REPORT
TO
THE CITY OF GUELPH

PRELIMINARY REMEDIAL ACTION PLAN
FORMER IMICO PROPERTY
200 BEVERLEY STREET
GUELPH, ONTARIO

Prepared by:

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April 2014

701996

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AN ARCADIS COMPANY

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14 April 2014

City of Guelph
City Hall
59 Carden Street
Guelph, Ontario
N1H 3A1

Attention: Prasoon Adhikari, M. Sc., P. Eng., QP_{ESA}
Environmental Engineer

Re: **Preliminary Remedial Action Plan**
Former IMICO Property
200 Beverley Street
Guelph, Ontario

Dear Sirs:

Decommissioning Consulting Services is pleased to provide the following preliminary remedial action plan report for the former IMICO foundry located at 200 Beverley Street in the City of Guelph. The report presents and discusses approaches to be taken to remediate and or manage subsurface contamination present on the subject site.

We trust that the information presented in this report is of assistance to the City of Guelph in initiating the redevelopment of this former industrial property. Please do not hesitate to contact us should you have any questions or if we may be of further assistance.

Yours very truly,

DECOMMISSIONING CONSULTING SERVICES

Richard Browne, M.A.Sc, P.Eng.
Senior Vice President

Stephen Prior, P.Eng.
Senior Project Manager

Enc.

EXECUTIVE SUMMARY

Decommissioning Consulting Services (DCS), an ARCADIS company, has been retained by the City of Guelph (the City) to prepare a Preliminary Remedial Action Plan for the brownfield property located at 200 Beverley Street in the City of Guelph. This property was formerly occupied by the International Malleable Iron Company (IMICO) and is commonly known as the IMICO site/property.

The work was completed as part of an evaluation of the property in preparation for redevelopment. This evaluation included completion of Phase One and Phase Two Environmental Site Assessments (ESAs) that further defined the extent of contamination on the site. These studies built on the knowledge gained through previous investigations completed by others since 1989. The DCS reports, as well as the previous documents, should be reviewed to gain a more complete understanding of the subsurface environmental conditions present at the site.

Viable options for management of the impacted soil include Risk Assessment (RA) or Modified Generic Risk Assessment (MGRA) in combination with some excavation and off-site disposal. remedial options for the groundwater include an RA or a MGRA, in conjunction with localized free product and potential volatile organic compounds (VOC) remediation. The use of the RA approach would need to be acceptable to the future owners of property.

In addition to completion of the RA it will be necessary to determine the source and extent of the petroleum hydrocarbon (PHC) free product found in monitoring well OW23S within the east portion of the site. If required, a skimmer pump could be installed to remove the free product for storage and later disposal.

The cost to complete the RA would be approximately $100,000 to $150,000. This assumes no additional work to determine the source of the VOCs on and off the property and to further delineate impacts, if requested by the Ministry of the Environment (MOE).

The presence of off site impacts will need to be further investigated. The City, MOE and other stakeholders will need to agree upon the appropriate measures to remediate and/or manage the off site groundwater impacts which include VOCs.

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1.0 INTRODUCTION

Decommissioning Consulting Services (DCS) has been retained by the City of Guelph (the City) to prepare a Preliminary Remedial Action Plan (RAP) for the brownfield property located at 200 Beverley Street in the City of Guelph. This property was formerly occupied by IMICO (IMICO site or site).

The work was completed as part of an evaluation of the property in preparation for redevelopment and to reflect amended regulations (O. Reg. 153/04) under Environmental Protection Act (EPA). This evaluation included completion of Phase One and Phase Two Environmental Site Assessments (ESAs) that further defined the extent of contamination on the site. These studies were built on the knowledge gained through previous investigations completed by others since 1989. The DCS reports, as well as the previous documents, should be reviewed to gain a more complete understanding of the subsurface environmental conditions present at the site.

2.0 SITE BACKGROUND INFORMATION

2.1 SITE LOCATION

The site under investigation comprises a number of parcels of land and is described as Part of Lots 1, 2 and 3, Range 3, Division F, Registered Plan 343, City of Guelph, County of Wellington. The site is located in the south eastern quadrant of the City of Guelph and is bounded by Guelph Rail Line to the north, Beverley Street to the south, and Stevenson Street South to the west.

2.2 SITE DESCRIPTION

The Phase Two property is approximately 52,250 square meters (m^2) (12.9 acres) in area. The site consists of a topographically flat former heavy industrial property within an older industrial/commercial area of Guelph. The vacant site is overgrown by scrub growth. The location of the site is shown on the Key Plan (Figure 1) which follows this page.

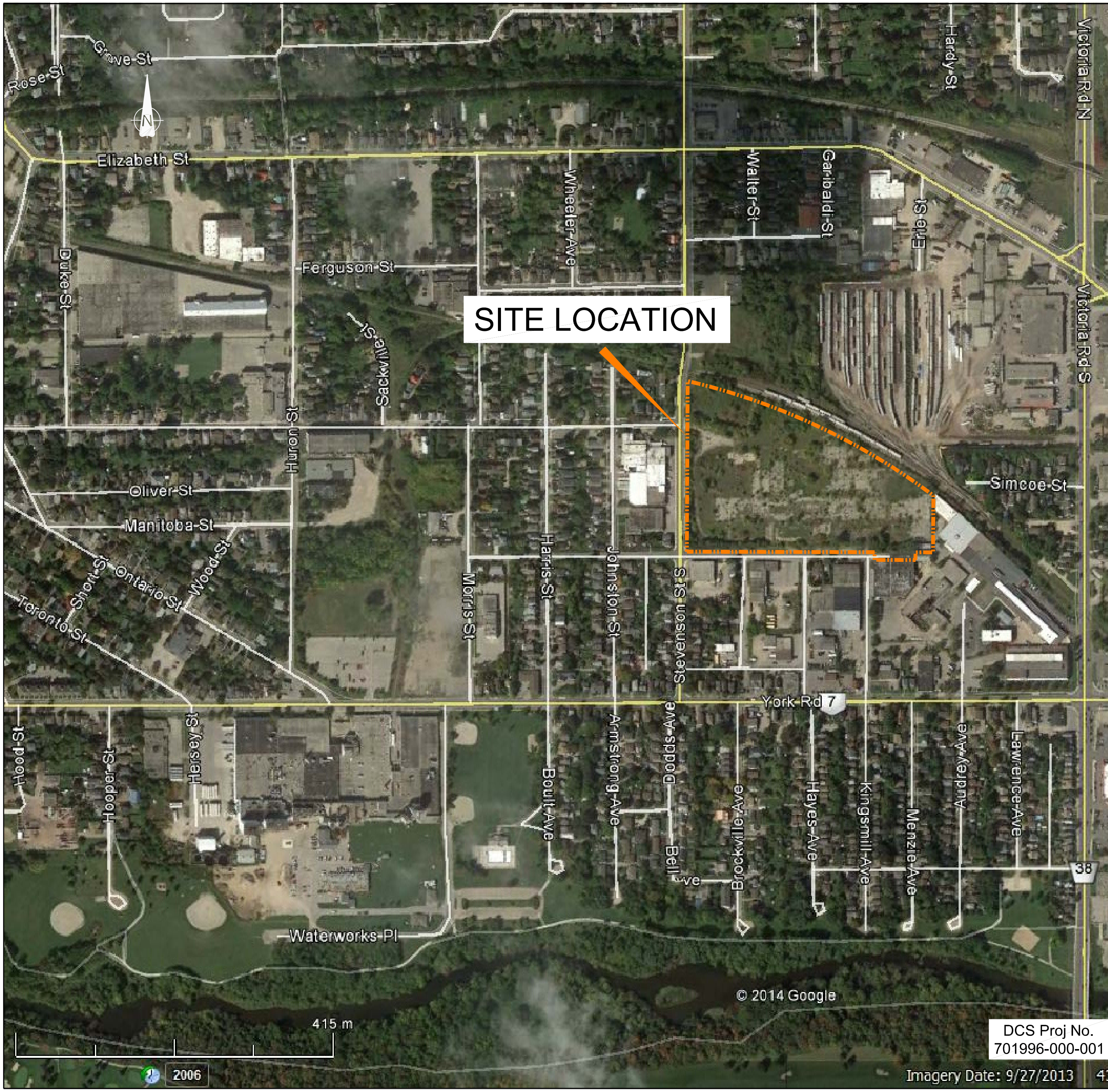
2.2.1 Adjacent Properties

The adjacent land uses at the time of a site visit on 7 November 2013 were as follows:

North: Guelph Rail Line

South: Beverley Street followed by mainly industrial and commercial properties: ABS Friction was previously located at 10 Kingsmill Avenue, Dresco Plumbing and Supply is located at 24 Hayes Avenue, residential dwellings are located at 201, 203, and 205 Beverley Street, Stan's Plumbing and Heating Supplies is located at 101 Beverley Street, and *In Situ* Contractors are located at 150 Stevenson Street South (at the intersection of Beverley Street and Stevenson Street South).

West: Stevenson Street South followed by Steele Bros. located at 60 Johnston Street, Choice Enterprises and Transportation Services is located at 143 Stevenson Street South, Sign Art Centre of Guelph Inc. is located at 145 Stevenson Street South, 147 Stevenson Street South houses WYGA Construction Ltd., as well as George's Furniture & Giorgio's Galleria, residential dwellings are located at 109 and 111 Stevenson Street South.



DCS AN ARCADIS COMPANY

DECOMMISSIONING CONSULTING SERVICES

CITY OF GUELPH

200 BEVERLEY STREET, CITY OF GUELPH

FORMER IMICO FACILITY
REMEDIAL ACTION PLAN

KEY PLAN

DCS Proj No. 701996-000-001

FEB. 2014	SCALE 1:7,500±	FIGURE 1

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East: a former industrial facility (490 York Road) that is currently being used for commercial purposes

No unusual conditions were observed on the adjacent lands. It should be noted that observations were made, for the most part, from the site or from publicly accessible areas.

Other property uses within the Phase Two Study Area consist mainly of low-rise commercial and industrial properties with some residential dwellings. Most of the properties just outside of the Phase Two Study Area are residential homes.

The nearest water body to the site is the Eramosa River, which is about 550 m southeast of the site. Several sensitive species of turtles, fish, snakes, insects, and plants were identified within Wellington region as discussed in Section 4.3.4 *Water Bodies and Areas of Natural Significance* of the Phase One ESA. Most of these species have not been observed in the area of the site for decades and the site and surrounding area is not generally suitable to provide habitat for these species.

2.3 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

2.3.1 Previous Investigations by Other Consultants

A number of subsurface environmental investigations have been completed over the past 15 years. A summary of these reports was provided in the *Phase One Environmental Site Assessment, 200 Beverley Street, Guelph, Ontario* report prepared by DCS for the City, dated February 2014. These include the following:

- Sections of "*Environmental Investigations, Report Recommendations*", prepared for International Malleable Iron Company Limited by Proctor & Redfern Limited (P&R), dated August 1989.

- "*Draft Environmental Investigation, International Malleable Iron Company, 200 Beverley Street, Guelph, Ontario*", prepared for the Bank of Montreal by P&R, dated 10 June 1991.

- "*Final Draft for Discussion, Hydrogeologic Site Investigation, Former IMICO Foundry Site, Guelph, Ontario*", prepared for the City of Guelph by Gartner Lee Limited (Gartner Lee), dated August 1998.

- "*Supplemental Hydrogeologic Investigation, Former IMICO Site*", prepared for the City of Guelph by Gartner Lee, dated March 1999.

- "*City of Guelph, Former IMICO Facility, Demolition and Waste Removal Report*", prepared for the City of Guelph by Earth Tech (Canada) Inc. (Earth Tech), dated October 1999.

- Additionally, DCS reviewed a letter (*Progress Report #6*) from the City of Guelph to the MOE dated 23 August 2001, a letter (*Progress Report #7*) from the City of Guelph to the MOE, dated 6 March 2002 and a technical memorandum ("Summary of Environmental Conditions and Resultant Redevelopment Constraints at 200 Beverley Street, Guelph") prepared by CH2M HILL Canada Limited, dated 13 November 2003.

- "*Phase I Environmental Site Assessment, Former IMICO Property, 200 Beverley Street, Guelph, Ontario*", prepared for the City of Guelph by DCS, dated December 2007.

- "*Phase II Environmental Site Assessment, Former IMICO Property, 200 Beverley Street, Guelph, Ontario*", prepared for the City of Guelph by DCS, dated December 2007.

- "*Preliminary Remedial Action Plan, Former IMICO Property, 200 Beverley Street, Guelph, Ontario*", prepared for the City of Guelph by DCS, dated March 2008.

- "*2011 Annual Groundwater Monitoring Report, Former IMICO Site, 200 Beverley Street, Guelph, Ontario*", prepared for the City of Guelph by AECOM, dated August 2013.

2.3.2 Phase One ESA (DCS, 2013)

Numerous environmental studies have been completed in the past by others and these have been summarized in the following report prepared by DCS for City:

- *Phase One Environmental Site Assessment, 200 Beverley Street, Guelph*, Ontario, dated February 2014

The following paragraphs summarize the findings and recommendations of the Phase One ESA.

2.3.2.1 Historic Land Use

IMICO purchased the site at 200 Beverley Street in 1912 for development as a foundry. No evidence of previous commercial or industrial land use has been found. The foundry operated as an iron-jobbing facility for the production of various metallic forms using malleable and ductile iron.

A complete description of the historic land use is provided in the Phase One ESA report (DCS, 2014).

2.3.2.2 Historic Nearby Land Use

Nearby historic land use activities that could have had a detrimental effect on the site included:

- a facility operated by Canadian Oil Company at the northwest corner of Elizabeth Street and Victoria Street. This facility operated from at least 1938 to 1957.

- a facility operated by Guelph Stove Works located at 490 York Road, immediately to the east of the IMICO property. This facility included machine shops, enamelling facilities, presses and assembly areas. This facility operated from at least 1930 to later than 1964. Further information was not available at the time of the preparation of this report.

- a plant operated by Holody Electro-Plating located at 66 Victoria Road South. This facility operated from at least 1957 to the present.

- a coal/coke dealer was located at 141 Victoria Road South in 1957. Additional information is not available.

- a number of wood working facilities operated along Elizabeth Street and Victoria Roads between 1926 and the present.

2.3.2.3 Current Land Uses

There was no evidence of current activities on the site could significantly affect the quality of the soil or groundwater. The site is currently fenced and no tenants occupy the property.

2.3.2.4 Potentially Contaminating Activities

Potentially contaminating activities (PCAs) identified at the site include:

1) Placement of fill of unknown origin across the site.
2) Former underground storage tank in the northeast corner of the site.
3) Former iron and steel manufacturing and processing at the site.
4) Former metal treatment, coating, and finishing at the site.
5) Former use and storage of PCBs at the site.

Potentially contaminating activities in the Phase One Study Area include:

6) Chemical manufacturing, processing, and bulk storage adjacent to the site.
7) Rail yard, tracks, and spurs adjacent to the site.

2.3.2.5 Areas of Potential Environmental Concern

The Areas of Potential Environmental Concern (APEC) on the site are summarized in the table below:

APEC	Location of APEC on Phase One Property	Potentially Contaminating Activity	Location of PCA (on or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil and/or Sediment)
APEC 1	Entire property	Importation of Fill of Unknown Quality (30)	On-site	Metals and inorganic parameters	Soil and Groundwater
APEC 2	Eastern portion, former location of UST and machine shop	Gasoline and Associated Product Storage in Fixed Tanks (28), Metal Treatment, Coating and Finishing (33)	On-site	Metals and inorganic parameters Petroleum Hydrocarbons (PHCs) and Benzene, Toluene, ethylbenzene and Xylene (BTEX), Volatile Organic Compounds (VOCs)	Soil and Groundwater

APEC	Location of APEC on Phase One Property	Potentially Contaminating Activity	Location of PCA (on or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil and/or Sediment)
APEC 3	Central portion of the site, in the vicinity of the former capacitor room, cooling tower and offices	Iron and Steel Manufacturing and Processing (32), Use and storage of PCBs at the site	On site	PHCs and BTEX PCBs PAHs VOCs	Soil and Groundwater
APEC 4	Southern portion of the site, formerly housing the sand mixer, foundry sumps, and the electrical shop	Iron and Steel Manufacturing and Processing (32)	On site	PHCs and BTEX PCBs PAHs VOCs	Soil and Groundwater
APEC 5	Western portion of the property, former maintenance garage	Garage, Maintenance and Repair Area	On site	PHCs and BTEX PAHs VOCs	Soil and Groundwater
APEC 6	Former core room, power house, and boiler house	Use and storage of PCBs	On site	PHCs and BTEX PCBs PAHs VOCs	Soil and Groundwater
APEC 7	Northeastern portion of the property, former storage and warehousing, including storage of PCBs, and as a machine shop	Iron and Steel Manufacturing and Processing (32), Metal Treatment, Coating and Finishing (33), Use and Storage of PCBs.	On site	PHCs and BTEX PCBs PAHs VOCs	Soil and Groundwater
APEC 8	Northwestern property boundary	Chemical manufacturing, processing, and bulk storage (8)	Off site	PHCs and BTEX PCBs PAHs VOCs	Soil and Groundwater

APEC	Location of APEC on Phase One Property	Potentially Contaminating Activity	Location of PCA (on or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil and/or Sediment)
APEC 9	Northwestern property boundary	Rail yard, tracks, and spurs adjacent to the site (46)	Off site	Metals and inorganics PHCs and BTEX PAHs	Soil and Groundwater

Note: Number in brackets refers to PCA referenced in Schedule D, Table 2, O. Reg. 153/04

It should be noted that contamination is present in the groundwater on the eastern property boundary and on the adjacent property located at 490 York Road. At the time of writing, no source has been identified. If the source is located off site it is possible that on site contaminant levels may increase in the future.

2.3.2.6 Assessment of APECs

The APECs listed in Section 2.3 of greatest concern on the site include those associated with on-site activities (PCAs 1 to 6). Contaminants of Concern (CoC) associated with these PCAs include metals and inorganic parameters, BTEX, PHCs, PCBs, PAHs, and VOCs, as listed above.

The rationale for the conclusion that these APECs are considered to be of greatest concern to the site is provided below.

PCA 1: Placement of fill across the site from an unknown source (APEC 1)

- Metal concentrations exceeding MOE Table 2 industrial/commercial/community land use Standards were previously reported in the fill across the site by DCS in 2007.
- DCS found metals, PAHs and PHCs impacts in soil and groundwater in 2007 and in 2013.

PCA 2: Former UST in the northeast corner of the site (APEC 2)

- The UST reportedly contained gasoline.
- DCS identified PHC impacts in soil in this area during the 2007 investigation as well as PAHs.

PCA 3: Former iron and steel manufacturing and processing at the site (APECs 3, 4, and 7)

- The site was previously owned by IMICO and used as a foundry from its purchase in 1912 until the plant closed in 1989.
- Previous demolition and remediation work have occurred at the property.
- DCS found PHC, PAH, PCB, VOC soil and groundwater contamination across the entire property in 2007 and in 2013.

PCA 4: Former metal treatment, coating, and finishing at the site (APECs 2 and 7)

- The site was previously owned by IMICO and used as a foundry from its purchase in 1912 until the plant closed in 1989.
- Previous demolition and remediation work have occurred at the property.
- DCS found PHC, PAH, PCB, VOC soil and groundwater contamination across the entire property in 2007 and in 2013.

PCA 5: Former use and storage of PCBs at the site (APEC 6)

- The former PCB storage area was identified in the northeast portion of the property.
- PCB impacts were found by DCS in the 2007 and 2013.

PCA 6: Former garage, maintenance and repair area (APEC 5)

- Two maintenance garages were previously located on the north western portion of the property.
- DCS found PAH and metals soil contamination in 2007 and in 2013.

PCAs which are believed to have resulted in negligible APECs include PCAs 7 and 8. The rationale for the conclusion that these APECs are of negligible concern is provided below:

PCA 7: Chemical manufacturing, processing, and bulk storage (APEC 8)

- While the bulk chemical storage facility is of concern and adjacent to the property, it is not thought to impact the quality of the soil and groundwater at the property as groundwater impacts for the anticipated COC from this facility have not been identified in this area.

PCA 8: Rail yard, tracks, and spurs (APEC 9)

- While the Guelph Rail Line is of concern and adjacent to the property, it is not thought to impact the quality of the soil and groundwater at the property as not spills have been reported in the past.

2.3.3 Phase Two ESA (DCS 2013-2014)

A Phase Two ESA field program was completed in December 2013. At that time ten test pits were excavated and three boreholes were advanced. In addition, chemical data for ground water samples collected from 22 monitor wells by AECOM was used during the preparation of the DCS Phase Two ESA. The location of these wells and test pits is shown on Drawing 701996-RAP-2.1.

The general geology of the property consists of granular fill and native soils overlying the dolostone bedrock. Groundwater monitoring wells have been installed at the soil/bedrock contact in the shallow and deep bedrock to obtain water groundwater levels and to monitor contaminant distribution laterally and vertically.

Groundwater flow in the shallow bedrock/overburden is generally to the south while the flow in the deep bedrock appears to be radial from a high located near the east property boundary. Work completed by AECOM in 2011 appeared to indicate the groundwater high is seasonal as it was not present during the summer months but was observed in the spring and early winter. The linear groundwater velocity in the shallow bedrock is estimated to be 5 m/year and ranges between 5 and 20 m/year in the deep bedrock. An upward vertical hydraulic gradient was found to be present in wells OW3, OW9, OW-11, OW18, OW27, OW07-34 and OW07-36 during the sampling event completed in October 2013.

The geology consists of a granular overburden that averages 1.65 m in thickness across the property. Under the City of Guelph by-laws all groundwater within the City limits is considered to be potable. Therefore, MOE Table 6 (Generic Site Conditions for Shallow Soils in a Shallow Groundwater Condition) is applicable to the property.

Contamination is present in the soil across the property. The predominant contaminant in the soil is metals with some PAHs and PCBs being present. The work completed in 2013 did not detect any VOCs or PHCs in the soil above the MOE Table 6 Site Condition Standards (SCS).

Contamination in the groundwater is generally confined to the east part of the site and consists of volatile organic compounds with occasional PAHs and metals, including elevated zinc. Based on the analytical data collected by AECOM the contamination is also present on the property to the east located at 490 York Road. The source of this contamination has not been determined.

Information provided by AECOM indicated that petroleum hydrocarbon (PHC) free product has been detected in monitoring well OW23(S) located in the former Machine Shop and Warehouse area. Product thicknesses of up to 8 cm have been recorded in 2013. Based on the analytical results it is suspected that the free product PHC of the F3 fraction (580,000 ug/L). Product was not detected in the groundwater samples recovered from nearby groundwater monitoring wells (OW22, OW18-1, OW18-11, OW13-39S, OW13-39D, OW9-I and OW9-II) nor were elevated PHC concentrations found in the soil samples recovered during the 2013 filed investigation (TP8, TP 9 and BH13-40). This suggests the source is in the vicinity of OW23(s).

Sewers may be present across the property as information regarding their removal has not been located. However, given the granular nature of the overburden it is possible that utility trench backfill will not provide a preferential pathway for the movement of contaminants off the property in the groundwater.

3.0 SITE GEOLOGY AND HYDROGEOLOGY

3.1 SURFACE/OVERBURDEN GEOLOGY

The overburden/surficial geology consists of the following:

3.1.1 Asphalt

Asphalt was found in some locations for thicknesses ranging up to 100 mm.

3.1.2 Topsoil

A layer of topsoil was found to range from 100 to 150 mm in thickness. It is described as brown, moist and containing numerous rootlets.

3.1.3 Fill Soils

Fill soils were found in all test pit and borehole locations. The fill was found to range in thickness from 0.30 m to 1.83 m below ground surface (m bgs.). A substantial thickness of fill was found in a number of areas across the property. It was known that at least two locations (TP-5 and TP-6, former PCB Storage area) had been the subject of a remedial program. At the other locations the cause for the fill extending to bedrock was not known.

Much of the site was covered by material that could be described as fill/reworked native sands. This stratum frequently contains coal, clinker, ash, metal, and detritus from the former foundry operations. However, the granular matrix of the fill was very similar to that found in the underlying native stratum. Based on the site history there was not believed to have been a large-scale importation of granular material. However, there may have been reworking of the on-site soils as a result of initial construction and subsequent expansion activities associated with the foundry.

Some black staining was observed within the fill during the previous investigations however no staining was noted during the 2013 Phase Two ESA activity. No odours were detected in the fill within the test pits. GasTech readings were non-detect.

3.1.4 Sand, Gravel and Cobbles

Native soils were encountered underlying the fill at depths ranging from 0.30 to 0.76 m bgs. The soil is described as grey to brown, moist and consisting of sand, gravel and cobbles.

No staining or odours were noted in the native soils. GasTech readings were non-detect.

3.2 BEDROCK GEOLOGY

A review of the OGS Earth, an on-line add-on to Google Earth, indicates the bedrock consists of the Eramosa member of the Guelph Formation. It is described as a fossiliferous dolostone that may be locally bituminous.

Bedrock at the site was found at depths ranging from 1.53 m to 3.15 m bgs. The bedrock is described as grey limestone with some shaley partings. The drill core recovery of the bedrock was generally greater than 90% and the Rock Quality Designation (RQD) ranged between 60 and 80% indicating the rock is rated as good.

Fractures in the bedrock generally were horizontal to sub-horizontal and the spacing generally decreased with depth. Numerous vugs (cavities), some completely in-filled with calcite, were present throughout the rock profile.

3.3 SITE HYDROGEOLOGY

The groundwater elevations were determined in 2013 and shown on drawings provided in the DCS Phase Two ESA. In general, the groundwater flow direction in the shallow bedrock was to the south while flow in the deep bedrock was radial from a high located along the east property line. Based on previous work the groundwater high in the deep bedrock may be seasonal.

3.3.1 Groundwater: Horizontal Hydraulic Gradients

3.3.1.1 Shallow Bedrock

The groundwater flow within the shallow bedrock is to the south at a gradient of 0.03 m/m. Hydraulic conductivity testing was not completed during this investigation, however, testing was completed during the Phase II ESA work completed by DCS in 2007. At that time the hydraulic conductivity (K) in the shallow bedrock was estimated to be 1.75 x 10^{-6} m/s. Using the estimated K, gradient value and an estimated effective porosity of 0.1, the linear groundwater flow velocity was estimated to be 15 m per year.

3.3.1.2 Deep Bedrock

The hydraulic gradients in the deep bedrock are estimated to be 0.025 m/m to the south and 0.1 m/m to the east. The hydraulic conductivity of the deep bedrock was determined to be 5.64 x 10^{-6} m/sec during the DCS 2007 Phase II. Assuming an effective porosity of 0.1 and the determined bedrock parameters, the linear groundwater velocity was estimated to be approximately 55 m/year.

3.3.1.3 Vertical Hydraulic Gradients

Using the groundwater levels measured by AECOM in 2013 the vertical hydraulic gradient is generally upward and ranges from 0.02 to 0.4 m/m.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 SOIL

4.1.1 Historic Data

The historic soil chemistry data from previous subsurface investigation work completed by DCS and others has been provided in the 2014 Phase Two ESA. Only non-volatile compounds are shown in the tables and on the drawings as volatile data older than 18 months may not be used for a Record of Site Conditions. As it is possible a Record of Site Conditions may be generated for the property only current data (data obtained within 18 months of investigative work) was used.

Based on the data provided, it was identified that metals contamination was widespread across the property with the major impacts being from lead and zinc. The maximum lead concentration found on the property is 822 ug/g compared to the MOE Table 6 SCS for both Residential/Parkland/Institutional (RPI) and Industrial/Commercial/Community (ICC) land uses of 120 ug/g. The maximum zinc concentration found was 6,170 ug/g, compared to the MOE Table 6 SCS of 340 ug/g.

In addition, elevated concentrations of PAHs and PCB were also found. PCBs (1.5 ug/g) were found at ground surface in one location near the west side of the property while the PAHs were widely scattered across the property. A large number of PAHs were found at various depths throughout the soil profile.

4.1.2 Current Investigation

During the DCS 2013 soil investigation analysis for metals, PAHs, PCBs, VOCs and PHCs were completed. The results of analysis are provided in the DCS Phase Two ESA report.

The location of the samples collected during the 2013 investigation were based on the intent to further delineate locations where elevated values for PCBs, PAHs, PHCs and VOCs concentrations found during the 2007 investigation.

Elevated concentrations of lead, zinc, and cadmium are still widespread across the property. The concentrations detected were less than those found during the 2007 investigation but still above both RPI and ICC Table 6 SCS. The metals were found throughout the soil profile.

PHC analysis found PHC F3 fraction in soils recovered at test pit location TP-8 from a sample recovered from a sample obtained at a depth of 0.1 m bgs above RPI Table 6 SCS but below ICC Table 6 SCS. The concentration of benzene and tetrachloroethylene in soils from test pit location TP-11 at a depth of 0.015 m bgs were above RPI Table 6 SCS but below ICC Table 6 SCS, as was the concentration of trichloroethylene at monitoring well locations OW13-39S and OW13-40 in samples recovered from just above the bedrock surface

PCB concentrations were detected in one sample recovered from test pit location TP-8, excavated between the former machine shop and annealing oven buildings.

PAH concentrations were found in the three samples from across the property: two samples were recovered from test pits excavated in the east end of the property (TP-8 and TP-9) and one sample from the central portion of the property (TP-11). Several PAH compounds were detected in concentrations above RPI and/or ICC Table 6 SCS in each of the aforementioned samples submitted.

The analytical data for metals in soils obtained during the DCS 2007 and 2013 investigations are shown on Drawing 701996-RAP-4.1. Analytical data for PAHs and PCBs is illustrated on Drawing 701996-RAP-4.2. Analytical data for VOCs and PHCs detected in the soils during the 2013 DCS investigation is shown on Drawing 701996-RAP-4.3.

4.2 GROUNDWATER

4.2.1 Historic Investigation

As indicated previously, only data for volatile compounds that is less than 18 months old may typically be used in a report prepared to support an RSC. Annual groundwater monitoring programs have been completed for the property for a number of years by AECOM; DCS has been provided copies of the analytical results for 2012 and 2013. Given the age of the data, data collected in 2012 has been considered as historic information.

The 2012 groundwater was analysed for metals and inorganics, PHCs, VOCs, PAHs, and semi-volatile compounds (SVOCs). The analytical results are provided in the 2014 DCS Phase Two ESA.

Metals (zinc) exceeded the MOE Table 6 SCS for the 2012 groundwater investigation.

Petroleum hydrocarbons (F1 and F2 fractions) were found in concentrations exceeding the MOE Table 6 SCS in one groundwater sample collected from OW25, located near the centre of the property. PHC values exceeding the MOE Table 6 SCS were also found in three other off site locations. Two locations were found along Beverley Street to the south (OW7-36S and OW7-36D) and the final location (OW30-D) was found to the east on the property located at 490 York Road.

Elevated concentrations of VOCs in groundwater above the Table 6 SCS were found in monitoring wells OW26S (located near the centre of the property along the south property line), OW9-II, OW18-II, OW24(S), OW24(D), OW6, OW28D and OW23D located at the east end of the property and OW27(S), OW27(D), OW29(S), OW29(D) and OW36D which are located off site The VOCs generally consisted of daughter products of trichloroethylene (i.e. 1,1-dichloroethylene, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, trichloroethylene, and vinyl chloride). These compounds are found in both the shallow (soil/bedrock contact) and deep (bedrock) monitoring wells. The maximum concentration was found in a well located on the adjacent property to the east at 490 York Road. At this location a concentration of 4,800 ug/L (Table 6 SCS 0.5 ug/L) for 1,1,1-trichloroethane was found in monitoring well OW30D.

The concentration of PAH compound benzo(a)pyrene was found to exceed the MOE Table 6 SCS. In addition, the Reportable Detection Limit (RDL) for a number of parameters was found to exceed the applicable MOE Table 6 SCS. It was suspected that this elevated RDL was due to matrix interference from the elevated VOC concentrations in that sample.

4.2.2 Current Investigation

The groundwater samples collected by AECOM during the 2012 and 2013 investigation were analysed for metals and inorganics, VOCs, PAHs, and PHCs. The analytical results are provided in the DCS Phase Two ESA.

PHCs above the MOE Table 6 SCS were found in two groundwater samples recovered from the Phase Two property and from one borehole located to the south of the property. PHC (F2 and F3 fractions) were found in the groundwater sample recovered from OW22(S) and PHC (F2, F3, and F4 fractions) were detected OW23(S). These monitoring wells are located at the east end of the property the former machine shop and warehouse area. PHC (F4 Gravimetric fraction) was detected at concentrations above the MOE Table 6 SCS in monitoring well OW36(S). This monitoring well is located on Beverley Street to the south of the property.

PAH concentrations above the applicable SCS were found in groundwater samples recovered from OW22(S) and OW23(S) that are located on the property and from OW30(S) which is located to the east of the site on the property located at 490 York Road. Exceedances included benzo(a)pyrene, chrysene, fluoranthene, phenanthrene and pyrene on the property and benzo(a)pyrene, benzo(b/j)fluoranthene and chrysene on the neighbouring property. In addition, the RDL for a number of PAHs exceeded the MOE Table 6 SCS. It is assumed this is due to matrix interference and dilution required from other parameter groupings.

VOCs exceeded MOE Table 6 SCS in most of the groundwater samples recovered from the east end of the site. The elevated VOCs comprised trichloroethylene (TCE) or breakdown daughter products. Benzene concentrations were also detected in a number of groundwater samples recovered from the vicinity of the former powerhouse, at the east end of the property in the machine shop and warehouse and in an area that formerly contained USTs. Additionally, the RDL were found to exceed the MOE Table 6 for a number of VOCs. It is suspected these are due to matrix interference and the requirement for dilution for other parameter groupings.

Elevated metals (zinc) were found above the MOE Table 6 SCS were found in groundwater recovered from monitoring wells located at the east end of the site.

Based on information provided by AECOM, free product has been detected in monitoring well OW23(S). Product thicknesses of up to 8 cm have been recorded. Based on the analytical results it is suspected that the free product is PHCs (i.e. PHC F3 fraction 580,000 ug/L). The source of the free product was not determined during this investigation as DCS were relying on information provided by AECOM.

Analytical data for metals, PAHs, VOC and PHCs is shown on Drawing 701996-RAP-4.4.

5.0 REMEDIAL ACTION OBJECTIVES

5.1 SCREENING OF REMEDIAL ACTION ALTERNATIVES

A number of remedial options are potentially available to address both soil and groundwater impact on the site. Given site conditions and the nature of the impacts some remedial options are viable while some are not. Our assessment of the viability of the potential options is provided below:

Remediation Alternative	Soil	Groundwater
Risk Assessment	Viable	Viable
Modified Generic Risk Assessment	Viable	Viable
Excavation and Disposal	Viable	Not Viable
Soil Washing	Viable	Not Viable
In Situ Solidification/Stabilization	Viable	Not Viable
Natural Attenuation	Not Effective for metals	Viable
Groundwater Extraction and treatment	Not Effective for metals	Viable
Enhanced Bio Remediation *In Situ* (Direct push Oxygen Release Compound slurry injection)	Not Effective for metals	Not viable in Bedrock
Dissolved Oxygen Enhancement *In Situ*	Not Effective for metals	Viable
Anaerobic Reductive de-chlorination *In Situ*	Not Effective for metals	Viable
Enhanced Bioremediation *In Situ* (Air sparging)	Not Effective for metals	Not viable in Bedrock
Biopile *Ex Situ* (Assuming adequate area available on site)	Not Effective for metals	Not Viable
Land farming *Ex Situ* (Assuming adequate area available on site)	Not Effective for metals	Not Viable
Slurry phase biological treatment *Ex Situ* (Assuming adequate area available on site)	Not Effective for metals	Not Viable
Incineration *Ex Situ*	Not Effective for metals	Not Viable
Thermal Desorption *Ex Situ*	Not Effective for metals	Not Viable
Bioreactor *Ex Situ*	Not Effective for metals	Not Viable
Soil Flushing *In Situ* (with use of surfactant/co- solvent)	Not Effective for metals	Not viable in Bedrock
Soil Vapour Extraction *In Situ* (Assumed not combined with Bio-venting or Air sparging)	Not Effective for metals	Not viable in Bedrock

Remediation Alternative	Soil	Groundwater
Multi-Phase Extraction *In Situ* (Heat enhanced if required for polishing)	Not Effective for metals	Not viable in Bedrock
Permeable Reactive Wall Barrier	Not Effective for soils	Technically Viable in Bedrock

Viable options are discussed in greater detail in Section 6.

5.2 EXTENT OF CONTAMINATION - SOIL

Under O.Reg 153/04 the site is considered to be a shallow soil condition property in that the overburden is less than 2 m in thickness. Therefore, the MOE Table 6 is considered to be the applicable generic standard at the site.

Contaminants on the property include metals, PHCs, PAHs and PCBs. The extent of impacts is shown on Drawing 701996-RAP-5.1.

The extent of impacts and estimate volume of impacted soil, based on an average depth to bedrock of 1.65 m and a property area of approximately 52,250 m^2 is provided in the table below:

Parameter	Impacted Area (m^2)	Percent of Property	Volume of Impacted Soil (m^3)
Metals	41,600	80	67,500
PAHs	26,650	51	43,975
PCBs	850	2	525
VOCs	165	<1	275

As may be seen, the metals and PAHs exceeding the MOE Table 6 SCS are widespread across the property. It should also be noted that the extent of metals is based on the sampling locations. Considering the previous site use as a metal foundry, metals may be more widespread than that detected during the previous investigations. It would be therefore prudent to assume that metals and PAHs in the soil are present across the site.

PCBs are generally restricted to one area located at the west end of the site in the vicinity of the former maintenance garage.

The VOCs were found in the recently drilled boreholes located at the east end of the site.

5.3 EXTENT OF CONTAMINATION - GROUNDWATER

The limits of groundwater impact, based on the investigations completed by AECOM in 2012 and 2013 are shown on Drawing 701996-RAP-5.2. As may be seen the impacts are generally restricted to the east end of the property and along the south property line. The major impacts in the groundwater are VOCs (TCE and its degradation products).

The portions of the property underlain by impacted groundwater are provided in the table below:

Parameter	Impacted Area (m^2)	Percent of Property
VOCs	21,500	41
PAHs	3,000	6
PHCs	7,200	13
Metals	3,100	6

At this time it is not possible to determine the volume of impacted groundwater as the lower limits of impact have not been determined.

Contaminants in the groundwater at the east end of the property were generally found to the east of a line extending north from the center line of Kingsmill Avenue. In this area PAHs, PHCs and VOCs exceeded the applicable MOE Table 6 SCS.

In addition, free product was detected in one monitoring well OW23S, located in the former machine shop and warehouse area. At this time the composition of the free product has not been determine. However, based on the analytical results of the groundwater it appears to be PHC based. In this monitoring well the F2 fraction was detected at 13,000 ug/L (Table 6 SCS 150 ug/L), F3 at 580,000 ug/L (Table 6 SCS 500 ug/L) and F4 at 23,000 ug/L (Table 6 SCS 500 ug/L). In addition a number of PAHs (chrysene, fluoranthene, phenathrene and pyrene) were found in excess of their applicable MOE Table 6 SCS.

It should be noted there is limited information available of the extent of dissolved metals in the groundwater. However, sampling in 2013 did detect zinc, the predominant contaminant present in the soil, to be present in concentrations above the MOE Table 6 SCS at the east end of the property.

6.0 REMEDIAL ACTION ALTERNATIVES

6.1 SOIL REMEDIAL ACTION ALTERNATIVES

6.1.1 No Action

If no actions are taken the site will remain impacted and the City may at some time in the future be ordered by the MOE to undertake remedial measures on the property. This is not considered to be a viable approach.

6.1.2 Natural Attenuation and Institutional Controls/Barriers

This approach is similar to no action in that the metals, PAHs and PCBs will remain in the soil while the VOCs that are present at the east end of the site may gradually degrade with time. The contaminants that are present will be accessible to human and ecological receptors.

Implementation of institutional controls/barriers could include the placement of a hard surface such as asphalt or the placement of clean fill across the site. Either option will prevent access to the contaminants to human or ecological receptors at ground surface. However, further measures would potentially be required to protect subsurface construction/utility workers.

This would be considered to be a short term or interim remedial measure as the asphalt would have to be maintained in perpetuity and the soil cap would have to be maintained as erosion would cause the cap to be removed. Some soils could be transported to the street and eventually into the storm sewers.

6.1.3 In-Situ Solidification/Stabilization and Institutional Controls

In situ solidification and stabilization are described as follows:

Solidification - refers to processes that encapsulate a waste to form a solid material and to restrict contaminant migration by decreasing the surface area exposed to leaching and/or by coating the waste with low-permeability materials. Solidification can be accomplished by a chemical reaction between a waste and binding (solidifying) reagents or by mechanical processes. Solidification of fine waste particles is referred to as microencapsulation, while solidification of a large block or container of waste is referred to as macroencapsulation.

Stabilization - refers to processes that involve chemical reactions that reduce the leachability of a waste. Stabilization chemically immobilizes hazardous materials or reduces their solubility through a chemical reaction. The physical nature of the waste may or may not be changed by this process.

Solidification and stabilization at the property could consist of mixing the soil with cement powder at a ratio that would have to be determined by bench scale testing. This would prevent precipitation from entering the ground and leaching the contaminants into the underlying aquifer. This would also prevent ecological receptors from entering the soil and coming onto contact with the contaminants. However, plant life would eventually take root resulting in possible uptake of the contaminants.

If this option was selected it would result in a hard cap being created and precipitation largely running off the site. As groundwater infiltration would be significantly influenced proper storm water management design would be required.

A pilot study would be required to determine the optimal method of stabilization. A total of approximately 67,500 m^3 of soil would have to be processed. Pre-engineering studies, including a pilot study would be required as well as construction supervision and reporting. The costs to process the soil including excavation, treatment and placing the treated soil on the site are expected to exceed that of the soil excavation and off site disposal option.

6.1.4 Soil Washing

Soil washing is a technology that uses liquids (usually water, sometimes combined with chemical additives) and a mechanical process to scrub soils. This scrubbing removes hazardous contaminants and concentrates them into a smaller volume. Hazardous contaminants tend to bind, chemically or physically, to silt and clay. Silt and clay, in turn, bind to sand and gravel particles. The soil washing process separates the contaminated fine soil (silt and clay) from the coarse soil (sand and gravel). When completed, the smaller volume of soil, which contains the majority of the fine silt and clay particles, can be further treated by other methods (such as incineration or bioremediation) or disposed of according to provincial and federal regulations. The clean, larger volume of soil is not toxic and can be used as backfill. Soil washing is used to treat a wide range of contaminants, such as metals, gasoline, fuel oils, and pesticides.

This process requires a pilot study to determine the effectiveness of the process and would also require a large area for the plant to be constructed. Given the size of the site this could be completed on site, however, as the majority of the site is impacted the plant must be readily transportable in order to move it around the property.

A pilot study would have to be completed prior to start of the soil washing process. Pre-remediation activities including the development of specification and engineering studies as well as construction supervision and the production of a final report would be required. Given an estimated volume of 67,500 m^3 of impacted soils the costs would be expected to be in excess of the soil excavation and off site disposal cost.

6.1.5 Excavation and Off Site Disposal

As may be seen on Drawing 701996-RAP-5.1 metals are the predominant contaminant present on the property. At some locations the metal impacts are accompanied by elevated PAH and in 2007 by PHCs. *In situ* or *ex situ* treatment of soils with multiple contaminant types becomes difficult and costly. Any *ex situ* soil treatment requires soil excavation. Given the relative low cost of off site haulage and disposal relative to *in situ* and *ex situ* soil treatment alternatives, this option is considered to be viable. For the purposes of this RAP it is assumed that the presence of metals in the soil will dictate the limits of remediation.

The impacted soils cover the majority of the property with the exception of the former open area along the northwest edge of the property line. The estimated area of impacted soil is approximately 41,600 m^2 across the entire site. Based on an average depth of 1.65 m the total volume of soil to be removed from the site is 67,500 m^3. Clean-up to the MOE Table 6 standards would result in removal of approximately 80% of the soil from the site.

Testing would have to be completed to determine the disposal site for the soil. It is estimated that removal of the impacted soil and placement of clean soil will take a minimum of 4 months. In addition, there would be increased traffic on the roads in the neighbourhood that may result in more rapid breakdown of the road bed and surface that may not have been designed for heavy vehicular traffic. A detailed specification would need to be developed which would require mud tracking controls, dust controls, soil quality monitoring and possible air quality monitoring.

The cost to complete the excavation and disposal are provided in the table below:

Item	Units	Number of Units	Cost per Unit	Total Cost
Development of Technical Specifications and Selection of Contractor to complete the soil excavation programme	Lump Sum	1	$100,000	$100,000
Excavation and disposal of impacted soil (no topsoil or seed)	Tonnes	135,000	$65	$8,775,000
Replacement with clean backfill and compact	Tonnes	135,000	$25	$3,375,000
Supervision	/day	200	$1,200	$240,000
Confirmation Testing	/sample	75	$300	$27,500
Compaction Testing	/day	145	$1,200	$174,000
Testing of Backfill	/sample	170	$40	$6,800
Technical Report and Project Management	Lump sum	1	$70,000	$50,000
Total				**$12,748,300**

6.1.6 Risk Assessment

6.1.6.1 Full Scope Risk Assessment

A Risk Assessment (RA) would determine the appropriate contaminant cleanup concentrations (property specific standards (PSS)) for both human health and ecological receptors for the specific landuse configuration and receptor exposure scenarios proposed for the site. Given the site specific nature of the analyses and the risk management measures (RMM) implemented, higher contaminant concentrations can be permitted on the site, thereby reducing remediation costs.

The RA is completed in order to determine whether or not the measured on-site concentrations of contaminants pose an unacceptable risk to on and off site human and ecological receptors. Following completion of the RA a Record of Site Conditions (RSC) is to be filed on the MOE's Environmental Site Registry (ESR). Therefore, the RA must be completed in accordance with O.Reg. 153/04 – RSC. The key steps in completion of an RA are:

i. Environmental Site Characterization;
ii. Development of a Conceptual Site Model (CSM);
iii. Preparation and Submission to the MOE of a PreSubmission Form (PSF);
iv. Human Health Risk Assessment (HHRA);
v. Ecological Risk Assessment (ERA);
vi. Development of Property Specific Standards (PSS);
vii. Development of a Risk Management Plan (RMP);
viii. Submission of a RA report to the MOE for its review;
ix. Revision of the RA report addressing the MOE review comments; and
x. Submission of a revised RA report to the MOE for its further review.

The last two steps are repeated until the RA is accepted, but in our experience the revised RA report is generally accepted with only minor additional revisions.

Once the RA is accepted by the MOE, and any remediation required have been completed, then a RSC can be prepared and filed on the MOE's ESR. Risk management barriers and similar RMM would have to be implemented prior to site occupancy.

Further details of the requirements to be completed in preparation of a full scope RA are provided below.

6.1.6.1.1 Environmental Site Characterization and Conceptual Model

An environmental site characterization must be completed prior to the start of the RA process. Numerous investigations have been completed on the site culminating with the DCS Phase Two ESA which has been previously referenced. Based on the data collected to date there would be minimal requirement for obtaining additional subsurface information, however, groundwater monitoring should continue. Resolution of the potential off-site source of VOC impacts in the groundwater on the southeast side of the site will likely be required.

The information gathered through the process is used as a basis for describing the site and developing the conceptual site model. The CSM provides a simplified description of the geologic, hydrogeologic and contaminant conditions that will be present along with the potential contaminant pathways to the anticipated receptors. This CSM is used to describe the site for the PSF that is submitted to the MOE for their approval prior to the start of the RA process.

6.1.6.1.2 Preparation of the PreSubmission Form

As the first approval stage in conducting a RA, a PSF must be submitted by the RA property owner to the MOE for review in advance of the RA report. Conducting a RA includes compiling property characterization and receptor characterization information in the PSF. The Qualified Person (QP_{RA}) should develop the PSF with a team of experts who possess the expertise required to address all exposure pathways and receptors of potential concern.

The PSF provides an opportunity to confirm with the MOE that the RA approach and general scope as described in both narrative and visual forms (CSM) are appropriate for the site and COCs being considered.

The QP_{RA} must prepare the PSF for the property owner, based on the results of the Phase One ESA, and Phase Two ESA and any other information that the QP_{RA} considers relevant. The MOE will prepare a letter of response that indicates the review timeline required for the RA approach, as well as comments concerning the scope of the RA. The purpose of the PSF is to:

- Identify the RA property and ownership;
- Identify the risk assessment team technical leads and self-declaration of the QP_{RA};
- Confirm that a Phase One ESA and Phase Two ESA have been conducted as prescribed by the RSC Regulation;
- Provide the proposed scope of the RA including a preliminary conceptual site model and hazard identification of the RA property by:

  1. Describing the RA property setting, contaminant sources, potential COCs, transport pathways, exposure pathways (including the results of any screening level assessment, if performed), and human and ecological receptors;
  2. Including a summary of key data that supports the conceptual model,;
  3. Proposing the collection of additional data, if required; and,
  4. Proposing an approach for proceeding with the RA that will determine the timeline for the RA review.

The PSF provides the MOE with a general view on the approach to the RA and the RA team at an early stage. The potential impacts for additional impacted groundwater entering the site from adjacent property would have to be addressed in the submission of the PSF.

6.1.6.1.3 Human Health Risk Assessment (HHRA), Ecological Risk Assessment (ERA) and Development of Property Specific Standards (PSS)

The heart of a RA is the completion of the HHRA, ERA and subsequent development of PSS based on the conclusions of the HHRA and ERA. Data bases of toxicity information of the contaminants of concern are researched to obtain the most up to date information, and the increased risks to the various receptors due to exposure to the contaminants are calculated using formulae approved by the MOE. The MOE has established a maximum permissible risk factor and if the calculated risk for a particular contaminant exceeds that value, then the existing situation is judged unacceptable and RMM are warranted. However, if the calculated risk is lower than the risk factor, then a PSS can be developed that is proportionately higher than the generic standard listed in the MOE Table 6. For those contaminants where a RMM is required to reduce receptor exposures to acceptable levels, then PSS can be developed for the case after implementation of the RMM.

6.1.6.1.4 Development of Risk Management Measurements

A component of any RA is the development of RMM and the preparation of a RMP, signed and sealed by a professional engineer or geoscientist. The RMM may include design and implementation of engineered controls such as physical barriers and venting systems, administrative controls such as barring construction over certain areas of the site, or simple monitoring of RA sites where the contaminants of concern are not present in concentrations exceeding the PSS. For the subject site, it is hoped that the RA will conclude that no engineered controls are required for the site, and that only monitoring of indoor air and of groundwater will be required, to ensure that unsafe levels of contaminants do not arise in the future. The key elements of the RMM would be incorporated into the MOE Certificate of Property Use (CPU) prepared for the site.

6.1.6.1.5 Preparation and Submission of RA Report

Upon completion of the site characterization, HHRA and ERA, development of PSS and a RMP, all these elements are consolidated in a single document, accompanied by background factual information, and submitted to the MOE for its review. The duration of the MOE's initial review is expected to be 16 weeks to 22 weeks.

6.1.6.1.6 Revision of RA Report and Re-Submission to the MOE

After receipt of the MOE review comments on the RA report, one of three scenarios will occur:

- The first is that the MOE accepts the RA report as originally submitted and no further work on the RA is required (this is extremely unlikely).
- The second is that the MOE has provided a series of comments, but feels that responding to the comments will be quite simple, and ‘stops the clock’ during the 16 week review period, allowing the consultant to prepare an Addendum addressing the comments.
- The third and most likely scenario is that the MOE provides a list of comments and asks that the RA report be revised and resubmitted, starting a new 16 to 22 week review period. The revised report must contain a section specifically dealing with the MOE review comments and how they were addressed.

The review process can continue indefinitely, but in our experience it normally lasts two or three cycles.

6.1.6.1.7 Preparation of a Certificate of Property Use and Record of Site Condition

Once the RA has been accepted by the MOE, it may be possible to proceed immediately to the preparation and filing of a RSC on the MOE’s ESR. However, if the RA’s RMP requires that remediation of contaminated media is required, or if implementation of engineered controls is required, to lower risk levels to acceptable values, then filing of the RSC may have to be deferred until completion of these activities. Where risk management measures are required the MOE will prepare a CPUwhich will be referred to in the RSC for the site.

Contrary to RSCs based solely on Phase One and II ESAs, the MOE reviews drafts of the RSCs to ensure that the risk management measures called for in the RA are appropriately described on the RSC. This process can take several weeks or months.

A RSC cannot be filed if the limits of contamination have not been defined or is free product is present on the property. Ultimately the engineered controls specified in the RMP and CPU will need to be installed. Prior to occupancy of the risk managed property it will be necessary for a QP_{ESA} to inspect the installations and prepare written confirmation that they are satisfactory.

The costs for the RA and associated submissions would be on the order of $150,000. Any required soil or groundwater remediation and/or treatment would be in addition to this cost.

6.1.6.2 Modified Generic Risk Assessment (MGRA)

In this approach the MGRA model developed by the MOE is used to complete the risk assessment calculations and generate the PSS. This model is consistent with the pathways and receptors used to generate the generic standards. Flexibility has been allowed, within a certain range, in certain aspects of the assessment. For example, the model can be adjusted to reflect some site-specific conditions including soil type, distance to a surface water body, fraction of organic carbon in the soil and depth to groundwater. The MGRA model also includes some generic RMM such was hard caps, soil caps and building restrictions.

The streamlined RA can be completed in a much shorter duration of time compared to a full formal risk assessment, however, there are some limitations. All of the receptors and pathways included in the generic standards are included in the MGRA. This may not be consistent with site-specific information. There are some limitations in the MGRA, such as no risk management measures outside of the default ones embedded in the MGRA can be incorporated. It cannot be applied to sites where Table 1 standards apply and does not have much application to those sites close to water (Table 8 and 9). At the site neither limitation is present.

For metals in soils, there is the potential to implement a risk management measure of a hard cap or soil cap. It should be noted that there limits to the maximum concentrations allowed even after the implementation of a cap, for example arsenic cannot be higher than 47 µg/g and lead cannot be higher than 1000 µg/g.

For the site the MGRA approach may provide a viable option for remediation of the impacted soil present.

The costs for the MGRA would be on the order of $60,000.

6.2 GROUNDWATER REMEDIAL ACTION ALTERNATIVES

6.2.1 No Action

If no actions are undertaken the impacts in the groundwater will remain and possibly migrate off-site with the groundwater flow. Based on information generated during previous groundwater investigations this could occur to the south and possibly to the east. This option is unlikely to be acceptable to the MOE.

6.2.2 Natural Attenuation and Institutional Controls/Barriers

This alternative is similar to no action. Potentially a grouted or injected barrier could be implemented to prevent the migration of the contaminated groundwater off-site. However, such a barrier would result in change to groundwater flow patterns and potential migration of contaminated groundwater to different locations both on and off site. Therefore, detailed hydrogeological investigation and modelling would need to be carried out before implementation. The analyses may determine that barrier installation alone is not viable.

6.2.3 *In Situ* Physical/Chemical Treatment – Oxidation

In Situ Remediation of the contaminants in the groundwater could be completed using oxidizing compounds that are injected into the bedrock. This could require completion of a series of boreholes drilled into the bedrock in a grid pattern across the property. These boreholes could be advanced into the bedrock using pneumatic air track drills which are much quicker than bedrock coring. The oxidizing compounds would be injected into the boreholes and allowed to act.

One approach would be to use proprietary compounds such as RegenOx™ and Oxygen Release Compound (ORC™) to clean the soil and groundwater of organic based compounds.

RengenOx uses solid alkaline oxidant that employs sodium percarbonate. It is introduced in two separate phases (RegenOx-A activator complex and RegenOx-B, oxidizer complex) that are combined and injected into the ground that provides an effective oxidation reaction without an exothermic reaction that could results in excess heat being introduced into the groundwater. The RegenOx would be used to reduce the highly elevated levels to lower levels where other compounds are more effective.

After the contaminant levels have been reduced biostimulating compounds such as ORC would be introduced. These compounds would encourage the growth of the biological components that would consume the remaining contaminants present. The ORC would provide free oxygen for the microorganisms (bugs) to consume while active.

After a period of time groundwater samples would be obtained to assess the effectiveness of the remedial measure and, if necessary, additional injects would be completed. This process would be continued until the required level of contamination has been attained.

The time frame for this process can be extensive as the compounds would have to enter all fractures in the bedrock in order to break down the contaminants into their constituent components.

As illustrated on Drawing 701996-RAP-5.2 VOC, PAH, PHC and metal impacts are present in the groundwater within the east portion of the site. However, west of the Kingsmill Avenue projected alignment only VOC concerns have been identified in the bedrock. The VOC impacts within the western portion of the site are much lower than the eastern portion of the site. It therefore may be possible to address the VOC groundwater impacts to the west of the Kingsmill Avenue projected alignment using a RA approach. The *in situ* groundwater remediation program would therefore just be considered for the eastern portion of the 200 Beverly Street site.

Use of the *in situ* oxidation remediation technology within the eastern portion of the site would require a detailed hydrogeologic study. This program would assess the contaminated bedrock conditions (i.e. bedrock fracturing) to determine where additional boreholes are required to ensure that sufficient chemicals are injected. This study could cost in the order of $75,000 to $100,000. The estimated costs for installation of additional permanent wells and an initial round of oxidant injection would be in the order of $500,000. It is anticipated that completion of these injections would be required at least three times., The costs associated with each subsequent injection phase followed by groundwater monitoring and reporting would be in the order of $200,000.

6.2.4 *In Situ* Anaerobic Reductive De-chlorination

Enhanced anaerobic biodegradation is the practice of adding hydrogen (an electron donor) to groundwater and/or soil to increase the number and vitality of indigenous microorganisms performing anaerobic bioremediation (reductive de-chlorination) on any anaerobically degradable compound or chlorinated contaminant. The most commonly targeted chlorinated groundwater contaminants are primarily used in industry as degreasing agents such as those found on the site.

This process could require the completion of a series of boreholes drilled into the bedrock in a grid pattern similar to that described above. A similar iterative procedure would also be followed.

The time frame for this remedial process can be extensive as the contaminants have entered into the fractures in the bedrock and the reductive chlorination compounds will also have to enter the fractures to breakdown the contaminants present.

The costs for this remediation technology would be very similar to that presented in Section 6.2.3. for *In Situ* Physical/Chemical Treatment – Oxidation. Given the various contaminants present, this technology would be considered in conjunction with completion of a risk assessment potentially both oxidation and reduction technologies would be used.

6.2.5 Groundwater Extraction and Chemical Treatment – Granular Activated Carbon (GAC) Adsorption

Ex-Situ treatment of the groundwater can be accomplished though a pump and treat system. The groundwater is removed from the bedrock and pumped through a series of GAC filters to remove any organic species that may be present.

This system would require a series of wells, each equipped with a submersible pump to remove the groundwater. Some of the existing monitoring wells could potentially be utilized for this purpose. The recovered groundwater would then be pumped through a series of tanks containing the granulated carbon with the recovered groundwater being pumped to an on-site storage tank. After testing the water could then be re-injected into the bedrock or discharged to the sanitary sewers for polishing at the Guelph Water Treatment facility prior to discharge.

Sampling of the water between each filter should be completed on a routine basis to assess the continued viability of the GAC filters. If a threshold value is attained the filter should be removed from the system and a new filter installed.

Routine monitoring of groundwater should also be completed to assess the remaining levels of contaminants.

As with the *in situ* groundwater remediation technologies, it is assumed that remediation standards would be established using a RA approach and groundwater treatment would be carried out primarily in the eastern portion of the site.

Prior to the use of a pump and treat system it will be necessary to complete a detailed hydrogeologic study to determine optimum pumping rates and to assess if additional wells are required. This study could cost on the order of $75,000 to $100,000. Capital costs could be on the order of $535,000, including design, contract supervision, start-up and initial sampling and analysis. Annual operating and maintenance costs would be on the order of $150,000.

6.2.6 Permeable Reactive Barrier (PRB)

A PRB is an in-situ remediation process where groundwater passes through a barrier that has been constructed below the water that chemically reduces the contaminants to their constituent parts. This technology can be effective in eliminating the contaminants without the requirements for pumping and treating the water ex-situ or injecting chemicals into the groundwater for in-situ treatment.

While this technology is feasible for the contaminants in the groundwater the costs could potentially be prohibitive. At the site it would be necessary to drill or excavate trenches into the bedrock to construct the PRB. Given that the bedrock is limestone it is not possible to excavate mechanically and therefore it would be necessary to drill and blast to break up the bedrock. As the site is within the City limits this might not be possible. The length of PRB can be reduced by using a funnel and gate approach where in a barrier would be grouted into the adjacent rock to direct the groundwater to the PRB. Further hydrogeological analyses would be required to determine the viability of this option. The cost for this feasibility study would be on the order of $75,000 to $100,000.

6.2.7 Risk Assessment

The completion of a RA, both the Full Scope RA and MGRA, of the groundwater would follow a similar process as that described for the soil. If the RA for the groundwater is completed at the same time as the RA for the soil little or no additional costs would be incurred. RA would likely have to be combined with a program of groundwater treatment and/or barriers. The RA would establish the groundwater PSS and the remediation methods carried out to meet these contaminant standards, where exceeded. At some locations subsurface remediation may not be required but a program of sub slab venting may be sufficient to control PHC/VOC contaminant vapours. The RMMs to be taken will need to be compatible with the redevelopment plans for the site.

7.0 ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

7.1 EVALUATION CRITERIA

The remedial alternatives described above are evaluated in the sections below using the following criteria:

- Viability – the more viable the option the higher the ranking
- Complexity – the more complex the option the lower the ranking
- Site Disturbance – the lower the disturbance to the property the higher the ranking
- Public Acceptance – the more likelihood of public acceptance the higher the ranking
- Risk to Human and Ecological Health – the greater the risk the lower the ranking
- Clean up time – the longer for clean-up the lower the ranking
- Overall Cost – the higher the cost the lower the ranking

7.2 COMPARATIVE ANALYSIS OF SOIL REMEDIAL ALTERNATIVES

A comparison of the technologies for remediation of the soil is provided on Table 7.1. It should be noted that No Action and Natural Attenuation are not included as they are considered not viable for the soil due to metals and that they are likely unacceptable to the MOE.

Preliminary estimates of costs for some options are provided on Table 7.1. It should be noted these costs are approximate only and may vary based on the conditions found in the field.

7.3 COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES

A comparison of the technologies for remediation of the groundwater is provided on Table 7.2. It should be noted that No Action and Natural Attenuation are not included as they are considered not viable for the groundwater as they are likely unacceptable to the MOE.

Preliminary estimates of costs for the various options are provided on Table 7.2. It should be noted these costs are approximate only and may vary significantly based on the conditions found in the field.

TABLE 7.1
POTENTIALLY VIABLE SOIL REMEDIATION OPTIONS
200 BEVERLEY STREET, GUELPH

Criteria/Considerations	REMEDIATION TECHNOLOGY									
	In Situ Solidification/Stablization		Soil Washing		Excavation and Disposal		Risk Assessment		Modified Generic Risk Assessment	
Limiting Factors (1 = Low 10 = high)	Requires pilot project; sufficient area to complete process		Requires pilot project; sufficient area to complete process		High water table/dewatering; Proximity of landfill for disposal; Underground structures and utilities can slow work		Requires critical hydrological, geological and geochemical factors; Extensive characterization; Source and NAPL removal required.		Requires critical hydrological, geological and geochemical factors; Extensive characterization; Source and NAPL removal required; Limited Options for Remedial Management Measures	
Viability	5	There are a large number of unknowns that have to be addressed before the process can be initiated	5	There are a large number of unknowns that have to be addressed before the process can be initiated	10	All contaminants in the soil will be removed	9	RA will address many concerns at the site	3	A MGRA will result in Remedial Measures and Site Restrictions being implemented
Complexity	6	There are a large number of unknowns that have to be addressed before the process can be initiated	6	There are a large number of unknowns that have to be addressed before the process can be initiated	9	Excavation is low complexity, however, detailed specification must be generated	4	An RA is complex and requires the approval of the MOE	6	A MGRA is less complex than an RA and requires the approval of the MOE
Site Disturbance	1	Large site disturbance	2	Large site disturbance	2	The entire site would be excavated resulting in disturbance to the site and will impact on neighbours due to high truck traffic	8	Site disturbance may result if Remedial Measures are required	8	Site disturbance may result if Remedial Measures are required
Public Acceptance	4	The process is not understood by the public	4	The process is not understood by the public	4	Although all contaminants would be removed the impact on neighbours due to high truck traffic would be high	4	As the process can be complex the public may not have a complete understanding of the process. Future owners must be willing to accept this process.	4	As the process can be complex the public may not have a complete understanding of the process. Future owners must be willing to accept this process.
Risk to human health and environment	6	All contaminants would be contained but there is possibility of dust being generated	7	All contaminants would be removed but there is possibility of dust being generated	8	All contaminants would be removed but there is possibility of dust being generated	7	Most contaminants may be left in place	7	Contaminants may be left in place
Timeframe for clean-up of site	5	The process can take over two years to complete	5	The process can take over two years to complete	6	The process could take over 1 year to complete	4	Process can take over 2 years to complete	6	Process can take over 1 year to complete
Overall costs	1	The costs could exceed excavation and disposal (i.e. >$12.8 million)	1	The costs could exceed excavation and disposal (i.e. >$12.8 million)	1	The costs could exceed $12,800,000	7	The RA costs can be up to $150,000 plus any required on site soil and/or groundwater treatment. The RA will substantially reduce other required remediation measures.	7	MGRA Costs can be up to $60,000 plus any required on site soil and/or groundwater treatment. The RA will substantially reduce other required remediation measures.
Total Score	28		30		40		43		41	

TABLE 7.2
POTENTIALLY VIABLE GROUNDWATER REMEDIATION OPTIONS
200 BEVERLEY STREET, GUELPH

Criteria/Consideration	REMEDIATION TECHNOLOGY									
	In-Situ Oxidation		*In-Situ* Anaerobic Reductive De-chlorination		Groundwater Extraction and Treatment		Risk Assessment		Modified Generic Risk Assessment	
Limiting Factors (1 = Low 10 = High)	Contaminant in fractured bedrock; Requires additional boreholes; VOC migration; Pilot study required		Contaminant in fractured bedrock; Requires additional boreholes; VOC migration; Pilot study required		Contaminant in fractured bedrock; VOC migration; Pilot study required		Potential contaminant migration; Requires critical hydrological, geological and geochemical factors; Extensive characterization; Source and NAPL removal required.		Requires critical hydrological, geological and geochemical factors; Extensive characterization; Source and NAPL removal required; Limited Options for Remedial Management Measures	
Viability	3	Fractured bedrock may result in incomplete remediation	3	Fractured bedrock may result in incomplete remediation	3	Fractured bedrock may result in incomplete remediation	10	RA will address or minimize concerns at the site, however, remedial measures will be required.	5	A MGRA will address or minimize concerns at the site, however Remedial Measures will be required
Complexity	3	Pilot study and more detailed hydrogeologic information required	3	Pilot study and more detailed hydrogeologic information required	3	Pilot study and more detailed hydrogeologic information required	4	An RA is complex and requires the approval of the MOE	6	A MGRA is less complex than an RA and requires the approval of the MOE
Site Disturbance	10	Limited disturbance to the site is required	10	Limited disturbance to the site is required	8	Equipment required on site	8	Site disturbance may result if Remedial Measures are required	8	Site disturbance may result if Remedial Measures are required
Public Acceptance	5	The process is not understood by the public	5	The process is not understood by the public	5	The process is not understood by the public	6	As the process can be complex the public may not have a complete understanding of the process. Future owners must be willing to accept this process.	6	As the process can be complex the public may not have a complete understanding of the process. Future owners must be willing to accept this process.
Risk to Human Health and Environment	4	Contaminants may be left in place	4	Contaminants may be left in place	4	Contaminants may be left in place	7	Contaminants may be left in place	7	Contaminants may be left in place
Timeframe for clean-up of site	3	Time frame can be up to two years	3	Time frame can be up to two years	3	Time frame can be up to two years	4	Process can take over 2 years to complete	6	Process can take over 2 years to complete
Overall Costs	3	East portion of site pilot study $75-100,000, initial program - $500,000, subsequent injection program costs - $200,000	3	East portion of site pilot study $75-100,000, initial program - $500,000, subsequent injection program costs - $200,000	3	East portion of site pilot study $75-100,000, initial program - $535,000, annual operation and maintenance costs - $150,000	5	The costs can be up to $150,000 plus any required soil and/or groundwater treatment. The RA will substantially reduce other required remediation measures.	3	Costs can be up to $60,000 plus any required soil and/or groundwater treatment. The RA will substantially reduce other required remediation measures.
Total Score	31		31		29		44		41	

8.0 CONCLUSIONS

8.1 SOILS

As described previously there are a number of options available for the remediation of the soil at the site. While all options could be considered potentially technically viable, the cost and complexity of each option should be considered in the selection of the preferred remedial measures.

The costs for solidification or soil washing of all the soils on the property are anticipated to equal or exceed the costs for soil excavation and off site disposal. These costs may be prohibitive for the City and the remedial technology may not be accepted by the MOE. Soil washing becomes difficult where there is a range of different contaminants present. Soil solidification may not be acceptable for future land use of the site. Therefore, these are not considered to be viable for remediation of the site.

Excavation and disposal of all impacted soils is estimated to cost on the order of $12,800,000. This cost is substantial; however, this is a proven technology and would likely be accepted by the MOE for remediation of the soils. The method would also be accepted by future land owners.

While the above technologies would remediate the soils on the property they would have limited effect on the impacted groundwater, therefore, additional remedial measures would be required.

The completion of a RA, either a Full Scope RA or the MGRA is considered to be viable for managing the soils at 200 Beverley Street. As described above, the MGRA process includes assumptions that may limit its use on the property and prevent its implementation. The RA program will likely require that some localized soil clean program be carried out.

The completion of a RA for the soils will result in the development of RMM. These may include the placement of a hard cap (asphalt, concrete, interlocking stone) clean soil covers or the installation of sub-slab volatile vapour venting where the contamination exceeds the PSS. Some soil excavation and off site disposal may be required. In addition, soil excavation to permit footing utility installation will result in the generation of excess soils that may require off site disposal at significant cost. A detailed soil management plan will need to be developed for the full site so that a cost effective program can be developed for addressing the contaminated soil on the site.

8.2 GROUNDWATER

The groundwater at the site is impacted with PHCs, PAHs ,VOCs and zinc. A review of the information provided on Drawing 701996-RAP-5.2 illustrates that the majority of the impacts are found at the east end of the site. Therefore, the remedial measures for the groundwater would be concentrated at this end of the site. It is anticipated that a RA will be first carried out and then treatment or RMMs will be developed where reported concentrations exceed the standards developed for the site.

Treatment of the groundwater, either *in situ* or *ex situ* is technically viable for the site, however, the time frame for these technologies can be excessive. Given the fractured nature of the bedrock and the extensive period of time the contaminants have been in place they may have migrated into numerous small fractures. Injection of either ORC or de-chlorination compounds may not come into contact with the contaminants for many years. During this time treatment of the groundwater would have to continue. Similar limitations will also be present for a pump and treat system.

At this time completion of a RA to reduce the groundwater remediation requirements on the site would be desirable. The RA, however, will not address off site groundwater CoCs.

A review of the information provided on Drawing 701996-RAP-5.2 indicates that the majority of the contaminants are present in the groundwater to the east of the line that extends north from the centreline of Kingsmill Avenue. Therefore, consideration should be given to severing or legally describing the property along this line. This would result in the site being divided into two lots that could have different future land uses, cleanup standards and remedial measures applied to each separate lot. If the property is severed it will be possible to produce one RA for the property with each parcel being assessed separately for the generation of PSS. As such, two sets of RMM and two RSCs could be filed for the site.

At this time there is sufficient information available from a geologic and hydrogeologic perspective to complete the RA. However, it should be noted that sufficient information may not be available to complete a RSC for either of the parcels. After generation of the PSS it would be determined if the measured analytical concentrations are less than the PSS. This will be particularly relevant at depth within the bedrock as the limits of contamination have not been determined in a number of monitoring wells. For the wells located at the east end of the property (i.e. to the east of Kingsmill Avenue) the limits of contamination have not been determined for a number of parameters. Therefore, if an RSC is to be obtained additional monitoring wells may have to be installed deeper in the bedrock.

While the RA and generation of PSS can be completed for the eastern portion of the property obtaining an RSC may be more problematic due to a number of factors.

If concentrations of contaminants are present in the groundwater greater than the PSS developed through the RA process it may be necessary to implement additional remedial options. These may include *in situ* or *ex situ* methods described above.

The presence of free product in monitoring well OW23S, located in the eastern portion, may complicate the generation of the RA and could prevent obtaining a RSC. This item will have to be addressed during the remediation process if an RSC is required.

From a review of the water level data and the information provided on the well details it appears the free product is located near the top of the screen. This could indicate the source is local and may only be within the groundwater in the vicinity of the monitoring well. Bailing of the well on a regular basis could determine if the volume of free product present on the groundwater was reducing. The use of a skimmer pump to remove the free product and transfer it to a storage tank for later disposal may be required.

A RA can only be carried out if the future land use is known and the types of structures and their construction understood. Depending on the proposed land use, some remediation of groundwater VOC impacts may be required for this site. The City, MOE and other stakeholders will need to resolve how off site groundwater impacts are to be further investigated and managed. Further discussion on this matter is required prior to finalizing the on site environmental remediation program.

If the RSC is required the RA will assume that remediation will be completed to remove the free product and VOCs. The elevated concentration for PHC found in the well will not be used in the risk calculation. At this time no information could be obtained on an investigation completed to assess the source or extent of impact. Based on information obtained during water level monitoring completed by AECOM free product has not been detected in any other monitoring well on the property. Therefore, its source is considered to be local. Work completed during the Phase One did not reveal the presence of a UST in the area, however, a geophysical survey could be completed to determine if one is present.

9.0 RECOMMENDATIONS

Based on the discussion above completion of a Full Scope RA for the site may be most viable option for the City. However, use of a RA would have to be acceptable to the future land owners and occupants of the property. The risk assessment calculations are anticipated to indicate that substantially higher contaminant levels can be permitted on site provided appropriate risk management measures, such as hard landscaping and clean soil barriers, are put in place. However, some additional localized soil and/or groundwater remediation will likely be required.

In addition to completion of the RA, it will be necessary to determine the source and extent of the free product found in monitoring well OW23S. If required a skimmer pump should be installed to remove the free product from the area for storage and subsequent off site disposal. . The sources of the VOCs impacting the groundwater the property will have to be determined. This should be completed based on discussions with the MOE. In addition, a geophysical survey could potentially be completed to determine if USTs are present on the site.

The cost to complete the RA is approximately $100,000 to $150,000 assuming no additional subsurface investigation work, including determining the source of the VOCs on the site, is requested by the MOE.

Further investigation of the potential off site source of the VOC groundwater impacts on the east side of the site is required. Ultimately, the City, the MOE and other stakeholders will need to agree on the requirements to manage off site groundwater impacts in the area of the site.

10.0 USE AND LIMITATIONS OF THIS REPORT

This report prepared for the City of Guelph does not provide certification or warranty, expressed or implied, that the investigation conducted by DCS uncovered all potential contaminants of environmental concern at the site. The work undertaken by DCS was directed to provide information on potential contamination that might have accrued from its historic use. Based on the results of the investigation, DCS found evidence of chemical parameters in concentrations exceeding the evaluation criteria selected for the site. The test data, chemical analyses and conclusions given in the reports, however, are the results of a sampling of the subsoils and groundwater encountered during the program, and based upon the total number of boreholes and monitoring wells performed, is considered to fairly represent the subsurface conditions within each area tested. It should be noted, however, that any assessment regarding the presence of contamination at the site is based on interpretation of conditions determined at specific locations and depths. This assessment cannot warrant that other pockets of contaminated soils are not located on the site. Chemical parameters were chosen based on potential contamination sources and, therefore, results are limited to those parameters tested.

Further, the reports were prepared by DCS for City of Guelph. The material in it reflects DCS' best judgement in light of the information available at the time of preparation, April 2014. Changes to soil and/or groundwater quality in the areas investigated can occur following the date of testing. Any use which a third party makes of the report, or reliance on, or decisions to be based on it, is the responsibility of such third parties.

11.0 CLOSURE

The data review for the Preliminary Remedial Action Plan was completed by Mr. Stephen Prior, P. Eng., QP_{ESA}. This report was prepared by Mr. Prior and reviewed by Mr. Richard W. Browne, M.A.Sc., P.Eng., QP_{ESA}, QP_{RA}.

Respectfully submitted,

DECOMMISSIONING CONSULTING SERVICES

Stephen R. Prior, P.Eng. QP_{ESA}	**Richard W. Browne, M.A.Sc., P.Eng. QP_{ESA}, QP_{RA}**
Senior Project Manager	Senior Vice President

12.0 REFERENCES

Ontario Regulation 153/04, made under Environmental Protection Act, (Records of Site Condition — Part XV.1 of the Act) Consolidation Period: From 31 Oct 2011a.

Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, 15 April 2011b, Ontario Ministry of the Environment.

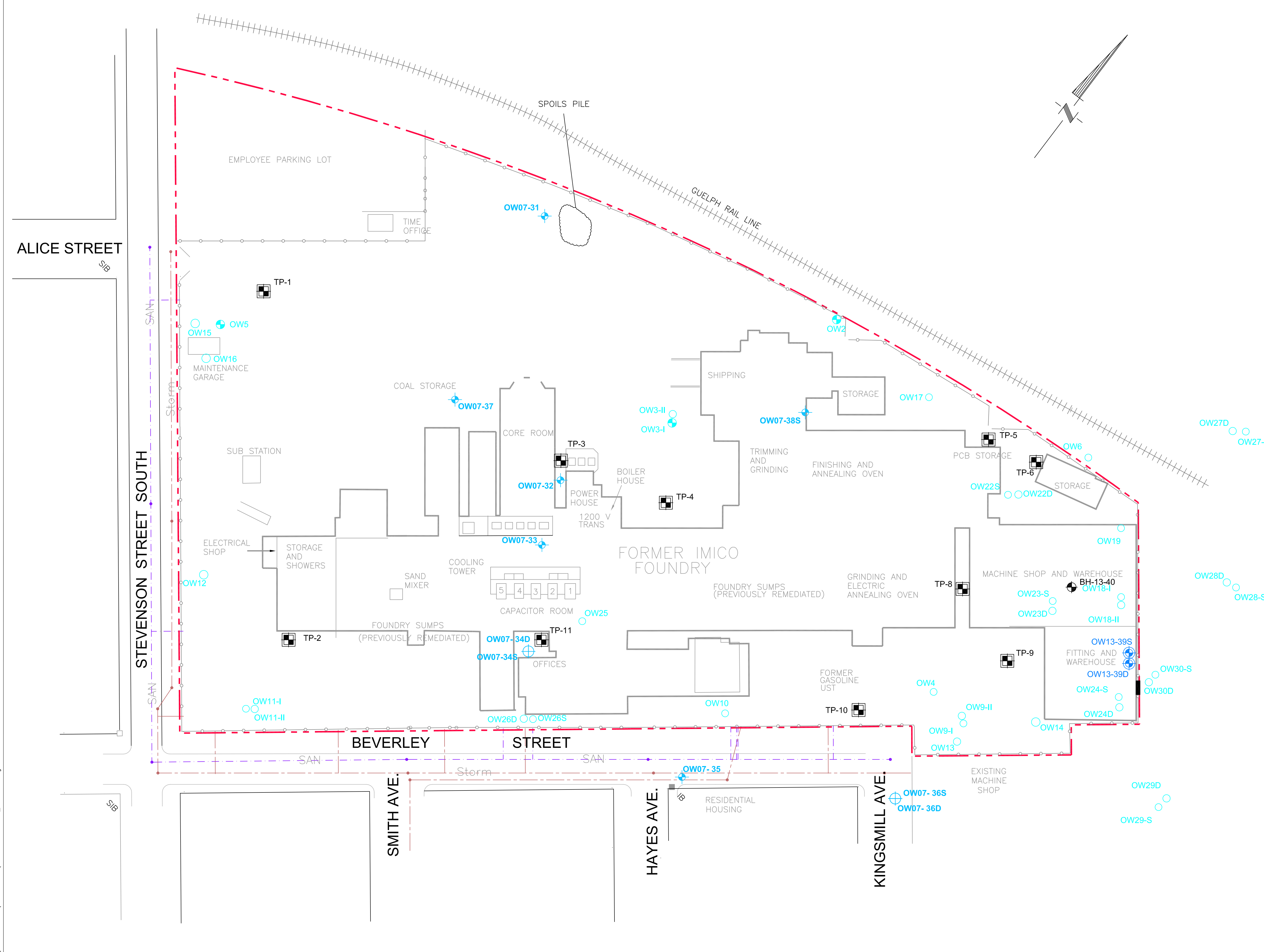
Protocol for Analytical Methods used in the Assessment of Properties Under Part XV.1 of the Environmental Protection Act, March 9, 2004 amended as of July 1, 2011c, Laboratory Services Branch, Ontario Ministry of the Environment.

Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario, April 15, Ontario Ministry of the Environment (MOE) 2011d, Prepared by Standards Development Branch Ontario Ministry of the Environment.

Phase One Environmental Assessment, 200 Beverley St., Guelph, Ontario, prepared for City of Guelph by Decommissioning Consulting Services, dated February 2014.

Phase II Environmental Site Assessment, 200 Beverley St., Guelph, Ontario, prepared for City of Guelph by Decommissioning Consulting Services Limited, dated 2007.

2011 Annual Groundwater Monitoring Report, Former IMICO Site, 200 Beverley Street, Guelph, Ontario, prepared for the City of Guelph by AECOM Canada Limited, dated August 2013.



LEGEND:

PROPERTY LINE

SAMPLING LOCATIONS - DCS

OW13-39 MONITORING WELL LOCATION (DCS 2013)

TP-1 TEST PIT LOCATION (DCS 2013)

BH-13-40 BOREHOLE LOCATION (DCS 2013)

OW07-31 SHALLOW MONITORING WELL IN ROCK (2007)

OW07- 36D DEEP MONITORING WELL IN ROCK (2007)

SAMPLING LOCATIONS - OTHERS

OW3-I MONITORING WELL (BY PROCTOR & REDFERN), 1990.

OW6 MONITORING WELL (BY GARTNER LEE), VARIOUS YEARS.

REFERENCE:

* ENVIRONMENTAL INVESTIGATION, INTERNATIONAL MALLEABLE IRON COMPANY, 200 BEVERLEY STREET, CITY OF GUELPH - BY PROCTOR AND REDFERN LIMITED, JUNE 1991.

* SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION, FORMER IMICO SITE - BY GARTNER LEE LIMITED, MARCH 1999.

* INTRUSIVE (TEST PIT) INVESTIGATION, FORMER IMICO FOUNDRY SITE - BY GARTNER LEE LIMITED, JULY 2000.

* INTERIM GROUNDWATER MONITORING REPORT, FORMER IMICO SITE, SUMMER 2006 GROUNDWATER MONITORING EVENTS - BY GARTNER LEE LIMITED, OCTOBER 2006.

*PHASE II ENVIRONMENTAL SITE ASSESSMENT, 200 BEVERLEY STREET, GUELPH, DCS. 2007

DCS AN ARCADIS COMPANY

DECOMMISSIONING CONSULTING SERVICES

CITY OF GUELPH

200 BEVERLEY STREET, CITY OF GUELPH

FORMER IMICO FACILITY

REMEDIAL ACTION PLAN

BOREHOLE AND MONITORING WELL LOCATIONS

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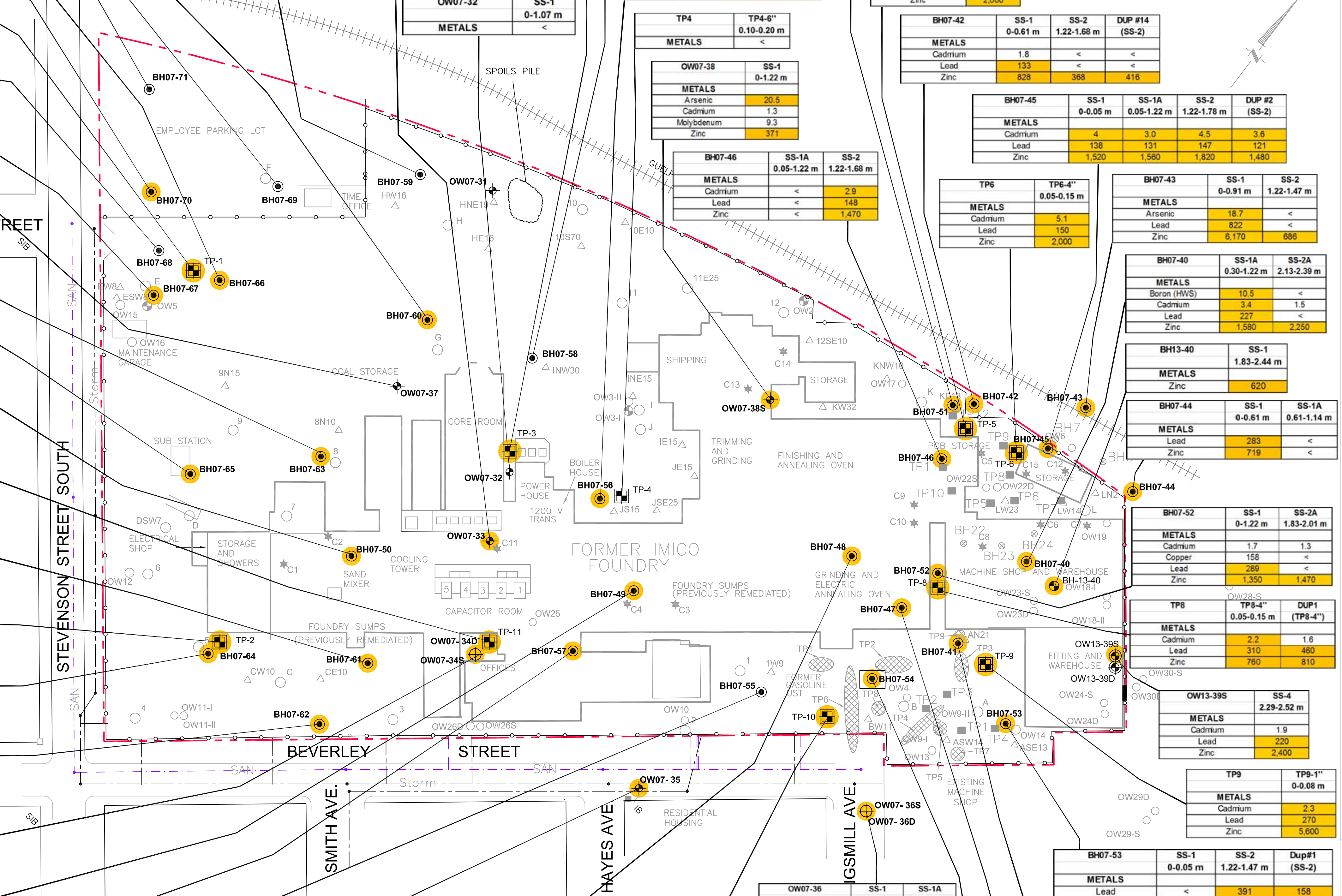

BH07-71	SS-1A 0.05-1.22 m	SS-2 1.22-1.32 m
METALS	<	<

BH07-69	SS-1A 0.08-1.22 m	SS-2 1.22-1.42 m
METALS	<	<

BH07-66	SS-1A 0.05-1.22 m	SS-2 1.22-1.32 m
METALS		
Zinc	<	349

BH07-70	SS-1A 0.05-1.22 m	SS-2 1.22-1.73 m
METALS		
Zinc	699	1,110

TP1	TP1-5" 0.08-0.18 m
METALS	
Zinc	360

BH07-68	SS-1 0-0.05 m	SS-1A 0.05-0.61 m
METALS	<	<

BH07-67	SS-1A 0.05-0.91 m	SS-2 1.22-1.37 m
METALS		
Arsenic	23	<
Cadmium	2.1	<
Lead	336	<
Zinc	379	538

OW07-37	SS-1 0-0.61 m	SS-1A 0.61-1.22 m
METALS	<	<

BH07-63	SS-1A 0.05-1.22 m	SS-2 1.22-1.88 m
METALS		
Zinc	<	354

BH07-65	SS-1A 0.05-0.61 m	SS-2 1.22-2.03 m
METALS		
Cadmium	1.4	<
Zinc	426	514

BH07-50	SS-1 0.05-1.07 m	SS-2 1.22-1.67 m
METALS		
Zinc	<	1,380

TP11	TP11-6" 0.10-0.20 m	DUP2 (TP11-6")
METALS		
Cadmium	1.9	3.8
Lead	230	470
Zinc	890	2,200

BH07-61	SS-1A 0.05-1.22 m	SS-2 1.22-1.88 m
METALS		
Cadmium	<	2.9
Lead	155	123
Zinc	771	782

TP2	TP2-4' 1.17-1.27 m
METALS	
Zinc	400

BH07-64	SS-1A 0.05-1.22 m	SS-2 1.22-2.29 m
METALS		
Zinc	<	563

BH07-62	SS-1A 0.05-0.61 m	SS-1B 0.61-1.22 m	Dup #6 (SS-1B)
METALS			
Cadmium	<	1.5	1.4
Lead	<	199	200
Zinc	<	479	527

OW07-34	SS-1 0-1.22 m
METALS	
Cadmium	1.3
Lead	274
Zinc	635

BH07-49	SS-1 0.15-0.30 m	SS-2 1.22-1.83 m
METALS		
Cadmium	<	1.5
Zinc	374	899

BH07-57	SS-1A 0.05-1.22 m	Dup #5 (SS-1A)	SS-2 1.22-1.88 m
METALS			
Cadmium	2	2.3	<
Lead	232	243	176
Zinc	679	805	628
Mercury	0.32	<	<

BH07-55	SS-1B 0.91-1.22 m
METALS	<

OW07-35	SS-1 0-1.22 m	SS-2 1.22-2.44 m
METALS		
Cadmium	<	1.6
Lead	<	160
Zinc	<	1,020

BH07-48	SS-1 0.10-1.22 m	SS-2 1.22-1.42 m
METALS		
Cadmium	1.5	<
Zinc	483	669

TP10	TP10-4' 1.17-1.27 m
METALS	
Cadmium	1.6
Lead	160
Zinc	940

BH07-54	SS-1A 0.05-0.61 m	SS-2 1.22-2.39 m
METALS		
Cadmium	1.3	2.3
Lead	150	<
Zinc	500	613

BH07-47	SS-1 0.15-1.22 m	SS-2 1.22-1.80 m
METALS		
Cadmium	1.4	<
Lead	146	<
Zinc	481	853

OW07-36	SS-1 0-0.61 m	SS-1A 0.61-1.22 m
METALS		
Cadmium	<	2
Lead	292	177
Zinc	<	908
EC (mS/cm)	3.02	0.706
SAR (meq/L)	24.3	7.04

BH07-41	SS-1 0-0.05 m	Dup #4 (SS-1)	SS-2 1.22-2.29 m
METALS			
Cadmium	<	<	1.4
Zinc	<	<	572

BH07-53	SS-1 0-0.05 m	SS-2 1.22-1.47 m	Dup#1 (SS-2)
METALS			
Lead	<	391	158

TP9	TP9-1" 0-0.08 m
METALS	
Cadmium	2.3
Lead	270
Zinc	5,600

OW13-39S	SS-4 2.29-2.52 m
METALS	
Cadmium	1.9
Lead	220
Zinc	2,400

TP8	TP8-4" 0.05-0.15 m	DUP1 (TP8-4")
METALS		
Cadmium	2.2	1.6
Lead	310	460
Zinc	760	810

BH07-52	SS-1 0-1.22 m	SS-2A 1.83-2.01 m
METALS		
Cadmium	1.7	1.3
Copper	158	<
Lead	289	<
Zinc	1,350	1,470

BH07-44	SS-1 0-0.61 m	SS-1A 0.61-1.14 m
METALS		
Lead	283	<
Zinc	719	<

BH13-40	SS-1 1.83-2.44 m
METALS	
Zinc	620

BH07-40	SS-1A 0.30-1.22 m	SS-2A 2.13-2.39 m
METALS		
Boron (HWS)	10.5	<
Cadmium	3.4	1.5
Lead	227	<
Zinc	1,580	2,250

BH07-43	SS-1 0-0.91 m	SS-2 1.22-1.47 m
METALS		
Arsenic	18.7	<
Lead	822	<
Zinc	6,170	686

BH07-45	SS-1 0-0.05 m	SS-1A 0.05-1.22 m	SS-2 1.22-1.78 m	DUP #2 (SS-2)
METALS				
Cadmium	4	3.0	4.5	3.6
Lead	138	131	147	121
Zinc	1,520	1,560	1,820	1,480

TP6	TP6-4" 0.05-0.15 m
METALS	
Cadmium	5.1
Lead	150
Zinc	2,000

BH07-42	SS-1 0-0.61 m	SS-2 1.22-1.68 m	DUP #14 (SS-2)
METALS			
Cadmium	1.8	<	<
Lead	133	<	<
Zinc	828	368	416

TP5	TP5-4' 1.17-1.27 m
METALS	
Cadmium	4.8
Lead	230
Zinc	2,000

BH07-51	SS-1 0-0.05 m	SS-2 1.22-2.06 m
METALS		
Cadmium	1.4	<
Lead	131	<
Molybdenum	9.9	<
Nickel	117	<
Zinc	1,220	536

BH07-56	SS-1A 0.05-0.91 m	SS-2 1.22-1.67 m
METALS		
Antimony	18.6	<
Cadmium	1.8	<
Copper	283	<
Lead	545	<
Zinc	472	664

TP4	TP4-6" 0.10-0.20 m
METALS	<

OW07-38	SS-1 0-1.22 m
METALS	
Arsenic	20.5
Cadmium	1.3
Molybdenum	9.3
Zinc	371

BH07-46	SS-1A 0.05-1.22 m	SS-2 1.22-1.68 m
METALS		
Cadmium	<	2.9
Lead	<	148
Zinc	<	1,470

BH07-58	SS-1A 0.05-0.61 m	SS-2 1.22-1.63 m
METALS	<	<

OW07-33	SS-1 0-1.22 m
METALS	
Zinc	720

TP3	TP3-6" 0.10-0.20 m
METALS	
Zinc	470

OW07-32	SS-1 0-1.07 m
METALS	<

BH07-60	SS-1 0-0.05 m	SS-1B 0.76-1.19 m
METALS		
Lead	<	132
Zinc	<	483

BH07-59	SS-1A 0.05-0.30 m	SS-1B 0.30-0.69 m
METALS	<	<

PARAMETERS	MOE RPI STANDARDS Cleanup Table 6	MOE ICC STANDARDS Cleanup Table 6
METALS		
Antimony	7.5	40
Arsenic	18	18
Boron (Hot Water Extractable)	1.5	2
Cadmium	1.2	1.9
Copper	140	230
Lead	120	120
Molybdenum	6.9	40
Nickel	100	270
Zinc	340	340
Mercury	0.27	3.9
Electrical Conductivity (mS/cm)	0.7	1.4
Sodium Adsorption Ratio (meq/L)	5	12

LEGEND:

PROPERTY LINE

SAMPLING LOCATIONS - DCS

- OW13-39 — MONITORING WELL LOCATION (DCS 2013)
- TP-1 — TEST PIT LOCATION (DCS 2013)
- BH-13-40 — BOREHOLE LOCATION (DCS 2013)
- OW07-31 — SHALLOW MONITORING WELL IN ROCK (2007)
- OW07-36D — DEEP MONITORING WELL IN ROCK (2007)
- BH07-39 — SHALLOW BOREHOLE (2007)

SAMPLING LOCATIONS - OTHERS

- L — TEST PIT LOCATION (BY PROCTOR & REDFERN),1990.
- 10S70 — TEST PIT LOCATION (ADDITIONAL BY PROCTOR & REDFERN),1990.
- C10 — COREHOLE LOCATON (BY PROCTOR & REDFERN),1990.
- OW3-I — MONITORING WELL (BY PROCTOR & REDFERN), 1990.
- OW6 — MONITORING WELL (BY GARTNER LEE), VARIOUS YEARS.
- TP9 — TEST PIT (BY GARTNER LEE), 2000.
- TP10 — TEST PIT (BY GARTNER LEE), 1999.
- BH7 — BOREHOLE LOCATION (BY GARTNER LEE), VARIOUS YEARS.

SAMPLE LOCATION — SAMPLE IDENTIFIER — DEPTH INTERVAL

BH07-49	SS-1 0.15-0.30 m	SS-2 1.22-1.83 m
METALS		
Cadmium	<	1.5
Zinc	374	899

EXCEEDS MOE RPI TABLE 6 STANDARD

EXCEEDS MOE ICC and RPI TABLE 6 STANDARD

MEETS MOE RPI and ICC TABLE 6 STANDARD

METAL EXCEEDANCES IN SOILS

ALL CONCENTRATIONS IN ug/g
SOIL DATA COMPARED TO 2011 MOE TABLE 6 STANDARDS

REFERENCE:

* ENVIRONMENTAL INVESTIGATION, INTERNATIONAL MALLEABLE IRON COMPANY, 200 BEVERLEY STREET, CITY OF GUELPH - BY PROCTOR AND REDFERN LIMITED, JUNE 1991.
* SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION, FORMER IMICO SITE - BY GARTNER LEE LIMITED, MARCH 1999.
* INTRUSIVE (TEST PIT) INVESTIGATION, FORMER IMICO FOUNDRY SITE - BY GARTNER LEE LIMITED, JULY 2000.
* INTERIM GROUNDWATER MONITORING REPORT, FORMER IMICO SITE, SUMMER 2006 GROUNDWATER MONITORING EVENTS - BY GARTNER LEE LIMITED, OCTOBER 2006.
* PHASE II ENVIRONMENTAL SITE ASSESSMENT, 200 BEVERLEY STREET, GUELPH, DCS. 2007

DCS AN ARCADIS COMPANY
DECOMMISSIONING CONSULTING SERVICES

CITY OF GUELPH
200 BEVERLEY STREET, CITY OF GUELPH

FORMER IMICO FACILITY
REMEDIAL ACTION PLAN
2007 & 2013 SOIL SAMPLING
METAL EXCEEDANCES

FEB. 2014	1:1500	701996-RAP-4.1

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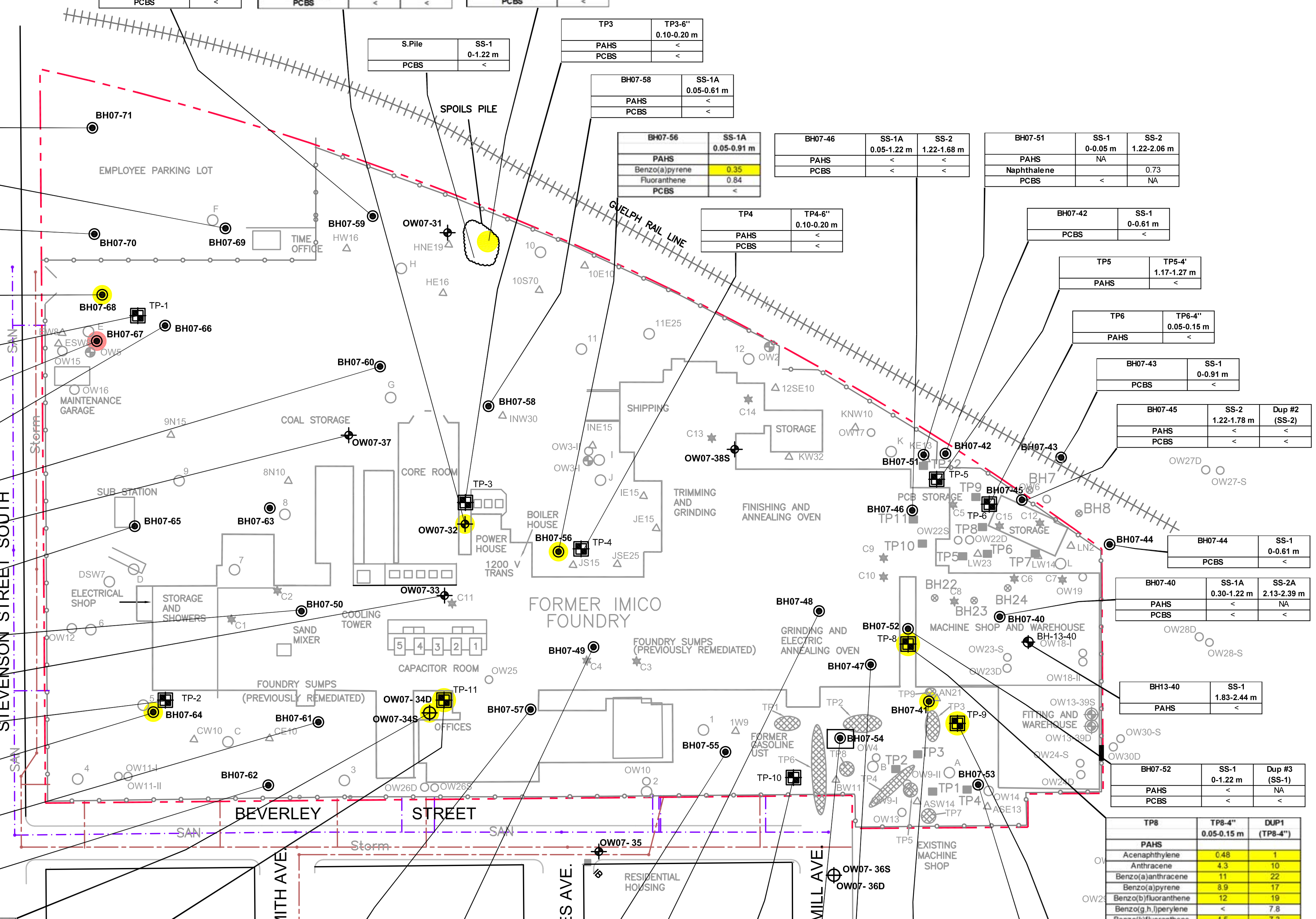
PARAMETERS	MOE RPI STANDARDS Cleanup Table 6	MOE ICC STANDARDS Cleanup Table 6
PAHS		
Acenaphthene	7.9	21
Acenaphthylene	0.15	0.15
Anthracene	0.67	0.67
Benzo(a)anthracene	0.5	0.96
Benzo(a)pyrene	0.3	0.3
Benzo(b)fluoranthene	0.78	0.96
Benzo(g,h,I)perylene	6.6	9.6
Benzo(k)fluoranthene	0.78	0.96
Chrysene	7	9.6
Dibenzo(a,h)anthracene	0.1	0.1
Fluoranthene	0.69	9.6
Fluorene	62	62
Indeno(1,2,3-cd)pyrene	0.38	0.76
Naphthalene	0.6	9.6
Phenanthrene	6.2	12
Pyrene	78	96
PCBS	0.35	1.1



BH07-71	SS-1A 0.05-1.22 m
PAHS	<

BH07-69	SS-1A 0.08-1.22 m
PAHS	<

BH07-70	SS-1A 0.05-1.22 m
PAHS	<
PCBS	<

BH07-68	SS-1 0-0.05 m	SS-1A 0.05-0.61 m
PAHS		<
Dibenzo(a,h)anthracene	0.31	
PCBS	<	<

TP1	TP1-5" 0.08-0.18 m
PAHS	<
PCBS	<

BH07-67	SS-1A 0.05-0.91 m	SS-2 1.22-1.37 m
PCBS	1.5	<

BH07-66	SS-1A 0.05-1.22 m	SS-2 1.22-1.32 m
PAHS	<	NA
PCBS	<	<

BH07-60	SS-1 0-0.05 m
PAHS	<

OW07-37	SS-1 0-0.61 m	SS-1A 0.61-1.22 m
PAHS	<	<

BH07-65	SS-1A 0.05-0.61 m	SS-2 1.22-2.03 m
PAHS	<	NA
PCBS	<	<

BH07-50	SS-1 0.05-1.07 m	SS-2 1.22-1.67 m
PCBS	<	<

OW07-33	SS-1 0-1.22 m
PCBS	<

TP2	TP2-4' 1.17-1.27 m
PAHS	<

BH07-64	SS-1A 0.05-1.22 m
PAHS	
Benzo(a)pyrene	0.44

BH07-61	SS-1A 0.05-1.22 m
PAHS	<
PCBS	<

BH07-62	SS-1B 0.61-1.22 m
PAHS	<
PCBS	<

OW07-34	SS-1 0-1.22 m	DUP #11 (SS-1)	SS-2 1.22-1.57 m
PAHS		NA	NA
Acenaphthene	94		
Anthracene	160		
Benzo(a)anthracene	200		
Benzo(a)pyrene	130		
Benzo(b)fluoranthene	190		
Benzo(g,h,I)perylene	70		
Benzo(k)fluoranthene	66		
Chrysene	180		
Dibenzo(a,h)anthracene	6		
Fluoranthene	660		
Fluorene	150		
Indeno(1,2,3-cd)pyrene	80		
Naphthalene	220		
Phenanthrene	900		
Pyrene	470		
PCBS	<	<	<

BH07-59	SS-1A 0.05-0.30 m
PAHS	<
PCBS	<

OW07-32	SS-1 0-1.07 m	SS-2 1.22-1.65 m
PAHS		NA
Benzo(a)anthracene	0.6	
Benzo(a)pyrene	0.54	
Dibenzo(a,h)anthracene	0.12	
Fluoranthene	0.78	
Indeno(1,2,3-cd)pyrene	0.46	
PCBS	<	<

S.Pile	SS-1 0-1.22 m
PCBS	<

N.Pile	SS-1 0-1.22 m
PAHS	
Benzo(a)pyrene	0.47
Fluoranthene	0.73
Indeno(1,2,3-cd)pyrene	0.44
PCBS	<

TP3	TP3-6" 0.10-0.20 m
PAHS	<
PCBS	<

BH07-58	SS-1A 0.05-0.61 m
PAHS	<
PCBS	<

BH07-56	SS-1A 0.05-0.91 m
PAHS	
Benzo(a)pyrene	0.35
Fluoranthene	0.84
PCBS	<

TP4	TP4-6" 0.10-0.20 m
PAHS	<
PCBS	<

BH07-46	SS-1A 0.05-1.22 m	SS-2 1.22-1.68 m
PAHS	<	<
PCBS	<	<

BH07-51	SS-1 0-0.05 m	SS-2 1.22-2.06 m
PAHS	NA	
Naphthalene		0.73
PCBS	<	NA

BH07-42	SS-1 0-0.61 m
PCBS	<

TP5	TP5-4' 1.17-1.27 m
PAHS	<

TP6	TP6-4" 0.05-0.15 m
PAHS	<

BH07-43	SS-1 0-0.91 m
PCBS	<

BH07-45	SS-2 1.22-1.78 m	Dup #2 (SS-2)
PAHS	<	<
PCBS	<	<

BH07-44	SS-1 0-0.61 m
PCBS	<

BH07-40	SS-1A 0.30-1.22 m	SS-2A 2.13-2.39 m
PAHS	<	NA
PCBS	<	<

BH13-40	SS-1 1.83-2.44 m
PAHS	<

BH07-52	SS-1 0-1.22 m	Dup #3 (SS-1)
PAHS	<	NA
PCBS	<	<

TP8	TP8-4" 0.05-0.15 m	DUP1 (TP8-4")
PAHS		
Acenaphthylene	0.48	1
Anthracene	4.3	10
Benzo(a)anthracene	11	22
Benzo(a)pyrene	8.9	17
Benzo(b)fluoranthene	12	19
Benzo(g,h,I)perylene	<	7.8
Benzo(k)fluoranthene	4.5	7.3
Chrysene	9.1	18
Dibenzo(a,h)anthracene	1.5	2.4
Fluoranthene	28	58
Indeno(1,2,3-cd)pyrene	5.9	8.8
Naphthalene	0.72	1.5
Phenanthrene	17	48
PCBS	0.4	<

TP9	TP9-1" 0-0.08 m
PAHS	
Benzo(a)anthracene	0.9
Benzo(a)pyrene	0.95
Benzo(b)fluoranthene	1.3
Dibenzo(a,h)anthracene	0.15
Fluoranthene	1.8
Indeno(1,2,3-cd)pyrene	0.68

TP11	TP11-6" 0.10-0.20 m	DUP2 (TP11-6")
PAHS		
Acenaphthylene	0.16	<
Anthracene	<	0.89
Benzo(a)anthracene	1.5	1.9
Benzo(a)pyrene	1	1.2
Benzo(b)fluoranthene	1.7	1.9
Dibenzo(a,h)anthracene	0.16	0.19
Fluoranthene	3.7	4.9
Indeno(1,2,3-cd)pyrene	0.53	0.58
2-Methylnaphthalene	1.1	<
Naphthalene	1.2	1.1

BH07-57	SS-1A 0.05-1.22 m
PAHS	<
PCBS	<

BH07-49	SS-2 1.22-1.83 m
PAHS	<
PCBS	<

BH07-55	SS-1B 0.91-1.22 m
PAHS	<

BH07-48	SS-1 0.10-1.22 m
PAHS	<
PCBS	<

TP10	TP10-4' 1.17-1.27 m
PAHS	<

BH07-54	SS-2 1.22-2.39 m
PAHS	<

BH07-47	SS-2 1.22-1.80 m
PAHS	<
PCBS	<

BH07-41	SS-1 0-0.05 m
PAHS	
Benzo(a)pyrene	0.53
Benzo(b)fluoranthene	0.9
Fluoranthene	1.6
Indeno(1,2,3-cd)pyrene	0.57
PCBS	<

BH07-53	SS-1 0-0.05 m	Dup #1 (SS-2)
PAHS	<	<

LEGEND:

PROPERTY LINE

SAMPLING LOCATIONS - DCS

- OW13-39 — MONITORING WELL LOCATION (DCS 2013)
- TP-1 — TEST PIT LOCATION (DCS 2013)
- BH-13-40 — BOREHOLE LOCATION (DCS 2013)
- OW07-31 — SHALLOW MONITORING WELL IN ROCK (2007)
- OW07-36D — DEEP MONITORING WELL IN ROCK (2007)
- BH07-39 — SHALLOW BOREHOLE (2007)

SAMPLING LOCATIONS - OTHERS

- L — TEST PIT LOCATION (BY PROCTOR & REDFERN),1990.
- 10S70 — TEST PIT LOCATION (ADDITIONAL BY PROCTOR & REDFERN),1990.
- C10 — COREHOLE LOCATON (BY PROCTOR & REDFERN),1990.
- OW3-I — MONITORING WELL (BY PROCTOR & REDFERN), 1990.
- OW6 — MONITORING WELL (BY GARTNER LEE), VARIOUS YEARS.
- TP9 — TEST PIT (BY GARTNER LEE), 2000.
- TP10 — TEST PIT (BY GARTNER LEE), 1999.
- BH7 — BOREHOLE LOCATION (BY GARTNER LEE), VARIOUS YEARS.

SAMPLE LOCATION — SAMPLE IDENTIFIER — DEPTH INTERVAL

BH07-56	SS-1A 0.05-0.91 m
PAHS	
Benzo(a)pyrene	0.35
Fluoranthene	0.84
PCBS	<

- EXCEEDS MOE RPI and ICC TABLE 6 STANDARD
- EXCEEDS MOE RPI TABLE 6 STANDARD
- MEETS MOE RPI and ICC TABLE 6 STANDARD

PAH EXCEEDANCES IN SOILS

PCB EXCEEDANCES IN SOIL

ALL CONCENTRATIONS IN ug/g
SOIL DATA COMPARED TO 2011 MOE TABLE 6 STANDARDS

REFERENCE:

* ENVIRONMENTAL INVESTIGATION, INTERNATIONAL MALLEABLE IRON COMPANY, 200 BEVERLEY STREET, CITY OF GUELPH - BY PROCTOR AND REDFERN LIMITED, JUNE 1991.

* SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION, FORMER IMICO SITE - BY GARTNER LEE LIMITED, MARCH 1999.

* INTRUSIVE (TEST PIT) INVESTIGATION, FORMER IMICO FOUNDRY SITE - BY GARTNER LEE LIMITED, JULY 2000.

* INTERIM GROUNDWATER MONITORING REPORT, FORMER IMICO SITE, SUMMER 2006 GROUNDWATER MONITORING EVENTS - BY GARTNER LEE LIMITED, OCTOBER 2006.

* PHASE II ENVIRONMENTAL SITE ASSESSMENT, 200 BEVERLEY STREET, GUELPH, DCS. 2007

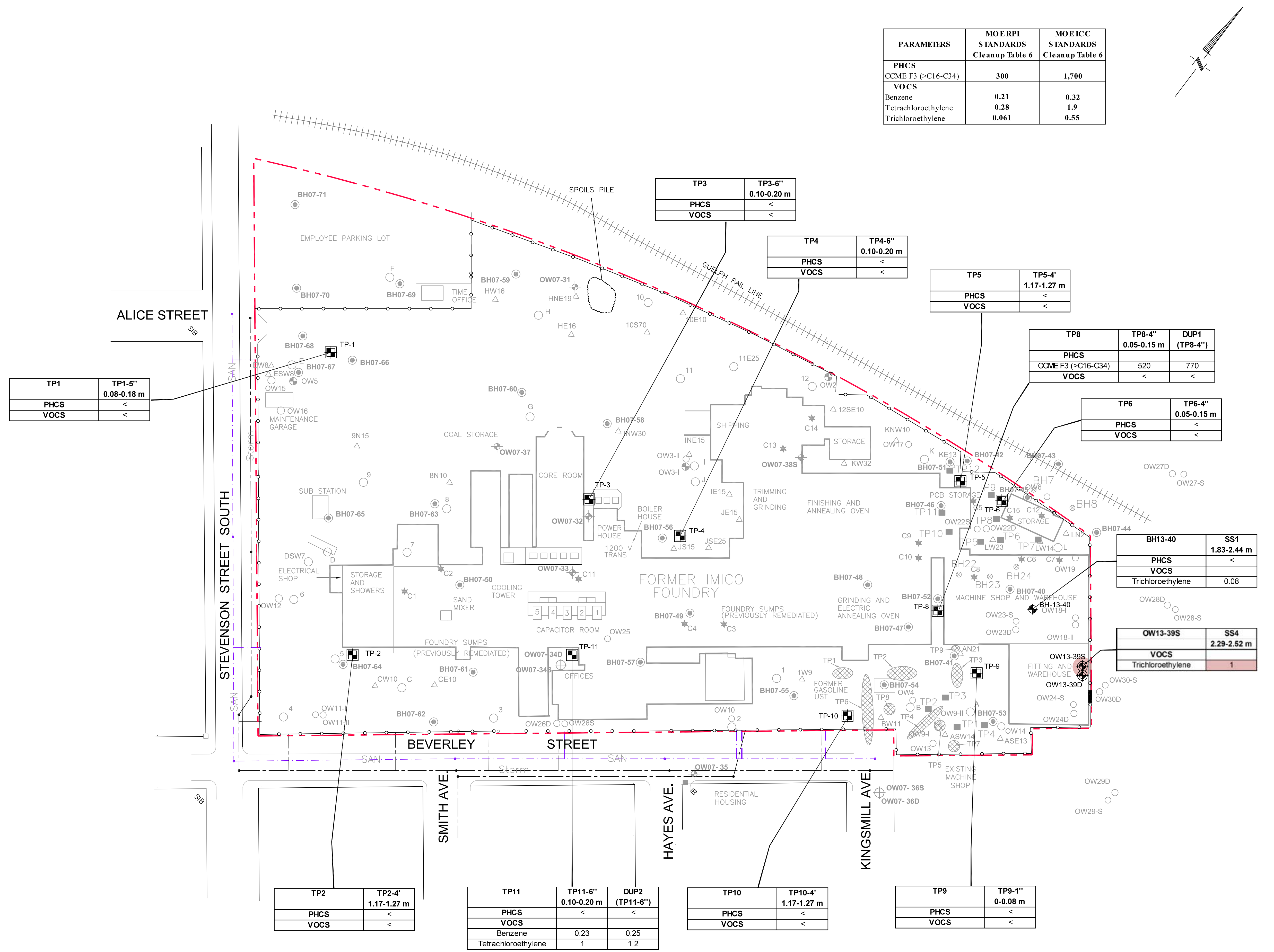
DCS AN ARCADIS COMPANY
DECOMMISSIONING CONSULTING SERVICES

CITY OF GUELPH
200 BEVERLEY STREET, CITY OF GUELPH

FORMER IMICO FACILITY
REMEDIAL ACTION PLAN
2007 & 2013 SOIL SAMPLING
PAH and PCB EXCEEDANCES

FEB. 2014	1:1500	701996-RAP-4.2

PARAMETERS	MOE RPI STANDARDS Cleanup Table 6	MOE ICC STANDARDS Cleanup Table 6
PHCS		
CCME F3 (>C16-C34)	300	1,700
VOCS		
Benzene	0.21	0.32
Tetrachloroethylene	0.28	1.9
Trichloroethylene	0.061	0.55



TP1	TP1-5" 0.08-0.18 m
PHCS	<
VOCS	<

TP3	TP3-6" 0.10-0.20 m
PHCS	<
VOCS	<

TP4	TP4-6" 0.10-0.20 m
PHCS	<
VOCS	<

TP5	TP5-4' 1.17-1.27 m
PHCS	<
VOCS	<

TP8	TP8-4" 0.05-0.15 m	DUP1 (TP8-4")
PHCS		
CCME F3 (>C16-C34)	520	770
VOCS	<	<

TP6	TP6-4" 0.05-0.15 m
PHCS	<
VOCS	<

BH13-40	SS1 1.83-2.44 m
PHCS	<
VOCS	
Trichloroethylene	0.08

OW13-39S	SS4 2.29-2.52 m
VOCS	
Trichloroethylene	1

TP2	TP2-4' 1.17-1.27 m
PHCS	<
VOCS	<

TP11	TP11-6" 0.10-0.20 m	DUP2 (TP11-6")
PHCS	<	<
VOCS		
Benzene	0.23	0.25
Tetrachloroethylene	1	1.2

TP10	TP10-4' 1.17-1.27 m
PHCS	<
VOCS	<

TP9	TP9-1" 0-0.08 m
PHCS	<
VOCS	<

LEGEND:

PROPERTY LINE

SAMPLING LOCATIONS - DCS

- OW13-39 — MONITORING WELL LOCATION (DCS 2013)
- TP-1 — TEST PIT LOCATION (DCS 2013)
- BH-13-40 — BOREHOLE LOCATION (DCS 2013)
- OW07-31 — SHALLOW MONITORING WELL IN ROCK (2007)
- OW07-36D — DEEP MONITORING WELL IN ROCK (2007)
- BH07-39 — SHALLOW BOREHOLE (2007)

SAMPLING LOCATIONS - OTHERS

- L — TEST PIT LOCATION (BY PROCTOR & REDFERN),1990.
- 10S70 — TEST PIT LOCATION (ADDITIONAL BY PROCTOR & REDFERN),1990.
- C10 — CORE HOLE LOCATON (BY PROCTOR & REDFERN),1990.
- OW3-I — MONITORING WELL (BY PROCTOR & REDFERN), 1990.
- OW6 — MONITORING WELL (BY GARTNER LEE), VARIOUS YEARS.
- TP9 — TEST PIT (BY GARTNER LEE), 2000.
- TP10 — TEST PIT (BY GARTNER LEE), 1999.
- BH7 — BOREHOLE LOCATION (BY GARTNER LEE), VARIOUS YEARS.

SAMPLE LOCATION / SAMPLE IDENTIFIER / DEPTH INTERVAL

OW13-39S	SS4 2.29-2.52 m
VOCS	
Trichloroethylene	1

EXCEEDS MOE RPI and ICC TABLE 6 STANDARD

TP11	TP11-6" 0.10-0.20 m	DUP2 (TP11-6")
PHCS	<	<
VOCS		
Benzene	0.23	0.25
Tetrachloroethylene	1	1.2

MEETS MOE RPI and ICC TABLE 6 STANDARD

EXCEEDS MOE RPI TABLE 6 STANDARD

VOC EXCEEDANCE IN SOILS

ALL CONCENTRATIONS IN ug/g
SOIL DATA COMPARED TO 2011 MOE TABLE 6 STANDARDS

REFERENCE:

* ENVIRONMENTAL INVESTIGATION, INTERNATIONAL MALLEABLE IRON COMPANY, 200 BEVERLEY STREET, CITY OF GUELPH - BY PROCTOR AND REDFERN LIMITED, JUNE 1991.

* SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION, FORMER IMICO SITE - BY GARTNER LEE LIMITED, MARCH 1999.

* INTRUSIVE (TEST PIT) INVESTIGATION, FORMER IMICO FOUNDRY SITE - BY GARTNER LEE LIMITED, JULY 2000.

* INTERIM GROUNDWATER MONITORING REPORT, FORMER IMICO SITE, SUMMER 2006 GROUNDWATER MONITORING EVENTS - BY GARTNER LEE LIMITED, OCTOBER 2006.

* PHASE II ENVIRONMENTAL SITE ASSESSMENT, 200 BEVERLEY STREET, GUELPH, DCS. 2007

DCS AN ARCADIS COMPANY
DECOMMISSIONING CONSULTING SERVICES

CITY OF GUELPH
200 BEVERLEY STREET, CITY OF GUELPH

FORMER IMICO FACILITY REMEDIAL ACTION PLAN

2013 SOIL SAMPLING
PHC and VOC EXCEEDANCES

FEB. 2014	1:1500	701996-RAP-4.3

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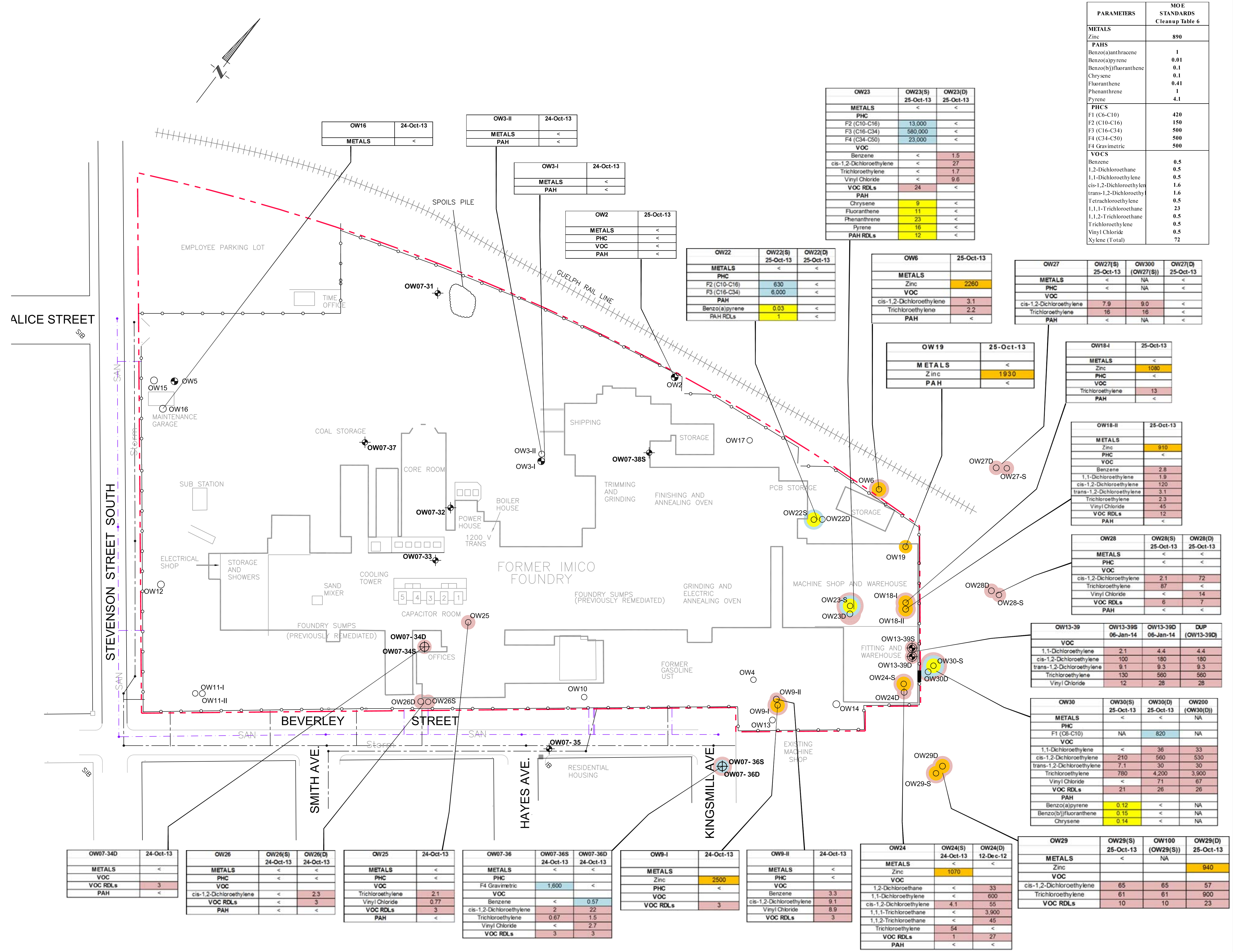

PARAMETERS	MOE STANDARDS Cleanup Table 6
METALS	
Zinc	890
PAHS	
Benzo(a)anthracene	1
Benzo(a)pyrene	0.01
Benzo(b/j)fluoranthene	0.1
Chrysene	0.1
Fluoranthene	0.41
Phenanthrene	1
Pyrene	4.1
PHCS	
F1 (C6-C10)	420
F2 (C10-C16)	150
F3 (C16-C34)	500
F4 (C34-C50)	500
F4 Gravimetric	500
VOCS	
Benzene	0.5
1,2-Dichloroethane	0.5
1,1-Dichloroethylene	0.5
cis-1,2-Dichloroethylen	1.6
trans-1,2-Dichloroethyl	1.6
Tetrachloroethylene	0.5
1,1,1-Trichloroethane	23
1,1,2-Trichloroethane	0.5
Trichloroethylene	0.5
Vinyl Chloride	0.5
Xylene (Total)	72

OW16	24-Oct-13
METALS	<

OW3-II	24-Oct-13
METALS	<
PAH	<

OW3-I	24-Oct-13
METALS	<
PAH	<

OW2	25-Oct-13
METALS	<
PHC	<
VOC	<
PAH	<

OW22	OW22(S) 25-Oct-13	OW22(D) 25-Oct-13
METALS	<	<
PHC		
F2 (C10-C16)	630	<
F3 (C16-C34)	6,000	<
PAH		
Benzo(a)pyrene	0.03	<
PAH RDLs	1	<

OW23	OW23(S) 25-Oct-13	OW23(D) 25-Oct-13
METALS	<	<
PHC		
F2 (C10-C16)	13,000	<
F3 (C16-C34)	580,000	<
F4 (C34-C50)	23,000	<
VOC		
Benzene	<	1.5
cis-1,2-Dichloroethylene	<	27
Trichloroethylene	<	1.7
Vinyl Chloride	<	9.6
VOC RDLs	24	<
PAH		
Chrysene	9	<
Fluoranthene	11	<
Phenanthrene	23	<
Pyrene	16	<
PAH RDLs	12	<

OW6	25-Oct-13
METALS	
Zinc	2260
VOC	
cis-1,2-Dichloroethylene	3.1
Trichloroethylene	2.2
PAH	<

OW27	OW27(S) 25-Oct-13	OW300 (OW27(S))	OW27(D) 25-Oct-13
METALS	<	NA	<
PHC	<	NA	<
VOC			
cis-1,2-Dichloroethylene	7.9	9.0	<
Trichloroethylene	16	16	<
PAH	<	NA	<

OW19	25-Oct-13
METALS	<
Zinc	1930
PAH	<

OW18-I	25-Oct-13
METALS	<
Zinc	1080
PHC	<
VOC	
Trichloroethylene	13
PAH	<

OW18-II	25-Oct-13
METALS	
Zinc	910
PHC	<
VOC	
Benzene	2.8
1,1-Dichloroethylene	1.9
cis-1,2-Dichloroethylene	120
trans-1,2-Dichloroethylene	3.1
Trichloroethylene	2.3
Vinyl Chloride	45
VOC RDLs	12
PAH	<

OW28	OW28(S) 25-Oct-13	OW28(D) 25-Oct-13
METALS	<	<
PHC	<	<
VOC		
cis-1,2-Dichloroethylene	2.1	72
Trichloroethylene	87	<
Vinyl Chloride	<	14
VOC RDLs	6	7
PAH	<	<

OW13-39	OW13-39S 06-Jan-14	OW13-39D 06-Jan-14	DUP (OW13-39D)
VOC			
1,1-Dichloroethylene	2.1	4.4	4.4
cis-1,2-Dichloroethylene	100	180	180
trans-1,2-Dichloroethylene	9.1	9.3	9.3
Trichloroethylene	130	560	560
Vinyl Chloride	12	28	28

OW30	OW30(S) 25-Oct-13	OW30(D) 25-Oct-13	OW200 (OW30(D))
METALS	<	<	NA
PHC			
F1 (C6-C10)	NA	820	NA
VOC			
1,1-Dichloroethylene	<	36	33
cis-1,2-Dichloroethylene	210	560	530
trans-1,2-Dichloroethylene	7.1	30	30
Trichloroethylene	780	4,200	3,900
Vinyl Chloride	<	71	67
VOC RDLs	21	26	26
PAH			
Benzo(a)pyrene	0.12	<	NA
Benzo(b/j)fluoranthene	0.15	<	NA
Chrysene	0.14	<	NA

OW29	OW29(S) 25-Oct-13	OW100 (OW29(S))	OW29(D) 25-Oct-13
METALS	<	NA	
Zinc			940
VOC			
cis-1,2-Dichloroethylene	65	65	57
Trichloroethylene	61	61	900
VOC RDLs	10	10	23

OW07-34D	24-Oct-13
METALS	<
VOC	
VOC RDLs	3
PAH	<

OW26	OW26(S) 24-Oct-13	OW26(D) 24-Oct-13
METALS	<	<
PHC	<	<
VOC		
cis-1,2-Dichloroethylene	<	2.3
VOC RDLs	<	3
PAH	<	<

OW25	24-Oct-13
METALS	<
PHC	<
VOC	
Trichloroethylene	2.1
Vinyl Chloride	0.77
VOC RDLs	3
PAH	<

OW07-36	OW07-36S 24-Oct-13	OW07-36D 24-Oct-13
METALS	<	<
PHC		
F4 Gravimetric	1,600	<
VOC		
Benzene	<	0.57
cis-1,2-Dichloroethylene	2	22
Trichloroethylene	0.67	1.5
Vinyl Chloride	<	2.7
VOC RDLs	3	3

OW9-I	24-Oct-13
METALS	
Zinc	2500
PHC	<
VOC	
VOC RDLs	3

OW9-II	24-Oct-13
METALS	<
PHC	<
VOC	
Benzene	3.3
cis-1,2-Dichloroethylene	9.1
Vinyl Chloride	8.9
VOC RDLs	3

OW24	OW24(S) 24-Oct-13	OW24(D) 12-Dec-12
METALS	<	<
Zinc	1070	
VOC		
1,2-Dichloroethane	<	33
1,1-Dichloroethylene	<	600
cis-1,2-Dichloroethylene	4.1	55
1,1,1-Trichloroethane	<	3,900
1,1,2-Trichloroethane	<	45
Trichloroethylene	54	<
VOC RDLs	1	27
PAH	<	<

LEGEND:

PROPERTY LINE

MONITORING WELL LOCATIONS - DCS

- OW13-39 — MONITORING WELL LOCATION (DCS 2013)
- OW07-31 — SHALLOW MONITORING WELL IN ROCK (2007)
- OW07-36D — DEEP MONITORING WELL IN ROCK (2007)

MONITORING WELL LOCATIONS - OTHERS

- OW3-I — MONITORING WELL (BY PROCTOR & REDFERN), 1990.
- OW6 — MONITORING WELL (BY GARTNER LEE), VARIOUS YEARS.

SAMPLE LOCATION

SAMPLE DATE

OW18-II	25-Oct-13
METALS	
Zinc	910
PHC	<
VOC	
Benzene	2.8
1,1-Dichloroethylene	1.9
cis-1,2-Dichloroethylene	120
trans-1,2-Dichloroethylene	3.1
Trichloroethylene	2.3
Vinyl Chloride	45
VOC RDLs	12
PAH	<

EXCEEDS MOE TABLE 6 STANDARD

NUMBER OF PARAMETERS WITH DETECTION LIMITS IN EXCESS OF THE TABLE 6 STANDARDS

MEETS MOE TABLE 6 STANDARD

PAH EXCEEDANCES IN GROUNDWATER

PHC EXCEEDANCES IN GROUNDWATER

VOC EXCEEDANCES IN GROUNDWATER

METAL EXCEEDANCES IN GROUNDWATER

NOTES:

1. ALL CONCENTRATIONS IN ug/L
2. MOST RECENT RESULTS SHOWN FOR EACH WELL.
3. VOC RDL: INDICATES NUMBER OF PARAMETERS WITH DETECTION LIMITS IN EXCESS OF THE TABLE 6 STANDARDS
4. GROUNDWATER DATA COMPARED TO 2011 MOE TABLE 6 STANDARDS

REFERENCE:

* ENVIRONMENTAL INVESTIGATION, INTERNATIONAL MALLEABLE IRON COMPANY, 200 BEVERLEY STREET, CITY OF GUELPH - BY PROCTOR AND REDFERN LIMITED, JUNE 1991.

* SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION, FORMER IMICO SITE - BY GARTNER LEE LIMITED, MARCH 1999.

* INTRUSIVE (TEST PIT) INVESTIGATION, FORMER IMICO FOUNDRY SITE - BY GARTNER LEE LIMITED, JULY 2000.

* INTERIM GROUNDWATER MONITORING REPORT, FORMER IMICO SITE, SUMMER 2006 GROUNDWATER MONITORING EVENTS - BY GARTNER LEE LIMITED, OCTOBER 2006.

* PHASE II ENVIRONMENTAL SITE ASSESSMENT, 200 BEVERLEY STREET, GUELPH, DCS. 2007

DCS AN ARCADIS COMPANY

DECOMMISSIONING CONSULTING SERVICES

CITY OF GUELPH

200 BEVERLEY STREET, CITY OF GUELPH

FORMER IMICO FACILITY REMEDIAL ACTION PLAN

2012 & 2013 GROUNDWATER SAMPLING AND EXCEEDANCES

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LEGEND:

- EXTENT OF METALS
- EXTENT OF PAH IMPACTS
- EXTENT OF PCB IMPACTS
- EXTENT OF VOC IMPACTS
- EXTENT OF PHC IMPACTS
- PROPOSED LINE SEVERING PROPERTY
- EXISTING PROPERTY LINE

SAMPLING LOCATIONS - DCS

- OW13-39 — MONITORING WELL LOCATION (DCS 2013)
- TP-1 — TEST PIT LOCATION (DCS 2013)
- BH-13-40 — BOREHOLE LOCATION (DCS 2013)
- OW07-31 — SHALLOW MONITORING WELL IN ROCK (2007)
- OW07- 36D — DEEP MONITORING WELL IN ROCK (2007)
- BH07-39 — SHALLOW BOREHOLE (2007)

SAMPLING LOCATIONS - OTHERS

- L — TEST PIT LOCATION (BY PROCTOR & REDFERN),1990.
- 10S70 — TEST PIT LOCATION (ADDITIONAL BY PROCTOR & REDFERN),1990.
- C10 — COREHOLE LOCATON (BY PROCTOR & REDFERN),1990.
- OW3-I — MONITORING WELL (BY PROCTOR & REDFERN), 1990.
- OW6 — MONITORING WELL (BY GARTNER LEE), VARIOUS YEARS.
- TP9 — TEST PIT (BY GARTNER LEE), 2000.
- TP10 — TEST PIT (BY GARTNER LEE), 1999.
- BH7 — BOREHOLE LOCATION (BY GARTNER LEE), VARIOUS YEARS.

REFERENCE:

* ENVIRONMENTAL INVESTIGATION, INTERNATIONAL MALLEABLE IRON COMPANY, 200 BEVERLEY STREET, CITY OF GUELPH - BY PROCTOR AND REDFERN LIMITED, JUNE 1991.

* SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION, FORMER IMICO SITE - BY GARTNER LEE LIMITED, MARCH 1999.

* INTRUSIVE (TEST PIT) INVESTIGATION, FORMER IMICO FOUNDRY SITE - BY GARTNER LEE LIMITED, JULY 2000.

* INTERIM GROUNDWATER MONITORING REPORT, FORMER IMICO SITE, SUMMER 2006 GROUNDWATER MONITORING EVENTS - BY GARTNER LEE LIMITED, OCTOBER 2006.

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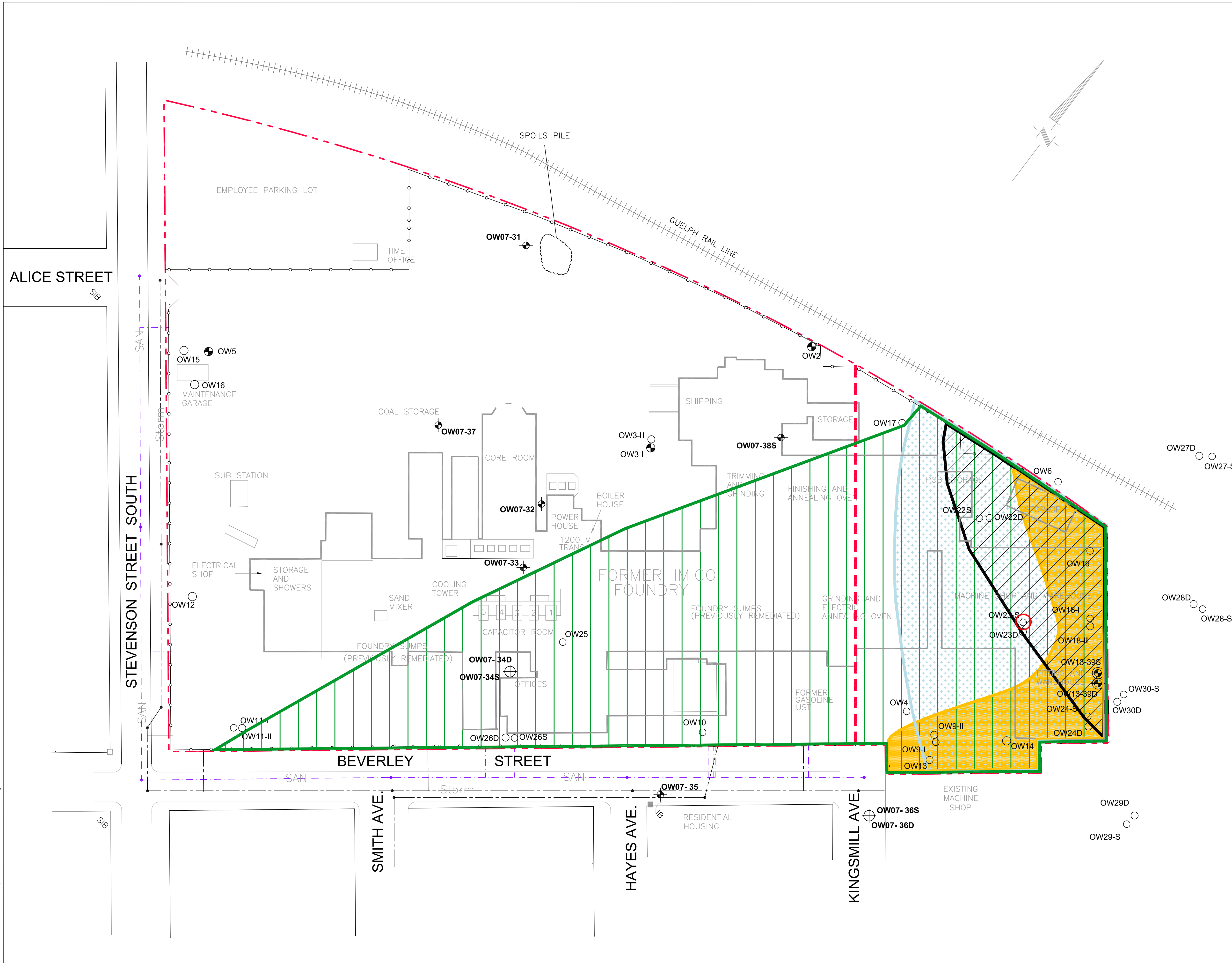
CITY OF GUELPH
200 BEVERLEY STREET, CITY OF GUELPH

FORMER IMICO FACILITY
REMEDIAL ACTION PLAN

EXTENT OF CONTAMINATION IN SOIL 2007 & 2013

FEB. 2014	1:1250	701996-RAP-5.1



LEGEND:

- EXTENT OF VOCs CONTAMINATION
- EXTENT OF PHCs CONTAMINATION
- EXTENT OF PAHs CONTAMINATION
- EXTENT OF METALS CONTAMINATION
- FREE PRODUCT ON GROUNDWATER SURFACE
- PROPOSED LINE SEVERING PROPERTY
- EXISTING PROPERTY LINE

SAMPLING LOCATIONS - DCS

- OW13-39 — MONITORING WELL LOCATION (DCS 2013)
- OW07-31 — SHALLOW MONITORING WELL IN ROCK (2007)
- OW07- 36D — DEEP MONITORING WELL IN ROCK (2007)

SAMPLING LOCATIONS - OTHERS

- OW3-I — MONITORING WELL (BY PROCTOR & REDFERN), 1990.
- OW6 — MONITORING WELL (BY GARTNER LEE), VARIOUS YEARS.

REFERENCE:

* ENVIRONMENTAL INVESTIGATION, INTERNATIONAL MALLEABLE IRON COMPANY, 200 BEVERLEY STREET, CITY OF GUELPH - BY PROCTOR AND REDFERN LIMITED, JUNE 1991.

* SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION, FORMER IMICO SITE - BY GARTNER LEE LIMITED, MARCH 1999.

* INTRUSIVE (TEST PIT) INVESTIGATION, FORMER IMICO FOUNDRY SITE - BY GARTNER LEE LIMITED, JULY 2000.

* INTERIM GROUNDWATER MONITORING REPORT, FORMER IMICO SITE, SUMMER 2006 GROUNDWATER MONITORING EVENTS - BY GARTNER LEE LIMITED, OCTOBER 2006.

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DECOMMISSIONING CONSULTING SERVICES

CITY OF GUELPH
200 BEVERLEY STREET, CITY OF GUELPH

FORMER IMICO FACILITY
REMEDIAL ACTION PLAN
EXTENT OF CONTAMINATION IN GROUNDWATER 2012 & 2013

FEB. 2014	1:1250	701996-RAP-5.2

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