Summary of Phase Two Environmental Site Assessment and Conceptual Site Model

70 Mississauga Road South,
Mississauga, Ontario

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Prepared for: Port Credit West Village Partners Inc.
c/o 40 King Street West, Suite 2700
Toronto ON M5H 3Y2

Prepared by: Stantec Consulting Ltd.
835 Paramount Drive, Suite 200
Stoney Creek ON L8J 0B4

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1.0 INTRODUCTION

Port Credit West Village Partners Inc. (PCWVP), retained Stantec Consulting Ltd. (Stantec) to conduct a Phase Two Environmental Site Assessment (ESA) at the former Imperial Oil Limited (IOL) Lands located at 70 Mississauga Road South in Port Credit, Ontario, herein referred to as the “Phase Two Property” or “the Site”. In this report, the terms “on-site” and “off-site” refer to the Phase Two Property and areas not located on the Phase Two Property, respectively.

The Phase Two ESA was conducted for PCWVP to support the future redevelopment of the Site to residential, parkland, commercial, and community (roadway) property uses. The objective of the Phase Two ESA was to characterize soil and groundwater at areas of potential environmental concern (APEC) identified in the Phase One ESA (Stantec, 2017b) and to further assess the presence, location, and concentration of contaminants of concern (COCs) previously identified by others ((Barenco, 2010) (Exp, 2013) (Exp, 2015a) (Exp, 2015b) (Exp, 2017)) in soil and groundwater at the Phase Two Property.

The Phase Two ESA was completed consistent with the industry practices documented in the Canadian Standard Association (CSA) Z769-00 standard for Phase Two ESAs and the requirements of Ontario Regulation (O.Reg.) 153/04.

Phase One and Two ESAs were conducted on the Site from 2008 to 2017 by Barenco Inc. (Barenco) (Barenco, 2010) and Exp Energy Services Ltd. (Exp) (Exp, 2013) (Exp, 2015a) (Exp, 2015b) (Exp, 2017)). Stantec completed a Phase One and Two ESA in 2017 (Stantec, 2017a) (Stantec, 2017b). This report includes a summary of the Phase Two programs completed at the Site between 2013 and 2017.

Figures, tables, and borehole logs referenced herein are presented in **Attachments A, B,** and **C**, respectively. Due to the size of the Site, the site plan has been subdivided into four quadrants to aid in the presentation of information associated with the Phase Two ESA.

1.1 SITE INFORMATION

The Phase Two Property is in an area of mixed commercial and residential land use on the southwestern corner of Mississauga Road South and Lakeshore Road West, and is bounded by Lakeshore Road West to the northwest, Mississauga Road South to the northeast, Lake Ontario to the southeast, and residential dwellings to the southwest along Pine Avenue South. The Phase Two Property has an area of approximately 29.4 hectares (72.8 acres).

The environmental conditions of the Site were previously evaluated by IOL through the completion of several ESAs since petroleum refining operations ceased in 1985. Phase One and Two ESAs were conducted from 2008 to 2015 (Barenco, 2010; Exp 2013, 2015a, and 2015b). The ESAs included the review of historical activities that may have impacted soil and groundwater at the Site, and characterization of soil, sediment, groundwater, and soil vapour.

During the Phase Two ESA, the Site was vacant. Structures remaining at the Phase Two Property included a vacant car wash and kiosk building on the northern corner of the Site (former gasoline service station property), a vacant fire hall building (also previously used as office space), and a former American Petroleum Institute (API) separator. Other features of note were a former Shale Pit in the central area of the Site that was utilized as a stormwater management pond, and a portion of the City of Mississauga Waterfront Trail adjacent to Lake Ontario. **Figure No. 1** presents a topographic map depicting the site location. **Figure Nos. 2** and **2a** present a site plan showing the site features including the buildings, monitoring well locations, underground utilities, APECs, as well as the adjacent properties.

A brick yard was reportedly established on the Phase Two Property in 1888 (Port Credit Weekly Focus 65, 1965). The use of the Phase Two Property prior to 1888 is unknown; however, a historical title search indicated the property was owned by private individuals between 1850 until transfer to Peel General Manufacturing Co. in 1884. Six buildings of unknown use were identified on the Phase Two Property in the 1910 fire insurance plan (FIP); three of these buildings were shown on the southeastern portion of the Phase Two Property along Joseph Street and were consistent with the outline of buildings shown on the 1928 FIP. The brick yard was active in the southeastern portion of the Phase Two Property on the 1928 FIP.

According to historical records, an oil and petrochemical refinery operated on the Phase Two Property between 1933 and 1985. The historical tanks and infrastructure associated with refinery operations were decommissioned by 1995.

The first developed land use of the Phase Two Property was therefore considered to be 1884, when Peel General Manufacturing Co. purchased the Phase Two Property from a private owner.

The objectives of the Phase Two ESA were to assess environmental impacts to soil and/or groundwater at the Site as a result of historical activities on-site or at neighboring/adjacent properties. Recommendations and the associated rationale for the Phase Two ESA were provided in Stantec's 2017 Environmental Due Diligence Program report (Stantec, 2017a) and Phase One ESA report (Stantec, 2017b).

The proposed future property use at the Site is a combination of residential, parkland, commercial, and community (roadways). Records of Site Conditions (RSCs) will be filed for all lands included in the proposed development. Although O.Reg. 153/04 would require mandatory filing of RSCs for the areas of the Site to be re-developed to residential and parkland property uses, RSCs for future community use (public roadways) are required to facilitate the conveyance of land to the City of Mississauga. PCWVP have also elected to file RSCs for land that will be developed to a commercial and community (private roadway) property use.

1.2 REGULATORY FRAMEWORK – APPLICABLE SITE CONDITIONS STANDARDS

The applicable Ontario Ministry of the Environment and Climate Change (MOECC) generic Site Condition Standards (SCS) for the proposed future use of the Phase Two Property were considered the MOECC Table 3 SCS for residential/parkland/institutional (RPI) land use in a non-potable groundwater condition, with medium to fine textured soil (MOE, 2011). Although redevelopment of the Site will include construction of roadways (community property use), the RPI Table 3 SCS were used across the Site since they are equally or more conservative (i.e., stringent) than the industrial/commercial/community Table 3 SCS.

The applicable MOECC generic SCS for the proposed future use of the Shoreline were considered to be the MOECC Table 9 Full Depth Generic SCS for use within 30 metres (m) of a water body in a non-potable groundwater condition.

The applicable SCS were selected based on a review of the following site-specific characteristics:

- Exp's (2013) and Stantec's (2017b) Phase One ESAs did not identify areas of natural significance on or adjacent to the Site. During Exp's Phase Two ESAs (2015a and 2015b) and Stantec's 2017 Phase Two ESA, surface soil and subsurface soil samples were collected and analyzed for pH. The pH results were within acceptable ranges of 5 to 9 for surface soils and 5 to 11 for subsurface soils. Therefore, the Site is not environmentally sensitive as per the definitions provided in Section 41 of O.Reg.153/04.
- During Stantec's 2017 environmental due diligence program, the depth to weathered bedrock ranged from approximately 2.3 m to 5.7 m below ground surface (BGS) (average depth was 3.3 m BGS). The former shale pit located in the southwestern portion of the Site is not considered a water body since it was used as a storm water management pond for historical operations at the Site. O.Reg.153/04 defines a water body as "a permanent stream, river, or similar watercourse or a pond or lake, but does not include a pond constructed on the property for the purpose of controlling surface water drainage". Thus, no water bodies were observed at the Phase Two Property. Portions of the Site are located within 30 m of a water body, as Lake Ontario is located immediately southeast of the Phase Two Property. Based on the subsurface investigation conducted as part of the current environmental program and a review of available mapping, the Site is not a shallow soil property.
- Grain size distribution analyses were completed during Exp's Phase Two ESAs (Barenco, 2010; Exp 2015a, 2015b, and 2017). Thirty-one of the 34 analyzed soil samples had less than 50 percent by mass of particles that were 75 micrometres or larger in mean diameter. Although three soil samples had 52 percent mass of particles that were 75 micrometres or larger in mean diameter, the dominant soil texture at the Site is considered medium/fine. The soil texture was confirmed based on consistent stratigraphy observed during Stantec's 2017 drilling programs (borehole logs are presented in **Attachment C**), as well as grain-size analysis completed by Stantec as part of a geotechnical investigation.
- Potable water obtained from Lake Ontario is supplied to properties located, in whole or in part, within 250 m of the boundaries of the Site through the municipal drinking water system, as defined in the Safe Drinking Water Act, 2002 (MOE, 2002). Based on the information reported in the Phase Two ESA (Exp, 2015b), Supplemental Phase Two ESA (Exp, 2015a), and Stantec's 2017 Phase One ESA (Stantec, 2017b) there are no active private water wells within 1 kilometre (km) of the Site. In addition, the Site is not located in an area designated in a municipal official plan as a wellhead protection area or other designation identified by the municipality for the protection of groundwater. Considering the above information, the non-potable groundwater SCS available in O.Reg. 153/04 were considered applicable at the Site.
- The proposed future use of the Site will include residential, commercial, community (roadways), and parkland property uses. Under Section 3(2) of O. Reg. 153/04, residential and parkland are the more sensitive of these land uses; therefore, the Table 3 SCS for RPI land use were considered applicable.

1.3 PAST INVESTIGATIONS

Several previous environmental investigations completed for the Phase Two Property were reviewed by Stantec. A list of the previous environmental reports reviewed by Stantec is presented below. Detailed report summaries are provided in the Stantec's (2017a) Phase One ESA report. **Figure No. 2** presents a detailed site plan and **Figure No. 2a** presents a site plan outlining the APECs identified in Stantec's 2017 Phase One ESA. Selected historical analytical data from 2013 to 2017 for soil and groundwater are presented in **Table Nos. 3a** and **3b** to **11a** and **11b** and **Table Nos. 12** to **20**, respectively. Borehole logs from previous Barenco (2010), Exp (2013 to 2015a, b, and 2017) and Stantec (2017b) investigations are provided in **Attachment C**. The following previous environmental investigations were reviewed by Stantec:

- "Assessment of Greenway Study Lands, Imperial Oil Limited, South Property, Port Credit, Ontario" prepared by Golder Associates Ltd. for IOL, dated June 30, 1995.
- "Assessment of Proposed Waterfront Trail Lands, Imperial Oil Limited, South Property, Port Credit, Ontario", prepared by Golder Associates Ltd. for IOL, dated March 31, 1997.
- "Remedial Measures, proposed Waterfront Trail Lands, Imperial Oil Limited, South Property, Port Credit, Ontario", prepared by Golder Associates Ltd. for the City of Mississauga, dated March 9, 1998.
- "Site Specific Guidelines Development for the Greenway Study Lands, South Property, Imperial Oil Lands, Port Credit, Ontario", prepared by Golder Associates Ltd. for the City of Mississauga, dated September 1999.
- "Preliminary Environmental Assessment, 10 Mississauga Road South, Mississauga, Ontario", prepared by Barenco, for IOL, dated April 30, 2010.
- "Phase I Environmental Site Assessment, 10 Mississauga Road South, Mississauga, Ontario", prepared by Exp, for IOL, dated May 24, 2013.
- "Phase II Environmental Site Assessment, 10 Mississauga Road South, Mississauga, Ontario", prepared by Exp, for IOL, dated August 8, 2015.
- "Supplemental Phase II Environmental Site Assessment, 10 Mississauga Road, South, Mississauga, Ontario", prepared by Exp, for IOL, dated July 24, 2015.
- "Soil Vapour Probe Sampling Program Report", 10 Mississauga Road South, Port Credit, Ontario, prepared by Exp, for IOL, dated January 22, 2016.
- "Soil Vapour Probe Installation and Sampling Program Report", Adjacent to 10 Mississauga Road South, Port Credit, Ontario, prepared by Exp, for IOL, dated January 22, 2016.
- "Phase II Environmental Site Assessment and Site Decommissioning Program, 181 Lakeshore Road West, Mississauga, Ontario", prepared by Exp., for IOL, dated January 27, 2017.
- "Environmental Due Diligence Program", Port Credit Imperial Oil Lands, 70 Mississauga Road South, Mississauga, Ontario, prepared by Stantec for Port Credit Village Partners Inc., dated March 2, 2017.
- "Phase One Environmental Site Assessment", 70 Mississauga Road South, Port Credit, Ontario, prepared by Stantec for Port Credit Village Partners Inc., August 18, 2017.

1.3.1 Data Corroboration and Validation

Stantec conducted Phase One and Two ESA studies in 2017 to corroborate the findings of the Exp studies summarized above as required by O.Reg. 153/04. Stantec has also utilized information collected by Stantec's geotechnical group as part of the September and October 2017 geotechnical investigation completed on the Site (Stantec, 2017c). In the absence of guidance in O.Reg. 153/04, the data corroboration and validation was undertaken consistent with the requirements of Section 6.1.2 of CSA Standard Z769-00 for conducting Phase II ESAs.

Stantec reviewed the available documents provided by PCWVP, as prepared by Exp and Barenco, the previous consultants for the Site. Field methods, the laboratory accreditation, monitoring well screen placement, and the overall pattern of groundwater concentrations in terms of temporal and spatial consistency were also reviewed.

Stantec advanced boreholes to confirm previous soil analytical results. Stantec's sampling was completed consistent with the methodologies required by O.Reg. 153/04. Stantec collected groundwater samples from select accessible on-site monitoring wells in 2017. An appropriately accredited laboratory analyzed groundwater samples for the COCs identified by the Phase One ESA (Stantec, 2017b). Stantec's analytical results were compared with Exp's analytical results to identify possible inconsistencies. Stantec advanced boreholes to horizontally and/or vertically delineate soil impacts identified in previous stages of the Phase Two ESA.

2.0 SCOPE OF THE PHASE TWO ESA INVESTIGATION

The Phase Two ESA was conducted to further assess the presence and location of COCs that could potentially be associated with APECs identified at the Phase Two Property, as summarized in the Phase One ESA (Stantec, 2017b). Historical industrial activities at the Site and on neighboring properties included activities that may have resulted in the identified areas of impact to soil and groundwater.

Fifteen APECs were identified at the Phase Two Property. One APEC is associated with historical on-site and off-site PCAs, six of the APECs were associated with on-site historical PCAs, and the remaining eight APECs were associated with off-site PCAs. The locations of the PCAs and APECs are shown on **Figure No. 2a**. The PCAs and APECs are discussed in detail below.

APEC 1: Located along the northwestern property boundary. A historical commercial auto body shop (PCA 10) formerly operated in the northern corner of the Phase Two Property (formerly referred to as 181 Lakeshore Road West), and historical commercial auto body shops operated adjacent to the Site at 125 High Street; 72 Wesley Avenue; and 200, 212, 266, 280, and 286 Lakeshore Road West.

APEC 2: Located in the western corner of the Phase Two Property. 321 Lakeshore Road West (located approximately 70 m west of the Phase Two Property), historically operated as a vehicle repair shop (PCA 10) with associated underground storage tanks (USTs).

APEC 3: The historical operation of a brick manufacturing facility (PCA 12) occurred within the eastern portion of the Phase Two Property.

APEC 4: Includes the entire Phase Two Property. An oil and petrochemical refinery (PCA 14) operated on the Phase Two Property between 1933 and 1985.

APEC 5: Located along the northwestern property boundary. 250 Lakeshore Road West (located approximately 25 m northwest of the Phase One Property), historically operated as a distribution terminal and refinery products loading area with various storage tanks (PCA 14).

APEC 6: Located on the northern corner of the Phase Two Property. A gasoline service station with associated USTs (PCA 28) was formerly located on the northern corner of the Phase Two Property.

APEC 7: Located on the northeastern portion of the Phase Two Property. A historical UST (PCA 28) was observed on the roadway of Bay Street in front of an unknown building identified as 31 Bay Street (located approximately 215 m northeast of the Phase Two Property) on the 1928 FIP.

APEC 8: Located along the northwestern Phase Two Property boundary. A historical gasoline service station with associated USTs (PCA 28) historically operated 25 m northwest of the Phase Two Property at 182 and 200 Lakeshore Road West.

APEC 9: Located within the northern corner of the Phase Two Property. 150 Lakeshore Road West (located approximately 70 m north of the Phase Two Property), historically operated as a gasoline service station with associated USTs (PCA 28).

APEC 10: Fill material of unknown quality was identified across the entire Phase One Property.

APEC 11: Historical rail spurs (PCA 46), were located within the northwestern, southeastern, and central portions of the Phase Two Property.

APEC 12: Located along the northwestern Phase Two Property boundary. Historical operation of a dry cleaner located approximately 130 m northwest of the Phase Two Property at 228 Lakeshore Road West.

APEC 13: Located on the northern corner of the Phase Two Property. Historical operation of a dry cleaner (PCA 37) located approximately 70 m north (150 Lakeshore Road West) of the Phase Two Property.

APEC 14: Located on the eastern corner of the Phase Two Property. Historical landfilling (PCA 58) occurred immediately east of the Phase Two Property at J.C. Saddington Park.

APEC 15: Historical PCB storage (PCA 55) reportedly occurred within the northeastern portion of the Phase Two Property.

The main objectives of the soil and groundwater sampling programs were to assess the lateral and vertical extent of impacts identified previously at the Phase Two Property by others, corroborate and verify the locations and concentrations of the COCs previously identified at the Phase Two Property, and provide supplemental data to meet MOECC RSC filing requirements. The Phase Two ESAs included the advancement of boreholes and test pits, installation of monitoring wells, and completion of soil and groundwater sampling events.

2.1 OVERVIEW OF THE SITE INVESTIGATIONS

The summaries of the Phase Two investigations have been organized by time period. The Phase Two ESAs comprised the following activities:

Exp Phase Two ESA (May 2013 to February 2014)

- During this Phase Two program, 570 test pits (TP1A/B to TP580A/B) and 1,234 boreholes (TH300 to TH999 and TH1200 to TH1734) were advanced. Test pits were advanced to a maximum depth of 5.5 m BGS and boreholes were advanced to a maximum depth of 13.8 m BGS.
- Eighty of the boreholes were completed as monitoring wells (refer to borehole logs included in **Attachment C** for installation details).
- Fourteen soil samples were analyzed for grain size distribution to determine the soil texture and allow for the classification of the Phase Two Property within the generic site condition standards.
- Water level elevations and groundwater samples were collected from each newly installed monitoring well and select existing monitoring wells.
- Hydraulic conductivity testing in monitoring wells was conducted using bailers or slugs.
- Soil and groundwater samples were submitted for laboratory analysis of COCs, which included volatile organic compounds (VOCs), petroleum hydrocarbon fractions 1 to 4 (PHC F1 to F4), semi-VOCs (SVOCs) (including polycyclic aromatic hydrocarbons (PAH), chlorophenols (CPs), acids/base neutrals (ABNs)), polychlorinated biphenyls (PCBs), and inorganic parameters.

Exp Supplemental Phase Two ESA (January to June 2015)

- During this program, 20 boreholes (TH560D, TH562C, TH1342C, TH1563B, TH1602C, TH1702B, TH1800A and TH1800B to TH1805A and TH1805B, TH1806, and TH1807) were advanced to depths ranging from approximately 3.4 m to 16.8 m BGS.
- All 20 boreholes were completed as monitoring wells in close proximity to existing monitoring wells at the Site.
- 202 existing and newly installed monitoring wells, as well as three recovery wells were monitored for groundwater levels.
- Soil and groundwater samples were analyzed for COCs, which included VOCs, PHC F1 to F4, PAH, PCBs, and inorganic parameters.

Exp Phase II ESA and Site Decommissioning Program (November to December 2016)

- A gasoline service station was previously located on the northern corner of the Phase Two Property. The decommissioning program involved the demolition of the canopy, removal of three USTs and associated piping, and the removal of an oil/grit separator.
- The final depths of the UST excavation were between 3.8 m and 4.1 m BGS, the oil/grit separator excavation was terminated 2.0 m BGS, and the product piping trench and piers excavation was terminated 1.1 m BGS. Soil quality was tested at the final extents of the excavations and trenches.
- Five test pits (TP1 to TP5) and seven boreholes (TH1 to TH7) were advanced to a maximum depth of 5.2 m BGS. Six of the boreholes were completed as monitoring wells (TH1 to TH6). Fill material was encountered at depths up to 3.2 m BGS. Monitoring wells TH1, TH2, TH4, and TH5 were advanced outside of the excavations, TH3 was advanced within the extent of the pump island excavation, and TH6 was advanced within the extent of the UST excavation.
- Soil was analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX), VOCs, PHCs, PAHs, and metals and groundwater was analyzed for BTEX, VOCs, PHCs, and metals.

Stantec Due Diligence Program (January to February 2017)

- The scope of work included advancing 26 boreholes (MW17-001 to MW17-011, MW17-012D, MW17-013 to MW17-019, MW17-020D to MW17-25D, and MW17-026) that ranged in depth from 2.7 m to 16.8 m BGS.
- Each of the 26 boreholes was completed as a monitoring well.
- 148 existing and newly installed monitoring wells were monitored for groundwater levels, headspace vapour concentrations, and the thickness of liquid petroleum hydrocarbons (LPH).
- Soil and groundwater samples were recovered from the newly advanced monitoring wells and submitted for analysis of VOCs, BTEX, and PHC F1 to F4.

Stantec Supplemental Phase Two ESA (June to November 2017)

- 18 existing monitoring wells were monitored for groundwater levels. Groundwater samples were collected for COCs, which included BTEX, PHC F1 to F4, VOCs, PAHs, ABNs, CPs, metals, and PCBs.
- Hydraulic conductivity testing in monitoring wells was conducted using bailers or slugs.
- 21 environmental boreholes were advanced to depths ranging from approximately 1.8 m to 16.8 m BGS. This program was completed in conjunction with a geotechnical investigation.

- Eleven of the 21 boreholes were completed as monitoring wells.
- Water level elevations and groundwater samples were collected from each newly installed monitoring well and selected existing monitoring wells.
- Soil and groundwater samples were submitted for analysis of BTEX, PHC F1 to F4, VOCs, PAHs, ABNs, CPs, metals, and PCBs. In addition, soil samples were analyzed for electrical conductivity (EC) and sodium adsorption ratio (SAR) and groundwater samples were analyzed for sodium and chloride.

The following activities were completed during Stantec's Phase Two ESA programs discussed above:

- Soil samples collected in the field from the boreholes and test pits were field-screened for combustible vapor concentrations (CVCs) using a, RKI Eagle™ 2 combustible gas detector or equivalent. The Eagle 2 is also equipped with a photoionization detector (PID) and was also used to field-screen for total organic vapors (TOV).
- Selected soil samples were recovered from the completed boreholes and test pits and submitted to Maxxam Analytics International Corporation (Maxxam) of Mississauga, Ontario for analyses of the COCs.
- Monitoring and sampling of newly installed and selected accessible pre-existing monitoring wells, and submission of groundwater samples to Maxxam for laboratory analysis of the identified potential COCs.
- Interpretation of the field data and the analytical results.
- For the purposes of this Phase Two Summary report, applicable data were compared with the Ministry of Environment (MOE) (2011) Table 3 SCS for RPI use.
- Preparation of a Phase Two ESA summary report consistent with the requirements of O.Reg. 153/04 and CSA standard Z769-00.

It is noted that some of the borehole and/or monitoring wells locations advanced during the Phase Two ESA investigations are located beyond the boundaries of the Phase Two Property, specifically beyond the southern Phase Two Property boundary. Although these locations were included in the investigation locations described in **Section 2.1**, they are not discussed within the remaining sections of the report.

3.0 RESULTS OF THE INVESTIGATION

3.1 STRATIGRAPHY

The Site is located in the physiographic region called Iroquois Plain, which consists of surficial soils predominately composed of clay till overlain by sand. The localized ground conditions consist of subsurface soils classified as glaciolacustrine deposits. (Chapman and Putnam 1984). The Quaternary Geology of Ontario, Southern Sheet, Map 2556, issued by the Ministry of Northern Development and Mines, 1991, indicates that the region of the Site is comprised of glaciolacustrine deposits consisting of sand, gravelly sand and gravel, and nearshore beach deposits. Chapman and Putnam also indicates the presence of till plains, and Map 2566 indicates the presence of silt and clay glaciolacustrine deposits in proximity to the east of the Site.

The Phase Two ESA investigations indicated the soil profile generally consisted of:

- Ground surface cover consisting of organics with topsoil or asphalt; underlain by,
- Fill materials consisting of sand with gravel, sandy silt, sandy clay with gravel, clay with sand, or clay; underlain by,
- Brown to grey sandy silt with silty clay/clayey silt layers and discontinuous sand layers.

Fill material was encountered at depths ranging from 0.2 m to 3.8 m BGS, with thickness generally ranging from 1.2 m to 2.0 m. Native soil (i.e., sandy silt with silty clay layers) was encountered at depths ranging from 1.2 m to 5.3 m BGS, with an estimated average thickness of 2.5 m. The Shale Pit in the southwest portion of the Phase Two Property at one time extended approximately 100 m to the north of the current configuration. This portion of the Sale Pit was backfilled prior to 1985. Thus, fill was encountered at a depth of 8.3 m BGS, and native soil was encountered from 8.3 m to 11.0 m BGS in this area.

The underlying geology comprises the Georgian Bay Formation, Meaford-Dundas beds of shale, and limestone of the Upper Ordovician period (MNDM, 1991a). Shale bedrock was observed at depths ranging from 2.3 m to 5.7 m BGS, with rock quality generally transitioning from weathered to unweathered with increasing depth. Moderately weathered shale was encountered in the previously backfilled area north of the existing Shale Pit at a depth of 11.0 m BGS.

Borehole logs from the 2013 to 2017 Site investigations are provided in **Attachment C**. Historical grain size analysis records are also provided in **Attachment C**. The grain size analysis results indicated that soil contains 50% or more by mass of particles that are smaller than 75 micrometres in mean diameter. Thus, the medium to fine textured soil SCS are considered applicable for the Site.

3.2 HYDROGEOLOGY

3.2.1 Groundwater Elevation and Flow Direction

The historical monitoring wells (i.e., installed from 2013 to 2015) were advanced in APECs identified during the Phase One ESA (Exp, 2013) to provide delineation of potential contamination sources. Test pits and monitoring wells advanced by Exp in 2016 were completed in conjunction with the decommissioning program with the intent to delineate the soil and access groundwater conditions within the northern corner of the Site. Monitoring wells installed by Stantec in 2017 were advanced to horizontally and vertically delineate COCs, and to address any data gaps along the property boundaries during the pre-purchase due diligence period.

Monitoring wells were installed such that the screen interval intersected the groundwater level observed during the drilling investigation. Deeper monitoring wells (i.e., installed into weathered or unweathered bedrock) were installed below the water table such that the screen was completely immersed in the aquitard to provide vertical delineation.

The depth to groundwater at each monitoring well was determined under conditions where no pumping or other activity that would influence water levels was being conducted. Water levels and depth to LPH, if present, were measured using a Solinst Model 122 oil/water interface probe, or equivalent. The interface probe was scrubbed with a brush and a solution of distilled water and diluted Alconox® powdered cleaner to remove particulate matter. The interface probe was then rinsed with a Alconox® and distilled water solution. The water level was measured relative to the top of pipe elevation, which was surveyed with respect to a permanent surveying benchmark. The groundwater monitoring results are presented on **Table No. 2.**

The depth to groundwater and presence/absence of LPH was monitored at selected accessible monitoring wells at the Phase Two Property by Exp in January, March, May, and June 2015. Stantec monitored the depth to groundwater and presence/absence of LPH at selected accessible monitoring wells at the Phase Two Property during a winter program (January and February 2017), summer program (June 2017), and a fall program (September, October, and November 2017). LPH were not detected in the monitoring wells using the interface probe or observed on the surface of water purged from the wells during the 2015 and 2017 monitoring events, with the exception of five monitoring wells. Measurable LPH was observed in monitoring wells BH90-214, BH90-215, TH114, TH118, and TH129B during the January 2015, March 2015, and January 2017 monitoring events, as follows:

- The LPH thickness, measured in the accessible monitoring wells during the January 2015 event, via one pass of a disposal bailer, ranged from 10 mm (TH118) to 100 mm (BH90-214).
- The LPH thickness, measured in the accessible monitoring wells during the March 2015 event, via one pass of a disposal bailer, ranged from 65 mm (TH118) to 580 mm (BH90-215).
- The LPH thickness, measured in the accessible monitoring wells during the 2017 monitoring period, via one pass of a disposable bailer, ranged from an LPH sheen (TH1702 and TH1702B) to 140 mm in BH90-214 (January 2017).

The five monitoring wells where measurable LPH was observed are located in the area north of the existing Shale Pit that was backfilled during the operational period of the refinery. The monitoring wells are within either Quadrant 1 or 3 and are identified on **Figure Nos. 13a, 13b**, and **13d**.

During the March 2015 monitoring event, the groundwater levels measured by Exp in selected accessible monitoring wells installed in the overburden ranged from 0.06 m BGS (TH121) to 5.69 m BGS (TH1367). The groundwater elevations in the overburden monitoring wells and the inferred groundwater flow direction during the March 2015 monitoring event are shown on **Figure No. 3a**. During the January and February 2017 monitoring event, the groundwater levels measured by Stantec in the accessible monitoring wells installed in the overburden ranged from 0.27 m BGS (TH820) to 5.55 m BGS (BH90-212). The groundwater elevations in the overburden monitoring wells and the inferred groundwater flow direction during the January monitoring event are shown on **Figure No. 3c.** During the June 2017 monitoring event, the groundwater levels measured by Stantec in the accessible monitoring wells installed in the overburden ranged from 0.49 m BGS (TH1565) to 1.86 m BGS (MW17-015). Due to the limited data collected from overburden wells during the June 2017 event, the groundwater flow direction could not be inferred. During the fall 2017 monitoring event, the groundwater levels measured by Stantec in the accessible monitoring wells installed in the overburden ranged from 2.15 m BGS (TH1531) to 3.13 m BGS (TH564). The groundwater elevations in the overburden monitoring wells and the inferred groundwater flow direction during the September and October 2017 monitoring event are shown on **Figure No. 3e**. Observed fill materials as well as other buried infrastructure (e.g., abandoned utilities, foundations, etc.) will influence the groundwater elevations observed in monitoring wells installed in overburden. The presence of these subsurface features has likely created perched groundwater conditions over much of the Phase Two Property. Perched groundwater conditions will be sensitive to seasonal and meteorological effects. The variable profile of the overburden groundwater surface presented in **Figures No. 3a, 3c and 3e** suggests that both perched and unconfined groundwater conditions are present.

During the March 2015 monitoring event, the groundwater levels measured by Exp in the selected accessible bedrock monitoring wells ranged from approximately 0.13 m BGS (BH90-204B) to 15.34 m BGS (TH562C). The groundwater elevations in the bedrock monitoring wells and the inferred groundwater flow direction during the March 2015 monitoring event are shown on **Figure No. 3b**. During the January and February 2017 monitoring event, the groundwater levels measured by Stantec at the accessible bedrock monitoring wells ranged from 0.08 m BGS (TH546C) to 16.12 m BGS (MW17-022D). The groundwater elevations in the bedrock monitoring wells and the inferred groundwater flow direction during the January monitoring event are shown on **Figure No. 3d**. During the June 2017 monitoring event, the groundwater levels measured by Stantec at the accessible bedrock monitoring wells ranged from 0.26 m BGS (19B) to 10.71 m BGS (TH562C). Due to the limited data collected from bedrock wells during the June 2017 event, the groundwater flow direction could not be inferred. During the fall 2017 monitoring event, the groundwater levels measured by Stantec at the accessible bedrock monitoring wells ranged from 1.32 m BGS (MW17-031D) to 5.49 m BGS (TH1702). The groundwater elevations in the bedrock monitoring wells and the inferred groundwater flow direction during the September and October 2017 monitoring event are shown on **Figure No. 3f**. In many cases screened intervals in bedrock groundwater monitoring wells were installed to different depths at the same general locations (i.e., nested monitoring wells) to vertically delineate observed groundwater impacts. It is common for groundwater elevations within monitoring wells installed into bedrock to be influenced by hydrostatic pressures associated fracture networks (i.e., groundwater elevations measure higher than the elevation of the water bearing fracture(s)). The bedrock groundwater surface interpretations **(Figures No. 3b, 3d**, and **3f**) considered groundwater elevation data that was representative of monitoring wells will screened intervals at generally similar elevations.

Based on the water level data obtained during the March 2015, January 2017, and September and October 2017 events, the inferred direction of groundwater flow in the overburden wells (representative of both perched and unconfined groundwater conditions) was generally to the east and southeast (**Figure Nos. 3a, 3c,** and **3e**). Based on the water level data obtained during the March 2015, January 2017, and September and October 2017 events, the inferred direction of groundwater flow in the bedrock wells was generally to the east and southeast (**Figure Nos. 3b, 3d,** and **3f**).

3.2.2 Hydraulic Gradients

Average horizontal hydraulic gradient (i_h) was calculated at the Phase Two Property using selected isopotential contour lines and the following equation.

$$i_h = \frac{h_2 - h_1}{L}$$

Where: h_x = Groundwater elevation (m) at isopotential contour
L = Horizontal distance (m) between contours

Due to the size of the Site, three horizontal gradients were calculated from the March 2015 and January 2017 data and two horizontal gradients were calculated from the Fall 2017 data. The horizontal gradients in the overburden were as follows, based on the groundwater direction contours presented in **Figure Nos. 3a, 3c,** and **3e**:

- Exp 2015: Horizontal gradients ranged from 0.01 m/m to 0.02 m/m
- January 2017: Horizontal gradients ranged from 0.01 m/m to 0.02 m/m
- September to October 2017: Horizontal gradients were 0.01 m/m

The minimum, maximum, and average horizontal gradients in overburden were 0.01 m/m, 0.02 m/m, and 0.01 m/m, respectively.

The horizontal gradients in bedrock were as follows, based on the groundwater direction contours presented in **Figure Nos. 3b, 3d,** and **3f**:

- Exp 2015: Horizontal gradients ranged from 0.01 m/m to 0.03 m/m
- January 2017: Horizontal gradients ranged from 0.01 m/m to 0.02 m/m
- September to October 2017: Horizontal gradients were 0.01 m/m

The minimum, maximum, and average horizontal gradients in bedrock were 0.01 m/m, 0.03 m/m, and 0.01 m/m, respectively.

The vertical hydraulic gradient is the difference in hydraulic head (water level in the well) divided by the vertical distance between the two monitoring wells. The vertical distance between each monitoring well is calculated from the depth mid-point of the monitoring well screened interval.

Vertical Hydraulic Gradient = (Groundwater Elevation at Shallow Well – Groundwater Elevation at Deep Well) / (Screen Mid-Point Elevation of Shallow Well – Screen Mid-Point Elevation of Deep Well).

A positive vertical gradient indicates a downward gradient, while a negative vertical gradient indicates an upward gradient. Vertical hydraulic gradients were calculated where a contaminant was present in groundwater at a concentration greater than the applicable SCS. The vertical gradient was calculated using the following monitoring well pairs, trios, or quads:

- BH90-204A/BH90-204B/TH1807
- TH129A to TH129C
- TH548A to TH548C
- TH560A to TH560D

- TH562A to TH562C
- TH1303A/TH1303B
- TH1366A/TH1366B
- TH1563A/TH1563B
- TH1600/TH1602B/TH1602C
- TH1703A/TH1703B
- TH1800A/TH1800B
- TH1801A/TH1801B
- TH1802A/TH1802B
- TH1803A/TH1803B
- TH1805A/TH1805B

The results of the vertical gradient calculations are tabulated below.

Table A: March 2015 Vertical Hydraulic Gradients

Well ID	Monitoring Date	Water Elevation (m relative to datum)	Water Elevation Difference (m)	Vertical Gradient	Gradient Direction
BH90-204A	27-Mar-15	78.93	-0.29	-0.08	Upwards
BH90-204B	27-Mar-15	79.22			
BH90-204B	27-Mar-15	79.22	2.59	1.74	Downwards
TH1807	27-Mar-15	76.63			
TH1366A	26-Mar-15	76.65	0.44	0.17	Downwards
TH1366B	26-Mar-15	76.21			

Table B: January 2017 Vertical Hydraulic Gradients

Well ID	Monitoring Date	Water Elevation (m relative to datum)	Water Elevation Difference (m)	Vertical Gradient	Gradient Direction
TH129A	5-Jan-17	79.64	3.39	0.89	Downwards
TH129B	5-Jan-17	76.25			
TH129B	5-Jan-17	76.25	-0.19	-0.06	Upwards
TH129C	5-Jan-17	76.44			
TH548A	03-Jan-17	80.66	1.07	0.38	Downwards
TH548B	03-Jan-17	79.59			
TH548B	03-Jan-17	79.59	-0.17	-0.06	Upwards
TH548C	17-Jan-17	79.76			
TH560A	4-Jan-17	78.13	0.93	0.36	Downwards
TH560B	4-Jan-17	77.20			
TH560B	4-Jan-17	77.20	0.43	0.13	Downwards
TH560C	4-Jan-17	76.77			
TH560C	4-Jan-17	76.77	2.07	0.26	Downwards
TH560D	4-Jan-17	74.70			
TH562A	04-Jan-17	80.24	0.58	0.23	Downwards
TH562B	04-Jan-17	79.66			
TH562B	04-Jan-17	79.66	2.58	0.24	Downwards
TH562C	04-Jan-17	77.08			
TH1303A	3-Jan-17	75.75	0.17	0.02	Downwards
TH1303B	3-Jan-17	75.58			
TH1563	03-Jan-17	81.62	2.79	0.45	Downwards
TH1563B	17-Jan-17	78.83			
TH1600	03-Jan-17	78.55	-0.18	-0.07	Upwards
TH1602B	04-Jan-17	78.73			
TH1602B	04-Jan-17	78.73	3.57	0.33	Downwards
TH1602C	04-Jan-17	75.16			
TH1703A	05-Jan-17	78.92	2.57	0.38	Downwards
TH1703B	05-Jan-17	76.35			
TH1801A	3-Jan-17	77.42	2.82	0.20	Downwards
TH1801B	3-Jan-17	74.60			
TH1802A	3-Jan-17	79.29	3.76	0.29	Downwards
TH1802B	3-Jan-17	75.53			
TH1803A	4-Jan-17	80.18	4.77	0.35	Downwards
TH1803B	4-Jan-17	75.41			
TH1805A	03-Jan-17	79.72	3.88	0.63	Downwards
TH1805B	03-Jan-17	75.84			

3.3 FINE-MEDIUM SOIL TEXTURE

For a site to be classified as medium and fine textured soil, at least 2/3 of the soil on a site must contain 50% or more particles with a diameter less than 75 micrometres. Thirty-four soil samples, representative of the native soil on the Site, were collected during the Exp Phase Two ESA and Decommissioning Program and were submitted for grain size analysis. Thirty-one of the 34 analyzed soil samples had less than 50 percent by mass of particles that were 75 micrometres or larger in mean diameter. Although three soil samples had 52 percent of particles that were 75 micrometres or larger in mean diameter, the dominant soil texture at the Site is considered medium/fine. The native soil at the Site is classified as medium and fine textured. The soil texture was confirmed based on consistent stratigraphy observed during Stantec's 2017 drilling program (borehole logs are presented in **Attachment C**), as well as grain-size analysis completed by Stantec as part of a geotechnical investigation.

3.4 SOIL QUALITY

Soil samples were collected by Exp and Stantec for laboratory analysis during various events completed between 2013 and 2017. Through consideration of APECs, laboratory analysis of collected soil samples was completed for BTEX, PHCs, VOCs, PAHs, ABNs, CPs, metals, PCBs, and general chemistry parameters.

The Phase Two ESA soil analytical results, including the soil analytical results from Exp (2015a, 2015b, and 2017) are summarized below and in **Table Nos. 3a** and **3b** to **11a** and **11b**. A summary of maximum reported analytical soil concentrations is presented on **Table No. 21**. Locations where analytical results are greater than the Table 3 SCS are shown on **Figure Nos. 4a** to **12e**, and cross-section **Figure Nos. 23a-i, 25a-i, 27a-i, 29 a-i,31a-i, 33a-i,** and **35a-i**.

Samples exceeding RPI Standards:

- 3399 soil samples were submitted for BTEX analysis between 2013 and 2017; 483 of the submitted samples had benzene exceedances, 71 had toluene exceedances, 80 had ethylbenzene exceedances, and 124 soil samples exceeded the standard for xylenes
- 3399 soil samples were submitted for PHC F1 analysis and 3400 soil samples were submitted for PHC F2 to F4 between 2013 and 2017. Of the analyzed soil samples, 697 had PHC F1 exceedances, 885 had PHC F2 exceedances, 372 had PHC F3 exceedances, and 84 had PHC F4 exceedances
- 3367 soil samples were submitted for VOC analysis between 2013 and 2017. Three parameters had a single exceedance: chlorobenzene, chloroform, and ethylene dibromide, four parameters (1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichloropropane, and 1,1,2-trichloroethane) had two exceedances, two parameters (1,1,2,2-tetrachloroethane and trichloroethene) had three exceedances, one parameter (1,2-dichloroethane) had 10 exceedances, and there were 53 soil samples that exceeded the standard for hexane
- 3777 soil samples were submitted for PAH analysis between 2013 and 2017. Of the analyzed soil samples, 82 had acenaphthylene exceedances, 104 had anthracene exceedances, 95 had benzo(a)anthracene exceedances, 156 had benzo(a)pyrene exceedances, 68 had benzo(b/j)fluoranthene exceedances, six had benzo(g,h,i)perylene exceedances, one parameter (benzo(k)fluoranthene) had 29 exceedances, 12 soil samples had chrysene exceedances, 48 had dibenzo(a,h)anthracene exceedances, 189 had fluoranthene exceedances,

56 had indeno(1,2,3-cd)pyrene exceedances, 242 had methylnaphthalene exceedances, 146 had naphthalene exceedances, 66 had phenanthrene exceedances, and three soil samples exceeded the standard for pyrene

- 559 soil samples were submitted for ABN analysis between 2013 and 2017. Four of the soil samples had a 1,1-biphenyl exceedance and three soil samples exceeded the standard for bis(2-ethylhexyl) phthalate
- 632 soil samples were submitted for analysis of chlorophenols between 2013 and 2017, and all of which were less than the applicable standard
- 3776 soil samples were submitted for metal analysis between 2013 and 2017. Of the analyzed soil samples, four had antimony exceedances, 28 had arsenic exceedances, eight had barium exceedances, 35 had boron exceedances, 13 had cadmium exceedances, two had chromium exceedances, 47 had cobalt exceedances, 17 had copper exceedances, 115 had lead exceedances, 66 had mercury exceedances, 16 had molybdenum exceedances, three had nickel exceedances, eight had selenium exceedances, four had thallium exceedances, 18 had vanadium exceedances, and 24 had zinc exceedances
- Soil samples were analyzed for the following four general chemistry parameters: pH, cyanide, EC, and SAR. Forty-six soil samples were submitted for pH analysis, all of which were in the acceptable range for surface and subsurface soils. Thirty soil samples were submitted for cyanide analysis, all of which were less than the applicable standard. 3666 soil samples were submitted for EC and SAR analysis, and 109 of the samples had EC exceedances and 107 soil samples exceeded the standard for SAR

1350 soil samples were submitted for PCB analysis between 2013 and 2017, of which six soil samples exceeded the standard for PCBs. In addition, the reportable detection limits (RDLs) for various parameters were greater than the Table 3 SCS at several sampling locations between May 2013 and November 2017 due to sample dilution during laboratory analysis. A summary is presented below:

- The RDLs for benzene were greater than the Table 3 SCS at several sampling locations in either May, August, September, October, November, and/or December 2013 and/or January 2014
- The RDLs for PHC F1 were greater than the Table 3 SCS at TP401 and DUP93 (duplicate sample of TH425) during the August 2013 event, and at BH17-064 during the September 2017 event
- The RDLs for one or more of the following VOC parameters were greater than the Table 3 SCS at several sampling locations during at least one of the events that occurred within May, June, July, August, September, October, November, and/or December 2013, January 2014, March 2015, and/or September 2017: acetone, bromodichloromethane, bromoform, bromomethane, carbon tetrachloride, chlorobenzene, chloroform, dibromochloromethane, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichloroethane, 1,1-dichloroethene, trans-1,2-dichloroethene 1,2-dichloropropane, 1,3-dichloropropene, ethylene dibromide, methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), methyl tert-butyl ether (MTBE), methylene chloride, styrene, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, tetrachloroethene (PCE), 1,1,1-trichloroethane, 1,1,2-trichloroethane, and vinyl chloride
- The RDLs for one or more of the following PAH parameters were greater than the Table 3 SCS at several sampling locations during at least one of the events that occurred between May 2013 and November 2017: acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b/j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, methylnaphthalene (total), naphthalene, and phenanthrene

- The RDLs for one or more of the following ABN parameters were greater than the Table 3 SCS at several sampling locations between December 2013 and/or October 2017: 1,1-biphenyl, bis(2-chloroethyl) ether, bis(2-chloroisopropyl) ether, bis(2-ethylhexyl) phthalate, 4-chloroaniline, 3,3'-dichlorobenzidine, diethyl phthalate, dimethyl phthalate, 2,4-dinitrophenol, 2,4-dinitrotoluene, 2,6-dinitrotoluene, phenol, and 1,2,4-trichlorobenzene
- The RDLs for one or more of the following CP parameters were greater than the Table 3 SCS at several sampling locations during at least one of the 2013 soil sampling events: 2-chlorophenol, 2,4-dichlorophenol, pentachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol

The primary locations of the Table 3 SCS exceedances for the associated parameter groupings were in the following areas:

- **BTEX and PHC F1 to F4**: former tank farms and refinery processing areas (APECs 1 to 5, 7, 8, 10, 11, 12, 14, and 15)
- **VOCs**: former tank farms, refinery processing areas, and administration area (APECs 1 to 5, 7, 8, 10 to 12, and 15)
- **PAHs**: majority of the Site, particularly the refinery processing area (APECs 1 to 5, 7, 8, 10 to 12, 14, and 15)
- **ABN**: former southern tank farm (APECs 4 and 10)
- **Metals, EC, and SAR**: former tank farms, refinery processing area, and harbor inlet (APECs 1, 3 to 5, 7, 8, 10, 11, 12, 14, and 15)
- **PCBs**: Shale Pit backfill extension, administration area, and former northeast tank farm (APECs 1, 3 to 5, 7, 8, 10, and 15)

There is no indication of the occurrence of contaminants related to the chemical or biological transformation of the contaminants analyzed. Dependent upon concentration and proximity to the saturated zone, it is possible that contaminant mass detected in soil could contribute to groundwater contamination. In areas with elevated soil concentrations of PHC parameters, there is a possibility that LPH could be present. This was evident by measurable thickness of LPH on the surface of groundwater within monitoring wells located north of the existing Shale Pit, as presented in **Table No. 2**.

3.4.1 Contaminants of Concern – Soil

COCs in soil at the Phase Two Property were typically identified using the following rationale:

- A parameter was considered a COC if it was detected at a concentration greater than the Table 3 SCS.
- A parameter was considered a COC if the RDL for the parameter was greater than the Table 3 SCS.
- If a parameter was not detected at concentrations greater than the laboratory RDLs in all the soil samples analyzed for that parameter and the RDLs were less than or equal to the Table 3 SCS or a Table 3 SCS has not been established, the parameter was assumed to be absent from the Phase Two Property.
- Parameters detected at concentrations greater than the laboratory RDLs, for which no Table 3 SCS was available, were not considered COCs if the parameter was naturally occurring (e.g., metals such as iron and magnesium); otherwise, the parameter was considered a COC.

The following parameters were considered COCs in soil:

- BTEX
- PHC F1 to F4
- Chlorobenzene, chloroform, ethylene dibromide, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichloropropane, 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane, trichloroethene, 1,2-dichloroethane, and hexane
- Acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b/j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, methylnaphthalene, naphthalene, phenanthrene, and pyrene
- 1,1-biphenyl and bis(2-ethylhexyl) phthalate
- Antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc
- EC and SAR
- PCBs

3.5 GROUNDWATER QUALITY

Groundwater samples were collected by Exp and Stantec for laboratory analysis during various events completed between 2013 and 2017. Through consideration of APECs, laboratory analysis of collected groundwater samples was completed for BTEX, PHCs, VOCs, PAHs, ABNs, CPs, metals, sodium, cyanide, chloride, and PCBs.

The Phase Two ESA groundwater analytical results, including the groundwater analytical results from Exp (2015a, 2015b, and 2017) are summarized below and in **Table Nos. 12** to **20**. A summary of groundwater analytical maximum concentration data is presented on **Table No. 22**. Sample locations, depth interval of samples, and a summary of analytical results are shown directly on **Figure Nos. 13a** to **21e** and cross-section **Figure Nos. 24a-i, 26a-i, 28a-i, 30a-i, 32a-i, 34a-i,** and **36a-i.**

Stantec monitoring wells that were installed into bedrock (i.e., locations with the suffix “D”) used telescoped well installation methods to limit the potential of vertical migration of COC. It was confirmed that Exp did not use telescoped well installation methods while installing bedrock monitoring wells for the Exp Phase Two ESA. Since more recent monitoring wells, at similar depths, were installed by Stantec within close proximity of the noted Exp monitoring wells, groundwater results at the following bedrock monitoring well locations were not included in the data set:

- TH129B: this location had measurable LPH on the groundwater surface; new monitoring well MW17-044D (screen depth of 5.5 m to 7.0 m BGS) met the Table 3 SCS.
- TH1800B: this location had concentrations of benzene exceeding Table 3 SCS. New monitoring well MW17-023D (screen depth of 15.0 m to 16.5 m BGS) met the Table 3 SCS.
- TH1602C: this location had concentrations of benzene exceed Table 3 SCS. New monitoring well MW17-022D (screen depth of 14.7 m to 16.2 m BGS) met the Table 3 SCS.

Samples exceeding Table 3 SCS

- 260 groundwater samples were submitted for BTEX analysis between 2013 and 2017, of which 37 of the samples had benzene exceedances, one had an ethylbenzene exceedance, and two exceeded the standard for xylenes
- 257 groundwater samples were submitted for PHC F1 and 258 groundwater samples were submitted for PHC F2 to F4 analysis between 2013 and 2017; 18 of the samples had PHC F1 exceedances, 75 had PHC F2 exceedances, 18 had PHC F3 exceedances, and four had PHC F4 exceedances
- 177 groundwater samples were submitted for VOC analysis between 2013 and 2017, all of which were less than the applicable standard
- 117 groundwater samples were submitted for PAH analysis between 2013 and 2017. One of the samples had a benzo(b/j)fluoranthene exceedance and two samples (one parent and one duplicate) exceeded the standard for chrysene. This exceedance was noted at Stantec monitoring well MW17-044D in October 2017. A groundwater sample collected at this location in November 2017 had PAH concentrations well below the Table 3 SCS. The PAH results in October 2017 are considered anomalous and are likely attributed to sediment entrained in the groundwater sample
- Groundwater samples were submitted for ABN analysis between 2013 and 2017, all of which were less than the applicable standard
- 71 groundwater samples were submitted for analysis of chlorophenols between 2013 and 2017, all of which were less than the applicable standard
- 125 groundwater samples were submitted for metals analysis between 2013 and 2017, all of which were less than the applicable standard
- 29 groundwater samples were submitted for inorganic parameters (chloride, cyanide, and sodium) between 2013 and 2017. Eight groundwater samples exceeded the standard for chloride and 11 groundwater samples exceeded the standard for sodium
- 119 groundwater samples were submitted for PCB analysis between 2013 and 2017, all of which were less than the applicable standard

In addition, the RDLs for various parameters were greater than the Table 3 SCS at several sampling locations between November 2013 and November 2017 due to sample dilution during laboratory analysis. A summary is presented below:

- The RDLs for PHC F1 were greater than the Table 3 SCS at several sampling locations during at least one of the December 2013, January 2014, and January, October, and November 2017 sampling events
- The RDLs for one or more of the following VOC parameters were greater than the Table 3 SCS at several sampling locations in June 2017: bromomethane, carbon tetrachloride, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-cis-dichlroethene, 1,2-trans-dichloroethene, 1,3-dichloropropene, ethylene dibromide, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, tetrachloroethene, 1,1,2-trichloroethane, trichloroethene, and vinyl chloride. Of the VOC parameters listed above, four parameters (1,2-dichloroethane, 1,1-dichloroethene,

1,2-cis-dichlroethene, and vinyl chloride) had measurable concentrations that were below the Table 3 SCS. The other ten VOC parameters did not have detectable concentrations

- The RDLs for at least one of the following PAH parameters were greater than the Table 3 SCS at several sampling locations in either November and December 2013, January and February 2014, and October 2017: acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b/j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno (1,2,3-cd)pyrene
- The RDLs for bis(2-ethylhexyl) phthalate, diethyl phthalate, and dimethyl phthalate were greater than the Table 3 SCS at several sampling locations in November 2013 and/or January 2014. Bis(2-ethylhexyl) phthalate and diethyl phthalate had measurable concentrations that were below the Table 3 SCS. Dimethyl phthalate concentrations have not been detected above RDLs
- The RDLs for pentachlorophenol were greater than the Table 3 SCS at several sampling locations in November 2013 and/or January 2014. Pentachlorophenol concentrations have not been detected above RDLs

The primary locations of the Table 3 SCS exceedances for the associated parameter groupings were in the following areas:

- **BTEX and PHC F1 to F4**: former tank farms, refinery processing, and rail tanker loading areas (APECs 1, 2, 4, 5, 8, 10, and 11)
- **PAHs**: majority of the Site, particularly the refinery processing area (APECs 4 and 10)
- **Sodium and Chloride**: exclusively in bedrock groundwater in the refinery processing area and the former west tank farm area (APECs 3, 4, 10, and 11). As sodium and chloride impacts were not observed in overburden groundwater, it is possible that observed concentrations are associated with background conditions rather than an anthropogenic origin.

It is acknowledged information included in this Phase Two ESA summary identifies locations where vertical delineation of specific COC in groundwater was not achieved. Deeper monitoring wells were installed in January 2018 to vertically delineate the following contaminants of concern at the noted locations:

- Benzene (TH564)
- PHC F2 (TH1378 and MW17-013)

Furthermore, groundwater characterization at a number of monitoring well locations that met the Table 3 SCS has only been completed from one sampling event. It is acknowledged that more than one sampling event may be required to confirm groundwater meets the applicable SCS. A groundwater sampling program was undertaken from January to February 2018, which consisted of resampling 37 monitoring wells.

Groundwater analytical results from these newly installed monitoring wells, as well as existing monitoring wells that were resampled, will be presented in a revised Phase Two ESA report.

Groundwater samples that were submitted for the analysis of metal parameters were field filtered using a 45 micrometre in-line filter prior to being preserved. There is no indication of the occurrence of contaminants related to the chemical or biological transformation of the contaminants analyzed. Concentrations of PHC parameters in groundwater have been observed at the Site that are sufficiently elevated to suggest LPH, beyond that observed, may be present on the groundwater table

3.5.1 Contaminants of Concern - Groundwater

COCs in groundwater at the Phase Two Property were typically identified using the rationale described in **Section 3.4.1** above.

Ethylbenzene has not been detected at the Site at concentrations greater than the Table 3 SCS in groundwater samples collected between 2013 to 2017, with the exception of monitoring well TH1561 in December 2013. Monitoring well TH1561 was resampled in June 2017 following additional low-flow purging. Ethylbenzene was not detected in the June 2017 sample and the RDL was below the Table 3 SCS; therefore, it was not considered a groundwater COC.

Benzo(b/j)fluoranthene has not been detected at the Site at concentrations greater than the Table 3 SCS in groundwater samples collected between 2013 to 2017, with the exception of the duplicate sample recovered from monitoring well MW17-044D in October 2017. Monitoring well MW17-044D was resampled in November 2017 following additional low-flow purging. Benzo(b/j)fluoranthene was in the November 2017 sample and the RDL was below the Table 3 SCS; therefore, it was not considered a groundwater COC.

Chrysene has not been detected at the Site at concentrations greater than the Table 3 SCS in groundwater samples collected between 2013 to 2017, with the exception of the parent and duplicate samples recovered from MW17-044D in October 2017. Monitoring well MW17-044D was resampled in November 2017 following additional low-flow purging. Chrysene was not detected in the November 2017 sample and the RDL was below the Table 3 SCS; therefore, it was not considered a groundwater COC.

The RDLs for bromomethane, carbon tetrachloride, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-cis-dichloroethene, 1,2-trans-dichloroethene, 1,3-dichloropropene, ethylene dibromide, 1,1,1,2- tetrachloroethane, 1,1,2,2-tetrachloroethane, tetrachloroethene, 1,1,2-trichloroethane, trichloroethene, and vinyl chloride were greater than the Table 3 SCS at monitoring wells TH1381, TH1565, and the duplicate sample of TH1565 during the June 2017 sampling event. These VOC parameters had not been detected at concentrations greater than normal laboratory RDLs in previous samples from monitoring wells TH1381 and TH1565 or any other monitoring well on the Phase Two Property. Therefore, VOC parameters were not carried forwarded as COCs.

The RDLs for the following PAH parameters were greater than the Table 3 SCS: acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b/j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno (1,2,3-cd)pyrene. RDLs exceeding the standard of these PAH parameters were reported for samples collected from monitoring wells TH546A, TH546B, TH560A, TH560B, TH1303A, TH1303B, TH1367, TH1368A, TH1477, TH1483, TH1517, TH1565, TH1701, TH1703B, and MW17-044D during either the November 2013, December 2013, January 2014, February 2014, or October 2017 sampling events. Groundwater samples were recovered from four of these well locations (TH546B, TH560B, TH1703B, and MW17-044D) after the event in which the RDL exceeded the standard. The subsequent RDLs for these four wells were less than the applicable standard. Therefore, additional PAH data are required to confirm these parameters as COCs at the remaining 11 locations (TH546A, TH560A, TH1303A, TH1303B, TH1367, TH1368A, TH1477, TH1483, TH1517, TH1565, and TH1701). PAHs will be considered a tentative COC until these 11 wells can be resampled and the RDL values are confirmed to be less than the applicable standard.

The RDLs for bis(2-ethylhexyl) phthalate, diethyl phthalate, and dimethyl phthalate were greater than the Table 3 SCS at monitoring wells TH546A, TH546B, TH560A, TH560B, TH1303B, TH1367, TH1477, TH1483, TH1565, and TH1703B during either the November 2013 or January 2014 sampling events. Since only three of these well locations (TH546B, TH560B, and TH1303B) were sampled after the RDL exceeded the standard in 2013 or 2014, additional data for these three ABN parameters are required to confirm these parameters as COCs.

The RDLs for pentachlorophenol were greater than the Table 3 SCS at monitoring wells TH546A, TH546B, TH560A, TH560B, TH1303B, TH1367, TH1477, TH1483, TH1565, and TH1703B during either the November 2013 or January 2014 sampling events. However, detectable concentrations of pentachlorophenol were not noted in either soil or groundwater for the Site. Furthermore, chlorophenols were not identified as COCs in groundwater in the Phase One ESA (Stantec, 2017). Only one sample (recovered from TH564 in October 2017) has been analyzed for pentachlorophenol since 2014. Therefore, it was not considered a groundwater COC.

The following parameters were considered COCs in groundwater:

- Benzene
- Xylene
- PHC F1 to F4
- Sodium and chloride
- Bis(2-ethylhexyl) phthalate, diethyl phthalate, and dimethyl phthalate
- Acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b/j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno (1,2,3-cd)pyrene

3.6 QUALITY ASSURANCE AND QUALITY CONTROL RESULTS

The Phase Two ESA included the implementation of the following quality assurance/quality control (QA/QC) program to obtain data that were considered accurate and representative of actual soil and groundwater conditions at the Site. The program consisted of, but was not limited to:

- Proper sample containment, preservation, handling, and transportation
- Use of an accredited laboratory
- Use of RDLs appropriate for the required evaluation, where possible
- Due regard for necessary health and safety precautions

For sampling efforts conducted by Stantec, the following was completed:

- All project staff were properly trained and equipped to undertake the tasks involved in the project
- Detailed protocols for collecting, documenting, preserving, and transporting samples, as well as conducting field activities, were applied

- The analytical methods proposed by the laboratory were reviewed prior to the submission of samples to ensure that where possible the RDLs for the requested analyses met, or were lower than, the respective standards to which the analytical data were to be compared
- One blind field duplicate soil sample for analysis of BTEX, PHCs, VOCs, PAHs, ABNs, CPs, metals, PCBs, and/or general chemistry parameters (pH, cyanide, EC, and SAR) was collected for approximately every 10 submitted soil samples to evaluate both laboratory precision and the field sampling and handling procedures
- One blind field duplicate groundwater sample was collected for approximately every 10 submitted for analysis of BTEX, PHCs, VOCs, PAHs, ABNs, CPs, metals, and PCBs to evaluate both laboratory precision and the field sampling and handling procedures
- Laboratory-supplied field blank samples were submitted for analysis of BTEX, PHCs, and VOCs as part of the January, June, and October 2017 sampling programs and for BTEX and PHCs as part of the September and November 2017 sampling programs
- Laboratory-supplied trip blank samples were submitted for analysis of BTEX, PHCs, and VOCs as part of the June, September, and October 2017 sampling programs and for BTEX and PHCs as part of the November 2017 sampling program
- A laboratory Certificate of Analysis was received for each soil and groundwater sample submitted for analysis and each parameter for which analysis was requested
- Field and analytical data were evaluated and interpreted by both the sampling personnel and the project scientific and management teams
- Independent checks of all engineering/scientific calculations, figures, and tables were conducted

Soil and groundwater samples collected by Stantec were handled consistent with the requirements of O.Reg. 153/04. A review of sampling methods used by Exp indicated that their methods were generally consistent with the requirements of O.Reg. 153/04. In addition to the field QC samples identified above for soil and groundwater, laboratory QC measures included analysis of laboratory replicates, filter blanks, and filter spikes.

3.6.1 Review of Field Program QA/QC

Blind soil and groundwater field duplicates were collected during the subsurface investigations to evaluate the precision associated with sampling and analytical methods. The parent sample and its field duplicate were used to calculate the relative percent difference (RPD). The RPD was calculated as follows:

Where: C_1 is the concentration in the parent sample; and

$$RPD = \left| \frac{C_1 - C_2}{(C_1 + C_2)/2} \right| \times 100$$

C_2 is the concentration of the sample replicate

Based on the Maxxam Ontario QA/QC Interpretation Guide, RPDs of 30% for PHCs, metals, and general chemistry parameters, 40% for PAHs, ABNs, CPs, and PCBs, and 50% for BTEX and VOC parameters were considered acceptable for soil analyses. RPDs of 20% for metal and other parameters (chloride, cyanide, and sodium) and RPDs of 30% for BTEX, PHCs, VOCs, PAHs, ABNs, CPs, and PCBs were considered acceptable for groundwater analyses.

RPD's were not calculated where the concentration of a parameter in either the parent or duplicate sample was either below or within five times the RDL.

The RPD was calculated for each parameter present at concentrations greater than five times the laboratory RDL in both the parent and duplicate samples. The calculated RPDs for soil and groundwater met the respective screening criteria for each parameter as listed above, with the following exceptions:

Soil - BTEX

- During the Phase Two ESA,168 field duplicates were submitted for analysis of BTEX
  - The RPD for 27 parent and field duplicate soil sample pairs exceeded the screening criterion for benzene (55% to 187%) between 2013 and 2014
  - The RPD for 49 parent and field duplicate soil sample pairs exceeded the screening criterion for ethylbenzene (53% to 186%) between 2013 and 2017
  - 25 parent and field duplicate soil sample pairs exceeded the screening criterion for toluene (55% to 183%) between 2013 and 2017
  - The RPD for 61 parent and field duplicate soil sample pairs exceeded the screening criterion for xylenes (50% to 193%) between 2013 and 2017

Soil - PHCs

- During the Phase Two ESA, 1024 field duplicates were submitted for analysis of PHCs
  - The RPD for 57 parent and field duplicate soil sample pairs exceeded the screening criterion for PHC F1 (30% to 171%), 87 parent and field duplicate soil sample pairs exceeded the screening criterion for PHC F2 (30% to 159%), 51 parent and field duplicate soil sample pairs exceeded the screening criterion for PHC F3 (30% to 151%), and the RPD for 47 parent and field duplicate soil sample pairs exceeded the screening criterion for PHC F4 (32% to 164%) between 2013 and 2014
  - The RPD for 32 parent and field duplicate soil sample pairs exceeded the screening criterion for hexane (50% to 178%) between 2013 and 2017

Soil - PAHs

- During the Phase Two ESA, 780 field duplicates were submitted for analysis of PAHs
  - The RPD for six parent and field duplicate soil sample pairs exceeded the screening criterion for acenaphthene (53% to 199%) in 2013
  - Eight parent and field duplicate soil sample pairs exceeded the screening criterion for anthracene (71% to 199%) in 2013
  - 11 parent and field duplicate soil sample pairs exceeded the screening criterion for benzo(a)anthracene (42% to 199%) in 2013

- 11 parent and field duplicate soil sample pairs exceeded the screening criterion for benzo(a)pyrene (47% to 199%) in 2013
- 15 parent and field duplicate soil sample pairs exceeded the screening criterion for benzo(b/j)fluoranthene (41% to 199%) in 2013
- Seven parent and field duplicate soil sample pairs exceeded the screening criterion for benzo(k)fluoranthene (60% to 199%) in 2013
- The RPD for two parent and field duplicate soil sample pairs exceeded the screening criterion for dibenzo(a,h)anthracene (40% to199%) in 2013
- The RPD for two parent and field duplicate soil sample pairs exceeded the screening criterion for acenaphthylene (84% to 158%) between 2013 and 2014
- 14 parent and field duplicate soil sample pairs exceeded the screening criterion for benzo(g,h,i)perylene (46% to 199%) between 2013 and 2014
- 13 parent and field duplicate soil sample pairs exceeded the screening criterion for chrysene (44% to199%) between 2013 and 2014
- 18 parent and field duplicate soil sample pairs exceeded the screening criterion for fluoranthene (40% to199%) between 2013 and 2014
- 15 parent and field duplicate soil sample pairs exceeded the screening criterion for fluorene (40% to199%) between 2013 and 2014
- Eight parent and field duplicate soil sample pairs exceeded the screening criterion for indeno(1,2,3-cd) pyrene (44% to199%) between 2013 and 2014
- 36 parent and field duplicate soil sample pairs exceeded the screening criterion for methylnaphthalene (42% to 200%) between 2013 and 2014
- 29 parent and field duplicate soil sample pairs exceeded the screening criterion for 1-methylnaphthalene (40% to 193%) between 2013 and 2014
- 29 parent and field duplicate soil sample pairs exceeded the screening criterion for 2-methylnaphthalene (43% to 199%) between 2013 and 2014
- 16 parent and field duplicate soil sample pairs exceeded the screening criterion for naphthalene (42% to 159%) between 2013 and 2014
- 33 parent and field duplicate soil sample pairs exceeded the screening criterion for phenanthrene (43% to 199%) between 2013 and 2014
- The RPD for 19 parent and field duplicate soil sample pairs exceeded the screening criterion for pyrene (40% to 199%) between 2013 and 2014

Soil - Metals

- During the Phase Two ESA, 487 field duplicates were submitted for analysis of metals

  - The RPD for one parent and field duplicate soil sample pair exceeded the screening criterion for antimony (33%) in 2013
  - One parent and field duplicate soil sample pair exceeded the screening criterion for cadmium (64%) in 2013
  - 10 parent and field duplicate soil sample pairs exceeded the screening criterion for mercury (31% to 120%) in 2013
  - Four parent and field duplicate soil sample pairs exceeded the screening criterion for molybdenum (38% to 101%) in 2013
  - The RPD for 3 parent and field duplicate soil sample pairs exceeded the screening criterion for vanadium (47% to 82%) in 2013
  - The RPD for 14 parent and field duplicate soil sample pairs exceeded the screening criterion for arsenic (30% to 65%) between 2013 and 2014
  - 30 parent and field duplicate soil sample pairs exceeded the screening criterion for barium (30% to 193%) between 2013 and 2014
  - Seven parent and field duplicate soil sample pairs exceeded the screening criterion for boron (30% to 84%) between 2013 and 2014
  - 23 parent and field duplicate soil sample pairs exceeded the screening criterion for chromium (30% to 170%) between 2013 and 2014
  - 24 parent and field duplicate soil sample pairs exceeded the screening criterion for cobalt (32% to 96%) between 2013 and 2014
  - 33 parent and field duplicate soil sample pairs exceeded the screening criterion for nickel (30% to 130%) between 2013 and 2014
  - The RPD for 15 parent and field duplicate soil sample pairs exceeded the screening criterion for uranium (31% to 81%) between 2013 and 2014
  - The RPD for 66 parent and field duplicate soil sample pairs exceeded the screening criterion for copper (31% to 191%) between 2013 and 2016
  - The RPD for 44 parent and field duplicate soil sample pairs exceeded the screening criterion for lead (31% to 191%) between 2013 and 2015
  - The RPD for 24 parent and field duplicate soil samples exceeded the screening criterion for zinc (32% to 146%) between 2013 and 2017

Soil – EC, SAR, and Cyanide

- During the Phase Two ESA, 186 field duplicates were submitted for analysis of EC
  - The RPD for 23 parent and field duplicate soil sample pairs exceeded the screening criterion for EC (31% to 109%) between 2013 and 2017

Soil - PCBs

- During the Phase Two ESA, 97 field duplicates were submitted for analysis of PCBs
  - The RPD for 1 parent and field duplicate soil sample pair exceeded the screening criteria for PCBs (172%) in 2013

The elevated RPDs were likely attributable to soil heterogeneity. Therefore, the elevated RPDs did not have an effect on the interpretation of the analytical results.

Groundwater

- RPD for 2-methylnaphthalene (37%) exceeded the screening criterion in the groundwater sample recovered from monitoring well TH564 in November 2013
- RPD for phenanthrene (64%) exceeded the screening criterion in the groundwater sample recovered from monitoring well TH1703B in January 2014

With regards to the groundwater RPDs above the screening criteria, 2-methylnaphthalene and phenanthrene were not considered COC because concentrations in the parent and duplicate samples were less than the Table 3 SCS. Therefore, the elevated RPDs did not have an effect on the interpretation of the analytical results. The soil and groundwater RPDs are presented in **Table Nos. 3a** and **3b** to **11a** and **11b** and **Table Nos. 12** and **20**, respectively**.**

RDLs were greater than the Table 3 SCS for several parameters, as discussed in **Sections 3.4** and **3.5**. Elevated RDLs are likely attributable to matrix interference and are therefore, not considered to represent a concern. The effect of elevated RDLs on the selection of groundwater COCs is discussed in **Section 3.5.1**. The elevated RDLs did not affect the interpretation of the analytical results.

The analyzed parameters were not detected at concentrations greater than the laboratory RDLs in the trip or field blank samples submitted for analysis, indicating that the groundwater analytical results were not affected by sample handling, storage, or transport.

In addition to the assessment of field duplicate, field blank, and trip blank samples, the analytical laboratories followed internal QA/QC protocols, which included method blank, matrix spike, spiked blank, QC standard, and laboratory duplicate analyses. The analytical laboratories reported that the results for their internal QA/QC were within acceptable limits.

Review of the 2013 to 2017 Maxxam Certificates of Analysis QA/QC data quality waiver and laboratory interpretation provided by Exp (Exp, 2015) did not identify significant QC issues with the potential to affect the interpretation of the analytical data or the identification of soil or groundwater COCs at the Phase Two Property.

Based on the above assessment, it is Stantec’s opinion that the results of the QA/QC procedures indicated that the DQO for the soil and groundwater data were met, and that the data were of acceptable quality and adequate for their intended use.

4.0 PHASE TWO CONCEPTUAL SITE MODEL

The Phase Two CSM represents a refinement of the Phase One CSM after conducting site characterization activities. The Phase Two ESA did not identify any new APECs. An updated understanding of each APEC, which will be used to guide the risk assessment, is provided below.

4.1 SITE CHARACTERISTICS

4.1.1 AREAS OF POTENTIAL ENVIRONMENTAL CONCERN (APECS)

The Phase One ESA (Stantec, 2017b) identified on- and off-site PCAs with the potential to contribute to APECs on the Phase Two Property. Fifteen APECs were identified at the Phase Two Property. APEC 1 is associated with historical on-site and off-site PCAs, while six of the APECs were associated with on-site historical PCAs, and the remaining eight APECs were associated with off-site PCAs. The locations of the PCAs and APECs are shown on **Figure No. 2a**. The PCAs and APECs are discussed in detail below.

APEC 1: Located along the northwestern property boundary. A historical commercial auto body shop (PCA 10) formerly operated in the northern corner of the Phase Two Property (formerly referred to as 181 Lakeshore Road West), and historical commercial auto body shops operated adjacent to the Site at 125 High Street; 72 Wesley Avenue; and 200, 212, 266, 280, and 286 Lakeshore Road West.

APEC 2: Located in the western corner of the Phase Two Property. 321 Lakeshore Road West (located approximately 70 m west of the Phase Two Property), historically operated as a vehicle repair shop (PCA 10) with associated USTs.

APEC 3: The historical operation of a brick manufacturing facility (PCA 12) occurred within the eastern portion of the Phase Two Property.

APEC 4: Includes the entire Phase Two Property. An oil and petrochemical refinery (PCA 14) operated on the Phase Two Property between 1933 and 1985.

APEC 5: Located along the northwestern property boundary. 250 Lakeshore Road West (located approximately 25 m northwest of the Phase One Property), historically operated as a distribution terminal and refinery products loading area with various storage tanks (PCA 14).

APEC 6: Located on the northern corner of the Phase Two Property. A gasoline service station with associated USTs (PCA 28) was formerly located on the northern corner of the Phase Two Property.

APEC 7: Located on the northeastern portion of the Phase Two Property. A historical UST (PCA 28) was observed on the roadway of Bay Street in front of an unknown building identified as 31 Bay Street (located approximately 215 m northeast of the Phase Two Property) on the 1928 FIP.

APEC 8: Located along the northwestern Phase Two Property boundary. A historical gasoline service station with associated USTs (PCA 28) historically operated 25 m northwest of the Phase Two Property at 182 and 200 Lakeshore Road West.

APEC 9: Located within the northern corner of the Phase Two Property. 150 Lakeshore Road West (located approximately 70 m north of the Phase Two Property), historically operated as a gasoline service station with associated USTs (PCA 28).

APEC 10: Fill material of unknown quality was identified across the entire Phase One Property.

APEC 11: Historical rail spurs (PCA 46), were located within the northwestern, southeastern, and central portions of the Phase Two Property.

APEC 12: Located along the northwestern Phase Two Property boundary. Historical operation of a dry cleaner located approximately 130 m northwest of the Phase Two Property at 228 Lakeshore Road West.

APEC 13: Located on the northern corner of the Phase Two Property. Historical operation of a dry cleaner (PCA 37) located approximately 70 m north (150 Lakeshore Road West) of the Phase Two Property.

APEC 14: Located on the eastern corner of the Phase Two Property. Historical landfilling (PCA 58) occurred immediately east of the Phase Two Property at J.C. Saddington Park.

APEC 15: Historical PCB storage (PCA 55) reportedly occurred within the northeastern portion of the Phase Two Property.

4.2 PROPERTY USE AND SERVICES

The Phase Two Property is currently vacant. Structures remaining at the Phase Two Property included a vacant car wash and kiosk building on the northern corner of the Site (former gasoline service station property), a vacant fire hall building (also previously used as office space), and a former API separator. Other features of note were a former Shale Pit in the central area of the Phase Two Property that was utilized as a stormwater management pond, and a portion of the City of Mississauga Waterfront Trail adjacent to Lake Ontario. The proposed property land use is a combination of residential, parkland, commercial, and community (roadway).

Underground utilities associated with various former buildings and operations on-site may still be present. Hydrants were observed along the northwestern and southwestern property boundaries and water lines connecting the hydrants may be present. Stantec understands that with the exception of potential underground utility service connections to the vacant car wash and kiosk building on the northern corner of the Phase One Property, there are no other active underground utilities and no other evidence of underground utilities at the Phase Two Property. Utilities identified during the Phase Two ESA are shown on **Figure No. 2**.

The Phase Two Property was not part of or adjacent to an area of natural significance. The soil pH was within the permitted ranges of 5 to11 for subsurface soils and 5 to 9 for surface soils. In addition, the Phase Two Property was not a shallow soil property and did not include a water body. Portions of the Site are located within 30 m of a water body, since Lake Ontario is located immediately southeast of the Phase Two Property. However, the Phase Two Property was not environmentally sensitive under Section 43.1 of O.Reg.153/04.

4.3 STRATIGRAPHY, SOIL CHARACTERISTICS, AND SOIL MANAGEMENT

4.3.1 Stratigraphy

The Site is located in the physiographic region called Iroquois Plain, which consists of surficial soils predominately composed of clay till overlain by sand. The localized ground conditions consist of subsurface soils as classified as glaciolacustrine deposits. (Chapman & Putnam 1984). The Quaternary Geology of Ontario, Southern Sheet, Map 2556, issued by the Ministry of Northern Development and Mines, 1991, indicates that the region of the Site comprises glaciolacustrine deposits consisting of sand, gravelly sand and gravel, and nearshore beach deposits. Chapman and Putnam (1984) also indicates the presence of till plains, and Map 2566 indicates the presence of silt and clay glaciolacustrine deposits in proximity to the east.

The Phase Two ESA investigations indicated the soil profile generally consisted of:

- Ground surface cover consisting of organics with topsoil or asphalt; underlain by,
- Fill materials consisting of sand with gravel, sandy silt, sandy clay with gravel, clay with sand, or clay; underlain by,
- Brown to grey sandy silt with silty clay/clayey silt layers and discontinuous sand layers.

Fill material was encountered at depths ranging from 0.2 m to 3.8 m BGS, with thickness generally ranging from 1.2 m to 2.0 m. Native soil (i.e., sandy silt with silty clay layers) was encountered at depths ranging from 1.2 m to 5.3 m BGS, with an estimated average thickness of 2.5 m. The Shale Pit in the southwest portion of the Phase Two Property at one time extended approximately 100 m to the north of the current configuration. This portion of the Sale Pit was backfilled prior to 1985. Thus, fill was encountered at a depth of 8.3 m BGS, and native soil was encountered from 8.3 m to 11.0 m BGS.

The underlying geology comprises Georgian Bay Formation, Meaford-Dundas beds of shale, and limestone of the Upper Ordovician period (MNDM, 1991a). Shale bedrock was observed at depths ranging from 2.3 m to 5.7 m BGS, with rock quality generally transitioning from weathered to unweathered with increasing depth. Moderately weathered shale was encountered in the previously backfilled area north of the existing Shale Pit at a depth of 11.0 m BGS.

Borehole logs from the 2013 to 2017 Site investigations are provided in **Attachment C**. Historical grain size analysis records are also provided in **Attachment C**. The stratigraphy of the Site is summarized in the cross-sections included as **Figure Nos. 23a** to **36i**. **Figure No. 22** illustrates the location of the cross-sections.

4.3.1.1 Grain Size

Soil at the Phase Two Property was considered medium to fine textured based on field observations and a review of available borehole logs.

Grain size distribution analyses were completed during Exp's Phase Two ESAs (Barenco, 2010; Exp 2015a, 2015b, and 2017). Thirty-one of the 34 soil samples had less than 50 percent by mass of particles that were 75 micrometres or larger in mean diameter. Although three soil samples had 52 percent mass of particles that were 75 micrometres or larger in mean diameter, the dominant soil texture at the Site is considered medium/fine. Exp's grain size results are included in **Attachment C**. The soil texture was confirmed based on consistent stratigraphy observed during Stantec's 2017 drilling programs (borehole logs are presented in **Attachment C**), as well as grain-size analysis completed by Stantec as part of a geotechnical investigation.

4.3.2 Soil Management

Soil cuttings generated during the 2008 Preliminary Environmental Assessment (Barenco, 2010), 2013-2014 Phase II ESA (Exp, 2015b), and the 2015 Supplemental Phase II ESA (Exp, 2015a) were left on-site. Daylighting services were provided by GFL Environmental Inc. (GFL) during the September 2013 to January 2014 Phase II ESA. The cuttings produced during the daylighting activities and purge water collected during the groundwater sampling program were disposed of at the GFL facility in Pickering, Ontario. In addition, the purge water collected during the 2015 Supplemental Phase II ESA was also disposed of at the GFL Pickering facility. Daylighting services were also provided by GFL during the 2016 Phase II ESA and Site Decommissioning Program. Cuttings produced during the daylighting activities were disposed of at the GFL facility in Pickering. Disposal of purge water and additional soil cuttings generated on-site was not discussed within the report (Exp, 2017).

Any soil cuttings and purged groundwater collected by Stantec in 2017 was drummed on-site and will be removed during the remediation excavation.

4.4 HYDROGEOLOGIC CHARACTERISTICS

Groundwater monitoring data are summarized in **Table No. 2**. Groundwater was observed at the range of depths listed below. Screened intervals of monitoring wells installed at the Site are completed within both the overburden and bedrock material.

The following summary of water levels of monitoring wells installed in the overburden is provided:

- March 2015: 0.06 m BGS (TH121) to 5.69 m BGS (TH1367)
- January and February 2017: 0.27 m BGS (TH820) to 5.55 m BGS (BH90-212). Four (BH90-116, BH92-305, BH92-315, and BH92-322) of the monitoring wells that were monitored in January 2017 were damaged, thus the depth to groundwater could not be measured and five of the monitoring wells (TH1304A, TH1478, TH1369A, TH1561, and MW17-005) monitored in January 2017 were dry when measured for groundwater depth. Monitoring well MW17-005 was monitored two days later and a measurable volume of water was present in the well pipe
- June 2017: 0.49 m BGS (TH1565) to 1.86 m BGS (MW17-015)
- Fall 2017: 2.15 m BGS (TH1531) to 3.13 m BGS (TH564). Two of the monitoring wells (TH1381 and MW17-019) monitored in September 2017 and one monitoring well (TH1378) monitored in November 2017 were dry when measured for groundwater depth

Summary of water levels of monitoring wells installed in bedrock:

- March 2015: 0.13 m BGS (BH90-204B) to 15.34 m BGS (TH562C)
- January and February 2017: 0.08 m BGS (TH546C) to 16.12 m BGS (MW17-022D). One of the monitoring wells (19C) monitored in January 2017 was reported as dry, and when monitored again 13 days later it was reported to

be damaged. Therefore, the depth to groundwater could not be measured at monitoring well 19C in January 2017

- June 2017: 0.26 m BGS (19B) to 10.71 m BGS (TH562C)
- September to October 2017: 1.32 m BGS (MW17-031D) to 5.49 m BGS (TH1702)

Groundwater elevation and inferred direction in the overburden wells for March 2015, January 2017, and September and October 2017 are presented on **Figure Nos. 3a, 3c,** and **3e**. Observed fill materials as well as other buried infrastructure (e.g., abandoned utilities, foundations, etc.) will influence the groundwater elevations observed in monitoring wells installed in overburden. The presence of these subsurface features has likely created perched groundwater conditions over much of the Phase Two Property. Perched groundwater conditions will be sensitive to seasonal and meteorological effects. The variable profile of the overburden groundwater surface presented in **Figures No. 3a, 3c and 3e** suggests that both perched and unconfined groundwater conditions are present. Groundwater elevation and direction in bedrock wells for March 2015, January 2017, and September and October 2017 are presented **Figure Nos. 3b, 3d,** and **3f**. It is common for groundwater elevations within monitoring wells installed in bedrock to be influenced by hydrostatic pressures associated fracture networks. The bedrock groundwater surface interpretations **(Figures No. 3b, 3d**, and **3f**) considered groundwater elevation data that was representative of monitoring wells will screened intervals at generally similar elevations.

The inferred direction of groundwater flow in the overburden and bedrock material was generally towards the east and southeast, which is towards Lake Ontario.

The average hydraulic gradient in the overburden and bedrock wells for the Phase Two Property was 0.01 m/m. The vertical gradients measured in March 2015 at well pairs BH90-204A/BH90-204B, BH90-204B/TH1807, and TH1366A/TH1366B ranged between -0.08 m/m (BH90-204A/BH90-204B)) to 1.74 m/m (BH90-204B/TH1807).

The vertical gradients measured in January 2017 at well pairs TH129A/TH129B, TH129B/TH129C, TH548A/ TH548B, TH548B/ TH548C, TH560A/ TH560B, TH560B/ TH560C, TH560C/ TH560D, TH562A/TH562B, TH562B/TH562C, TH1303A/TH1303B, TH1563/TH1563B, TH1600/ TH1602B, TH1602B/ TH1602C, TH1703A/TH1703B, TH1801A/TH1801B, TH1802A/TH1802B, TH1803A/TH1803B, and TH1805A/TH1805B ranged between -0.07 m/m (TH1600/ TH1602B) and 0.89 m/m (TH129A/TH129B).

4.5 SOIL AND GROUNDWATER CHARACTERIZATION

The Phase Two Property is not considered a sensitive site as defined by O.Reg.153/04 s.41. In addition, the Phase Two Property does not contain a watercourse and is not classified as a shallow soil property. However, portions of the Site are located within 30 m of a water body, because Lake Ontario is located immediately southeast of the Phase Two Property.

Geologic and hydrogeologic parameters that influence the derivation of component values for the MOE (2011) generic SCS were compared between the site-specific data and the generic values used in the derivation of the SCS. The majority of site-specific parameters were similar to the defaults, and therefore the generic SCS are considered to apply at the Site. MOECC notes that deviations from the generic assumptions do “not necessarily indicate that the generic criteria are not valid for a given site.” (MOE, 2011) and that “There are many interrelated parameters and factors that were used in the development of the generic standards, and in many cases one factor…can be outweighed by differences in other factors in a manner that, overall, there is sufficient natural protection provided by the site. In addition, it must also be considered that the component that drives the standard may not be affected by the particular limiting condition…" (MOE, 2011). Therefore, it is the opinion of the QP_{ESA} that the Table 3 generic SCS are appropriate for use at the Site.

4.5.1 Soil Characterization – Phase Two ESA

The Phase Two ESA soil analytical results, including the soil analytical results from Exp (2015a and 2015b) are summarized below and in **Table Nos. 3a** and **3b** to **11a** and **11b**. A summary of soil analytical maximum concentration data is presented on **Table No. 21**. Analytical results greater than the Table 3 SCS are shown on **Figure Nos. 4a** to **12e**, and on cross-sections on **Figure Nos. 23a-i, 25a-i, 27a-i, 29 a-i, 31a-i, 33a-i,** and **35a-i**.

A summary of soil analytical results was presented and discussed in **Section 3.4**.

4.5.1.1 Area of Soil Impacts

The primary locations of the Table 3 SCS exceedances for the associated parameter groupings were in the following areas:

- **BTEX and PHC F1 to F4**: former tank farms and refinery processing areas (APECs 1 to 5, 7, 8, 10, 11, 12, 14, and 15)
- **VOCs**: former tank farms, refinery processing areas, and administration area (APECs 1 to 5, 7, 8, 10 to 12, and 15)
- **PAHs**: majority of the Site, particularly the refinery processing area (APECs 1 to 5, 7, 8, 10 to 12, 14, and 15)
- **ABN**: former southern tank farm (APECs 4 and 10)
- **Metals, EC, and SAR**: former tank farms, refinery processing area, and harbor inlet (APECs 1, 3 to 5, 7, 8, 10, 11, 12, 14, and 15)
- **PCBs**: Shale Pit backfill extension, administration area, and former northeast tank farm (APECs 1, 3 to 5, 7, 8, 10, and 15)

There is no indication of the occurrence of contaminants related to the chemical or biological transformation of the contaminants analyzed. It is likely that contaminant mass detected within the soil contributes to groundwater contamination. Based on the measured soil concentrations there is a possibility that LPH could be present. This was evident by measurable thickness of LPH on the surface of groundwater within monitoring wells located north of the existing Shale Pit, as presented in **Table No. 2**.

BTEX, PHC, VOC, PAH, ABN, metals, PCB, and EC/SAR have been identified in soil at the Site at concentrations greater than the Table 3 SCS. Although the primary source of identified impacts is likely associated with the former on-site petrochemical refinery operation (PCA 14 (Crude Oil, Refining, Processing, and Bulk Storage) and PCA 46 (Rail Yards, Tracks, and Spurs)), other the possible sources could be a result of one or more of the following PCA (**Figure 2a**): PCA 10 (Commercial Auto Body Shops), PCA 12 (Concrete, Cement, and Lime Manufacturing), PCA 28 (Gasoline and Associated Products Stored in Fixed Tanks), PCA 30 (Importation of Fill Material of Unknown Quality), PCA 37 (Operation of Dry Cleaning Equipment), PCA 55 (Transformer Manufacturing, Processing, and Use), and PCA 58 (Waste Disposal and Waste Management).

4.5.2 Groundwater Characterization – Phase Two ESA

The Phase Two ESA groundwater analytical results, including the groundwater analytical results from Exp (2015a and 2015b) are summarized below and in **Table Nos. 12** to **20**. A summary of groundwater analytical maximum concentration data is presented on **Table No. 22**. Sample locations, depth interval of samples, and a summary of analytical results are shown on **Figure Nos. 13a** to **21e** and in cross-section on **Figure Nos. 24a-i, 26a-i, 28a-i, 30a-i, 32a-i, 34a-i,** and **36a-i.**

A summary of groundwater analytical results was presented and discussed in **Section 3.5**.

4.5.2.1 Area of Groundwater Impacts

The primary locations of the Table 3 SCS exceedances for the associated parameter groupings were in the following areas:

- **BTEX and PHC F1 to F4**: former tank farms, refinery processing, and rail tanker loading areas (APECs 1, 2, 4, 5, 8, 10, and 11)
- **PAHs**: majority of the Site, particularly the refinery processing area (APECs 4 and 10)
- **Sodium and Chloride**: exclusively in bedrock groundwater in the refinery processing area and the former west tank farm area (APECs 3, 4, 10, and 11). As sodium and chloride impacts were not observed in overburden groundwater, it is possible that observed concentrations are associated with background conditions rather than an anthropogenic origin.

There is no indication of the occurrence of contaminants related to the chemical or biological transformation of the contaminants analyzed. It is likely that the contaminant mass detected within the soil is the source of the groundwater contamination. Based on the measured soil concentrations, there is a possibility that LPH could be present. As mentioned in **Section 3.2.1**, LPH has been observed in the area north of the Shale Pit.

<u>BTEX</u>

Concentrations of benzene, ethylbenzene, and xylene parameters greater than the Table 3 SCS were identified in monitoring wells installed in both the overburden material and bedrock. BTEX exceedances were identified at 20 monitoring well locations across the Phase Two Property between 2013 and 2017. These impacts were reported at monitoring wells located within APECs 1, 2, 4, 5, 8, and/or 10. Although the primary source of identified impacts is likely associated with the former on-site petrochemical refinery operation (PCA 14 (Crude Oil, Refining, Processing, and Bulk Storage), other possible contributing sources may be associated with the following PCAs: PCA 10 (Commercial Auto Body Shops), PCA 28 (Gasoline and Associated Products Stored in Fixed Tanks, and PCA 30 (Importation of Fill Material of Unknown Quality).

Groundwater analytical results for BTEX parameters are presented in **Table No.12**, on **Figure Nos. 13a** to **13e** and in cross-section on **Figure Nos. 26a** to **36a**.

PHCs

Groundwater exceedances were identified in monitoring wells installed in both the overburden material and bedrock. Concentrations of PHC F1 to F4 parameters greater than the Table 3 SCS were identified in the groundwater sampled at the Phase Two Property between 2013 and 2017. These impacts were reported at 30 monitoring wells located across the Site and within APECs 1 to 5, 7, 8, 10, 11, and 13 to 15. Although the primary source of identified impacts is likely associated with the former on-site petrochemical refinery operation (PCA 14 (Crude Oil, Refining, Processing, and Bulk Storage) and PCA 46 (Rail Yards, Tracks, and Spurs)), other possible contributing sources may be associated with the following PCAs: PCA 10 (Commercial Auto Body Shops), PCA 12 (Concrete, Cement, and Lime Manufacturing), PCA 28 (Gasoline and Associated Products Stored in Fixed Tanks, PCA 30 (Importation of Fill Material of Unknown Quality), , PCA 37 (Operation of Dry Cleaning Equipment), PCA 55 (Transformer Manufacturing, Processing, and Use), and PCA 58 (Waste Disposal and Waste Management).

Groundwater analytical results for PHC parameters are presented in **Table No.13**, and on **Figure Nos. 14a** to **14e** and in cross-section on **Figure Nos. 26b** to **36b**.

PAHs

Two PAH exceedances were identified at bedrock monitoring well MW17-044D, located within APECs 4 and 10 during the October 2017 event. Monitoring well MW17-044D is located near the center of the Site, within the extent of the former shale pit. Therefore, the PAH exceedances of benzo(b/j) fluoranthene and chrysene may be attributable to PCAs 14 (Crude Oil, Refining, Processing, and Bulk Storage) or 30 (Importation of Fill Material of Unknown Quality), since this area was backfilled after the historical brick manufacturing operations on-site ceased. A groundwater sample collected at this location in November 2017 had PAH concentrations well below the Table 3 SCS. The PAH results in October 2017 are considered anomalous and are likely attributed to sediment within the groundwater sample. However, it should be noted that RDLs for 10 different PAH parameters were greater than the Table 3 SCS at several sampling locations in either November and December 2013, January and February 2014, and October 2017. Groundwater samples were recovered at four of these well locations (TH546B, TH560B, TH1703B, and MW17-044D) after the event in which the RDL exceeded the standard. The subsequent RDLs for samples collected at these four monitoring wells were less than the applicable standard. Therefore, additional PAH data are required to confirm these parameters as COCs in the remaining 11 locations (TH546A, TH560A, TH1303A, TH1303B, TH1367, TH1368A, TH1477, TH1483, TH1517, TH1565, and TH1701). PAHs will be considered a tentative COC until these 11 monitoring wells can be resampled and the RDL values are confirmed to be less than the applicable standard.

Groundwater analytical results for PAH parameters are presented in **Table No.15**, and on **Figure Nos. 16a** to **16e** and in cross-section on **Figure Nos. 26d** to **36d**.

Sodium and Chloride

Groundwater exceedances were identified at monitoring wells installed in the bedrock of the Phase Two Property. Concentrations of chloride and sodium parameters greater than the Table 3 SCS were identified in the groundwater sampled at the Phase Two Property between 2013 and 2017. These impacts were reported at nine monitoring wells located across the Site and within APECs 3, 4, 10, and/or 11, which are associated with the following PCAs: PCA 12 (Concrete, Cement, and Lime Manufacturing), PCA 14 (Crude Oil, Refining, Processing, and Bulk Storage), PCA 30 (Importation of Fill Material of Unknown Quality), and PCA 11 (Rail Yards, Tracks, and Spurs). As sodium and chloride impacts were not observed in overburden groundwater, it is possible that observed concentrations are associated with background conditions rather than an anthropogenic origin.

Groundwater analytical results for chloride and sodium parameters are presented in **Table No.19**, and on **Figure Nos. 20a** to **20e** and in cross-section on **Figure Nos. 26h** to **36h**.

4.5.3 Climatic and Meteorological Conditions

Daily average temperatures for the Port Credit (Toronto) area range from a minimum of -5.5ºC (January) to a maximum of 21.5ºC (July). Precipitation (rain and snowfall) ranges from approximately 48 mm (February) to 78 mm (August). Snow depth in the area is greater than 1 cm approximately 72 days per year and the minimum temperature in the area is greater than 0ºC approximately 229 days per year (EC, 2018).

Since the Phase Two Property is covered by grass, low-lying vegetation, trees, and asphalt surfaces, it is considered unlikely that the local climate or meteorological conditions have significantly affected the distribution of the COCs at the Phase Two Property.

4.6 VAPOUR INTRUSION CONSIDERATIONS – FUTURE DEVELOPMENT

4.6.1 Soil Vapour Intrusion

It is expected that the pending O.Reg. 153/04 Risk Assessment for the Site will indicate that a residential receptor could be exposed to COCs at concentrations that may result in potential health risk in the absence of risk management measures via direct contact with soil and via inhalation of vapours in indoor air associated with COCs in soil and groundwater. The O.Reg. 153/04 Risk Assessment will also consider potential health risk to subsurface workers who may come in contract with impacted soil and groundwater during construction activities.

Risk Management Measures (RMM) will be recommended for the Site as part of future development to manage potential vapour intrusion to the potential residential property use.

Future redevelopment at the Site will include the construction of parking (storage) garages in all buildings. The potential risk to indoor residents via soil and groundwater to indoor air vapour inhalation pathways will be mitigated by the ventilation requirements of the storage (parking) garage (as per the 2006 Ontario Building Code). Specific development blocks of the Site will require more than one level of underground parking to accommodate parking requirements. For these development blocks, permanent foundation drainage features are likely to be required in these areas as below grade parking structures requiring more than one level may extend into the groundwater table. Perimeter and underfloor drains will not be considered to avoid possible treatment requirements of collected groundwater prior to discharge to municipal systems. For this reason, it is anticipated that building foundations requiring permanent drainage will be waterproofed. The waterproofing of building foundations is also expected to sufficiently mitigate potential intrusion of COC vapours into the parking structures (in addition to the OBC storage garage ventilation requirements summarized above).

Vapour migration and/or intrusion concerns may exist with the installation of new or replaced buried utilities at the Site. Although potential human health receptors and associated exposure pathways will be evaluated through the completion of the Risk Assessment (including consideration of subsurface workers that may come in contact impacted soil or groundwater), standard construction practices or specifications can typically reduce/block preferential vapour migration in utilities and utility trenches.

With the requirement for RMM to be incorporated into future development, the design and operation of heating, ventilating and air condition (HVAC) systems, and location of subsurface utilities is unlikely to influence or be affected by soil vapour intrusion pathways. Redevelopment that incorporates a parking (storage) garage will include separate HVAC systems, thereby isolating any building occupants. Subsurface utilities would also enter the building within the parking (storage) garage level, which would isolate any receptors from any soil vapour intrusion pathways that may be present.

4.7 CONTAMINANT PATHWAYS AND RECEPTORS

As noted previously, a risk assessment is being undertaken to address the contaminants that exceed the O.Reg. 153/04 Table 3 SCS. The risk assessment is to be referenced when evaluating the contaminant pathways and receptors.

5.0 CONCLUSIONS

The Phase Two ESA included a review of historical investigations for the Phase Two Property and adjacent properties, the advancement of boreholes, test pits, installation of monitoring wells, and soil and groundwater sampling programs. The Phase Two ESA field activities were undertaken between May 2013 and November 2017. Soil and groundwater samples were collected for analysis of one or more of the following: BTEX, PHCs, VOCs, PAHs, ABNs, CPs, metals, Na, Cl, PCBs, pH, and general chemistry parameters. The findings of the Phase Two ESA were as follows:

- The Table 3 SCS for RPI land use in a non-potable groundwater condition with medium to fine textured soils were considered the primary standards applicable at the Phase Two Property.
- The Phase Two ESA investigations indicated the soil profile generally consisted of:
  - Ground surface cover consisting of organics with topsoil or asphalt; underlain by,
  - Fill materials consisting of sand with gravel, sandy silt, sandy clay with gravel, clay with sand, or clay; underlain by,
  - Brown to grey sandy silt with silty clay/clayey silt layers and discontinuous sand layers.
- Bedrock in the vicinity of the Phase Two Property was mapped as Georgian Bay Formation, Meaford-Dundas beds of shale and limestone of the Upper Ordovician period (MNDM, 1991a). Shale bedrock was observed at depths ranging from 2.3 m to 5.7 m BGS, with rock quality generally transitioning from weathered to unweathered with increasing depth. Moderately weathered shale was encountered in the previously backfilled area north of the existing Shale Pit at a depth of 11.0 m BGS.
- Three monitoring events were completed between March 2015 and October 2017, which allowed groundwater elevations to be evaluated during three different seasons (winter, spring, and fall). Based on the water level data obtained during the March 2015, January 2017, and September and October 2017 events, the inferred direction of groundwater flow in the overburden wells was generally to the east and southeast. Observed fill materials as well as other buried infrastructure (e.g., abandoned utilities, foundations, etc.) will influence the groundwater elevations observed in monitoring wells installed in overburden. The presence of these subsurface features has likely created perched groundwater conditions over much of the Phase Two Property.
- Based on the water level data obtained during the March 2015, January 2017, and September and October 2017 events, the inferred direction of groundwater flow in the bedrock wells was generally to the east and southeast.
- The average horizontal hydraulic gradient in both the overburden and bedrock between March 2015, January 2017, and the Fall of 2017 was 0.01 m/m.
- The vertical hydraulic gradients calculated at the Phase Two Property based on March 2015 data ranged from -0.08 m/m (BH90-204A/BH90-204B) with an upwards gradient direction to 1.74 m/m (BH90-204B/TH1807) with a downwards gradient direction. The vertical gradients were calculated using the March 2015 data from three monitoring well pairs. The general gradient direction was determined to be downwards. The vertical hydraulic gradients calculated at the Phase Two Property based on January 2017 data ranged from -0.07 m/m (TH1600/TH1602B) with an upwards gradient direction to 0.89 m/m (TH129A/TH129B) with a downwards

gradient direction. The vertical gradients for eighteen monitoring well pairs were calculated based on January 2017 data, and the general gradient direction was determined to be downwards.

- The following parameters were considered COCs in soil:
  - BTEX
  - PHC F1 to F4
  - Chlorobenzene, chloroform, ethylene dibromide, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichloropropane, 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane, trichloroethene, 1,2-dichloroethane, and hexane
  - Acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b/j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, methylnaphthalene, naphthalene, phenanthrene, and pyrene
  - 1,1-biphenyl and bis(2-ethylhexyl) phthalate
  - Antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc
  - EC and SAR
  - PCBs
- The following parameters were considered COCs in groundwater:
  - Benzene
  - Xylene
  - PHC F1 to F4
  - Sodium and chloride
  - Bis(2-ethylhexyl) phthalate, diethyl phthalate, and dimethyl phthalate
  - Acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b/j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno (1,2,3-cd)pyrene
- The evaluation of QA/QC procedures indicated that the DQOs for the soil and groundwater data were met, and that the data were of acceptable quality and adequate for their intended use.

Based on the results of the Phase Two ESA, the Table 3 SCS were not met for all COC parameters at the Phase Two Property at the time of the assessment. Soil and groundwater impacts at the Site will be managed using a combination of targeted remedial excavation with off-site disposal, risk assessment, risk management, and soil management. It is recommended that remedial objectives for soil and groundwater will be established by deriving property specific standards (PSS) through the completion of O.Reg. 153/04 Risk Assessment(s). The Risk Assessment will evaluate potential COC human health and ecological risks, and recommend any required Risk Management Measures that will be necessary to manage exposure.

The targeted remedial excavation and soil management program was initiated at the Site in December 2017 to address identified soil impacts that would represent a source for continued impact to groundwater. It is expected that residual impacts to soil and groundwater will remain at the Site upon completion of the targeted remedial excavation program. Any residual concentrations of COC in exceedance of generic Table SCS will be managed through the PSS by the Risk Assessment(s) and any recommended Risk Management Measures.

6.0 CLOSURE

This report was prepared by Breanne Graham and reviewed by Jill Peters-Dechman.

Respectively submitted,

STANTEC CONSULTING LTD.

Breanne Graham, B.A.
Environmental Scientist
Tel: 905-381-3274
Breanne.Graham@stantec.com

Jill Peters-Dechman, P.Eng.
Senior Environmental Engineer
Tel: 613-738-6073
Jill.Peters-Dechman@stantec.com

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