and Metalwares Ltd and GSW Heating Products Company manufactured cookware and water heaters between approximately 1930 and 1998 on what is now the fleet yard of the 330 Wentworth St N property. A 3,000-L spill of hydraulic oil occurred in 1997 at GSW. The PHC impacted area is located in the southeast corner of the property. Previous investigations also showed TCE impacts to groundwater near the southwest property boundary. **Off-Site:** Historical or existing metal fabrication facilities were identified at the following locations within the Phase I Study Area:
35. Mining, Smelting and Refining; Ore Processing; Tailings Storage	**On-Site:** Welco Castings Inc operated a lead smelting facility at 2 Hillyard St between the late 1990s and 2002.
39. Paints Manufacturing, Processing and Bulk Storage	**On-Site:** The Niagara Paint and Chemical Company paint manufacturing facility operated on the 2 Hillyard St property between 1948 and 2002. **Off-Site:** Hotz Environmental operates a latex paint recycling facility on the adjacent property to the north at 6 Hillyard St. A spill of latex sludge to ground surface occurred at the facility in 2012.
43. Plastics (including Fibreglass) Manufacturing and Processing	**Off-Site:** Ontario Orthotic Lab manufactures custom orthotics at 42 Niagara St. Stoney Creek Mould Ltd operated at 400 Wentworth St N in the 2010s.
46. Rail Yards, Tracks and Spurs	**On-Site:** An inactive railway track runs east-west through the centre of the Site. The track was formerly part of the TH&B Railway and was originally constructed in the 1890s. A spur line is also present on the 80 Brant St property, entering at the southwest corner. The 1911 FIP also shows a former spur line on the 330 Wentworth St N portion of the Site. **Off-Site:** Many current and/or historical railway tracks and spurs are located within the Phase I Study Area to the north, east, south, and west of the Site. The approximate locations of the tracks are shown on Figure 3.1.

Address	Distance from Site	Direction	Hydraulic Position Relative to Site
171 Brant St*	20 m	N	down-gradient
252 Gibson St	200 m	SE	up-gradient
601 Burlington St E	250 m	N	down-gradient
3 Hillyard St**	20 m	W	up-gradient
55 Hillyard St	220 m	NW	cross-gradient
44 Munroe St	70 m	W	up-gradient
46 Munroe St	90 m	W	up-gradient
42 Niagara St	150 m	NW	cross-gradient
275 Sherman St N	80 m	SE	up-gradient
371 Sherman St N	40 m	E	up-gradient
400 Wentworth St N	200 m	W	up-gradient
404 Wentworth St N	110 m	W	up-gradient
410 Wentworth St N	190 m	NW	up-gradient
20 Myler St	160 m	SW	up-gradient

PCA	OBSERVATIONS
48. Salt Manufacturing, Processing and Bulk Storage	**On-Site:** A salt storage shed is located on the Site in the fleet yard area of the 330 Wentworth St N property. The building was constructed in 2001.
49. Salvage Yard, including automobile wrecking	**On-Site:** The 80 Brant St property was used as a scrap metal storage and recycling yard from the 1980s until 2013. **Off-Site:** Veterans Salvage operated at 62 Brant St from the 1950s to 1990s. Philip Enterprises Inc operated salvage yards at 237 Brant St and at 171 Brant St. Records indicate 150 L of diesel fuel and 23 L of hydraulic oil were spilled to the ground at 237 Brant St in the 1991 and 2006. Dennis Alfred Rogers Salvage operated at 61 Princess St. HT Scrap Metals World operated at 350 Wentworth St N.
51. Solvent Manufacturing, Processing and Bulk Storage	**On-Site:** The Niagara Paint and Chemical Company paint manufacturing facility operated on the 2 Hillyard St property between 1948 and 2002. Approximately 130,000 L of solvents were stored in six USTs in the north yard of the property. Dispensing lines ran from the USTs into the mixing room. Two USTs containing naphtha and mineral spirits were also located in the south yard. Approximate 50 205-L drums containing various solvents including methyl isobutyl ketone and methyl ethyl ketone were stored at the south end of the west building.
52. Storage, maintenance, fuelling and repair of equipment, vehicles, and material used to maintain transportation systems	**Off-Site:** The City of Hamilton Operations Centre is located on the adjacent property to the south at 330 Wentworth St N. Municipal fleet vehicles are repaired, maintained and refuelled at the facility. There are five diesel and gasoline ASTs located on the property. In 1988, 250 L of hydraulic oil was leaked to ground at the 330 Wentworth St N property. The oil water separator serving the floor drains from this facility is located in the southeast corner of the Site.
55. Transformer Manufacturing, Processing and Use	**On-Site:** The Niagara Paint and Chemical Company paint manufacturing facility operated on the 2 Hillyard St property between 1948 and 2002. A fire insurance inspection report form 1989 describes PCB-filled transformers in-use on the property. GSW Heating Products Co had 12 PCB-containing capacitors in-use on what is now the 330 Wentworth St N property. **Off-Site:** The properties at 319 Sherman Ave N, 330 Wentworth St N, 10 Hillyard St, and 30 Milton St were identified as PCB storage sites. PCB-containing transformers, capacitors, barrels, drums of soil, and ballasts were stored on these properties.
56. Treatment of Sewage equal to or greater than 10,000 litres per day	**On-Site:** The 1911 FIP and 1927 air photo show three settling tanks were formerly located on what is now the 2 Hillyard St property. The settling tanks were part of the City of Hamilton Sewage Disposal Works.
57. Vehicles and Associated Parts Manufacturing	**Off-Site:** Nasco Products Ltd, a manufacturer of automotive clutches and plates, was located approximately 170 m east of the Site at 303 Sherman Ave N. Amcan Castings Ltd operated at 9 and 10 Hillyard St. There was a spill of 8,000 L of molten aluminum to the ground at the 9 Hillyard St property in 2007.

PCA	OBSERVATIONS
58. Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners	**On-Site:** From approximately 1915 to 1942 the Brant St Dump (also called the East End Dump) operated on the Site. The 330 Wentworth St N property is also identified as a waste transfer station in the O. Reg. 347 waste receiver records. **Off-Site:** Philip Enterprises Inc (1990s) and Hotz Ferrous Inc (2010s) operated waste transfer facilities at 171 Brant St. Philip Enterprises Inc also operated a waste transfer facility at 237 Brant St in the 1980s. Plaza Integrated Environments operated a waste transfer facility at 3 Hillyard St in the 2000s to 2010s. Hotz Environmental operates a latex paint recycling facility on the adjacent property to the north at 6 Hillyard St. Canadian Waste Services Inc and Philip Enterprises Inc operated a waste transfer facility at 77 Brant St. Newalta Corporation operated a waste transfer facility at 237 Brant St. A former landfill Site was located on the south side of Burlington St E between McKinstry St and Birch Ave.

6.3 AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

The PCAs described in Section 6.2 are considered to be contributing to 16 Areas of Potential Environmental Concern (APECs) on the Site, as described in the following table and depicted on Figure 3.2.

Table 6-3 Summary of APECs

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
1	Southeast portion of fleet yard on the 330 Wentworth St N property	A 3,000-L spill of hydraulic oil occurred in 1997 at GSW Heating Products Co. (**34.** Metal Fabrication)	On-Site	PHCs BTEX	Soil and Groundwater

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
2	Northwest edge of Site on the 80 Brant St property	**10.** Commercial Autobody Shops **28.** Gasoline and Associated Products Storage in Fixed Tanks **32.** Iron and Steel Manufacturing and Processing **33.** Metal Treatment, Coating, Plating and Finishing **39.** Paints Manufacturing, Processing and Bulk Storage **46.** Rail Yards, Tracks and Spurs **49.** Salvage Yard, including automobile wrecking **55.** Transformer Manufacturing, Processing and Use **57.** Vehicles and Associated Parts Manufacturing **58.** Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners	Off-Site to the northwest	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater
3	Entire Site	**30.** Importation of Fill Material of Unknown Quality	On-Site	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
4	West portion of Site on the 2 Hillyard St property	**2.** Adhesives and Resins Manufacturing, Processing and Bulk Storage **28.** Gasoline and Associated Products Storage in Fixed Tanks **35.** Mining, Smelting and Refining; Ore Processing; Tailings Storage **39.** Paints Manufacturing, Processing and Bulk Storage **51.** Solvent Manufacturing, Processing and Bulk Storage **55.** Transformer Manufacturing, Processing and Use	On-Site	M&I PHCs VOCs PCBs	Soil and Groundwater

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
5	Southwest corner of Site on the 2 Hillyard and 330 Wentworth St N properties	**2.** Adhesives and Resins Manufacturing, Processing and Bulk Storage **5.** Asphalt and Bitumen Manufacturing **8.** Chemical Manufacturing, Processing and Bulk Storage **11.** Commercial Trucking and Container Terminals **27.** Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles **28.** Gasoline and Associated Products Storage in Fixed Tanks **32.** Iron and Steel Manufacturing and Processing **33.** Metal Treatment, Coating, Plating and Finishing **49.** Salvage Yard, including automobile wrecking **52.** Storage, maintenance, fuelling and repair of equipment, vehicles, and material used to maintain transportation systems **55.** Transformer Manufacturing, Processing and Use	Off-Site to the southwest	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
6	Northwest corner on the 2 Hillyard and 80 Brant St properties	**8.** Chemical Manufacturing, Processing and Bulk Storage **10.** Commercial Autobody Shops **11.** Commercial Trucking and Container Terminals **28.** Gasoline and Associated Products Storage in Fixed Tanks **32.** Iron and Steel Manufacturing and Processing **33.** Metal Treatment, Coating, Plating and Finishing **34.** Metal Fabrication **43.** Plastics (including Fibreglass) Manufacturing and Processing **46.** Rail Yards, Tracks and Spurs **58.** Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners	Off-Site to the west	M&I PAHs PHCs VOCs	Soil and Groundwater
7	South portion of Site on the 330 Wentworth St N property	**14.** Crude Oil Refining, Processing and Bulk Storage	On-Site and Off-Site to the south	PHCs VOCs	Soil and Groundwater
8	Three existing or former lines on the Site	**46.** Rail Yards, Tracks and Spurs	On-Site	M&I PAHs PHCs VOCs	Soil and Groundwater
9	Two areas on the 80 Brant St and 330 Wentworth St N properties	**28.** Gasoline and Associated Products Storage in Fixed Tanks	On-Site	PHCs VOCs	Soil and Groundwater
10	West portion of the 2 Hillyard St property	**56.** Treatment of Sewage equal to or greater than 10,000 litres per day	On-Site	M&I VOCs PHCs	Soil and Groundwater

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
11	Southcentral portion of Site on the 330 Wentworth St N property	**22.** Fertilizer Manufacturing, Processing and Bulk Storage **33.** Metal Treatment, Coating, Plating and Finishing **34.** Metal Fabrication **55.** Transformer Manufacturing, Processing and Use	On-Site	M&I PHCs VOCs PCBs	Soil and Groundwater
12	East edge of Site on the 330 Wentworth St N and 80 Brant St properties	**8.** Chemical Manufacturing, Processing and Bulk Storage **18.** Electricity Generation, Transformation and Power Stations **28.** Gasoline and Associated Products Storage in Fixed Tanks **32.** Iron and Steel Manufacturing and Processing **34.** Metal Fabrication **46.** Rail Yards, Tracks and Spurs **55.** Transformer Manufacturing, Processing and Use **57.** Vehicles and Associated Parts Manufacturing	Off-Site to the east	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater
13	North portion of Site on the 80 Brant St property	**49.** Salvage Yard, including automobile wrecking **58.** Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners	On-Site	M&I PHCs VOCs	Soil and Groundwater
14	Centre of Site on the 330 Wentworth St N property	**48.** Salt Manufacturing, Processing and Bulk Storage	On-Site	Inorganics	Soil and Groundwater
15	North and East portions of 330 Wentworth St N property	**58.** Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners	On-Site	M&I PAHs PHCs VOCs	Soil and Groundwater

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
16	South portion of 330 Wentworth St N property	The oil-water separator for the floor drains of the off-Site 330 Wentworth St N Operations Center building is located on the Site (**52.** Storage, maintenance, fuelling and repair of equipment, vehicles, and material used to maintain transportation systems**)**	On-Site	M&I PHCs VOCs	Soil and Groundwater

Notes:
M&I = metals and inorganics
PAHs = polycyclic aromatic hydrocarbons
PHCs = petroleum hydrocarbons
VOCs = volatile organic compounds
PCBs = polychlorinated biphenyls

6.4 PHASE I CONCEPTUAL SITE MODEL

As part of the Phase I ESA, a Conceptual Site Model (CSM) was prepared for the Site. The following sections provide details regarding the CSM.

6.4.1 FIGURES

The Phase I CSM is presented as Figures 3.1 and 3.2. The CSM presents the following information for the Site and the Phase I Study Area:

- Existing buildings and structures;
- Water bodies located in whole, or in part, within the Phase I Study Area, if any;
- Areas of natural significance located in whole, or in part, within the Phase I Study Area, if any;
- Drinking water wells at the Site, if any;
- Roads, including names, within the Phase I Study Area;
- General current uses of properties adjacent to the Site;
- Areas where PCAs have occurred, including location of tanks; and,
- APECs, as identified in Section 6.3.

6.4.2 POTENTIALLY CONTAMINATING ACTIVITY

As described in Section 6.2, there was eleven types of PCAs identified within the Phase I Study Area. The locations of the PCA are indicated on the CSM, Figure 3.1.

6.4.3 AREAS OF POTENTIAL ENVIRONMENTAL CONCERN AND POTENTIAL CONTAMINANTS OF CONCERN

As described in Section 6.3, there were 16 APECs identified at the Site. The locations of the APECs are indicated on the CSM, Figure 3.2.

6.4.4 IMPACT OF UNDERGROUND UTILITIES

Underground utilities can affect contaminant distribution and transport. Trenches excavated to install utility services, and the associated granular backfill may provide preferential pathways for horizontal contaminant migration in the shallow subsurface. Locating underground utilities was beyond the scope of work for this Phase I ESA.

6.4.5 GEOLOGICAL AND HYDROGEOLOGICAL INFORMATION

The Site is located within the former Sherman Inlet. In the early twentieth century fill was imported from off-Site sources to fill in the Sherman Inlet and associated wetlands. The fill is reportedly variable in nature and comprised of sands, clay, ash, cinders, gravel, glass, wood, cobbles, brick, metal debris, slag, concrete, and foundry sand. The depth of fill ranges from approximately 1 to 10 m across the Site.

In the former wetland areas of the Site, organic peat material is present beneath the fill. Native clayey silt to silty clay soil underlies the peat and fill. Bedrock, consisting of Queenston shale, lies approximately 30 m below ground surface.

Shallow groundwater flow at the Site is estimated to be highly influenced by the presence of fill materials associated with the infilling of the former Sherman Inlet. Based on previous subsurface investigations at the Site, groundwater flow patterns were inferred to follow the branches of the former Sherman Inlet, with overall flow directed to the north towards Hamilton Harbour, as shown in Figure 3.1.

The hydraulic conductivity of the fill materials is estimated to be high, while the hydraulic conductivity of the underlying native clayey silt to silty clay soils is estimated to be low.

6.4.6 UNCERTAINTY AND ABSENCE OF INFORMATION

During the records review, WSP relied on information obtained from municipal, provincial, and independent sources as referenced in this report. Although the information was assessed for consistency, verification of the accuracy or the completeness of this third party information was not completed and was not part of the scope of work.

7 CONCLUSIONS

A Phase I ESA was conducted for the site of a proposed HSR Storage and Maintenance Facility (Site). The Site is approximately 7.9 hectares and includes 2 Hillyard St, 80 Brant St, the former CP Rail tracks between Hillyard St and Birch Ave, and the fleet yard at 330 Wentworth St N. The objective of the Phase I ESA was to assess the Site for actual and/or potential environmental concerns associated with the Site

through a review of available historical records, Site reconnaissance, and interviews. The findings of the Phase I ESA are documented in this report and reflect Site conditions observed at the time of the Site reconnaissance.

Based on information obtained as part of the Phase I ESA records search, Site reconnaissance and interview process, the following findings are presented:

- The Site is situated within the former Sherman Inlet. In the early twentieth century fill was imported from off-Site sources to fill in the Sherman Inlet and associated wetlands. The fill is reportedly variable in nature and comprised of sands, clay, ash, cinders, gravel, glass, wood, cobbles, brick, metal debris, slag, concrete, and foundry sand. The depth of fill ranges from approximately 1 to 10 m across the Site.
- The Site has been under industrial use since the early 1900s. Former occupants of the Site include TH&B Railway (several track lines), W.A. Freeman Co Ltd Fertilizer Works, Canadian Oil Companies Ltd, City of Hamilton Sewage Disposal Works, Duro Aluminium Ltd, Sheridan Warehousing, Niagara Paint & Chemical Company, GSW Heating Products Inc, Hamilton Specialty Bar (scrap metal yard), and Welco Castings Inc.
- At the time of the Site reconnaissance in 2017, the 330 Wentworth St N portion of the Site was in use as a fleet yard for municipal vehicles; the 2 Hillyard St property was in use by Duke Electric Ltd, Petrie Truck Supply Ltd, and The Hamilton Brewery; the 80 Brant St property was undeveloped and vacant; and, the former TH&B Railway tracks were overgrown and no longer in use.
- Shallow groundwater flow at the Site is estimated to be highly influenced by the presence of fill materials associated with the infilling of the former Sherman Inlet. Groundwater flow patterns are inferred to follow the branches of the former Sherman Inlet, with overall flow directed to the north towards Hamilton Harbour.
- The hydraulic conductivity of the fill materials is estimated to be high, while the hydraulic conductivity of the underlying native clayey silt to silty clay soils is estimated to be low.

The results of the Phase I ESA identified the following 16 PCAs on the Site:

2. Adhesives and Resins Manufacturing, Processing and Bulk Storage
14. Crude Oil Refining, Processing and Bulk Storage
22. Fertilizer Manufacturing, Processing and Bulk Storage
28. Gasoline and Associated Products Storage in Fixed Tanks
30. Importation of Fill Material of Unknown Quality
33. Metal Treatment, Coating, Plating and Finishing
34. Metal Fabrication
35. Mining, Smelting and Refining; Ore Processing; Tailings Storage
39. Paints Manufacturing, Processing and Bulk Storage
46. Rail Yards, Tracks and Spurs
48. Salt Manufacturing, Processing and Bulk Storage
49. Salvage Yard, including automobile wrecking
51. Solvent Manufacturing, Processing and Bulk Storage

55. Transformer Manufacturing, Processing and Use
56. Treatment of Sewage equal to or greater than 10,000 litres per day
58. Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners

The Site is situated within a predominantly industrial land use area. The following PCAs were identified off-Site within the Phase I Study Area:

2. Adhesives and Resins Manufacturing, Processing and Bulk Storage
5. Asphalt and Bitumen Manufacturing
8. Chemical Manufacturing, Processing and Bulk Storage
10. Commercial Autobody Shops
11. Commercial Trucking and Container Terminals
14. Crude Oil Refining, Processing and Bulk Storage
16. Drum and Barrel and Tank Reconditioning and Recycling
18. Electricity Generation, Transformation and Power Stations
27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles
28. Gasoline and Associated Products Storage in Fixed Tanks
30. Importation of Fill Material of Unknown Quality
32. Iron and Steel Manufacturing and Processing
33. Metal Treatment, Coating, Plating and Finishing
34. Metal Fabrication
39. Paints Manufacturing, Processing and Bulk Storage
43. Plastics (including Fibreglass) Manufacturing and Processing
46. Rail Yards, Tracks and Spurs
49. Salvage Yard, including automobile wrecking
52. Storage, maintenance, fuelling and repair of equipment, vehicles, and material used to maintain transportation systems
55. Transformer Manufacturing, Processing and Use
57. Vehicles and Associated Parts Manufacturing
58. Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners

The PCAs listed above are considered to be contributing to 16 APECs on the Site, as described in the following table:

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs (PCA Numbers indicated)	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
1	Southeast portion of fleet yard on the 330 Wentworth St N property	A 3,000-L spill of hydraulic oil occurred in 1997 at GSW Heating Products Co. (34)	On-Site	PHCs BTEX	Soil and Groundwater

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs (PCA Numbers indicated)	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
2	Northwest edge of Site on the 80 Brant St property	10, 28, 32, 33, 39, 46, 49, 55, 57, and 58	Off-Site to the northwest	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater
3	Entire Site	30	On-Site	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater
4	West portion of Site on the 2 Hillyard St property	2, 28, 35, 39, 51, and 55	On-Site	M&I PHCs VOCs PCBs	Soil and Groundwater
5	Southwest corner of Site on the 2 Hillyard and 330 Wentworth St N properties	2, 5, 8, 11, 27, 28, 32, 33, 49, 52, and 55	Off-Site to the southwest	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater
6	Northwest corner on the 2 Hillyard and 80 Brant St properties	8, 10, 11, 28, 32, 33, 34, 43, 46, and 58	Off-Site to the west	M&I PAHs PHCs VOCs	Soil and Groundwater
7	South portion of Site on the 330 Wentworth St N property	14	On-Site and Off-Site to the south	PHCs VOCs	Soil and Groundwater
8	Three existing or former lines on the Site	46	On-Site	M&I PAHs PHCs VOCs	Soil and Groundwater
9	Two areas on the 80 Brant St and 330 Wentworth St N properties	28	On-Site	PHCs VOCs	Soil and Groundwater
10	West portion of the 2 Hillyard St property	56	On-Site	M&I VOCs PHCs	Soil and Groundwater
11	Southcentral portion of Site on the 330 Wentworth St N property	22, 33, 34, and 55	On-Site	M&I PHCs VOCs PCBs	Soil and Groundwater

APEC	LOCATION OF APEC ON PROPERTY	CONTRIBUTING PCAs (PCA Numbers indicated)	LOCATION OF PCAs	CONTAMINANTS OF POTENTIAL CONCERN	MEDIA POTENTIALLY IMPACTED
12	East edge of Site on the 330 Wentworth St N and 80 Brant St properties	8, 18, 28, 32, 34, 46, 55, and 57	Off-Site to the east	M&I PAHs PHCs VOCs PCBs	Soil and Groundwater
13	North portion of Site on the 80 Brant St property	49 and 58	On-Site	M&I PHCs VOCs	Soil and Groundwater
14	Centre of Site on the 330 Wentworth St N property	48	On-Site	Inorganics	Soil and Groundwater
15	North and East portions of 330 Wentworth St N property	58	On-Site	M&I PAHs PHCs VOCs	Soil and Groundwater
16	South portion of 330 Wentworth St N property	The oil-water separator for the floor drains of the off-Site 330 Wentworth St N Operations Center building is located on the Site (52)	On-Site	M&I PHCs VOCs	Soil and Groundwater

Based on the results of the investigation, the possibility exists that one or more contaminants may have affected land or water on, in or under the Site. A Phase II ESA is recommended to investigate the 16 APECs identified in this Phase I ESA.

7.1 QUALIFIER AND LIMITATIONS

This report was prepared by WSP Canada Inc. for the exclusive use of the City of Hamilton. Third parties cannot rely on the findings and conclusions without written notification from WSP.

WSP warrants that the findings and conclusions contained herein have been prepared in accordance with generally accepted environmental site assessment methods. There is a possibility that materials may exist which could not be reasonably identified within the scope of the assessment or which were not apparent during the Site reconnaissance. WSP believes that the information collected during the assessment period concerning the property is reliable. However, WSP cannot warrant or guarantee that the information provided is absolutely complete or accurate beyond current environmental consulting standards.

All the findings available at the time of the preparation of the Phase I ESA and the conclusions made based on the findings are included in this report. Please note that with time the environmental condition of the Site can change. Conclusions related to Site conditions are based upon information gathered at the time of the assessment and may not be valid should Site conditions or related regulatory requirements change in the future.

WSP reserves the right to amend and/or supplement this report in the event additional information, documentation, or evidence becomes available. If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions and recommendations provided herein.

7.2 QUALIFICATIONS OF THE ASSESSORS

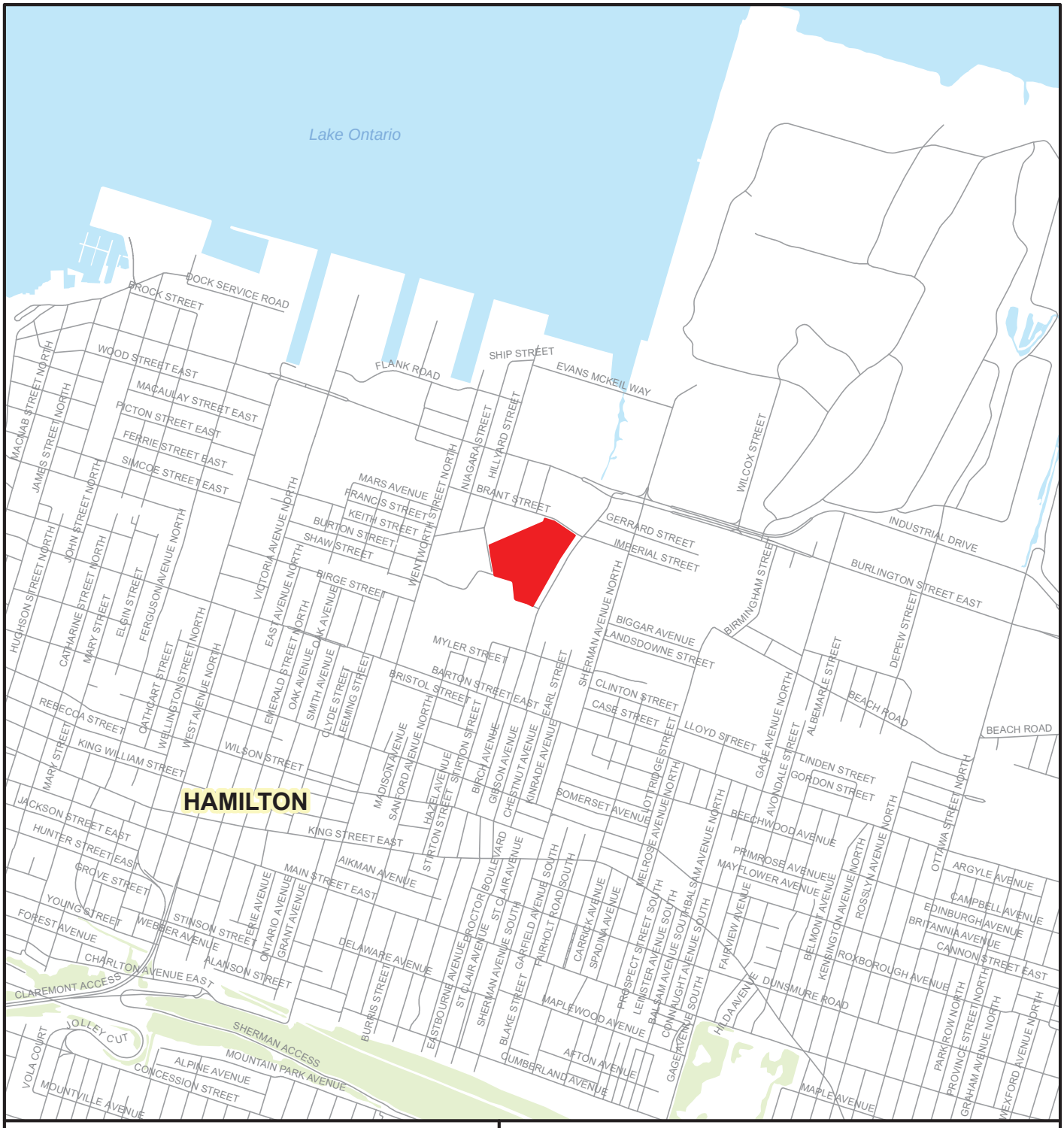
Ms. Rachel Bryan, M.A.Sc., P.Eng., is a Project Engineer in the Hamilton, Ontario office of WSP. She has experience in conducting Phase I and II Environmental Site Assessments on numerous residential, commercial, and industrial properties. Ms. Bryan also has experience in completing soil and groundwater contaminant delineation programs and is a Qualified Person (QP_{ESA}) with the MOECC under Ontario Regulation 153/04. She has also directed the implementation of soil remediation programs, verification sampling, and site restoration activities.

Mr. David A. MacGillivray, P.Eng., P.Geo., $QP_{ESA,RA}$, is the National Discipline Lead for Contaminated Lands and Environmental Site Assessments for WSP Canada. He is responsible for the operations of the environment group at WSP's Hamilton location. Mr. MacGillivray's career experience has included assignments involving Brownfields such as Phase One and Two ESAs, Record of Site Conditions, Risk Assessments, and Risk Management Plans. He has worked extensively in the area of groundwater resource development and groundwater impact assessment. Mr. MacGillivray also provides expertise in the completion of geotechnical and groundwater control studies for civil projects including subdivisions, transportation, buildings, and servicing. Mr. MacGillivray is a Qualified Person ($QP_{ESA,RA}$)with the Ministry of the Environment to complete Risk Assessments and submit Records of Site Condition under Ontario Regulation 153/04 (Brownfield Regulation).

BIBLIOGRAPHY

- Canadian Standards Association. 2001. Phase I Environmental Site Assessment Standard Z768-01. Canadian Standards Association.
- Chapman, L.J. and D.F. Putnam. 1984. The Physiography of Southern Ontario; Ontario Geological Survey. Special Volume 2. 270p. Accompanied by Map P.2715 (coloured), scale 1:600 000.
- Ministry of the Environment. 2004. Ontario Regulation 153/04 as amended by Ontario Regulation 511/09 – Records of Site Condition.
- Vos, M.A. 1969. Galt-Hamilton Sheet, Southern Ontario, Drift Thickness Series; Ontario Geological Survey, Preliminary Map No. P.535.
- Karrow, P.F. 1964. Bedrock Topography of the Hamilton Area, Southern Ontario; Ontario Geological Survey, Map 2034.
- Karrow, P.F. 1983. Quaternary Geology of the Hamilton Area, Southern Ontario; Ontario Geological Survey, Map P 2605

Figures



LEGEND

APPROXIMATE SITE BOUNDARY

N
W E
S

Data Source: Ministry of Natural Resources, Ontario Base Mapping, March 2014.

300 150 0 300 Metres

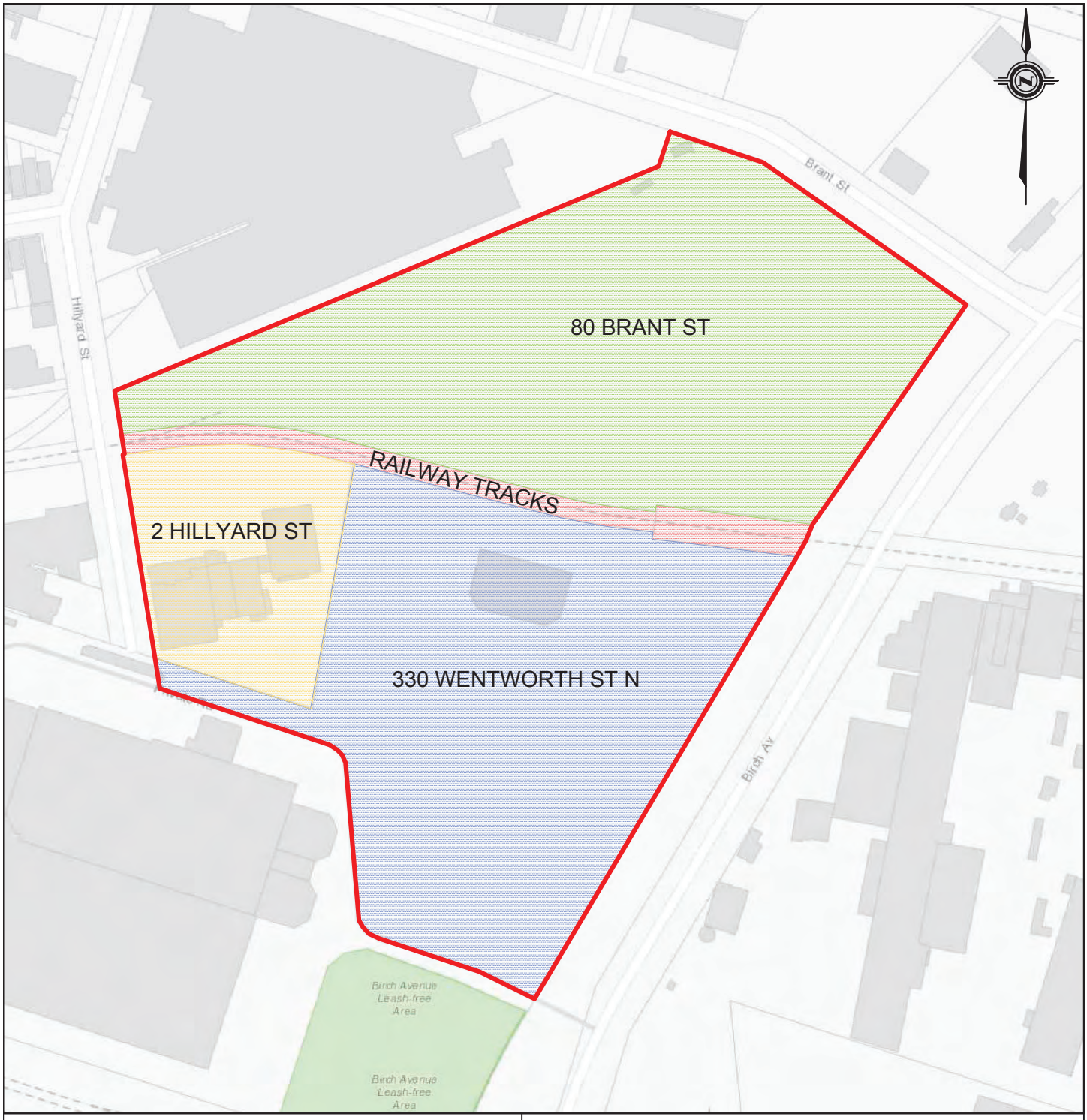
SITE LOCATION MAP

PHASE I ENVIRONMENTAL SITE ASSESSMENT
FUTURE HSR STORAGE & MAINTENANCE FACILITY
For City of Hamilton

DATE: APRIL 2017	SCALE: 1:25000
PROJECT: 161-17781-00 01	FILE. NO.:161-17781-00 01 F1

WSP

FIGURE 1



LEGEND

PROPERTY BOUNDARY (Approximate)

0 50 100 m

E L N

PHASE I ENVIRONMENTAL SITE ASSESSMENT
FUTURE HSR STORAGE & MAINTENANCE FACILITY
For: City of Hamilton

DATE: APRIL 2017	SCALE: AS SHOWN
PROJECT: 161-17781-00 - 01	REF. NO.: 161-17781-00 F2-SP

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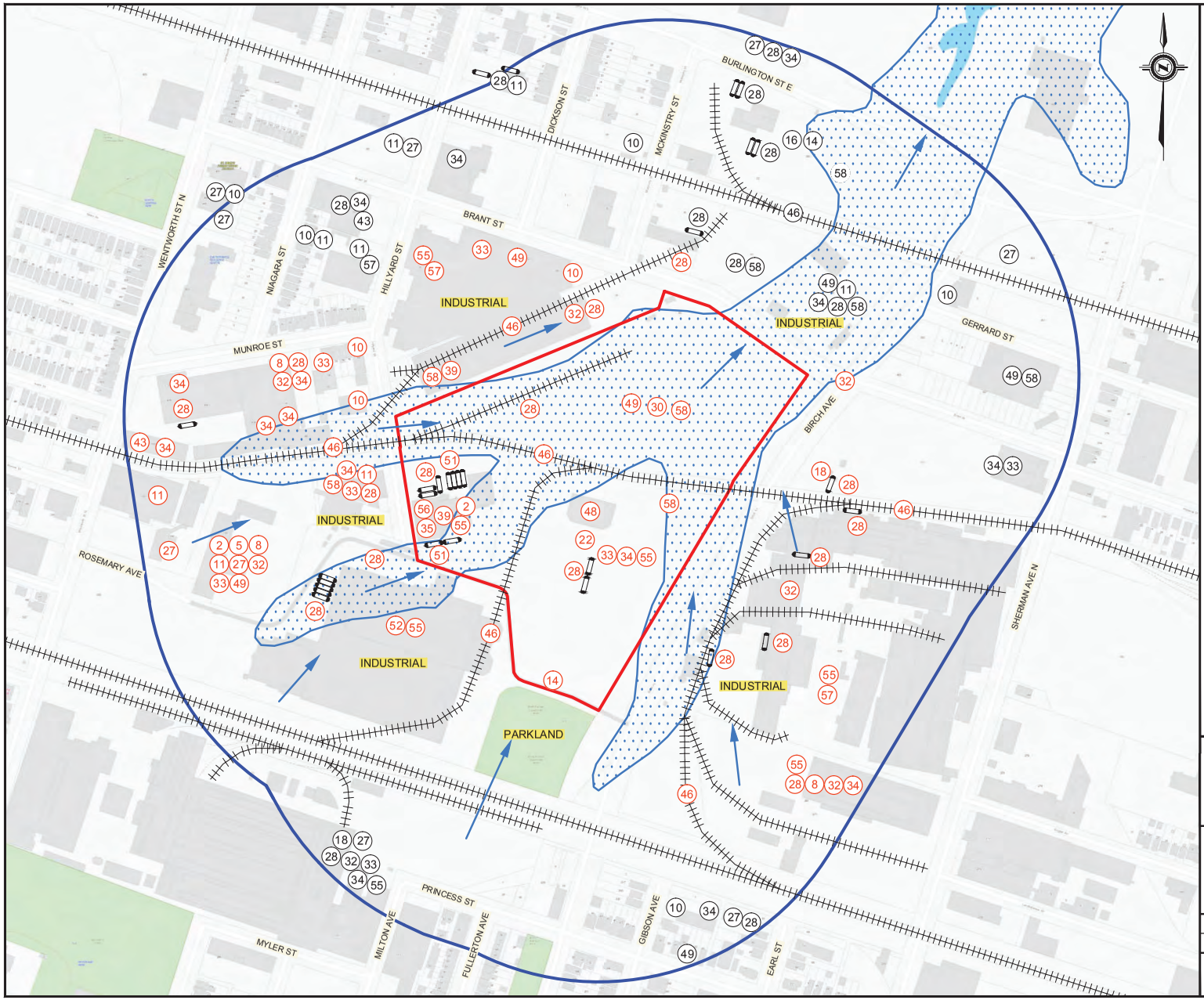
FIGURE



LEGEND

- SITE BOUNDARY (Approximate)
- PHASE I STUDY AREA BOUNDARY (250-m radius)
- APPROXIMATE LOCATION OF FORMER SHERMAN INLET (INFILLED)
- INFERRED GROUNDWATER FLOW DIRECTION
- UNDERGROUND FUEL STORAGE TANK (UST) (HISTORICAL OR EXISTING, LOCATION APPROXIMATE)
- HISTORICAL OR EXISTING RAILWAY TRACKS

POTENTIALLY CONTAMINATING ACTIVITIES (PCAs):

NOTE: PCAs HIGHLIGHTED RED ARE CONSIDERED TO BE CONTRIBUTING TO AN AREA OF POTENTIAL ENVIRONMENTAL CONCERN (APEC) ON THE SITE. THOSE SHOWN AS BLACK ARE NOT.

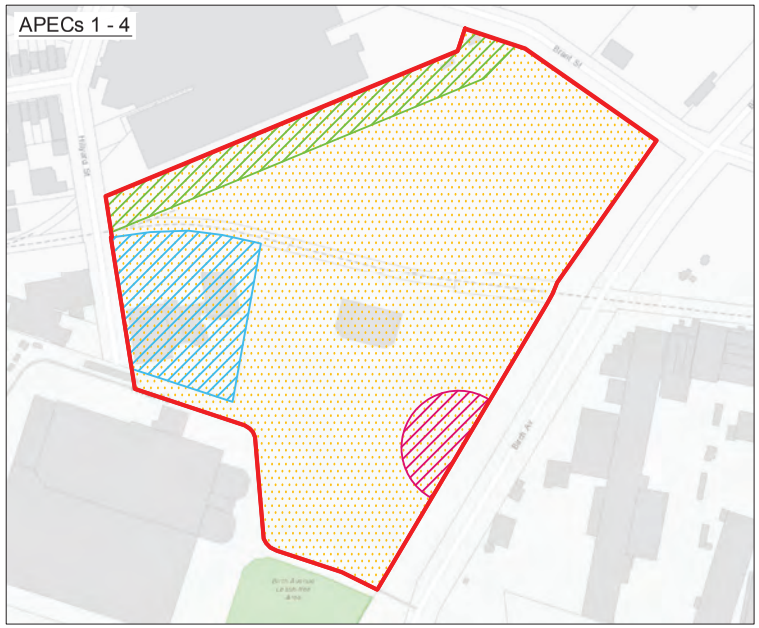
2. Adhesives and Resins Manufacturing, Processing and Bulk Storage
5. Asphalt and Bitumen Manufacturing
8. Chemical Manufacturing, Processing and Bulk Storage
10. Commercial Autobody Shops
11. Commercial Trucking and Container Terminals
14. Crude Oil Refining, Processing and Bulk Storage
16. Drum and Barrel and Tank Reconditioning and Recycling
18. Electricity Generation, Transformation and Power Stations
22. Fertilizer Manufacturing, Processing and Bulk Storage
27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles
28. Gasoline and Associated Products Storage in Fixed Tanks
30. Importation of Fill Material of Unknown Quality
32. Iron and Steel Manufacturing and Processing
33. Metal Treatment, Coating, Plating and Finishing
34. Metal Fabrication
35. Mining, Smelting and Refining; Ore Processing; Tailings Storage
39. Paints Manufacturing, Processing and Bulk Storage
43. Plastics (including Fibreglass) Manufacturing and Processing
46. Rail Yards, Tracks and Spurs
48. Salt Manufacturing, Processing and Bulk Storage
49. Salvage Yard, including automobile wrecking
51. Solvent Manufacturing, Processing and Bulk Storage
52. Storage, maintenance, fuelling and repair of equipment, vehicles, and material used to maintain transportation systems
55. Transformer Manufacturing, Processing and Use
56. Treatment of Sewage equal to or greater than 10,000 litres per day
57. Vehicles and Associated Parts Manufacturing
58. Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners

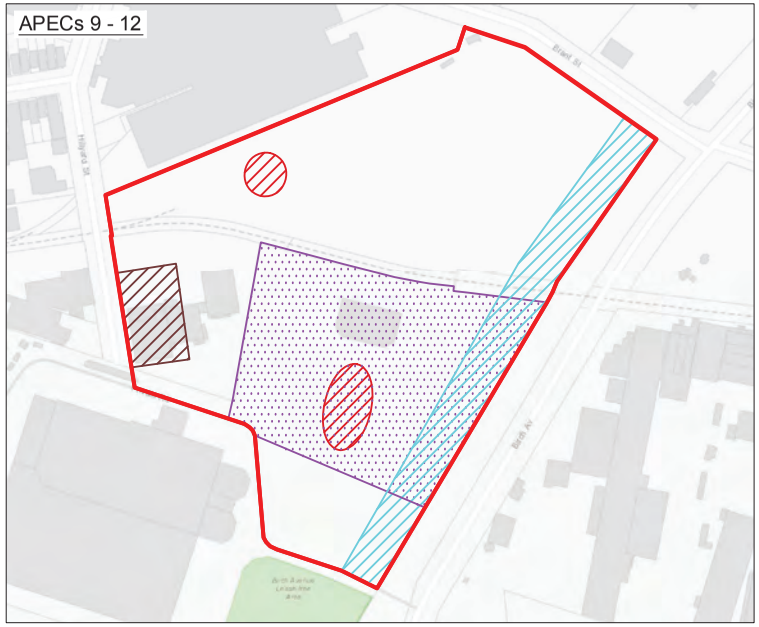
0 100 200 metres

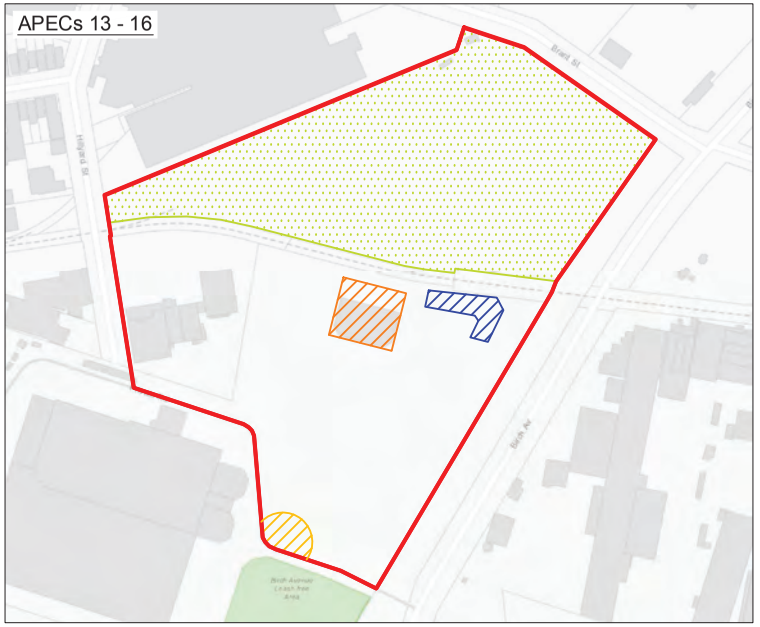
CONCEPTUAL SITE MODEL: POTENTIALLY CONTAMINATING ACTIVITIES

PHASE I ENVIRONMENTAL SITE ASSESSMENT
FUTURE HSR STORAGE & MAINTENANCE FACILITY
For: City of Hamilton

DATE: MARCH 2017	SCALE: AS SHOWN
PROJECT: 161-17781-00 - 01	REF. NO.: 161-17781-00 F3-CSM
WSP	FIGURE







LEGEND

SITE BOUNDARY (Approximate)

E EN LEN NMEN L N E N E

APEC NO.	REASON FOR APEC
APEC 1	3,000-L SPILL OF HYDRAULIC OIL IN 1997
APEC 2	OFF-SITE PCAs TO THE NORTHWEST
APEC 3	IMPORTATION OF FILL OF UNKNOWN QUALITY
APEC 4	PAINT MANUFACTURING AND LEAD SMELTING OPERATIONS
APEC 5	OFF-SITE PCAs TO THE SOUTHWEST
APEC 6	OFF-SITE PCAs TO THE WEST
APEC 7	CRUDE OIL PROCESSING AND BULK STORAGE
APEC 8	RAIL TRACKS AND SPURS
APEC 9	FUEL STORAGE IN FIXED TANKS
APEC 10	MUNICIPAL SEWAGE TREAMENT FACILITY
APEC 11	FERTILIZER MANUFACTURING AND METAL TREATMENT AND FABRICATION OPERATIONS
APEC 12	OFF-SITE PCAs TO THE EAST
APEC 13	SCRAP METAL FACILITY
APEC 14	SALT STORAGE FACILITY
APEC 15	WASTE TRANSFER
APEC 16	OIL-WATER SEPARATOR

0 100 200 metres

CONCEPTUAL SITE MODEL: AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

PHASE II ENVIRONMENTAL SITE ASSESSMENT
FUTURE HSR FACILITY
For: City of Hamilton

DATE: MARCH 2017	SCALE: AS SHOWN
PROJECT: 161-17781-00 - 01	REF. NO.: 161-17781-00 F3-CSM

WSP

FIGURE