SCIENCE INTEGRITY KNOWLEDGE

DUE DILIGENCE RISK ASSESSMENT OF 10, 29 AND 35 CANAL DRIVE, SAULT STE. MARIE, ONTARIO

December 21, 2023

Prepared For:

SIS Group
Attention: Mr. Tony Poro
1231 Peoples Road
Sault Ste. Marie, ON
P6C 3W7

Greenstone Environmental Engineering Ltd.
67 Elgin Street
Sault Ste. Marie, ON
P6A 2Y4

6605 Hurontario Street, Suite 500, Mississauga, Ontario ▪ L5T 0A3
Tel: 905-364-7800 ▪ Fax: 905-364-7816 ▪ www.intrinsik.com

DISCLAIMER

Intrinsik Corp. (Intrinsik) provided this report for SIS Group and Greenstone Environmental Engineering Ltd. (Greenstone). Intrinsik does not accept any responsibility for the use of this report for any purpose other than as specifically intended by SIS Group and Greenstone. Intrinsik does not have, and does not accept, any responsibility or duty of care whether based in negligence or otherwise, in relation to the use of this report in whole or in part by any third party. Any alternate use, including that by a third party, or any reliance on or decision made based on this report, are the sole responsibility of the alternative user or third party. Intrinsik does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Intrinsik makes no representation, warranty or condition with respect to this report or the information contained herein other than that it has exercised reasonable skill, care and diligence in accordance with accepted practice and usual standards of thoroughness and competence for the profession of toxicology and environmental assessment to assess and evaluate information acquired during the preparation of this report. Any information or facts provided by others, and referred to or utilized in the preparation of this report, is believed to be accurate without any independent verification or confirmation by Intrinsik. This report is based upon and limited by circumstances and conditions stated herein, and upon information available at the time of the preparation of the report.

Intrinsik has reserved all rights in this report, unless specifically agreed to otherwise in writing with SIS Group and Greenstone.

DUE DILIGENCE RISK ASSESSMENT OF 10, 29 AND 35 CANAL DRIVE, SAULT STE. MARIE, ONTARIO

Table of Contents

List of Tables

List of Figures

Appendices

LIST OF ABBREVIATIONS AND ACRONYMS

APEC	Areas of Potential Environmental Concern
BH	Borehole
COC	Contaminant of Concern
DL	Detection Limit
EBC	Effects-Based Concentration
EC	Electrical Conductivity
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ESA	Environmental Site Assessment
GW	Groundwater
GW2	Groundwater Component Value Protective of Indoor Air
GW3	Groundwater Component Value Protective of Aquatic Life
HASP	Health and Safety Plan
HC	Health Canada
HHRA	Human Health Risk Assessment
HWS	Hot water soluble
IAC	Indoor Air Criteria
IUR	Inhalation Unit Risk
KM	Kilometre
MBGS	Metres below ground surface
MECP	Ministry of Conservation and Parks
MGRA	Modified Generic Risk Assessment
MNRF	Ministry of Natural Resources and Forestry
MOECC	Ministry of the Environment and Climate Change
MW	Monitoring Well
NA	Not Applicable
ND	Non-Detect
NHIC	Natural Heritage Information Centre
NV	No Value
OHSA	Ontario Occupational Health and Safety Act
O.Reg. 153/04	Ontario Regulation 153/04
PAH	Polycyclic Aromatic Hydrocarbon
PCA	Potentially Contaminating Activity
PHC	Petroleum Hydrocarbon
PPE	Personal Protective Equipment
RA	Risk Assessment
RMM	Risk Management Measure
RMP	Risk Management Plan
RSL	Regional Screening Level
SAR	Sodium Adsorption Ratio
SCS	Site Condition Standard
S-IA	Soil-to-indoor air
S-OA	Soil-to-outdoor air
S-GW3	Soil-to-Groundwater Component Value Protective of Aquatic Life
TRV	Toxicological Reference Value
95% UCLM	Upper 95% Confidence Interval on the Arithmetic Mean
U.S. EPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VEC	Valued Ecosystem Component
VOC	Volatile Organic Compound

DUE DILIGENCE RISK ASSESSMENT OF 10, 29 AND 35 CANAL DRIVE, SAULT STE. MARIE, ONTARIO

1.0 INTRODUCTION

Intrinsik Corp. (Intrinsik) has been retained by Greenstone Environmental Engineering Ltd. (Greenstone) on behalf of SIS Group to assess potential risks to human health and ecological receptors associated with contaminants identified in on-site soil and groundwater at the property consisting of 10, 29 and 35 Canal Drive, Sault Ste. Marie, Ontario (hereafter referred to as the 'Site'). The Site is occupied by a vacant slab-on-grade commercial/industrial building and associated parking and landscaped areas. Greenstone conducted a Phase Two Environmental Site Assessment (ESA) which identified various metals and inorganics, polycyclic aromatic hydrocarbons (PAHs), and petroleum hydrocarbons (PHCs) in on-site soil, and volatile organic compounds (VOCs) and PAHs in on-site groundwater, at concentrations in excess of the applicable Ministry of the Environment, Conservation, and Parks (MECP) (formerly the Ministry of the Environment and Climate Change (MOECC)) Site Condition Standards (SCS).

To evaluate potential risks to human health and ecological receptors, a due diligence risk assessment (DDRA) was conducted which involved a comparison of concentrations of chemicals in soil and groundwater to the SCS and the associated component values derived to be protective of human health and the environment. The results of these comparisons were used to determine if risk management measures (RMMs) may be required to mitigate any potential unacceptable risks. It is Intrinsik's understanding that the Site will continue to be used for commercial purposes. Therefore, the current assessment was conducted to address potential risks under a commercial land use scenario.

This assessment was conducted using scientific approaches that are consistent with Ontario Regulation 153/04 (O. Reg. 153/04), as amended, and in accordance with accepted practices and usual standards of thoroughness and competence for the profession of toxicology and environmental risk assessment. The assessment was prepared for internal due diligence purposes and was not prepared for submission to the MECP to support the filing of a Record of Site Condition (RSC) under O. Reg. 153/04. The conclusions and recommendations provided within this report are based exclusively on the information provided within the Phase One and Two ESAs conducted by Greenstone (2023a,b).

2.0 SITE DESCRIPTION AND HISTORY

The Site is an irregularly shaped parcel of land with an area of approximately 2.2 hectares. The Site is currently owned and occupied by the City of Sault Ste., Marie and consists of a slab-on-grade commercial/industrial building formerly operating as The Mill Market (Greenstone, 2023a,b). The remainder of the Site consists of gravel-covered parking lots and grassed landscaped areas. It is Intrinsik's understanding that the Site will continue to be used for commercial purposes and may include an addition to the existing building which will also be slab-on-grade.

The Site is surrounded by community, commercial, and industrial land use as follows:

- North – A railway line followed by Bay Street with commercial buildings and a large parking lot beyond.
- East – Vacant commercial/industrial land (formerly containing three (3) settling ponds).
- West – Canal Drive followed by a hydroelectric power plant and commercial properties beyond Huron Street.
- South – A walking trail followed by St. Mary's River.

The Site is generally flat; however, the overall area has a gradual slope to the southeast towards the St. Mary's River located approximately 20 m to the south. The Site is separated from the St. Mary's River by the Hub Trail (a paved walking/bike trail).

The stratigraphy of the Site consists of imported fill material, composed of brown and grey coarse sand and gravel with black silt and debris, from ground surface to a maximum depth of 4.9 metres below ground surface (mbgs), followed by native surficial soil consisting of silt with minor quantities of clay. Moist to wet soil conditions were observed at depths ranging from 1.8 to 4.9 mbgs, and the static depth to groundwater was found to range from 1.57 to 3.26 mbgs. Groundwater is interpreted to flow to the south-southeast towards the St. Mary's River (Greenstone, 2023b).

Greenstone conducted a Phase One ESA in October and November 2023 which identified a number of on- and off-site potentially contaminating activities (PCAs) contributing to Areas of Potential Environmental Concern (APECs) on-site (Table 2-1).

Table 2-1 Potentially Contaminating Activities and Areas of Potential Concern Identified in the Phase One ESA (Greenstone, 2023a)

Number	*PCA*	*APEC*
1	Poor quality fill material used during Site development.	Entire Site
2	Eastern adjacent property historically included industrial ponds from at least 1975 to 1998.	Eastern portion of the Site
3	Adjacent properties to the north were used for various industrial operations, including a scrap metal yard and a chromium processing facility, from at least 1915 to 1975.	Northern portion of the Site
4	Adjacent properties to the west were used for various industrial operations, including a pulp and paper mill and a power generation facility, from at least 1915.	Western portion of the Site

Based on the findings of the Phase One ESA, Greenstone conducted a Phase Two ESA in November and October 2023 to assess the environmental conditions of on-site soil and groundwater and to evaluate the presence of potential contaminants of concern. This investigation included the advancement of seventeen (17) test pits (TP1 to TP17) and three (3) boreholes (BH18 to BH20). Nine (9) test pits (TP1, TP3, TP5, TP7, TP8, TP11, TP13, TP15, and TP17) and two (2) boreholes (BH18 and BH19) were completed as groundwater monitoring wells at depths ranging from 3.5 to 4.3 mbgs to characterize conditions in the shallow, unconfined groundwater aquifer (Greenstone, 2023b).

Seven (7) soil samples, representative of native materials (or the predominant fill material), were collected at depths ranging from 0.6 to 3.7 mbgs and were submitted for grain size analysis. Soils from four (4) of the seven (7) samples were classified as medium/fine grained. Under O. Reg.153/04, more than two-thirds of the Site needs to consist of medium/fine soils for the on-site soils to be classified as medium/fine textured. Based on field observations, Greenstone (2023b) conservatively classified on-site soils as coarse textured.

Soil and groundwater samples were collected and submitted for analysis of VOCs, PAHs, PHCs, metals, inorganics, and general chemistry. For the portion of the Site that is greater than 30 m from the St. Mary's River, Greenstone compared soil and groundwater results to the MECP Table 3 SCS for commercial/industrial/community properties with coarse-textured soils. For the portion of the Site that is within 30 m of the St. Mary's River, Greenstone compared soil and groundwater results to the MECP Table 9 SCS for all types of property use (Greenstone, 2023b).

In soil, concentrations of metals, PHCs, PAHs, and/or electrical conductivity (EC) exceeded the Table 3 and/or Table 9 SCS in thirteen (13) samples. In groundwater, exceedances were identified for PAHs in MW17, and for 1,1-dichloroethylene in MW5 (Greenstone, 2023b).

No free-phase PHCs (or light non-aqueous phase liquid (LNAPL) was measured within any on-site monitoring wells (Greenstone, 2023b).

3.0 IDENTIFICATION OF CONTAMINANTS OF CONCERN

The identification of contaminants of concern (COCs) to be retained for further assessment in the DDRA was based on the selection of the applicable SCS (Section 3.1), and a comparison of concentrations of chemicals in soil and groundwater to the SCS (Sections 3.2 and 3.3, respectively).

3.1 Selection of Applicable Site Condition Standards

The selection of the applicable SCS considered the following factors:

- The Site will continue to be used for commercial purposes.
- Although four (4) of seven (7) soil samples submitted for grain size analysis indicated that native soils were medium/fine textured, on-site soils were conservatively classified as coarse-textured.
- The Site has not been classified as a shallow soil property (*i.e.*, there is >2 m of overburden over more than two-thirds of the Site).
- The Site and properties in its vicinity are serviced by municipal drinking water provided by the City of Sault Ste. Marie.
- The Site includes land that is within 30 m of a permanent water body (*i.e.*, the St. Mary's River).

<u>Classification of Sensitive Site</u>

The Records of Site Condition Regulation (O. Reg. 153/04) defines a contaminated site as an environmentally sensitive area if it meets any of three (3) conditions. The first condition is related to areas of natural significance. A site is considered sensitive if it includes, is adjacent to, or is within 30 m of any one of the following:

- A provincial park designated by a regulation under the Provincial Parks and Conservation Reserves Act, 2006;
- An area of natural and scientific interest (life science or earth science) identified by the Ministry of Natural Resources and Forestry (MNRF) as having provincial significance;
- A wetland identified by the MNR as having provincial significance;
- An area designated by a municipality in its official plan as environmentally significant, however expressed, including designations of areas and environmentally sensitive, as being of environmental concern and as being ecologically significant;
- An area designated as an escarpment natural area or an escarpment protection area by the Niagara Escarpment Plan under the Niagara Escarpment Planning and Development Act;
- An area which is habitat of an endangered or threatened species identified under the Endangered Species Act, 2007;
- An area identified by the MNRF a significant habitat of endangered or threatened species;
- Property within an area designated as a natural core area or natural linkage area within the area to which the Oak Ridges Moraine Conservation Plan under the Oak Ridges Moraine Conservation Act, 2001 applies; or,
- An area set apart as wilderness area under the Wilderness Areas Act.

Greenstone retained ERIS to conduct a search for any Areas of Natural and Scientific Interest (ANSIs) within the study area. No ANSIs were identified as part of this search (Greenstone, 2023a,b). Greenstone conducted a supplemental review of available databases and identified the following conditions:

- The St. Mary's River was identified as a Natural Area by the Ontario Natural Heritage Information Centre (ONHIC), and by the MNRF as habitat for the threatened Lake Surgeon. Greenstone did not identify an information on the occurrences of Lake Sturgeon in the St. Mary's River on the MECP Species at Risk website.
- The Site and surrounding area were identified by the MNRF as potential habitat for the threatened Eastern Meadowlark. Greenstone indicated that the Site does not provide suitable habitat for this ground nesting grassland bird species.

Overall, for the purposes of the Phase One and Two ESAs, Greenstone (2023a,b) did not classify the Site as environmentally sensitive based on the potential occurrence of habitat for Lake Sturgeon or Eastern Meadowlark, or the identification of the St. Mary's River as a Natural Area.

Soil pH was measured for nine (9) surface samples (5.08-7.51) and nineteen (19) sub-surface samples (5.75-8.90) as part of the investigation conducted by Greenstone (2023b). The pH measurements were within the acceptable MECP ranges for surface (*i.e.*, pH 5-9) and subsurface soils (*i.e.*, pH 5-11).

Therefore, the Site is not considered to be an environmentally sensitive area and the applicable SCS are the Table 3 SCS for commercial/industrial/community properties with coarse textured soil for the portion of the Site greater than 30 m from the St. Mary's River, and the Table 9 SCS for all property uses for the portion of the Site within 30 m of the river. The selection of COCs in on-site soil was based on a comparison of the maximum concentrations or highest detection limits to these SCS.

The depth to static groundwater ranged from 1.57 to 3.26 mbgs (Greenstone, 2023b). Although the Site does not meet the definition of a "shallow soil property" as described within the regulation, when groundwater is found within 3 mbgs the assumptions used within the derivation of the Table 3 and 9 SCS are not considered to be sufficiently protective of the vapour infiltration pathway. The Table 7 SCS for groundwater were derived under the assumption that there may be limited distance for the attenuation of vapours as they migrate from impacted groundwater to indoor air. The MECP requires that these SCS are considered within an RA under conditions of shallow groundwater. Therefore, the selection of COCs in groundwater in the DDRA was based on a comparison of the maximum concentrations of contaminants to the Table 7 and 9 SCS for all property uses with coarse textured soils.

Chemicals with concentrations in excess of the applicable SCS were retained as COCs for further evaluation. For those chemicals that were not found above the laboratory detection limit in any sample, the highest detection limit was selected to represent the maximum concentration. For those chemicals for which the highest detection limit exceeded the highest measured concentration, the highest detection limit was used to represent the maximum concentration.

3.2 Contaminants of Concern in Soil

The selection of COCs in soil was based on a comparison of the maximum concentrations of chemicals measured in soil samples collected as part of the Phase Two ESA conducted by Greenstone (2023b) to the Table 3 SCS for commercial/industrial/community property use with coarse textured soils for samples collected from locations greater than 30 m from the St. Mary's River (*i.e.*, TP1 to TP11, TP18, BH19, and BH20) (Table 3-1), and a comparison of the maximum concentrations to the Table 9 SCS for all property uses for samples collected from locations within 30 m of the St. Mary's River (*i.e.*, TP12 to TP17) (Table 3-2). Chemicals with concentrations in excess of the Table 3 or 9 SCS were retained as COCs for further evaluation.

Table 3-1 Screening of Maximum Concentrations of Chemicals in Soil Against the Table 3 Site Condition Standards for Locations Greater than 30 m from the St. Mary's River

Chemical	***Location of On-Site Maximum Concentration***	***Sample Depth (mbgs)***	***Maximum Concentration (µg/g)***	***MECP Table 3 Site Condition Standard (µg/g)***
Metals and Inorganics				
Antimony	TP1-4	1.8-2.4	5	40
Arsenic	**BH20-4**	**1.8-2.4**	**160**	**18**
Barium	TP7-2	0.6-1.2	596	670
Beryllium	TP7-2 and TP9-1	Multiple depths	3	8
Boron (hot water soluble)	**TP7-6**	**3.1-3.7**	**7.5**	**2**
Boron (total)	TP11-5	2.4-3.1	28	120
Cadmium	TP7-2	0.6-1.2	0.7	1.9
Chromium (total)	**TP2-4**	**1.8-2.4**	**235**	**160**
Chromium VI	TP2-4	1.8-2.4	7.39	8
Cobalt	TP1-4 and TP7-2	Multiple depths	22	80
Copper	**TP7-2**	**0.6-1.2**	**582**	**230**
Cyanide (free)	All locations	Multiple depths	<0.005	0.051
Electrical Conductivity (mS/cm)	TP7-6	3.1-3.7	0.45	1.4
Lead	**TP1-4**	**1.8-2.4**	**697**	**120**
Mercury	TP1-4	1.8-2.4	1.6	3.9
Molybdenum	BH20-4	1.8-2.4	7	40
Nickel	TP1-4	1.8-2.4	77	270
Selenium	TP7-2	0.6-1.2	3	5.5
Silver	All locations	Multiple depths	<0.2	40
Sodium Adsorption Ratio (unitless)	TP3-5	2.4-3.1	4.86	12
Thallium	BH20-4	1.8-2.4	1	3.3
Uranium	TP7-6	3.1-3.7	2.0	33
Vanadium	TP7-2	0.6-1.2	43	86
Zinc	TP1-4	1.8-2.4	174	340
Volatile Organic Compounds (VOCs)				
Acetone	All locations	Multiple depths	<0.50	16
Benzene	TP1-4	1.8-2.4	0.199	0.32
Bromodichloromethane	All locations	Multiple depths	<0.05	18
Bromoform	All locations	Multiple depths	<0.05	0.61
Bromomethane	All locations	Multiple depths	<0.05	0.05
Carbon tetrachloride	All locations	Multiple depths	<0.05	0.21
Chlorobenzene	All locations	Multiple depths	<0.05	2.4
Chloroform	All locations	Multiple depths	<0.05	0.47
Dibromochloromethane	All locations	Multiple depths	<0.05	13
Dichlorobenzene, 1,2-	All locations	Multiple depths	<0.05	6.8
Dichlorobenzene, 1,3-	All locations	Multiple depths	<0.05	9.6

Table 3-1 Screening of Maximum Concentrations of Chemicals in Soil Against the Table 3 Site Condition Standards for Locations Greater than 30 m from the St. Mary's River

Chemical	*Location of On-Site Maximum Concentration*	*Sample Depth (mbgs)*	*Maximum Concentration (µg/g)*	*MECP Table 3 Site Condition Standard (µg/g)*
Dichlorobenzene, 1,4-	All locations	Multiple depths	<0.05	0.2
Dichlorodifluoromethane	All locations	Multiple depths	<0.05	16
Dichloroethane, 1,1-	All locations	Multiple depths	<0.05	17
Dichloroethane, 1,2-	All locations	Multiple depths	<0.05	0.05
Dichloroethylene, 1,1-	All locations	Multiple depths	<0.05	0.064
Dichloroethylene, 1,2-cis-	All locations	Multiple depths	<0.05	55
Dichloroethylene, 1,2-trans-	All locations	Multiple depths	<0.05	1.3
Dichloropropane, 1,2-	All locations	Multiple depths	<0.05	0.16
Dichloropropene, 1,3-	All locations	Multiple depths	<0.05	0.18
Ethylbenzene	All locations	Multiple depths	<0.018	9.5
Ethylene dibromide	All locations	Multiple depths	<0.05	0.05
Hexane (n-)	All locations	Multiple depths	<0.05	46
Methyl ethyl ketone	All locations	Multiple depths	<0.50	70
Methylene chloride	All locations	Multiple depths	<0.05	1.6
Methyl isobutyl ketone	All locations	Multiple depths	<0.50	31
Methyl tert-butyl ether (MTBE)	All locations	Multiple depths	<0.05	11
Styrene	All locations	Multiple depths	<0.05	34
Tetrachloroethane, 1,1,1,2-	All locations	Multiple depths	<0.05	0.087
Tetrachloroethane, 1,1,2,2-	All locations	Multiple depths	<0.05	0.05
Tetrachloroethylene	All locations	Multiple depths	<0.05	4.5
Toluene	TP1-4	1.8-2.4	1.38	68
Trichloroethane, 1,1,1-	All locations	Multiple depths	<0.05	6.1
Trichloroethane, 1,1,2-	All locations	Multiple depths	<0.05	0.05
Trichloroethylene	All locations	Multiple depths	<0.01	0.91
Trichlorofluoromethane	All locations	Multiple depths	<0.05	4
Vinyl chloride	All locations	Multiple depths	<0.02	0.032
Xylene mixture	TP1-4	1.8-2.4	3.82	26
Polycyclic Aromatic Hydrocarbons (PAHs)				
Acenaphthene	TP6-5	2.4-3.1	0.05	96
Acenaphthylene	TP1-4	1.8-2.4	0.12	0.15
Anthracene	TP5-4	1.8-2.4	0.14	0.67
Benz[a]anthracene	TP1-4	1.8-2.4	0.59	0.96
Benzo[a]pyrene	**TP1-4**	**1.8-2.4**	**0.64**	**0.3**
Benzo[b]fluoranthene	TP1-4	1.8-2.4	0.56	0.96
Benzo[g,h,i]perylene	TP1-4	1.8-2.4	0.28	9.6
Benzo[k]fluoranthene	TP1-4	1.8-2.4	0.33	0.96
Chrysene	TP1-4	1.8-2.4	0.61	9.6
Dibenz[a,h]anthracene	**TP1-4**	**1.8-2.4**	**0.11**	**0.1**
Fluoranthene	TP1-4	1.8-2.4	0.82	9.6
Fluorene	TP5-4	1.8-2.4	0.06	62
Indeno[1,2,3-cd]pyrene	TP1-4	1.8-2.4	0.28	0.76
Methlynaphthalene, 2-(1-)	TP6-5	2.4-3.1	1.01	76
Naphthalene	TP6-5	2.4-3.1	0.346	9.6
Phenanthrene	TP5-4	1.8-2.4	0.30	12
Pyrene	TP2-4	1.8-2.4	<14.0	96
Petroleum Hydrocarbons (PHCs)				
PHC F1 (C6-C10) - BTEX	All locations	Multiple depths	<10	55

Table 3-1 Screening of Maximum Concentrations of Chemicals in Soil Against the Table 3 Site Condition Standards for Locations Greater than 30 m from the St. Mary's River

Chemical	*Location of On-Site Maximum Concentration*	*Sample Depth (mbgs)*	*Maximum Concentration (µg/g)*	*MECP Table 3 Site Condition Standard (µg/g)*
PHC F2 (>C10-C16)	TP5-4 and BH20-4	1.8-2.4	7	230
PHC F3 (>C16-C34)	TP2-4	1.8-2.4	140	1,700
PHC F4 (>C34)	TP2-4	1.8-2.4	60	3,300

BOLDED values in greyscale indicate that maximum measured concentration was greater than the Table 3 Site Condition Standard for commercial/industrial/community property use with coarse textured soil.
< Concentration is below the value presented but cannot be more accurately quantified due to analytical uncertainty.

As presented in Table 3-1, the maximum concentrations of seven (7) chemicals in soil collected from locations greater than 30 m from the St. Mary's River exceeded the Table 3 SCS. Therefore, the following chemicals were retained as COCs in soil for further evaluation in the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA):

- Arsenic
- Boron (HWS)
- Chromium (total)
- Copper
- Lead
- Benzo(a)pyrene
- Dibenz(a,h)anthracene

Table 3-2 Screening of Maximum Concentrations of Chemicals in Soil Against the Table 9 Site Condition Standards for Locations within 30 m of the St. Mary's River

Chemical	*Location of On-Site Maximum Concentration*	*Sample Depth (mbgs)*	*Maximum Concentration (µg/g)*	*MECP Table 9 Site Condition Standard (µg/g)*
Metals and Inorganics				
Antimony	**TP14-7**	**3.1-3.7**	**3**	**1.3**
Arsenic	**TP14-7**	**3.1-3.7**	**54**	**18**
Barium	**TP15-3**	**1.2-1.8**	**505**	**220**
Beryllium	**TP15-3**	**1.2-1.8**	**5**	**2.5**
Boron (hot water soluble)	TP14-7	3.1-3.7	1.2	1.5
Boron (total)	TP14-7	3.1-3.7	33	36
Cadmium	**TP14-7**	**3.1-3.7**	**2.0**	**1.2**
Chromium (total)	**TP14-7**	**3.1-3.7**	**106**	**70**
Chromium VI	TP14-7	3.1-3.7	0.37	0.66
Cobalt	**TP14-7**	**3.1-3.7**	**210**	**22**
Copper	**TP14-7**	**3.1-3.7**	**1,640**	**92**
Cyanide (free)	All locations	Multiple depths	<0.005	0.051
Electrical Conductivity (mS/cm)	**TP16-3**	**1.2-1.8**	**1.42**	**0.7**
Lead	**TP14-7**	**3.1-3.7**	**269**	**120**
Mercury	**TP14-7**	**3.1-3.7**	**0.4**	**0.27**
Molybdenum	**TP16-3**	**1.2-1.8**	**5**	**2**
Nickel	**TP14-7**	**3.1-3.7**	**990**	**82**
Selenium	**TP16-3**	**1.2-1.8**	**7.2**	**1.5**
Silver	**TP14-7**	**3.1-3.7**	**0.6**	**0.5**
Sodium Adsorption Ratio (unitless)	TP13-4	1.8-2.4	1.27	5
Thallium	All locations	Multiple depths	<1	1
Uranium	**TP14-7**	**3.1-3.7**	**4.9**	**2.5**
Vanadium	TP15-3	1.2-1.8	44	86
Zinc	**TP14-7**	**3.1-3.7**	**3,400**	**290**
Volatile Organic Compounds (VOCs)				
Acetone	All locations	Multiple depths	<0.50	0.5
Benzene	All locations	Multiple depths	<0.0068	0.02

Table 3-2 Screening of Maximum Concentrations of Chemicals in Soil Against the Table 9 Site Condition Standards for Locations within 30 m of the St. Mary's River

Chemical	*Location of On-Site Maximum Concentration*	*Sample Depth (mbgs)*	*Maximum Concentration (µg/g)*	*MECP Table 9 Site Condition Standard (µg/g)*
Bromodichloromethane	All locations	Multiple depths	<0.05	0.05
Bromoform	All locations	Multiple depths	<0.05	0.05
Bromomethane	All locations	Multiple depths	<0.05	0.05
Carbon tetrachloride	All locations	Multiple depths	<0.05	0.05
Chlorobenzene	All locations	Multiple depths	<0.05	0.05
Chloroform	All locations	Multiple depths	<0.05	0.05
Dibromochloromethane	All locations	Multiple depths	<0.05	0.05
Dichlorobenzene, 1,2-	All locations	Multiple depths	<0.05	0.05
Dichlorobenzene, 1,3-	All locations	Multiple depths	<0.05	0.05
Dichlorobenzene, 1,4-	All locations	Multiple depths	<0.05	0.05
Dichlorodifluoromethane	All locations	Multiple depths	<0.05	0.05
Dichloroethane, 1,1-	All locations	Multiple depths	<0.05	0.05
Dichloroethane, 1,2-	All locations	Multiple depths	<0.05	0.05
Dichloroethylene, 1,1-	All locations	Multiple depths	<0.05	0.05
Dichloroethylene, 1,2-cis-	All locations	Multiple depths	<0.05	0.05
Dichloroethylene, 1,2-trans-	All locations	Multiple depths	<0.05	0.05
Dichloropropane, 1,2-	All locations	Multiple depths	<0.05	0.05
Dichloropropene, 1,3-	All locations	Multiple depths	<0.05	0.05
Ethylbenzene	All locations	Multiple depths	<0.018	0.05
Ethylene dibromide	All locations	Multiple depths	<0.05	0.05
Hexane (n-)	All locations	Multiple depths	<0.05	0.05
Methyl ethyl ketone	All locations	Multiple depths	<0.50	0.05
Methylene chloride	All locations	Multiple depths	<0.05	0.5
Methyl isobutyl ketone	All locations	Multiple depths	<0.50	0.5
Methyl tert-butyl ether (MTBE)	All locations	Multiple depths	<0.05	0.05
Styrene	All locations	Multiple depths	<0.05	0.05
Tetrachloroethane, 1,1,1,2-	All locations	Multiple depths	<0.05	0.05
Tetrachloroethane, 1,1,2,2-	All locations	Multiple depths	<0.05	0.05
Tetrachloroethylene	All locations	Multiple depths	<0.05	0.05
Toluene	TP14-7	3.1-3.7	0.08	0.2
Trichloroethane, 1,1,1-	All locations	Multiple depths	<0.05	0.05
Trichloroethane, 1,1,2-	All locations	Multiple depths	<0.05	0.05
Trichloroethylene	All locations	Multiple depths	<0.01	0.05
Trichlorofluoromethane	All locations	Multiple depths	<0.05	0.25
Vinyl chloride	All locations	Multiple depths	<0.02	0.02
Xylene mixture	All locations	Multiple depths	<0.05	0.05
Polycyclic Aromatic Hydrocarbons (PAHs)				
Acenaphthene	All locations	Multiple depths	<0.05	0.072
Acenaphthylene	All locations	Multiple depths	<0.05	0.093
Anthracene	TP14-7	3.1-3.7	0.08	0.22
Benz[a]anthracene	TP14-7	3.1-3.7	0.20	0.36
Benzo[a]pyrene	TP14-7	3.1-3.7	0.14	0.3
Benzo[b]fluoranthene	TP14-7	3.1-3.7	0.14	0.47
Benzo[g,h,i]perylene	TP14-7	3.1-3.7	0.06	0.68
Benzo[k]fluoranthene	TP14-7	3.1-3.7	0.07	0.48
Chrysene	TP14-7	3.1-3.7	0.20	2.8
Dibenz[a,h]anthracene	All locations	Multiple depths	<0.05	0.1

Table 3-2 Screening of Maximum Concentrations of Chemicals in Soil Against the Table 9 Site Condition Standards for Locations within 30 m of the St. Mary's River

Chemical	*Location of On-Site Maximum Concentration*	*Sample Depth (mbgs)*	*Maximum Concentration (µg/g)*	*MECP Table 9 Site Condition Standard (µg/g)*
Fluoranthene	TP14-7	3.1-3.7	0.30	0.69
Fluorene	All locations	Multiple depths	<0.05	0.19
Indeno[1,2,3-cd]pyrene	TP14-7	3.1-3.7	0.06	0.23
Methlynaphthalene, 2-(1-)	TP14-7	3.1-3.7	0.47	0.59
Naphthalene	**TP14-7**	**3.1-3.7**	**0.218**	**0.09**
Phenanthrene	TP14-7	3.1-3.7	0.21	0.69
Pyrene	TP14-7	3.1-3.7	0.25	1
Petroleum Hydrocarbons (PHCs)				
PHC F1 (C6-C10) - BTEX	All locations	Multiple depths	<10	25
PHC F2 (>C10-C16)	**TP15-3**	**1.2-1.8**	**32**	**10**
PHC F3 (>C16-C34)	**TP16-3**	**1.2-1.8**	**670**	**240**
PHC F4 (>C34)	**TP16-3**	**1.2-1.8**	**300**	**120**

BOLDED values in greyscale indicate that maximum measured concentration was greater than the Table 9 Site Condition Standard for all property use.
< Concentration is below the value presented but cannot be more accurately quantified due to analytical uncertainty.

As presented in Table 3-2, the maximum concentrations of twenty-one (21) chemicals in soil collected from locations within 30 m of the St. Mary's River exceeded the Table 9 SCS. Therefore, the following chemicals were retained as COCs in soil for further evaluation in the HHRA and ERA:

- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Cobalt
- Chromium (total)
- Copper
- EC
- Lead
- Mercury
- Molybdenum
- Nickel
- Selenium
- Silver
- Uranium
- Zinc
- Naphthalene
- PHC F2
- PHC F3
- PHC F4

3.3 Contaminants of Concern in Groundwater

The selection of COCs in groundwater was based on a comparison of the maximum concentrations of chemicals measured in samples collected by Greenstone (2023b) to the Table 7 SCS (to account for the presence of shallow groundwater) and to the Table 9 SCS (to account for the close proximity of the Site to the St. Mary's River) for all property uses with coarse textured soils (Table 3-3). Chemicals with concentrations in excess of the Table 7 and/or 9 SCS were retained as COCs for further evaluation.

Table 3-3 Screening of Maximum Concentrations of COCs in Groundwater Against the Table 3 and 7 Site Condition Standards

Chemical	*Location of Maximum Concentration*	*Maximum Concentration (µg/L)*	*MECP Table 7 SCS (µg/L)*	*MECP Table 9 SCS (µg/L)*
Metals and Inorganics				
Antimony	MW8	2.8	16,000	16,000

Table 3-3 Screening of Maximum Concentrations of COCs in Groundwater Against the Table 3 and 7 Site Condition Standards

Chemical	*Location of Maximum Concentration*	*Maximum Concentration (µg/L)*	*MECP Table 7 SCS (µg/L)*	*MECP Table 9 SCS (µg/L)*
Arsenic	MW11	25	1,500	1,500
Barium	MW11	370	23,000	23,000
Beryllium	All locations	<0.5	53	53
Boron (total)	MW8 and MW15	280	36,000	36,000
Cadmium	MW8	0.3	2.1	2.1
Chloride	MW3	362,000	1,800,000	1,800,000
Chromium (total)	MW18	2	640	640
Chromium VI	MW5 and MW18	<20	110	110
Cobalt	MW8	14.3	52	52
Copper	MW7	6	69	69
Cyanide (free)	All locations	<5	52	52
Lead	MW17	1	20	20
Mercury	All locations	<0.0001	0.1	0.29
Molybdenum	MW13	37	7,300	7,300
Nickel	MW17	223	390	390
Selenium	MW8	22	50	50
Silver	All locations	<0.1	1.2	1.2
Sodium	MW3	257,000	1,800,000	1,800,000
Thallium	All locations	<0.1	400	400
Uranium	MW5	7	330	330
Vanadium	MW13	6	200	200
Zinc	MW8	110	890	890
Volatile Organic Compounds (VOCs)				
Acetone	MW5	233	100,000	100,000
Benzene	All locations	<0.5	0.5	44
Bromodichloromethane	All locations	<0.3	67,000	67,000
Bromoform	All locations	<0.4	5	380
Bromomethane	All locations	<0.5	0.89	5.6
Carbon tetrachloride	All locations	<0.2	0.2	0.79
Chlorobenzene	All locations	<0.5	140	500
Chloroform	All locations	<0.5	2	2.4
Dibromochloromethane	All locations	<0.3	65,000	65,000
Dichlorobenzene, 1,2-	All locations	<0.4	150	4,600
Dichlorobenzene, 1,3-	All locations	<0.4	7,600	7,600
Dichlorobenzene, 1,4-	All locations	<0.4	0.5	8
Dichlorodifluoromethane	All locations	<0.5	3,500	3,500
Dichloroethane, 1,1-	All locations	<0.4	11	320
Dichloroethane, 1,2-	All locations	<0.5	0.5	1.6
Dichloroethylene, 1,1-	**MW5**	**7.4**	**0.5**	**1.6**
Dichloroethylene, 1,2-cis-	All locations	<0.4	1.6	1.6
Dichloroethylene, 1,2-trans-	All locations	<0.4	1.6	1.6
Dichloropropane, 1,2-	All locations	<0.5	0.58	16
Dichloropropene, 1,3-	All locations	<0.5	0.5	5.2
Ethylbenzene	All locations	<0.5	54	1,800
Ethylene dibromide	All locations	<0.2	0.2	0.25
Hexane (n-)	All locations	<5	5	51
Methyl ethyl ketone	MW5	17	21,000	470,000
Methyl isobutyl ketone	All locations	<5	5,200	140,000
Methyl tert-butyl ether	All locations	<2	15	190
Methylene chloride	MW5	8.6	26	610
Styrene	All locations	<0.5	43	1,300
Tetrachloroethane, 1,1,1,2-	All locations	<0.5	1.1	3.3
Tetrachloroethane, 1,1,2,2-	All locations	<0.5	0.5	3.2
Tetrachloroethylene	All locations	<0.3	0.5	1.6
Toluene	All locations	<0.4	320	14,000
Trichloroethane, 1,1,1-	All locations	<0.4	23	640

Table 3-3 Screening of Maximum Concentrations of COCs in Groundwater Against the Table 3 and 7 Site Condition Standards

Chemical	*Location of Maximum Concentration*	*Maximum Concentration (µg/L)*	*MECP Table 7 SCS (µg/L)*	*MECP Table 9 SCS (µg/L)*
Trichloroethane, 1,1,2-	All locations	<0.4	0.5	4.7
Trichloroethylene	All locations	<0.3	0.5	1.6
Trichlorofluoromethane	All locations	<0.5	2,000	2,000
Vinyl chloride	All locations	<0.2	0.5	0.5
Xylene mixture	All locations	<0.5	72	3,300
Polycyclic Aromatic Hydrocarbons (PAHs)				
Acenaphthene	All locations	<0.1	17	600
Acenaphthylene	MW17	0.2	1	1.4
Anthracene	MW17	0.5	1	1
Benz[a]anthracene	MW17	1.4	1.8	1.8
Benzo[a]pyrene	**MW17**	**1.43**	**0.81**	**0.81**
Benzo[b]fluoranthene	**MW17**	**1.50**	**0.75**	**0.75**
Benzo[g,h,i]perylene	**MW17**	**0.5**	**0.2**	**0.2**
Benzo[k]fluoranthene	**MW17**	**0.95**	**0.4**	**0.4**
Chrysene	**MW17**	**1.90**	**0.7**	**0.7**
Dibenz[a,h]anthracene	MW17	0.2	0.4	0.4
Fluoranthene	MW17	2.2	44	73
Fluorene	MW17	0.2	290	290
Indeno[1,2,3-cd]pyrene	**MW17**	**0.5**	**0.2**	**0.2**
Methlynaphthalene, 2-(1-)	MW18	0.2	1,500	1,500
Naphthalene	MW18	0.3	7	1,400
Phenanthrene	MW17	0.6	380	380
Pyrene	MW17	1.6	5.7	5.7
Petroleum Hydrocarbons (PHCs)				
PHC F1 (C6-C10) - BTEX	All locations	<20	420	420
PHC F2 (>C10-C16)	All locations	<20	150	150
PHC F3 (>C16-C34)	All locations	<50	500	500
PHC F4 (>C34)	All locations	<50	500	500

BOLDED values in greyscale indicate that maximum measured concentration was greater than the Table 7 and/or 9 Site Condition Standards for all property uses with coarse textured soils.
< Indicates that the concentration is lower than the value presented but cannot be more accurately quantified due to analytical uncertainty.

As presented in Table 3-3, the maximum measured concentrations of seven (7) chemicals in on-site groundwater exceeded the Table 7 and 9 SCS. Therefore, the following chemicals were retained as COCs for further evaluation in the HHRA and ERA:

- Dichloroethylene, 1,1-
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Chrysene
- Indeno(1,2,3-cd)pyrene

The general biodegradation of contaminants in the environment can, over time, reduce environmental levels of a specific compound while at the same time produce other breakdown products. In most circumstances, breakdown products are less toxic than the original contaminant. The anaerobic biodegradation of highly chlorinated compounds such as tetrachloroethylene to vinyl chloride is a mechanism that does not follow this general pattern and can be of concern when attempting to set generic criteria for highly chlorinated compounds. Future degradation of vinyl chloride parent compounds (*i.e.,* tetrachloroethylene, trichloroethylene, 1,1-dichloroethylene, *cis*-1,2-dichloroethylene, and *trans*-1,2-dichloroethylene) may result in higher future concentrations of vinyl chloride. Given that 1,1-dichloroethylene was in excess of the Table 7 and 9 SCS, in order to be protective of future vinyl chloride risks, the theoretical concentration of vinyl chloride (future condition) was determined.

The concentration for vinyl chloride (future condition) used in the assessment was the maximum measured concentration of vinyl chloride plus 10% of the maximum concentration of each of the parent compounds (*i.e.,* tetrachloroethylene, trichloroethylene, 1,1-dichloroethylene, *cis*-1,2-dichloroethylene, and *trans*-1,2-dichloroethylene) (Table 3-4).

Table 3-4 Theoretical Contribution of Parent Compounds to Future Vinyl Chloride Concentration (µg/L)

Chemical	***Maximum Measured Concentration***	***Theoretical Contribution to Future Vinyl Chloride Concentration***[a]
Dichloroethylene, 1,1-	7.4	0.74
Dichloroethylene, 1,2-*cis*	<0.4	0.04
Dichloroethylene, 1,2-*trans*	<0.4	0.04
Tetrachloroethylene	<0.3	0.03
Trichloroethylene	<0.3	0.03
Vinyl chloride (current condition)	<0.2	0.2
Vinyl chloride (future condition)		**1.1**

[a] The future concentration of vinyl chloride presented is based on the maximum measured concentration in groundwater (<0.2 µg/L) plus 10% of the maximum concentration of each parent compound (*i.e.,* tetrachloroethylene, trichloroethylene, 1,1-dichloroethylene, *cis*-1,2-dichloroethylene, and *trans*-1,2-dichloroethylene) protective of future degradation to vinyl chloride.

Given that the theoretical future vinyl chloride concentration (1.1 µg/L) exceeded the Table 7 and 9 SCS (0.5 µg/L), future vinyl chloride conditions was retained for further evaluation in the HHRA and ERA.

4.0 HUMAN HEALTH RISK ASSESSMENT

The HHRA was conducted using scientific approaches that are generally consistent with Ontario Regulation 153/04 (O. Reg. 153/04) and in accordance with accepted practices and usual standards of thoroughness and competence for the profession of toxicology and environmental risk assessment. The HHRA was conducted using the fundamental risk assessment framework that is recognized in Canada and worldwide (Figure 4-1).

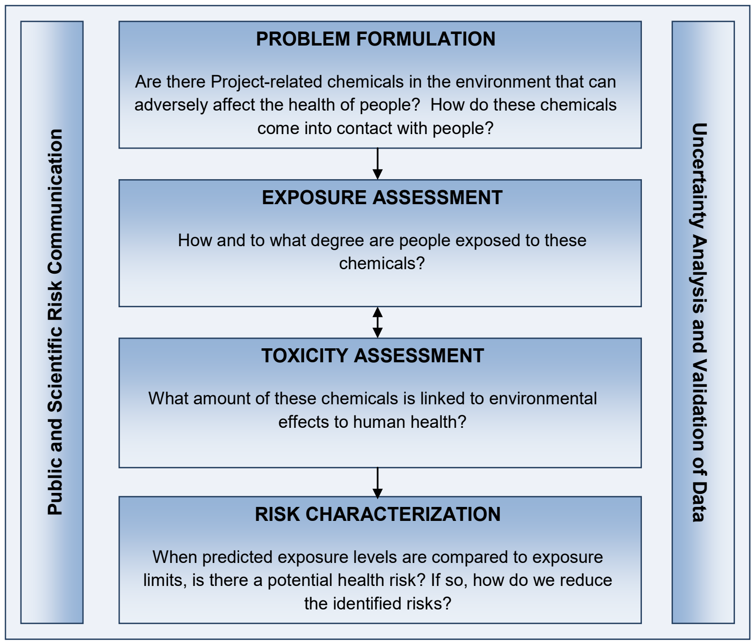

Figure 4-1 Standard Risk Assessment Framework

4.1 Problem Formulation

Typically, the development of a Conceptual Model is the result of completing the problem formulation phase of an RA (Figure 4-2). The key tasks requiring evaluation when developing a Conceptual Model include identifying human receptors of interest, developing an initial list of COCs, and identifying exposure pathways (*i.e.,* ways in which individuals may be exposed to compounds in the environment).

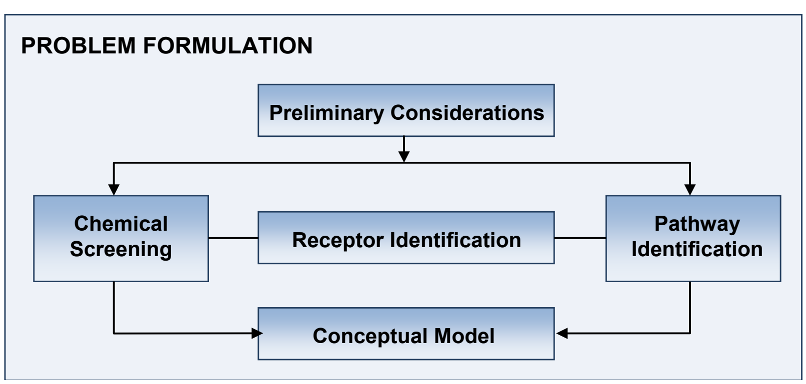

Figure 4-2 Components of the Conceptual Model

4.1.1 Identification of Potential Human Receptors

A human receptor is a hypothetical person (*e.g.,* infant, toddler, child, adolescent, adult) who may reside or work in the area being investigated and is, or could potentially be, exposed to the COCs. General physical and behavioural characteristics specific to the receptor type (*e.g.,* body weight, breathing rate, soil ingestion rate, *etc.*) are often used to determine the amount of chemical exposure received by each receptor. Due to differences in these characteristics between receptors of different age classes, predicted exposure will vary on a receptor-by-receptor basis. Consequently, the potential risks associated with exposure to COCs may differ depending on the receptor chosen for evaluation.

It is critical that the assessment is sufficiently comprehensive to ensure that overall risks have been adequately addressed. However, it is not feasible to consider all humans that may potentially be exposed to chemicals from the Site. As a result, it is important to select those human receptors that may be subject to the greatest potential risk. These will be people with the greatest probability of exposure to the chemicals detected on-site and those that have the greatest sensitivity to these chemicals.

Given the current and intended continued commercial/industrial land use of the Site, it was considered most appropriate to evaluate adult receptors under three (3) occupational scenarios to assess risks for receptors that may spend a significant amount of time on-site:

1. An outdoor maintenance worker – an adult who may be involved with on-going Site maintenance, repairs, landscaping, *etc.*;
2. A construction worker – an adult who may (from time to time) be involved in surface and sub-surface activities and/or construction-related matters which may provide the opportunity to come into direct or indirect contact with impacted soil and groundwater; and,
3. An indoor worker – an adult who may work inside any future on-site building.

4.1.2 Identification of Exposure Scenarios and Operable Exposure Pathways

Receptors may come into contact with chemicals in their environment in a variety of ways, depending on their daily activities and land use patterns. The means by which a person comes into contact with a chemical in an environmental medium are referred to as exposure pathways. The means by which a chemical enters the body from the environmental medium are referred to as exposure routes. There are three (3) major exposure routes through which chemicals can enter the body: inhalation; ingestion; and dermal absorption (*i.e.,* uptake through the skin).

Exposure pathways may require direct contact between receptors and the environmental media of concern (*e.g.,* incidental ingestion of soil or groundwater, dermal contact, *etc.*), or may be indirect requiring the movement of the chemical from one environmental medium to another (*e.g.,* the migration of vapours from soil or groundwater to indoor or outdoor air).

Due to the volatility of certain chemicals, their vapours have a tendency to migrate from subsurface soil and/or groundwater into the enclosed space of an indoor environment. Depending on site-specific soil characteristics, building parameters and levels of contamination, the inhalation of impacted indoor air can be a significant health concern to occupants. Exposures *via* the inhalation of impacted indoor air was considered to be a viable exposure pathway by which occupants (*e.g.,* indoor workers) of any future on-site building could be exposed to impacted soil and/or groundwater (Figure 4-3).

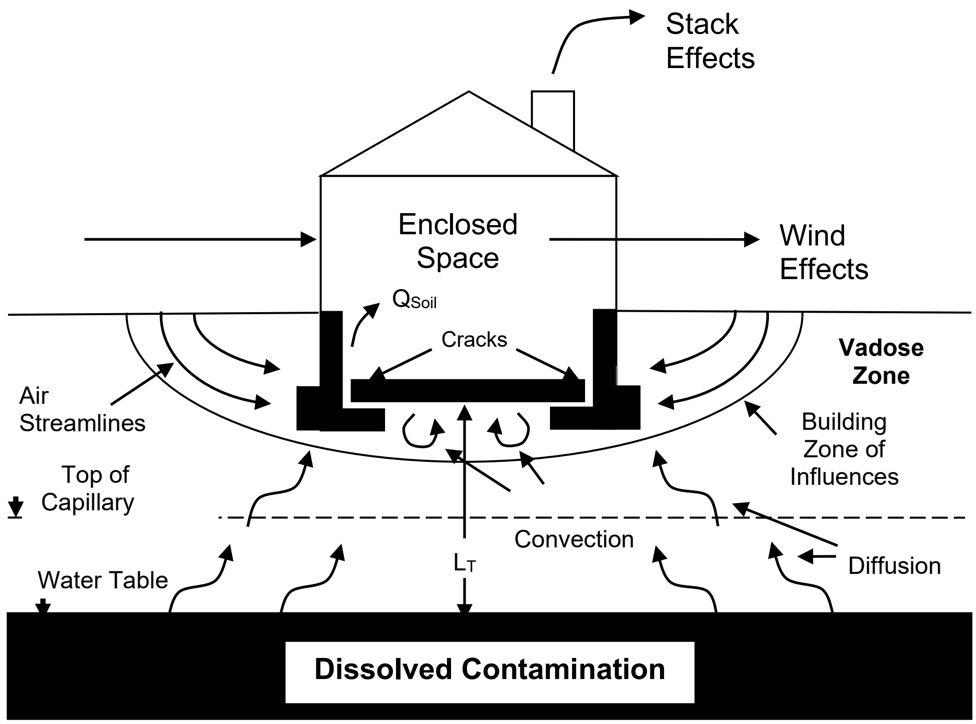

Figure 4-3 The Vapour Infiltration Pathway (U.S. EPA, 2004)

The MECP has derived health-based component values to protect human health *via* the indoor vapour infiltration exposure pathway. As with any predictive modelling exercise, the degree of uncertainty associated with predictive outcomes is, in part, a function of both the quantity and quality of site-specific data available. When predicting exposures resulting from the vapour infiltration pathway, two (2) general areas of uncertainty exist, including (1) the prediction of soil-vapour concentrations based on measurements in soil (µg/g) and/or groundwater (µg/L), and (2) the degree of attenuation between underlying soil-vapour concentrations and the indoor environment.

The degree of attenuation as vapours migrate both laterally and vertically through soils is dependent on many site-specific factors such as soil characteristics, building-associated pressure differentials, and the existence of preferential conduits such as underground utilities. The assessment of risks to building occupants based on a comparison of maximum concentrations to generic MECP component values is generally considered to be highly conservative and intended to ensure that unacceptable risks do not occur rather than identifying conditions in which risks will occur.

The primary exposure pathways of concern for individuals working in various on-site capacities include:

Outdoor Maintenance Workers:

- Incidental ingestion of surface soil and dust;
- Dermal contact with surface soil; and,
- Inhalation of vapours in outdoor ambient air.

Construction Workers:

- Incidental ingestion of soil/dust;
- Inhalation of soil/dust;
- Dermal contact with soil/dust;
- Inhalation of vapours in outdoor ambient air;
- Incidental ingestion and dermal contact with groundwater within a trench/excavation; and,
- Inhalation of vapours from soil and groundwater in air within a trench/excavation.

Indoor Worker:

- Inhalation of vapours *via* migration from soil and groundwater to indoor air.

4.1.3 Human Health Conceptual Site Model

The conceptual model provides an outline of the general exposure scenarios that were evaluated by bringing together the chemicals, receptors, and exposure pathways into one overall conceptual framework. Figure 4-4 provides the human health conceptual model in the absence of RMMs.

PRIMARY CONTAMINANT SOURCE		SECONDARY SOURCE	TERTIARY SOURCE	EXPOSURE PATHWAY	ON-SITE: OUTDOOR MAINTENANCE WORKER	ON-SITE: CONSTRUCTION WORKER	ON-SITE: INDOOR WORKER	OFF-SITE: INDOOR WORKER	OFF-SITE: OUTDOOR MAINTENANCE WORKER	OFF-SITE: CONSTRUCTION/ TRENCH WORKER
COCs IN SOIL	DIRECT SOIL CONTACT			INCIDENTAL INGESTION AND DERMAL CONTACT	√ [green]	√ [green]	X	X	√ [yellow]	√ [yellow]
COCs IN SOIL	RESUSPENSION OF SOIL	OUTDOOR PARTICULATE		INHALATION OF DUST	√ [green]	√ [green]	X	X	√ [yellow]	√ [yellow]
COCs IN SOIL	UPTAKE FROM SOIL	HOME GROWN PRODUCE		INGESTION OF HOME GROWN PRODUCE	X	X	X	X	X	X
COCs IN SOIL	VOLATILIZATION	OUTDOOR AIR		INHALATION OF OUTDOOR AIR	√ [green]	√ [green]	X	X	√ [yellow]	√ [yellow]
COCs IN SOIL	VOLATILIZATION	TRENCH AIR		INHALATION OF TRENCH AIR	X	√ [green]	X	X	X	√ [yellow]
COCs IN SOIL	VAPOUR INTRUSION	INDOOR AIR		INHALATION OF INDOOR AIR	X	X	√ [green]	√ [yellow]	X	X
COCs IN SOIL	LEACHING/MIGRATION VIA GROUNDWATER	SURFACE WATER		INCIDENTAL INGESTION AND DERMAL CONTACT	X	X	X	X	X	X
COCs IN SOIL	LEACHING/MIGRATION VIA GROUNDWATER	SURFACE WATER → UPTAKE	FISH	INGESTION OF LOCAL FISH	X	X	X	X	X	X
COCs IN GROUNDWATER	DIRECT GROUNDWATER CONTACT			INCIDENTAL INGESTION AND DERMAL CONTACT	X	√ [green]	X	X	X	√ [yellow]
COCs IN GROUNDWATER	VOLATILIZATION	OUTDOOR AIR		INHALATION OF OUTDOOR AIR	O	√ [green]	X	X	O	√ [yellow]
COCs IN GROUNDWATER	VOLATILIZATION	TRENCH AIR		INHALATION OF TRENCH AIR	X	√ [green]	X	X	X	√ [yellow]
COCs IN GROUNDWATER	VAPOUR INTRUSION	INDOOR AIR		INHALATION OF INDOOR AIR	X	X	√ [green]	√ [yellow]	X	X
COCs IN GROUNDWATER	LEACHING/MIGRATION	SURFACE WATER		INCIDENTAL INGESTION AND DERMAL CONTACT	X	X	X	X	X	X
COCs IN GROUNDWATER	LEACHING/MIGRATION	SURFACE WATER → UPTAKE	FISH	INGESTION OF LOCAL FISH	X	X	X	X	X	X

RECEPTOR CHARACTERIZATION — PATHWAYS OF POTENTIAL CONCERN

√ [green]	Indicates exposure pathway for receptor is complete and was assessed in the RA
√ [yellow]	Indicates exposure pathway for receptor is complete and was assessed qualitatively in the RA
X	Exposure pathway is not considered complete and was not assessed in the HHRA
O	Exposure pathway is considered insignificant and/or there is insufficient information available to evaluate this pathway; not assessed in the HHRA.

Figure 4-4 Human Health Conceptual Site Model

4.2 Exposure Assessment

The HHRA included a semi-quantitative assessment of risks to adult workers under three (3) exposure scenarios:

Outdoor Maintenance Worker

Under the outdoor maintenance worker scenario, it was assumed that an adult maintenance worker, responsible for daily landscaping including cutting grass, tending hedges and gardening, could potentially be directly and/or indirectly exposed to COCs in soil and groundwater. The maintenance worker was assumed to be exposed while working 9.8 hours/day, 5 days/week, 39 weeks/year for 56 years (MOE, 2011). For the assessment of carcinogenic risks, workers were assumed to work on-site for an entire adult lifetime (*i.e.*, a cancer amortization was not applied to adjust for a less-than-lifetime exposure).

While at work, it was assumed that 100% of the maintenance worker's time on-site was spent outdoors being exposed to COCs from impacted soils at a concentration equivalent to the maximum concentration *via* ingestion and dermal contact with soil/dust, and inhalation of vapours from impacted soil. These pathways were assessed by comparing concentrations to the MECP S2 and S-OA component values as described in Section 4.3.

Construction/Trench Worker

Under the construction/trench worker scenario, exposures were evaluated for an adult construction/trench worker involved in site redevelopment and underground utility maintenance. The worker was assumed to be exposed while working 10 hours/day, 5 days/week, 39 weeks/year for 1.5 years (MOE, 2011). While at work, it was conservatively assumed that 100% of the construction/trench worker's time was spent outdoors being directly exposed to COCs from impacted soils (*i.e.*, ingestion of soil/dust, inhalation of soil/dust, dermal contact with soil/dust). It was also assumed that the construction/trench worker was indirectly exposed to COCs from impacted soil *via* inhalation of vapours while within a trench and in outdoor ambient air at ground surface.

The construction/trench worker was assumed to be exposed to COCs in groundwater *via* incidental ingestion and dermal contact while within a trench, and the inhalation of vapours while within a trench and in outdoor ambient air at ground surface. Of the 10 hours/day spent on the Site, it was assumed that the construction/trench worker spent 2 hours working within an excavated trench below grade. These pathways were assessed by comparing maximum soil concentrations to the MECP S3 and S-OA component values as described in Section 4.3, and maximum groundwater concentrations to risk-based concentrations (RBCs) derived by Intrinsik.

Indoor Worker

Under the indoor worker scenario, it was assumed that an adult worker could potentially be exposed to COCs in soil and groundwater *via* the inhalation of vapours migrating from subsurface contamination to indoor air while spending time working in an on-site building. Indoor workers were assumed to spend 9.8 hours/day, 5 days/week, 50 weeks/year exposed to COCs in indoor air. For the assessment of carcinogenic risks in indoor air, workers were assumed to work within an on-site building for an entire adult lifetime (*i.e.*, a cancer amortization was not applied to adjust for a less-than-lifetime exposure). This pathway was assessed by comparing maximum concentrations to the MECP S-IA and GW2 component values for soil and groundwater, respectively.

4.2.1 Identification of Chemicals of Concern to Human Health

As described in Section 3, the initial selection of COCs in soil was based on a comparison of the maximum concentrations to the Table 3 SCS for commercial/industrial/community property use with coarse textured soils for samples collected from locations greater than 30 m from the St. Mary's River, and a comparison of the maximum concentrations to the Table 9 SCS for all property uses for samples collected from locations within 30 m of the St. Mary's River. Based on these comparisons, concentrations of seven (7) chemicals in soil collected from locations greater than 30 m from the St. Mary's River exceeded the Table 3 SCS, and the maximum concentrations of twenty-one (21) chemicals in soil collected from locations within 30 m of the St. Mary's River exceeded the Table 9 SCS. Each of these chemicals were retained as COCs. Given that the proximity of soil samples to the St. Mary's River affects the interpretation of risks for ecological components but does not influence the assessment of exposure and risks to human receptors, COCs in soil from both areas of the Site were combined for consideration in the HHRA.

The selection of COCs in groundwater was based on a comparison of the maximum concentrations to the Table 7 SCS (to account for the presence of shallow groundwater) and to the Table 9 SCS (to account for the close proximity of the Site to the St. Mary's River). The maximum measured concentrations of seven (7) chemicals in on-site groundwater exceeded the Table 7 and 9 SCS. Each of these chemicals (plus theoretical future vinyl chloride concentrations) in on-site groundwater were retained as COCs for further evaluation in the RA.

4.2.2 Characterizing Exposure Point Concentrations in Soil and Groundwater

The derivation of an appropriate exposure point concentration or EPC (*i.e.,* the concentration of a chemical in any environmental medium to which a receptor could reasonably be expected to be exposed over an extended period of time) is critical to the overall exposure assessment. The U.S. EPA Risk Assessment Guidance for Superfund (U.S. EPA, 1989) recommends that the upper 95% confidence interval on the arithmetic mean of the dataset (*i.e.,* the 95% UCLM) be used to represent the EPC. The rationale for the use of the 95% UCLM is that individuals, over a prolonged period of time, are assumed to move in a somewhat random fashion over the site in question and, therefore, may over time come into contact with an upper estimate of the average on-site soil concentration (*i.e.,* the 95% UCLM). Health Canada (2012; 2021) recommends that Preliminary Quantitative Risk Assessments (PQRAs) use the maximum on-site concentration to represent the EPC. An RA conducted under Ontario Regulation 153/04 must also employ the maximum on-site soil and/or groundwater concentration as the EPC. This recommendation inherently assumes that an individual is continuously in contact with the maximum on-site concentration for the entire exposure duration.

Although considered a highly conservative measure, the current DDRA has utilized the maximum measured concentrations of COCs in soil (Table 4-1) and groundwater (Table 4-2) as the EPCs as required under Ontario Regulation 153/04 and as recommended by Health Canada (2012; 2021) when conducting PQRAs.

Table 4-1 Maximum Concentrations of COCs in Soil (µg/g)

COC	*Maximum Concentration*
Metals and Inorganics	
Antimony	5
Arsenic	160
Barium	596
Beryllium	5
Boron (HWS)	7.5
Cadmium	2.0
Chromium (total)	235
Cobalt	210
Copper	1,640
Electrical Conductivity (mS/cm)	1.42
Lead	697
Mercury	1.6
Molybdenum	7
Nickel	990
Selenium	7.2
Silver	0.6
Uranium	4.9
Zinc	3,400
Polycyclic Aromatic Hydrocarbons (PAHs)	
Benzo(a)pyrene	0.64
Benzo(a)pyrene TPE	0.96
Dibenz(a,h)anthracene	0.11
Naphthalene	0.346
Petroleum Hydrocarbons (PHCs)	
PHC F2	32
PHC F3	670
PHC F4	300

Table 4-2 Maximum Concentrations of COCs in Groundwater (µg/L)

COC	*Maximum Concentration*
Volatile Organic Compounds (VOCs)	
Dichloroethylene, 1,1-	7.4
Vinyl chloride (future condition)[a]	1.1
Polycyclic Aromatic Hydrocarbons (PAHs)	
Benzo[a]pyrene	1.43
Benzo(a)pyrene TPE	2.1
Benzo[b]fluoranthene	1.50
Benzo[g,h,i]perylene	0.5
Benzo[k]fluoranthene	0.95
Chrysene	1.90
Indeno[1,2,3-cd]pyrene	0.5

[a] The future concentration of vinyl chloride presented is based on the maximum measured concentration in groundwater (<0.2 µg/L) plus 10% of the maximum concentration of each parent compound (*i.e.,* tetrachloroethylene, trichloroethylene, 1,1-dichloroethylene, *cis*-1,2-dichloroethylene, and *trans*-1,2-dichloroethylene) protective of future degradation to vinyl chloride.

Concentrations of multiple PAHs were in excess of the SCS in soil and groundwater. The hazard to human health from the carcinogenic effects of PAHs is evaluated on the basis of benzo(a)pyrene total potency equivalents (TPE), which is the sum of the estimated cancer potency relative to benzo(a)pyrene for all potentially carcinogenic PAHs. The benzo(a)pyrene TPE for a given soil or groundwater sample is calculated by multiplying the concentration of each individual PAH in the sample by its benzo(a)pyrene Toxic Equivalence Factor (TEF) and summing the products. The maximum concentrations of carcinogenic PAHs found in on-site soil and groundwater were used to calculate a benzo(a)pyrene TPE (Tables 4-3 and 4-4).

Table 4-3 Benzo(a)pyrene Total Potency Equivalent for Carcinogenic PAHs in Soil

PAH	*B(a)P Toxic Equivalence Factors (TEF)*[a]	*Maximum Soil Concentration (µg/g)*	*B(a)P TPE (µg/g)*
Acenaphthene	**0.001**	0.05	0.00005
Acenaphthylene	**0.01**	0.12	0.0012
Anthracene	**0.01**	0.14	0.0014
Benzo(a)anthracene	**0.1**	0.59	0.059
Benzo(a)pyrene	**1.0**	0.64	0.64
Benzo(b)fluoranthene	**0.1**	0.56	0.056
Benzo(g,h,i)perylene	**0.01**	0.28	0.0028
Benzo(k)fluoranthene	**0.1**	0.33	0.033
Chrysene	**0.01**	0.61	0.0061
Dibenzo(a,h)anthracene	**1.0**	0.11	0.11
Fluoranthene	**0.01**	0.82	0.0082
Indeno(1,2,3-cd)pyrene	**0.1**	0.28	0.028
Pyrene	**0.001**	<14.0	0.014
Benzo(a)pyrene Total Potency Equivalents (B(a)P TPE)			**0.96**

[a] TEF values were taken from MECP (2011).

Table 4-4 Benzo(a)pyrene Total Potency Equivalent for Carcinogenic PAHs in Groundwater

PAH	*B(a)P Toxic Equivalence Factors (TEF)*[a]	*Maximum Groundwater Concentration (µg/L)*	*B(a)P TPE (µg/L)*
Acenaphthene	**0.001**	<0.1	0.0001
Acenaphthylene	**0.01**	0.2	0.002
Anthracene	**0.01**	0.5	0.005
Benzo(a)anthracene	**0.1**	1.4	0.14
Benzo(a)pyrene	**1.0**	1.43	1.43
Benzo(b)fluoranthene	**0.1**	1.50	0.15
Benzo(g,h,i)perylene	**0.01**	0.5	0.005
Benzo(k)fluoranthene	**0.1**	0.95	0.095
Chrysene	**0.01**	1.90	0.019
Dibenzo(a,h)anthracene	**1.0**	0.2	0.2
Fluoranthene	**0.01**	2.2	0.022
Indeno(1,2,3-cd)pyrene	**0.1**	0.5	0.05
Pyrene	**0.001**	1.6	0.0016
Benzo(a)pyrene Total Potency Equivalents (B(a)P TPE)			**2.1**

[a] TEF values were taken from MECP (2011).

4.3 Risk Characterization

The MECP SCS for use at contaminated sites in Ontario were developed considering various receptors (*e.g.,* human and ecological), exposure pathways (*e.g.,* inhalation of vapours, leaching of chemicals into groundwater), exposure scenarios (*e.g.,* indoor worker, shorter-term construction worker scenarios) and other factors (*e.g.,* background levels in soil and groundwater). The final SCS typically represents the lowest of the individual component values. Therefore, an exceedance of the SCS does not necessarily indicate that concentrations are above levels considered to be protective of human health.

4.3.1 Contaminants of Concern in Soil

To determine if concentrations of COCs in soil are in excess of values protective of human health, maximum concentrations were compared to the MECP human health component values for coarse textured soils under an industrial/commercial/community land use. To reflect the most current scientific methodologies of the MECP, the MECP (2016) human health component values provided in the Modified Generic Risk Assessment (MGRA) model were revised using the most recently recommended MECP (2022) toxicity reference values (TRVs). The human health component values presented in Table 4-5 are protective of the following scenarios:

- S2 Soil Contact – Low-intensity, moderate-frequency soil ingestion and direct dermal contact for adults on a commercial/industrial property (adult outdoor maintenance worker).
- S3 Soil Contact – High-intensity, low-frequency soil ingestion, direct dermal contact, and inhalation of soil particulate protective of an adult worker digging in the soil (adult construction/subsurface worker).
- Commercial Soil to Indoor Air (S-IA) – Migration of chemical vapours from soil to indoor air under a commercial/industrial scenario (adult indoor worker); and,
- Soil to Outdoor Air (S-OA) – Migration of chemical vapours from soil to outdoor air (adult outdoor maintenance worker).

Table 4-5 Comparison of Maximum Concentrations of COCs in Soil to Human Health Component (µg/g)

COC	Maximum Concentration	S2 Soil Contact[a]	S3 Soil Contact[a]	Soil to Indoor Air (S-IA)[a]	Soil to Outdoor Air (S-OA)[a]
Metals and Inorganics					
Antimony	5	63	63	NA	NA
Arsenic	160	**18[c] (0.2)**	**18[c] (7.4)**	NA	NA
Barium	596	32,000	8,600	NA	NA
Beryllium	5	320	60	NA	NA
Boron (HWS)	7.5	NV	NV	NA	NA
Cadmium	2.0	7.9	7.9	NA	NA
Chromium (total)	235	240,000	240,000	NA	NA
Cobalt	210	250	2,500	NA	NA
Copper	1,640	1,900	1,900	NA	NA
EC (mS/cm)	1.42	NV	NV	NA	NA
Lead	697	**120[b]**	**120[b]**	NA	NA
Mercury	1.6	67	670	3.9	36
Molybdenum	7	1,200	1,200	NA	NA
Nickel	990	**310**	**310**	NA	NA
Selenium	7.2	1,200	1,200	NA	NA
Silver	0.6	490	490	NA	NA
Uranium	4.9	300	300	NA	NA

COC	Maximum Concentration	S2 Soil Contact[a]	S3 Soil Contact[a]	Soil to Indoor Air (S-IA)[a]	Soil to Outdoor Air (S-OA)[a]
Zinc	3,400	47,000	47,000	NA	NA
Polycyclic Aromatic Hydrocarbons (PAHs)					
Benzo(a)pyrene	0.64	0.7	17	5,400	68
Benzo(a)pyrene TPE	0.96	**0.7**	17	5,400	68
Dibenz(a,h)anthracene	0.11	0.7	26	880,000	790
Naphthalene	0.346	2,800	28,000	9.6	270
Petroleum Hydrocarbons (PHCs)					
PHC F2	32	22,000	48,000	380	25,000
PHC F3	670	40,000	260,000	NA	NA
PHC F4	300	42,000	400,000	NA	NA

Table 4-5 Comparison of Maximum Concentrations of COCs in Soil to Human Health Component (µg/g)

BOLDED values highlighted in grey are exceeded by the maximum on-site concentration.

NV Component value was not provided by the MECP as these chemicals were not considered to be a human health concern, or an appropriate TRV was not available.

NA Not applicable. Indicates that this chemical is insufficiently volatile to warrant assessment *via* this pathway.

[a] Component values are the MECP (2016) Table 3 human health component values for industrial/commercial/community properties with coarse textured soil (revised using the MECP (2022) TRVs).

[b] The MECP no longer endorses the use of the 2011 S2 and S3 component values (1,000 µg/g) and instead encourages the use of the Ontario background concentration (120 µg/g) as a screening benchmark.

[c] Value represents the Ontario background concentration when the MECP component value (in brackets) is lower than the background concentration.

Exposure to COCs in Soil for Outdoor Workers

Concentrations of arsenic, nickel, and benzo[a]pyrene TPE) were in excess of the S2 component values protective of long-term outdoor maintenance workers *via* direct contact and incidental ingestion of impacted soils. Concentrations of each of these chemicals (with the exception of benzo(a)pyrene TPE) also exceeded the S3 component values protective of short-term construction workers *via* direct contact, incidental ingestion, and inhalation of particulates. Due to general uncertainties in the toxicology of lead and a lack of regulatory guidance available for evaluating inhalation, oral, and dermal exposures, the MECP no longer endorses the use of the 2011 health-based component values and instead encourages the use of the Ontario background soil concentration (120 µg/g) as a screening benchmark. Concentrations of lead exceeded this background concentration.

The S2 (0.2 µg/g) and S3 (7.4 µg/g) component values for arsenic are lower than the Ontario background concentration (18 µg/g); therefore, the SCS defaults to the background concentration. Concentrations in excess of the background concentration were identified in eight (8) samples (38 µg/g in TP1-4 at 1.8-2.7 mbgs, 27 µg/g in TP2-4 at 1.8-2.4 mbgs, 26 µg/g in TP7-2 at 0.6-1.2 mbgs, 28 µg/g in TP10-2 at 0.6-1.2 mbgs, 21 µg/g in TP11-5 at 2.4-3.1 mbgs, 54 µg/g in TP14-7 at 3.1-3.7 mbgs, 33 µg/g in TP15-3 at 1.2-1.8 mbgs, and 160 µg/g in BH20-4 at 1.8-2.4 mbgs).

Exceedances of the S2 and S3 component values for nickel (310 µg/g) were restricted to a single sample (990 µg/g in TP14-7 at 3.1-3.7 mbgs). The exceedance of the S2 component value for benzo(a)pyrene TPE (0.7 µg/g) was also restricted to a single sample collected from TP1-4 at 1.8-2.4 mbgs.

Concentrations of lead in excess of the background concentration (120 µg/g) were identified in three (3) samples (697 µg/g in TP1-4 at 1.8-2.4 mbgs, 138 µg/g in TP7-2 at 0.6-1.2 mbgs, and 269 µg/g in TP14-7 at 3.1-3.7 mbgs)

Although many of the exceedances were identified in sub-surface soils to which long-term outdoor maintenance workers are unlikely to be exposed on a frequent or prolonged basis, it is recommended that measures are taken to prevent direct exposure to impacted on-site soils through the maintenance of existing capping measures, or the implementation of new measures. These exceedances were primarily identified in areas that are currently covered by gravel parking lots or grassed landscaping that may provide suitable protection against direct exposure to underlying impacted soils. It is recommended that a site inspection is conducted to ensure that impacted soils are not exposed to the surface. For areas where soils are exposed, or may become exposed through site redevelopment activities, new capping measures should be implemented. This may include the addition of hard caps (*e.g.*, asphalt, concrete, or paving stones) or soft caps consisting of a geotextile membrane covered by a minimum of 30 cm of clean topsoil to any areas that contain concentrations of COCs in excess of the S2 component values within 30 cm of the ground surface.

Concentrations of arsenic, lead, and nickel in on-site soils may represent a risk to workers involved in construction activities or underground utility maintenance as a result of incidental ingestion, dermal contact, and inhalation of particulates. Under the Ontario Occupational Health and Safety Act and Regulations for Construction Projects (OHSA), all construction workers "shall wear such protective clothing and use such personal protective equipment (PPE) or devices as necessary to protect the worker against the hazards to which the worker may be exposed" (O. Reg. 213/91, s. 21(2)). As such it is recommended that the appropriate PPE be employed as per OHSA during any on-site subsurface investigations. For construction workers, this would include the use of work gloves, long-sleeved shirts, and dust masks, as well as appropriate on-site hygiene, to minimize direct contact with impacted soils.

Concentrations of all COCs were below the S-OA component values protective of the inhalation of vapours in outdoor air. Therefore, it is not anticipated that COCs in on-site soil will result in unacceptable risks to outdoor workers *via* this pathway.

Exposure to COCs in Soil *via* the Inhalation of Vapours in Indoor Air

Concentrations of all COCs in soil were below the S-IA component values (where available) protective of the migration of vapours from soil to indoor air. Many COCs are considered to be insufficiently volatile to represent a potential concern *via* the inhalation of vapours. Therefore, based on the available data, concentrations of COCs in on-site soil are not considered to represent a risk to workers or site visitors *via* the inhalation of vapours in indoor air.

4.3.2 Contaminants of Concern in Groundwater

To determine which COCs in groundwater were in excess of values protective of human health, the maximum concentrations for COCs in groundwater were compared to the MECP human health component values for coarse textured soils under a commercial/industrial/community land use (Table 4-6). Under a non-potable groundwater scenario, human receptors have the potential to be indirectly exposed to COCs *via* the migration of vapours from groundwater to indoor air. To be protective of this scenario, the MECP has derived GW2 component values. Due to the presence of shallow groundwater (<3 mbgs) at the Site, the Table 7 GW2 values were selected for this comparison to account for the limited opportunity for vapours to attenuate prior to reaching the building foundation. To reflect the most current scientific methodologies of the MECP, the MECP (2016) human health component values provided in the MGRA model were revised using the most recently recommended MECP (2022) TRVs.

Construction workers may be exposed to groundwater COCs *via* the inhalation of vapours in trench air, inhalation of vapours in ambient air, as well as incidental ingestion and direct dermal contact with groundwater while spending time within a trench; however, the MECP has not provided health-based groundwater component values to be protective of these exposure pathways. As such, Intrinsik has derived RBCs to evaluate potential risks to construction workers exposed to groundwater COCs *via* these pathways (See Appendix A for derivation of RBCs). Although the outdoor maintenance worker would spend a similar amount of time outdoors as the construction worker while exposed to vapours in ambient air, the additional exposure pathways for the construction worker related to time spent within a trench or excavation make this receptor more susceptible to potential risks. Therefore, the inhalation of vapours in ambient outdoor air was only assessed for the construction worker.

Table 4-6 Comparison of Maximum Concentrations of COCs in Groundwater to Component Values and RBCs Protective of Human Health (µg/L)

COC	***Maximum Concentration***	***RBCs Protective of Trench Workers[a]***	***Table 7 Commercial GW2 Component Value[b]***
Volatile Organic Compounds (VOCs)			
Dichloroethylene, 1,1-	7.4	9,000	**1.2** (16.4)
Vinyl chloride (future condition)[c]	1.1	87	**0.12**
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benzo[a]pyrene	1.43	**0.49**	98
Benzo(a)pyrene TPE	2.1	**0.49**	98
Benzo[b]fluoranthene	1.50	8.5	2,400
Benzo[g,h,i]perylene	0.5	26	NV
Benzo[k]fluoranthene	0.95	5.0	3,000
Chrysene	1.90	68	2,800
Indeno[1,2,3-cd]pyrene	0.5	2.3	5,700

BOLDED values highlighted in grey are exceeded by the maximum on-site concentration.

(#) Value in brackets represents the GW2 component value directly protective of the COC when the MECP component value is based on the protection of future vinyl chloride concentrations based on degradation of parent compounds. Value was taken from column ET of the 'Physical Transport' tab of the MGRA model assuming a shallow groundwater condition.

a Represents the lower of the RBCs derived to be protective of non-carcinogenic and carcinogenic endpoints related to direct and indirect exposure to COCs in groundwater for construction/trench workers (See Appendix A for the derivation of RBCs).

b Component values are the MECP (2016) Table 7 human health component values for industrial/commercial/community properties with coarse textured soil (revised using the MECP (2022) TRVs).

c The future concentration of vinyl chloride presented is based on the maximum measured concentration in groundwater (<0.2 µg/L) plus 10% of the maximum concentration of each parent compound (*i.e.,* tetrachloroethylene, trichloroethylene, 1,1-dichloroethylene, *cis*-1,2-dichloroethylene, and *trans*-1,2-dichloroethylene) protective of future degradation to vinyl chloride.

<u>Exposure to COCs in Groundwater for Trench Workers</u>

As shown in Table 4-6, concentrations of benzo(a)pyrene and benzo(a)pyrene TPE in groundwater exceeded the RBC protective of construction/trench workers that may have direct and indirect contact with COCs in groundwater. Given that benzo(a)pyrene and other high molecular weight PAHs have limited volatility, exposure and risks related to the inhalation of vapours within a trench or in ambient ground-level are negligible. The primary pathway of concern for these PAHs is direct dermal contact with impacted groundwater. Given that the exceedance of the RBC is restricted to a single groundwater sample collected from MW17, it is not anticipated that construction/trench workers would have an opportunity to be exposed to groundwater within this area at a frequency and duration that would represent an unacceptable risk to these receptors. As a conservative measure, construction workers should follow appropriate OHSA regulations and use appropriate PPE during any on-site subsurface investigations to limit direct dermal contact with groundwater.

Exposure to COCs in Groundwater *via* the Inhalation of Vapours in Indoor Air

Although the maximum concentration of 1,1-dichloroethylene (7.4 μg/L) exceeded the MECP GW2 component value (1.2 μg/L), this component value is derived to be protective of potential future concentrations of vinyl chloride as a result of the degradation of parent compounds. When compared to the component value that is directly protective of 1,1-dichloroethylene (16.4 μg/L as presented in column ET of the 'Physical Transport' tab of the MGRA model with the depth to groundwater set at 40 cm to reflect a shallow groundwater condition), the maximum concentration was below this component value. Therefore, although there is the potential for 1,1-dichloroethylene to degrade and result in elevated concentrations of vinyl chloride which may represent a future risk, current concentrations of 1,1-dichloroethylene do not represent a risk to building occupants. In addition, although the theoretical future vinyl chloride concentration (1.1 μg/L) associated with the degradation of parent compounds exceeded the GW2 component value (0.12 μg/L), vinyl chloride was below detection in all eleven (11) groundwater samples. Further, concentrations of all parent compounds (*i.e.*, 1,1-dichloroethylene, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, tetrachloroethylene, and trichloroethylene) were also below detection in all groundwater samples, with the exception of a single sample collected from MW5 in which 1,1-dichloroethylene was measured at a concentration of 7.4 μg/L.

Therefore, based on the available data, it is not anticipated that vinyl chloride or parent compounds are present at concentrations in on-site groundwater that represent a potential risk to building occupants. It is recommended that an additional round of groundwater sampling is conducted to confirm the initial findings.

4.4 Potential Off-Site Health Risks

COCs in Soil

The re-suspension of on-site soils has the potential to result in wind-blown particulates travelling to off-site receptor locations. However, given that this is unlikely to result in the re-distribution of significant amounts of impacted soils to off-site properties, it is not anticipated that this pathway represents a potential risk to human health off-site. Therefore, COCs in on-site soil are not likely to result in an exceedance of the applicable Table 3 SCS or the occurrence of off-site human health risks at the nearest receptor location.

COCs in Groundwater

On-site groundwater is interpreted to flow to the south and southeast towards the St. Mary's River, and potentially to the vacant commercial/industrial property to the east. In the northwestern portion of the Site, groundwater may flow south to Canal Drive and the hydroelectric station beyond. As per O. Reg.153/04, potential risks to off-site receptors are primarily evaluated by assessing the potential for on-site contamination to result in an exceedance of the applicable SCS on off-site properties. Therefore, the potential for the seven (7) chemicals that were in excess of the Table 9 SCS (*i.e.*, 1,1-dichloroethylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene) to result in exceedances on off-site properties to the south and east was evaluated.

Concentrations of 1,1-dichloroethylene only exceeded the SCS in MW5 located in the northwestern portion of the Site. There are no additional wells located between MW5 and the downgradient property line. Therefore, there is the potential for the off-site migration of groundwater to the south to result in an exceedance of the SCS for 1,1-dichloroethylene on the property to the south (*i.e.*, the hydroelectric station). The off-site receptors with the greatest opportunity for exposure would be indoor workers *via* the inhalation of vapours in indoor air, and construction/trench workers that may be involved in excavation activities or underground utility maintenance; however, as shown in Section 4.3.2, concentrations of 1,1-dichloroethylene do not represent a potential risk to these workers (for both on-site and off-site receptors). It is recommended that MW5 is resampled to confirm the results of the initial investigation.

Exceedances for benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene were restricted to MW17 located along the eastern property line in the southern portion of the Site. Concentrations of PAHs were below detection in nine (9) of the eleven (11) monitoring wells. Measured concentrations for several PAHs were found in MW18; however, concentrations were below the Table 9 SCS. Based on the available groundwater data, the limited extent of PAH contamination in groundwater is not anticipated to represent a potential concern to off-site receptors to the south or east of the Site. Supplemental groundwater sampling is recommended for wells in the southern portion of the Site, including MW17, to confirm the initial sampling results.

Table 4-7 Potential for Off-Site Exceedances of the Site Condition Standards

COC	***Table 9 Standard (µg/L)***	***Locations of Potential Concern***	***Potential for Off-Site Exceedance***	***Potentially Affected Off-Site Property***	***Off-Site Receptors of Potential Concern***
1,1-Dichloroethylene	1.6	MW5 in the northwestern portion of the Site	Yes	Commercial/Industrial (Hydroelectric Station)	Indoor workers *via* migration of vapours to indoor air.
Benzo(a)pyrene	0.81	MW17 in the southeastern portion of the Site	Yes	Vacant Commercial/ Industrial Land	Construction workers *via* direct contact in a trench/excavation.
Benzo(b)fluoranthene	0.75				
Benzo(g,h,i)perylene	0.2				
Benzo(k)fluoranthene	0.4				
Chrysene	0.7				
Indeno(1,2,3-cd)pyrene	0.2				

5.0 ECOLOGICAL RISK ASSESSMENT

The ERA was conducted using scientific approaches that are generally consistent with O. Reg. 153/04 and in accordance with accepted practices and usual standards of thoroughness and competence for the profession of toxicology and environmental risk assessment.

5.1 Problem Formulation

The Site is an irregular-shaped parcel of land that covers an area of approximately 2.2 hectares, developed with a slab-on-grade commercial building and associated parking and landscaped areas. The surrounding properties consist primarily of commercial and industrial use. The Site is generally flat; however, the overall area has a gradual slope to the southeast towards the St. Mary's River located approximately 20 m to the south. The depth to groundwater was found to range from 1.57 to 3.26 mbgs. Groundwater is interpreted to flow to the south-southeast towards the St. Mary's River (Greenstone, 2023b). The Site is separated from the St. Mary's River by the Hub Trail (a paved walking/bike trail). It is Intrinsik's understanding that the Site will continue to be used for commercial purposes.

Greenstone (2023b) has indicated that for the purposes of the Phase Two ESA and the current DDRA, the Site is not considered to be located within an area of natural significance and does not include land that is within 30 m of an area of natural significance or part of such an area, and there are no threatened or endangered species that are anticipated to be utilizing the Site or adjacent properties as habitat. The Site has not been classified as a shallow soil property (*i.e.*, there is >2 m of overburden over more than two-thirds of the Site), and soils were conservatively classified as coarse-textured. Soil pH for surface and subsurface samples were within the acceptable MECP range. Therefore, the Site is not considered to be an environmentally sensitive area. Greenstone (2023b) has identified the applicable SCS as the Table 3 SCS for commercial/industrial/community properties with coarse textured soil for the portion of the Site greater than 30 m from the St. Mary's River, and the Table 9 SCS for all property uses for the portion of the Site within 30 m of the St. Mary's River.

The current assessment evaluated risks to ecological receptors assuming that receptors have the potential to have direct contact with all on-site soils without any barriers or restrictions.

5.1.1 Identification of Potential Ecological Receptors

Since the future commercial land use will not likely include the establishment of natural habitat but may include ornamental gardens and landscaping, protection of plants and soil invertebrates, and birds and mammals at a population or community level was considered to be the most appropriate assessment endpoint. Although topsoil will most likely be added to areas of the Site intended to support survival, growth, and reproduction of the valued ecological components (VECs), the current assessment assumed that ecological receptors would be exposed to levels of COCs in soil currently found on-site.

VECs are representative of groups of species that are common components of natural terrestrial and aquatic ecosystems in southern Ontario and include:

- Plant communities (*e.g.*, grasses, shrubs, trees);
- Soil invertebrate communities (*e.g.*, beetles, collembolans, earthworms);
- Bird populations; and,
- Small mammal populations.

The ERA assumed that terrestrial plants, such as grasses, herbaceous plants, shrubs, and both deciduous and coniferous trees would be exposed to COCs in soil *via* direct contact. Soil invertebrates include earthworms, insects, and other arthropods. Soil invertebrate exposure to soil is anticipated to occur through direct contact. It was assumed that the plants and soil invertebrates are essentially immobile with limited home ranges.

The Site is expected to be frequented by some common bird species that would consume earthworms and other invertebrates, as well as seeds or fruit. A few common mammals may also frequent the Site, such as skunk, hare, and raccoon, as well as small rodents. Voles and shrews are likely to receive relatively large chemical doses because they consume a large amount of food relative to their body weight. They also will commonly ingest soil during feeding.

The St. Mary's River is located within 30 m of the southern portion of the Site. Potential risks to aquatic organisms such as fish, invertebrates, amphibians, and aquatic plant species *via* incidental ingestion/direct contact with COCs in groundwater entering surface water were assessed to ensure that populations of these groups are able to successfully survive, grow, and reproduce. In addition, risks to benthic invertebrates exposed to COCs in soil *via* surface runoff to sediment were also assessed. It was conservatively assumed that the aquatic organisms are essentially immobile with limited home ranges.

5.1.2 Identification of Operable Exposure Pathways

Ecological receptors may be exposed to chemicals *via* any of several potential exposure pathways, such as ingestion, inhalation, and dermal contact. The exposure pathways that were considered to be applicable are described below for terrestrial plants, soil invertebrates, birds, mammals, and off-site aquatic VECs.

<u>Terrestrial Plants</u>

Terrestrial plants would be exposed to COCs in soil *via* direct contact (*i.e.*, root uptake). Therefore, exposure and risk to terrestrial plants are predicted by comparing concentrations of COCs in soil to concentrations that have been determined to be acceptable for growing plants.

Stem and/or foliar uptake of vapours is not considered to be a significant exposure pathway to COCs, relative to root uptake. Similarly, the resuspension of soils also has the potential to result in the deposition of particulates on to plant surfaces and the subsequent absorption of COCs; however, this is not considered to be a significant source of exposure relative to root uptake. In addition, methodologies for quantifying exposure *via* these pathways have not been identified within the scientific literature or within regulatory guidance.

<u>Soil Organisms</u>

The feeding and burrowing habits of soil invertebrates determine the exposure of these organisms to chemicals in soil. Some invertebrates, such as many earthworm species, are exposed to chemicals in soil because they ingest large amounts of soil during feeding. Other invertebrates that may be exposed to chemicals in the soil include mites, woodlice, snails and slugs, nematodes, insects, spiders, centipedes, carabid beetles, and many others. To assess exposure and risk to soil invertebrates, concentrations of COCs in soil were compared to concentrations that have been determined to be acceptable for soil invertebrate communities.

While gas exchange of soil-vapours by soil organisms may represent a potential exposure pathway, methods to quantify this exposure are not available and are beyond the scope of this

RA. It can be inherently assumed that the studies considered in the derivation of the benchmark soil concentrations protective of soil organisms would account for exposure from all potential routes, including gas exchange of soil-vapours.

<u>Terrestrial Wildlife</u>

Wildlife may be exposed to chemicals in the environment *via* three (3) distinct pathways: ingestion, inhalation, and dermal contact. Chemicals may be ingested through the consumption of impacted food and water, and by incidental ingestion of soil. Dermal exposure occurs when chemicals are absorbed through the skin as a result of direct contact with impacted soil. Dermal exposure is generally assumed to be negligible for birds and mammals. This is because feathers on birds and fur on mammals reduce dermal exposure by limiting the contact of skin with chemicals in soil (Sample *et al*., 1997). Exposure may occur *via* inhalation if chemicals are volatile, or if they are components of fine particulate matter, which may be re-suspended in ambient air. However, there is a paucity of available data describing the inhalation toxicity of chemicals to birds, and use of mammalian data is not possible due to the differences in avian and mammalian physiology. Inhalation toxicity data for mammalian wildlife are also limited for endpoints of interest in ERA (*e.g.*, reproduction). Food and soil ingestion tend to be the most significant routes of exposure, contributing the greatest to overall risk.

<u>Aquatic Life</u>

Aquatic life in off-site bodies of surface water have the potential to be exposed to COCs in groundwater *via* the migration of impacted groundwater to surface water. Common aquatic receptors, including various species of fish, invertebrates, amphibians, and aquatic plant species may be directly exposed to these COCs in surface water or within aquatic food webs. Although there is also the theoretical potential for foliar uptake of vapours, given the distance to the nearest surface water body, exposure *via* this pathway is considered to be negligible as vapours would be quickly diluted within the water column and the surrounding ambient air.

Benthic invertebrates have the potential to be exposed to COCs in soil from the southern portion of the Site *via* surface runoff to sediment.

5.1.3 Ecological Conceptual Site Model

The conceptual model provides an outline of the general exposure scenarios that were evaluated by bringing together the chemicals, receptors, and exposure pathways into one overall conceptual framework. Figure 5-1 provides the ecological conceptual model in the absence of RMMs.

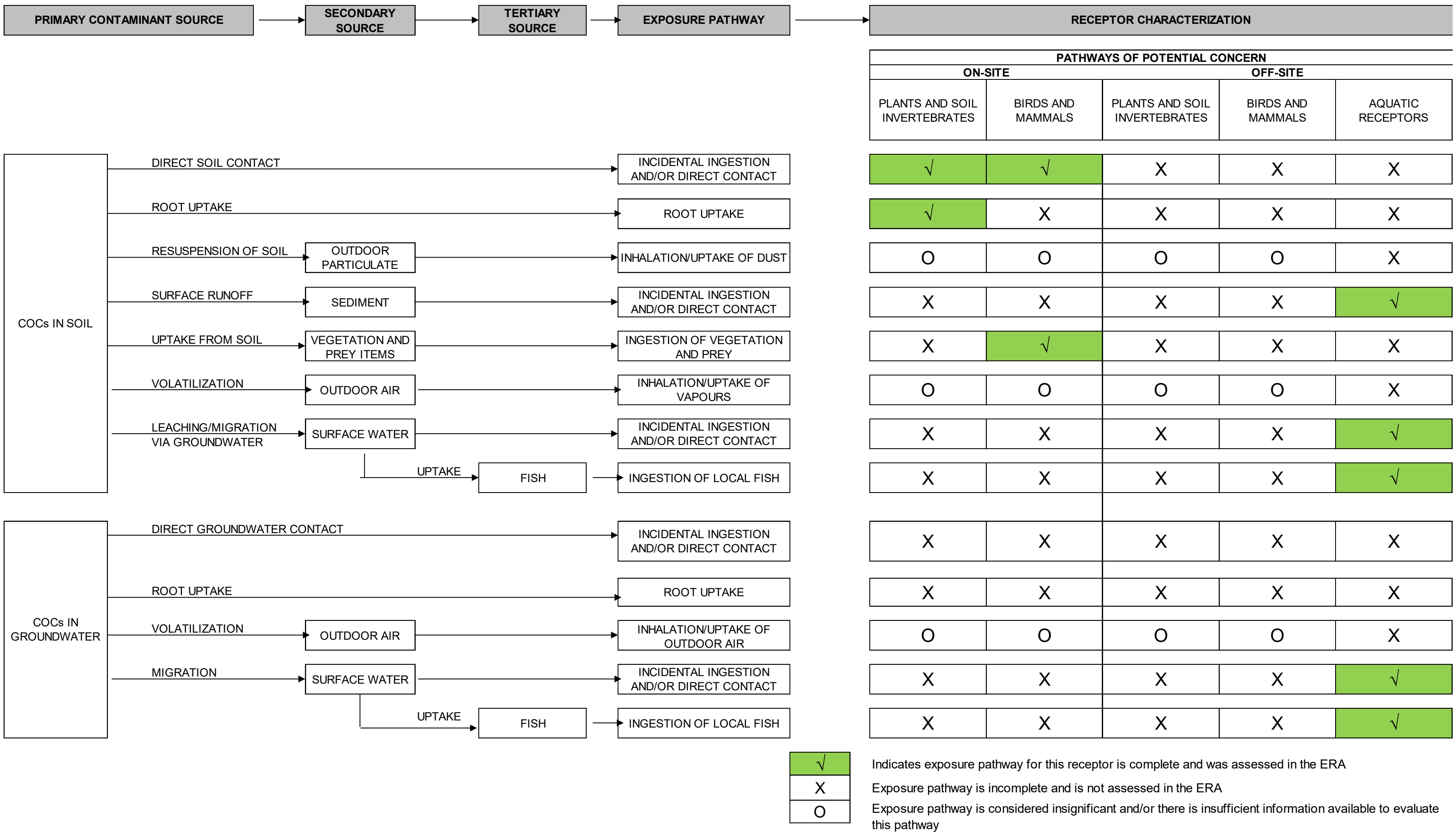

Figure 5-1 Ecological Conceptual Site Model

5.2 Exposure Assessment and Risk Characterization

The initial selection of COCs in soil was based on a comparison of the maximum concentrations to the Table 3 SCS for commercial/industrial/community property use with coarse textured soils for samples collected from locations greater than 30 m from the St. Mary's River, and a comparison of the maximum concentrations to the Table 9 SCS for all property uses for samples collected from locations within 30 m of the St. Mary's River. Based on these comparisons, concentrations of seven (7) chemicals in soil collected from locations greater than 30 m from the St. Mary's River exceeded the Table 3 SCS, and the maximum concentrations of twenty-one (21) chemicals in soil collected from locations within 30 m of the St. Mary's River exceeded the Table 9 SCS. Each of these chemicals were retained as COCs. Given that the proximity of soil samples to the St. Mary's River affects the interpretation of risks for certain ecological components/pathways, concentrations of COCs in soil from these areas of the Site were evaluated separately where appropriate.

The selection of COCs in groundwater was based on a comparison of the maximum concentrations to the Table 7 SCS (to account for the presence of shallow groundwater) and to the Table 9 SCS (to account for the close proximity of the St. Mary's River). The maximum measured concentrations of seven (7) chemicals in on-site groundwater exceeded the Table 7 and 9 SCS. Each of these chemicals (plus theoretical future vinyl chloride concentrations) in on-site groundwater were retained as COCs for further evaluation in the RA.

As described previously, the SCS represent the lowest of a series of component values designed to be protective of a number of human and ecological receptors. Therefore, an exceedance of the SCS does not necessarily indicate that concentrations are above those levels that are considered to be protective of ecological receptors.

The purpose of an ERA is to determine whether COCs in on-site soil and groundwater have the potential to result in unacceptable risks to ecological receptors. Therefore, the maximum concentrations or highest detection limits of COCs in on-site soil and groundwater that were in excess of the SCS were compared to the MECP component values protective of ecological receptors.

The following sections provide a qualitative evaluation of potential risks to on-site receptors as a result of exposure to COCs in soil and groundwater.

5.2.1 Contaminants of Concern in Soil

To further address the potential risks of COCs in soil to ecological receptors, the maximum concentration of each COC was compared to the MECP component values derived to be protective of birds/mammals, plants/soil organisms, and the leaching of chemicals from soil to groundwater and the subsequent movement to nearby surface water bodies (*i.e.*, the S-GW3 component values) (Table 5-1). For the portion of the Site within 30 m of the St. Mary's River, concentrations of COCs were also compared to the MECP sediment quality component value to be protective of benthic invertebrates *via* surface runoff of soils to sediment.

Table 5-1 Comparison of COC Concentrations in Soil to Ecological Component Values (µg/g)

COC	Maximum Concentration	MECP Component Values Protective of Ecological Receptors			
		Plants and Soil Organisms[a]	Birds and Mammals[a]	S-GW3[a]	Sediment Quality[b]
COCs in Soil for Locations Greater than 30 m from the St. Mary's River					
Arsenic	160	**40**	330	NV	-
Benzo(a)pyrene	0.64	72	46,000	3.8E+13	-
Boron (HWS)	7.5	**2**	NV	NV	-
Chromium (total)	235	500	**160**	NV	-
Copper	582	**230**	3,100	NV	-
Dibenz(a,h)anthracene	0.11	NV	NV	2.4E+13	-
Lead	697	1,100	**32**	NV	-
COCs in Soil for Locations Greater than 30 m from the St. Mary's River					
Antimony	3	40	1,500	NV	NV
Arsenic	54	**40**	330	NV	**6**
Barium	505	1,500	670	NV	NV
Beryllium	5	8	780	NV	NV
Cadmium	2.0	24	**1.9**	NV	**0.6**
Chromium (total)	106	500	160	NV	**26**
Cobalt	210	**80**	**180**	NV	**50**
Copper	1,640	**230**	3,100	NV	**16**
EC (mS/cm)	1.42	**1.4**	NV	NV	NV
Lead	269	1,100	**32**	NV	**31**
Mercury	0.4	50	20	1.2E+14	**0.2**
Molybdenum	5	40	74	NV	NV
Naphthalene	0.218	22	1,300	200	NV
Nickel	990	**270**	5,400	NV	**16**
PHC F2	32	260	NV	230	NV
PHC F3	670	1,700	NV	NV/NA	NV
PHC F4	300	3,300	NV	NV/NA	NV
Selenium	7.2	10	**5.5**	NV	NV
Silver	0.6	40	NV	NV	**0.5**
Uranium	4.9	2,000	33	NV	NV
Zinc	3,400	**600**	**340**	NV	**120**

BOLDED values highlighted in grey scale are exceeded by the maximum on-site concentration.

- Indicates that this is not an applicable pathway for the portion of the Site located greater than 30 m from the St. Mary's River.

NA Not applicable. This chemical is insufficiently mobile to represent a potential concern to off-site aquatic life.

NV indicates that the MECP has not provided a component value.

[a] Component values are the MECP Table 3 ecological component values for industrial/commercial/community property use with coarse textured soil.

[b] Component values are the MECP Table 9 ecological component values for all property use.

Risks to Plants/Soil Organisms and Birds/Mammals

Based on the comparison provided in Table 5-1, the maximum concentrations of numerous COCs in soil exceeded the component values protective of plants/soil organisms and birds/mammals. The MECP has not provided component values for PHCs protective of birds and mammals. Potential risks to mammalian and avian receptors were not assessed further, as consistent with CCME (2008). Most PHCs are readily metabolized by vertebrates and modified into forms that can be readily excreted (CCME, 2008). As a result, PHCs do not show a tendency for accumulation within animal tissues, nor are they readily absorbed and accumulated within the tissues of plants. Therefore, mammalian and avian receptors will not receive significant levels of exposure through food chain pathways. The CCME (2008) recognizes that there is limited information available describing the effects of exposure of terrestrial organisms to PHCs in soil, and in the development of the Canada Wide Standards for PHCs in soil considered the effects on soil invertebrates and plants only. This indicates the need to “preserve the principal ecological functions performed by the soil resource” (CCME, 2008).

Exceedances for one or more COCs were identified in numerous samples collected from varying depths across the Site, indicating that there is the potential for adverse effects to terrestrial ecological receptors that may be exposed to impacted soils. The MECP has developed a “modified ecological protection (MEP)” option within the MGRA Model, which is intended to both promote land redevelopment and preserve existing and potential future ecological habitat. This method provides property owners with a greener alternative to removing impacted soils or capping over ecological habitat. Using the MECP MGRA model and the MEP adjustment, modified ecological component values were derived for those soil COCs that exceeded the component values protective of plants/soil organisms and/or birds/mammals (Table 5-2).

Table 5-2 Comparison of COC Concentrations in Soil to Ecological Component Values with Modified Ecological Protection (µg/g)

COC	***Maximum Concentration***	***MECP Component Values with Modified Ecological Protection[a]***	
		Plants and Soil Organisms	***Birds/Mammals***
Arsenic	160	**76**	330,000
Boron (HWS)	7.5	**3.8**	NV
Chromium (total)	235	950	160,000
Cobalt	210	**150**	180,000
Copper	1,640	**430**	3,100,000
EC (mS/cm)	1.42	2.7	NV
Lead	697	2,100	32,000
Nickel	990	**510**	5,400,000
Selenium	7.2	19	5,500
Zinc	3,400	**1,100**	340,000

BOLDED values highlighted in grey scale are exceeded by the maximum on-site concentration.
NV No value. Indicates that the MECP has not provided a component value for this pathway/receptor group.
[a] Component values were derived using the MGRA model and modified ecological protection.

As shown in Table 5-2, with the application of the MEP factor, concentrations of all COCs were below the adjusted component values protective of birds/mammals. Concentrations of arsenic, boron (HWS), cobalt, copper, nickel, and zinc remain in excess of the component values protective of plants/soil organisms. This indicates that there may be adverse effects to these receptors in areas of the Site where elevated concentrations of these COCs are found in surface soils. Given that the Site does not contain natural habitat and consists of man-made landscaped areas, risks to plants and soil organisms may not represent a significant concern to property owners. If desired, potential adverse effects can be mitigated through the addition of clean topsoil to landscaped areas.

Risks to Off-Site Aquatic Life

Concentrations of all COCs in soil were below the S-GW3 component values (where available) protective of aquatic life *via* the leaching of COCs from soil to groundwater and the subsequent migration of groundwater to surface water.

The MECP has not provided S-GW3 component values protective of off-site aquatic organisms for PHC F3 and F4. Heavier fractions of PHCs (*i.e.*, F3 and F4) are considered to be insufficiently mobile to represent a potential concern to aquatic life *via* the migration of groundwater to off-site bodies of surface water. Therefore, PHC F3 and F4 are not anticipated to represent a potential risk to aquatic organisms in off-site surface water bodies. In addition, the MECP has not provided S-GW3 component values for metals and inorganics due to uncertainties associated with predicting the leaching of these chemicals from soil to groundwater. However, given that concentrations of all metals and inorganics in groundwater were below the Table 7 and 9 SCS, concentrations of these COCs in soil are not expected to represent a concern to aquatic life *via* leaching to groundwater and the subsequent migration of groundwater to surface water.

Therefore, no risks to aquatic life in off-site bodies of surface water are expected based on concentrations of COCs in soil.

Benthic Invertebrates

Concentrations of numerous metals in soil samples collected from within 30 m of the St. Mary's River exceeded the Sediment Quality component values protective of benthic invertebrates *via* surface runoff of soil to sediment. In addition, Sediment Quality component values are not available numerous additional COCs. This indicates that there is the potential for adverse effects to benthic invertebrates if impacted soils were to enter the St. Mary's River. Based on the current Site condition, it appears that soils within the southern portion of the Site are covered by a continuous layer of grass which would prevent surface runoff over the Hub Trail to the river. Measures should be taken to ensure that soils in this area continue to be covered by grass or other materials that would prevent surface runoff. Sediment fencing should be utilized during any activities that may result in the temporary redistribution or exposure of impacted soils.

5.2.2 Contaminants of Concern in Groundwater

To further address the potential risks of COCs in groundwater to ecological receptors, the maximum concentrations of those chemicals retained as COCs were compared to the Table 9 GW3 component values protective of aquatic receptors in off-site bodies of surface water (Table 5-3). The Table 9 GW3 component values assume that due to the proximity of the Site to surface water, concentrations of COCs will not attenuate as groundwater migrates from the Site to surface water. These GW3 values represent a surface water concentration protective of aquatic life multiplied by a 10-fold factor to account for dilution of groundwater in the receiving water body.

Table 5-3 Comparison of Maximum Concentrations of COCs in Groundwater to Component Values Protective of Aquatic Life (µg/L)

COC	*Maximum Concentration*	*Table 9 GW3*[a]
Volatile Organic Compounds (VOCs)		
Dichloroethylene, 1,1-	7.4	12,000
Vinyl chloride (future condition)[c]	1.1	360,000
Polycyclic Aromatic Hydrocarbons (PAHs)		
Benzo[a]pyrene	1.43	2.1
Benzo[b]fluoranthene	1.50	4.2
Benzo[g,h,i]perylene	0.5	**0.2**

Table 5-3 Comparison of Maximum Concentrations of COCs in Groundwater to Component Values Protective of Aquatic Life (µg/L)

COC	***Maximum Concentration***	***Table 9 GW3[a]***
Benzo[k]fluoranthene	0.95	1.4
Chrysene	1.90	**0.7**
Indeno[1,2,3-cd]pyrene	0.5	1.4

BOLDED values highlighted in grey scale are exceeded by the maximum on-site concentration.

[a] Component values are the MECP (2016) Table 9 GW3 component values for properties with coarse textured soil.

[c] The future concentration of vinyl chloride presented is based on the maximum measured concentration in groundwater (<0.2 µg/L) plus 10% of the maximum concentration of each parent compound (*i.e.,* tetrachloroethylene, trichloroethylene, 1,1-dichloroethylene, *cis*-1,2-dichloroethylene, and *trans*-1,2-dichloroethylene) protective of future degradation to vinyl chloride.

Risks to Aquatic Life

The maximum concentrations of benzo(g,h,i)perylene (0.5 µg/L) and chrysene (1.9 µg/L) exceeded the GW3 component values (0.2 and 0.7 µg/L, respectively). Exceedances of the GW3 values were restricted to MW17. Concentrations of benzo(g,h,i)perylene were below detection (<0.1 µg/L) in the remaining ten (10) monitoring wells. Chrysene was below detection (<0.05 µg/L) in nine (9) monitoring wells, and was measured at a concentration (0.22 µg/L) below the GW3 component value in MW18.

Based on the available groundwater data, the limited extent of PAH contamination in groundwater is not anticipated to represent a potential concern to aquatic life in the St. Mary's River. Supplemental groundwater sampling is recommended for wells in the southern portion of the Site, including MW17, to confirm the initial sampling results.

6.0 DISCUSSION OF UNCERTAINTY

The selection of COCs involved a comparison of the maximum measured concentration (or highest detection limit) of each chemical analyzed in soil and groundwater to the relevant SCS. It was assumed that the soil and groundwater samples collected as part of the Phase Two ESA conducted by Greenstone provide an accurate representation of on-site conditions. Despite this, it is possible that concentrations in excess of those reported may exist in areas of the Site. However, given the distribution of sampling locations throughout the Site, any areas of contamination not identified in the available data are likely to be isolated and not anticipated to significantly influence the outcome of the RA. The spatial variability of the sampling locations provided were considered to be adequate to meet the objectives of the RA.

6.1 Uncertainties in the HHRA

The following discussion describes areas of uncertainty in the HHRA and the degree of conservatism in the assumptions made to address those uncertainties. Given the general tendency for the assumptions to overestimate exposure, toxicity, and risk, it is considered likely that the overall risk characterization may have overestimated actual risks by a considerable degree but is unlikely to have underestimated potential health risks.

- Use of the maximum soil and groundwater concentrations to predict risks to human receptors likely resulted in an overestimation of exposure given that receptors are not anticipated to spend prolonged durations exposed to isolated areas of soil and groundwater;
- The on-site exposure durations assumed by the MECP in the derivation of the human health component values for the indoor worker (entire adult lifetime), outdoor maintenance worker (entire adult lifetime), and the construction worker (1.5 years) are considered to be highly conservative. In addition, the RBCs derived by Intrinsik assumed that the construction worker would be involved in excavation/trench activities in an area with the maximum concentration of each COC in groundwater for 195 days per year for 1.5 years. It is considered to be highly unlikely that any one person would be required to spend this amount of time in any one given area. In addition, it can be reasonably anticipated that indoor workers and outdoor maintenance workers will not spend an entire adult lifetime at a single occupation; and,
- Exposure to indoor air *via* volatilization for the indoor worker assumed that the maximum measured soil and groundwater concentrations for COCs existed below the entire footprint of the building. Since it is more likely that a range of concentrations will exist within the zone of influence, it is anticipated that the comparison of maximum concentrations to the MECP S-IA and GW2 component values represents an overestimation of risks for most future building scenarios.

Additional areas of uncertainty exist that may have varying degrees of influence on the exposure assessment. This includes:

- In the assessment of exposure to the construction worker while working within an on-site trench, it was assumed that the wind speed through the trench (*i.e.*, 102.5 cm/sec) was ¼ of the wind speed recommended by the MOE (2011) for ground surface (*i.e.*, 410 cm/sec). Although this is considered to be a realistic yet conservative assumption, predicted air concentrations and exposure *via* inhalation would be underestimated if actual wind speeds were lower than the value used within the RA.

- The vapour infiltration exposure pathway is, in part, based on vapour infiltration models, which were generally based on a number of studies involving measurements of advective flow of radon from soil air into buildings. Many of the methods developed are theoretical in nature and have not been extensively validated with empirical data. However, the methodologies can be used to provide a conservative estimate of exposure to vapours from the subsurface sources if some of the following assumptions and limitations are considered:

  - Contaminant vapours enter the structure through cracks and openings in the walls and foundation;
  - Convective transport or pressure driven flow occurs primarily within the building zone of influence;
  - Unless the floors and walls are perfect vapour barriers, all vapours originating from below the building will enter the building;
  - All soil properties in any one horizontal layer are homogenous;
  - The contaminant is evenly mixed within the zone of contamination;
  - The extent of contamination is greater than that of the building floor in contact with the soil;
  - The model does not account for transformation processes (*e.g.*, biodegradation, etc.); and,
  - The building ventilation rate and the difference in pressure between the interior of the structure and the soil surface are considered to be constant.

In any RA, the findings are based on available data from the specific site and the scientific literature, in conjunction with a number of assumptions. Every effort is made to ensure these data and assumptions adequately represent conditions for the Site. However, site-specific data can be limited which can result in uncertainty in the assessment. Where uncertainty exists, assumptions are made, and data are selected so as to err on the conservative side, where possible.

Overall, individual conservative assumptions made in the HHRA contribute to a potential overestimation of the actual risks. This overestimation is further magnified by the potential compounding effects of multiple conservative assumptions that were applied throughout the exposure and risk characterization phases.

6.2 Uncertainties in the ERA

In any RA, the findings are based on available data from the specific site, and the scientific literature, in conjunction with a number of assumptions. Every effort was made to ensure these assumptions and data adequately represent conditions at the site. However, data and scientific understanding of key environmental processes and factors can often be limited, resulting in uncertainty in the assessment. Varying degrees of uncertainty are introduced at all stages of the RA process. In order to clearly interpret the results of any RA, the major sources of uncertainty must be acknowledged and documented. Where uncertainty exists, assumptions are made, and data are selected to be on the conservative side. This ensures that potential impacts are much more likely to be overestimated rather than understated. This precautionary approach is in accordance with the ultimate goals of RA - protection of the environment. Some key sources of uncertainty associated with the current ERA include:

- To be consistent with the MECP's preferred approach for the completion of ERAs, the exposure assessment was conducted using the maximum concentrations of COCs for predicting exposure rather than using descriptive statistics on the sampling data. As a result, it is anticipated that exposure to ecological communities are significantly overestimated. Recognizing that it is the goal of the ERA to be protective of communities of plants/soil invertebrates and birds/mammals, use of the maximum concentrations to represent the EPCs will overestimate exposure to the communities as a whole and is a more accurate approach to be protective of individual organisms. Assuming that every individual organism within these communities are exposed to the maximum concentration (regardless of sample depth) is anticipated to significantly overpredict exposure and subsequently, risks to these communities;

- Comparing maximum soil concentrations to the MECP component values for birds and mammals assumes that mobile receptors would only consume plants and/or earthworms growing in soil with the maximum concentration for each COC. Incidental ingestion of soil for these wildlife also assumes that only soil with the maximum concentration for each COC is consumed. In reality, mobile receptors would likely forage over a larger area and be exposed to a wide range of COC concentrations in soil and food items;
- The MECP's use of uptake factors or regression equations to predict concentrations of COCs in food items inherently assumes that the form of the chemical in on-site soil and the soil characteristics are similar to those associated with the study used to derive these factors. If conditions at the site differ significantly from those within the study, there will be uncertainty in the applicability of these factors for predicting exposure;
- The soil ingestion rates, dietary compositions, and dietary consumption rates used by the MECP in the derivation of the birds/mammals component values were taken from reputable sources but may have been based on animals in captivity. These values may not be completely representative of parameters for individuals in the wild. This may result in the over- or underestimation of exposure;
- Since the use of a dose extrapolation method from test species to target species is not generally accepted, the MECP's use of TRVs for the avian and mammalian test species were selected as a surrogate for the selected VECs. This inherently assumes that these species will have a similar toxicological response as the test species. If the target species are more or less sensitive than the test species, risks may be over or under-predicted, respectively. The chemical form of the COC used to derive the TRV may differ from the form found in on-site soils or in food items; and,
- The MECP plants/soil organism component values are meant to be conservative values designed to rule out risks, rather than predict risks. That is, concentrations below these levels can safely be assumed to not result in unacceptable impacts. However, concentrations which exceed these levels do not necessarily imply adverse effects will occur. Although individual benchmark concentrations were not derived for plants and soil invertebrates by the MECP, the selected values are assumed to be protective of both types of receptors. However, even though these benchmarks are protective of both receptor types, there are differences in sensitivities to exposures and use of these values to predict risks may over predict risks to the less sensitive of the two groups.

7.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Intrinsik was retained by Greenstone on behalf of SIS Group to assess potential risks to human health and ecological receptors associated with contaminants identified in on-site soil and groundwater at 10, 29 and 35 Canal Drive, Sault Ste. Marie, Ontario (the 'Site'). This was determined by conducting a screening-level evaluation as part of a DDRA, where concentrations of chemicals present in soil and groundwater were compared to the MECP SCS and the associated component values derived to be protective of human health and the environment.

This assessment was conducted using scientific approaches that are generally consistent with O. Reg.153/04 and in accordance with accepted practices and usual standards of thoroughness and competence for the profession of toxicology and environmental risk assessment. The assessment was prepared for internal due diligence purposes and not for submission to the MECP for the purpose of obtaining an RSC. It was based exclusively on the site characterization information provided by Greenstone.

Based on the available data, the results of the assessment of potential human health and ecological risks related to concentrations of COCs in on-site soil and groundwater indicated the following:

<u>Human Health Risk Assessment</u>

- Concentrations of arsenic, nickel, and PAHs in soil were in excess of the MECP S2 component values protective of long-term outdoor maintenance workers that may have frequent direct contact with impacted soils. Additionally, concentrations of lead exceeded the Ontario background concentration that has been deemed to be protective of outdoor workers. Although many of the exceedances were identified in sub-surface soils to which long-term outdoor maintenance workers are unlikely to be exposed on a frequent or prolonged basis, it is recommended that measures are taken to prevent direct exposure to impacted on-site soils through the maintenance of existing capping measures, or the implementation of new measures. These exceedances were primarily identified in areas that are currently covered by gravel parking lots or grassed landscaping that may provide suitable protection against direct exposure to underlying impacted soils. It is recommended that a site inspection is conducted to ensure that impacted soils are not exposed, and for areas where soils are exposed, or may become exposed through site redevelopment or maintenance activities, new capping measures should be implemented. This may include the addition of hard caps (*e.g.*, asphalt, concrete, or paving stones) or soft caps consisting of a geotextile membrane covered by a minimum of 30 cm of clean topsoil to any areas that contain concentrations of COCs in excess of the S2 component values within 30 cm of the ground surface.

- Concentrations of arsenic, lead, and nickel in on-site soils may represent a risk to workers involved in construction activities or underground utility maintenance as a result of incidental ingestion, dermal contact, and inhalation of particulates. Under OHSA, all construction workers "shall wear such protective clothing and use such PPE or devices as necessary to protect the worker against the hazards to which the worker may be exposed" (O. Reg. 213/91, s. 21(2)). As such it is recommended that the appropriate PPE be employed as per OHSA during any on-site subsurface investigations. For construction workers, this would include the use of work gloves, long-sleeved shirts, and dust masks, as well as appropriate on-site hygiene, to minimize direct contact with impacted soils.

- Concentrations of all COCs were below the S-OA component values protective of the inhalation of vapours in outdoor air. Therefore, it is not anticipated that COCs in on-site soil will result in unacceptable risks to outdoor workers *via* this pathway.

- Concentrations of COCs in on-site soil and groundwater were below the MECP component values protective of indoor workers *via* the migration of vapours to indoor air. Although there is the potential for 1,1-dichloroethylene in groundwater to degrade and result in elevated concentrations of vinyl chloride which may represent a future risk, vinyl chloride was below detection in all eleven (11) groundwater samples. In addition, concentrations of all parent compounds (*i.e.*, 1,1-dichloroethylene, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, tetrachloroethylene, and trichloroethylene) were also below detection in all groundwater samples, with the exception of a single sample collected from MW5 in which 1,1-dichloroethylene was measured at a concentration of 7.4 µg/L.

    - Based on the available data, it is not anticipated that vinyl chloride or parent compounds are present at concentrations in on-site groundwater that represent a potential risk to building occupants. Supplemental groundwater sampling is recommended for wells in the northwestern portion of the Site, including MW5, to confirm the initial sampling results.

- Concentrations of PAHs in groundwater exceeded the RBC protective of construction/trench workers *via* direct contact with groundwater. Given that the exceedance of the RBC is restricted to a single groundwater sample collected from MW17, it is not anticipated that construction/trench workers would have an opportunity to be exposed to groundwater within this area at a frequency and duration that would represent an unacceptable risk to these receptors. As a conservative measure, construction workers should follow appropriate OHSA regulations and use appropriate PPE during any on-site subsurface investigations to limit direct dermal contact with groundwater.

Ecological Risk Assessment

- Concentrations of metals/inorganics, PAHs, and PHCs in on-site soil exceeded the MECP component values protective of plants/soil organisms and birds/mammals. This indicates that there may be adverse effects to these receptors in areas of the Site where elevated concentrations of these COCs are found in surface soils. Given that the Site does not contain natural habitat and consists of man-made landscaped areas, risks to terrestrial ecological receptors may be limited. Potential adverse effects can be mitigated through the addition of clean topsoil to landscaped areas.

- Concentrations of metals/inorganics in soil samples collected from within 30 m of the St. Mary's River exceeded the MECP Sediment Quality component values protective of benthic invertebrates *via* surface runoff of soil to sediment. Based on the current Site condition, it appears that soils within the southern portion of the Site are covered by a continuous layer of grass which would prevent surface runoff over the Hub Trail to the St. Mary's River. Measures should be taken to ensure that soils in this area continue to be covered by grass or other materials that would prevent surface runoff. Sediment fencing should be utilized during any activities that may result in the temporary redistribution or exposure of impacted soils.

- Concentrations of benzo(g,h,i)perylene and chrysene in groundwater exceeded the MECP GW3 component values protective of aquatic life *via* the migration of groundwater to surface water. Exceedances of the GW3 values were restricted to MW17. Concentrations of benzo(g,h,i)perylene were below detection in the remaining ten (10) monitoring wells. Chrysene was below detection in nine (9) monitoring wells, and was measured at a concentration below the GW3 component value in MW18.
    - Based on the available data, the limited extent of PAH contamination in groundwater is not anticipated to represent a potential concern to aquatic life in the St. Mary's River. Supplemental groundwater sampling is recommended for wells in the southern portion of the Site, including MW17, to confirm the initial sampling results.

<u>Off-Site Assessment</u>

- On-site groundwater is interpreted to flow to the south and southeast towards the St. Mary's River, and potentially to the vacant commercial/industrial property to the east. In the northwestern portion of the Site, groundwater may flow south to Canal Drive and the hydroelectric station beyond.

- Concentrations of 1,1-dichloroethylene in groundwater only exceeded the SCS in MW5 located in the northwestern portion of the Site. There are no additional wells located between MW5 and the downgradient property line. Therefore, there is the potential for the off-site migration of groundwater to the south to result in an exceedance of the SCS for 1,1-dichloroethylene on the property to the south (*i.e.*, the hydroelectric station). The off-site receptors with the greatest opportunity for exposure would be indoor workers *via* the inhalation of vapours in indoor air, and construction/trench workers that may be involved in excavation activities or underground utility maintenance; however, concentrations of 1,1-dichloroethylene do not represent a potential risk to these workers. It is recommended that MW5 is resampled to confirm the results of the initial investigation.

- Exceedances for PAHs in groundwater were restricted to MW17 located along the eastern property line in the southern portion of the Site. Concentrations of PAHs were below detection in nine (9) of the eleven (11) monitoring wells. Measured concentrations for several PAHs were found in MW18; however, concentrations were below the Table 9 SCS. Based on the available groundwater data, the limited extent of PAH contamination in groundwater is not anticipated to represent a potential concern to off-site receptors to the south or east of the Site. Supplemental groundwater sampling is recommended for wells in the southern portion of the Site, including MW17, to confirm the initial sampling results.

8.0 DOCUMENT SIGN-OFF

LIMITATIONS AND DISCLAIMER

Intrinsik was retained by Greenstone on behalf of SIS Group to assess potential risks to human health and ecological receptors associated with contaminants identified in on-site soil and groundwater at 10, 29, and 35 Canal Drive, Sault Ste. Marie, Ontario (the 'Site'). The conclusions and recommendations provided within this report are based exclusively on the site characterization information provided within the Phase One and Two ESAs prepared by Greenstone (2023a,b). It is assumed that the data provided by Greenstone provides an accurate representation of on-site conditions. Concentrations in excess of those reported may exist in areas of the Site, therefore, the accuracy of the risk estimates provided in this report are limited by the available site characterization data.

Intrinsik provided this report for Greenstone and SIS Group solely for the purpose stated in the report. Intrinsik does not have, and does not accept, any responsibility or duty of care whether based in negligence or otherwise, in relation to the use of this report in whole or in part by any third party. Any alternate use, including that by a third party, or any reliance on or decision made based on this report, are the sole responsibility of the alternative user or third party. Intrinsik does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Intrinsik makes no representation, warranty, or condition with respect to this report or the information contained herein other than that it has exercised reasonable skill, care, and diligence in accordance with accepted practice and usual standards of thoroughness and competence for the profession of toxicology and environmental assessment to assess and evaluate information acquired during the preparation of this report. Any information or facts provided by others and referred to or utilized in the preparation of this report, is believed to be accurate without any independent verification or confirmation by Intrinsik. This report is based upon and limited by circumstances and conditions stated herein, and upon information available at the time of the preparation of the report.

Intrinsik has reserved all rights in this report, unless specifically agreed to otherwise in writing with Greenstone and SIS Group.

Yours sincerely,
INTRINSIK CORP.

Adam Safruk, B.Sc., MES, QP_{RA}
Senior Environmental Health Scientist

9.0 REFERENCES

Greenstone. 2023a. Phase I Environmental Site Assessment. Site: 10, 29, & 35 Canal Drive, Sault Ste. Marie, Ontario. Greenstone Environmental Engineering Ltd. December 12, 2023.

Greenstone. 2023b. Phase II Environmental Site Assessment. Site: 10, 29, & 35 Canal Drive, Sault Ste. Marie, Ontario. Greenstone Environmental Engineering Ltd. December 12, 2023.

Health Canada 2012. Federal Contaminated Risk Assessment in Canada Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Health Canada, Environmental Health Assessment Services, Safe Environments Programme. Version 2.0. Revised and released 2012.

Health Canada. 2021. Federal Contaminated Site Risk Assessment in Canada, Part V: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Version 3.0. Health Canada, Ottawa.

MECP. 2011. Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario, revised version April 15, 2011. Standards Development Branch, Ontario Ministry of the Environment, Conservation, and Parks (formerly the Ministry of the Environment and Climate Change).

MECP. 2016. Modified Generic Risk Assessment Approved Model. Queen's Printer for Ontario, 2016. November 1, 2016. Standards Development Branch, Ontario Ministry of the Environment, Conservation, and Parks (formerly the Ministry of the Environment and Climate Change).

MECP. 2022. Human Health Toxicity Reference Values (TRVs) Selected for Use at Contaminated Sites in Ontario. Prepared by: Human Toxicology and Air Standards Section, Technical Assessment and Standards Development Branch, Ontario Ministry of the Environment, Conservation and Parks. December 2022.

Sample, B.E., Aplin, M.S., Efroymson, R.A., Suter II, G.W., and Welsh, C.J.E. 1997. Methods and tools for estimation of the exposure of terrestrial wildlife to contaminants. ORNL/TM-13391. Oak Ridge National Laboratory, Oak Ridge, TN.U.S. EPA. 1989. Risk Assessment Guidance for Superfund. U.S. Environmental Protection Agency, Washington, DC. EPA.

U.S. EPA. 2004. User's Guide for Evaluating Subsurface Vapour Intrusions into Buildings. United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C., February, 2004.

U.S. EPA. 2023. Composite Worker Air RSL November 2023 HQ01. United States Environmental Protection Agency Regional Screening Levels. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

APPENDIX A

DERIVATION OF RISK-BASED CONCENTRATIONS PROTECTIVE OF THE CONSTRUCTION WORKER VIA GROUNDWATER EXPOSURE PATHWAYS

APPENDIX A: DERIVATION OF RISK-BASED CONCENTRATIONS PROTECTIVE OF THE CONSTRUCTION WORKER VIA GROUNDWATER EXPOSURE PATHWAYS

A-1.0 INTRODUCTION

This appendix provides technical information related to the determination of whether exposure to contaminants of concern (COCs) in groundwater may pose unacceptable risks to construction workers. Construction workers may be exposed to groundwater COCs *via* the inhalation of vapours in trench air, inhalation of vapours in ambient air, direct dermal contact with and incidental ingestion of groundwater. However, the MECP has not provided health-based component values protective of these exposure pathways. As such, Intrinsik has derived risk-based concentrations (RBCs) to evaluate potential risks to construction workers exposed to groundwater COCs *via* these pathways. The technical information related to the derivation of these RBCs is presented in this appendix.

The estimation of exposure to COCs was based on the following parameters:

- The physical/chemical characteristics of COCs which determine the interaction and behaviour of a chemical with its surrounding environment (*e.g.*, water solubility, volatility, tendency to bind to particles);
- The characteristics of the environmental compartments at the site (*e.g.,* air, soil, subsurface soil and water), as well as the quantities of chemicals entering the compartments from various sources, and their persistence in these compartments;
- The behavioural and lifestyle characteristics of the human receptors that determine the actual exposures through interactions of the receptors with the various pathways (*e.g.,* respiration rate, body weight); and,
- The equations and algorithms used to predict exposures to the receptors.

This appendix has been divided into five (5) main components: human receptor characteristics (Section A-2.0), exposure assessment (Section A-3.0), toxicity assessment (Section A-4.0), risk characterization (Section A-5.0), and the derivation of risk-based concentrations (Section A-6.0).

A-2.0 HUMAN RECEPTOR CHARACTERISTICS

This appendix provides an evaluation of exposure and risks to an adult construction worker. The characteristics of the adult age group used in the current assessment are outlined in Table A-1. The MECP Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario (MECP, 2011), the Compendium of Canadian Human Exposure Factors for Risk Assessment (Richardson, 1997) and and the US Environmental Protection Agency (U.S. EPA, 1989) were the key sources of human exposure parameters used in the current assessment.

Table A-1 Receptor Characteristics for the Adult Construction/Trench Worker (20 years +)

Receptor Parameter	*Point Estimate*	*Description*	*Reference*
Body Weight (kg)	70.7	Arithmetic mean for male and female adults combined	MECP, 2011; Richardson, 1997
Body Weight (kg) – for development effects	63.1	Arithmetic mean for female adults	MECP, 2011; Richardson, 1997

Table A-1	Receptor Characteristics for the Adult Construction/Trench Worker (20 years +)		
Receptor Parameter	***Point Estimate***	***Description***	***Reference***
Surface Area of Hands (m^2)	0.089	Arithmetic mean for male and female adults combined	Health Canada, 2009; Richardson, 1997
Surface Area of Hands (m^2) – for developmental effects	0.082	Arithmetic mean for female adults	Richardson, 1997
Incidental Ingestion of Groundwater (L/day)	0.05	Value is based on incidental ingestion of surface water while swimming (L/hour). Construction worker was assumed to ingest 0.05 L for each day on-site.	U.S. EPA, 1989

A-3.0 EQUATIONS AND ALGORITHMS USED TO ESTIMATE HUMAN EXPOSURE RATES

The purpose of the following sections is to provide a worked example outlining how exposure estimates for the construction/trench worker, which are used to derive RBCs, were calculated for COCs in groundwater. The maximum concentration of COCs in groundwater are presented in Table A-2.

Table A-2	Maximum Concentrations of COCs in Groundwater (µg/L)
COC	***Maximum Concentration***
Volatile Organic Compounds (VOCs)	
Dichloroethylene, 1,1-	7.4
Vinyl chloride (future condition)[a]	1.1
Polycyclic Aromatic Hydrocarbons (PAHs)	
Benzo[a]pyrene	1.43
Benzo(a)pyrene TPE	2.1
Benzo[b]fluoranthene	1.50
Benzo[g,h,i]perylene	0.5
Benzo[k]fluoranthene	0.95
Chrysene	1.90
Indeno[1,2,3-cd]pyrene	0.5

[a] The future concentration of vinyl chloride presented is based on the maximum measured concentration in groundwater (<0.2 µg/L) plus 10% of the maximum concentration of each parent compound (*i.e.*, tetrachloroethylene, trichloroethylene, 1,1-dichloroethylene, *cis*-1,2-dichloroethylene, and *trans*-1,2-dichloroethylene) protective of future degradation to vinyl chloride.

A-3.1 Exposure via Inhalation of Vapours Migrating from Groundwater within an On-Site Trench

While spending time working within an on-site trench, it was assumed that a construction worker would be exposed to COCs *via* inhalation of vapours migrating from underlying groundwater along the bottom of the trench. This exposure was predicted by estimating the volatilization rates and the effect that it would have on the air concentrations within the trench. This receptor was assumed to be exposed to these vapours for 2 hours per day, 195 days per year for 1.5 years.

A groundwater volatilization factor (VF_{wamb}) was calculated based on the methodologies recommended by the Atlantic Partnership in RBCA (Risk-Based Corrective Action) Implementation (PIRI) (RBCA, 1995). The groundwater volatilization factor is the steady-state ratio of the concentration of a chemical in ambient air to the concentration in underlying impacted groundwater. Vapour flux rates from groundwater to soil vapour and subsequently from soil vapour to outdoor air are typically lower than the flux rates associated with volatilization directly from impacted soils (RBCA, 1995). As a result, the groundwater to outdoor air exposure pathway is generally not significant relative to the soil to outdoor air pathway. The VF_{wamb} factor accounts for the steady state partitioning of dissolved chemicals in groundwater to the soil vapour phase, the flux rate of soil vapour to trench air, and the mixing of soil vapours within the trench.

The VF_{TGW} was calculated as follows:

$$VF_{TGW} = \frac{H \ x \ C}{1 + \left(\frac{(U_{air} \ x \ \delta_{air} \ x \ L_{GW})}{D_{eff\ GW} \ x \ W} \right)}$$

where:

VF_{TGW}	=	Groundwater volatilization factor for trench air (mg/m^3-air/mg/L-water)
H	=	Henry's law constant (unitless)
C	=	Conversion factor (1,000 cm^3-kg/m^3-g)
U_{air}	=	Wind within the trench (102.5 cm/s)
δ_{air}	=	Mixing zone height within trench (200 cm)
L_{GW}	=	Depth to groundwater from bottom of trench (10 cm)
$D_{eff\ GW}$	=	Effective molecular diffusion above groundwater table (cm^2/s)
W	=	Width of source area parallel to wind (1,000 cm)

From the above equation, $D_{eff\ GW}$ is calculated as follows:

$$D_{effGW} = D^{air} * \frac{\theta_{as}^{\ 3.33}}{\theta_T^{\ 2}} + \left[\frac{D^{wat}}{H} * \frac{\theta_{ws}^{\ 3.33}}{\theta_T^{\ 2}} \right]$$

where:

$D_{eff\ GW}$	=	Effective molecular diffusion through soil above groundwater table (cm^2/s);
D^{air}	=	Diffusion coefficient in air (cm^2/s);
θ_{as}	=	Volumetric air content in vadose zone soils (0.241 cm^3-air/cm^3-soil (reflective of coarse soil));
θ_T	=	Total soil porosity (0.36 cm^3-pore space/cm^3-soil (reflective of coarse soil));
D^{wat}	=	Diffusion coefficient in water (cm^2/s);
H	=	Henry's law constant (unitless); and
θ_{ws}	=	Volumetric water content in vadose zone soil (0.119 cm^3-water/cm^3-soil (reflective of coarse soil)).

The concentration of COCs in trench air as a result of volatilization from groundwater was then calculated as follows:

$$C_{air-trench} = C_{GW} * VF_{TGW} * CF$$

where:

$C_{air-trench}$	=	Concentration of contaminant in trench air (µg/m^3)

C_{GW}	=	Concentration of contaminant in groundwater (mg/L)
VF_{TGW}	=	Groundwater volatilization factor for ambient air (mg/m^3-air/mg/L-water)
CF	=	Conversion factor (1,000 µg/mg)

Physical/chemical properties for volatile COCs used to predict exposure *via* the inhalation of vapours from groundwater within an on-site trench and in ambient outdoor air are provided in Table A-3. Values were taken from MECP (2011), unless otherwise noted.

Table A-3 Physical/Chemical Properties used to Predict Exposure from the Inhalation of Vapours from Impacted Groundwater

COC	*Diffusion Coefficient in Air (cm²/sec)*	*Diffusion Coefficient in Water (cm²/sec)*	*Unitless Henry's Law Constant*
Volatile Organic Compounds (VOCs)			
Dichloroethylene, 1,1-	9.00E-02	1.04E-05	1.07E+00
Vinyl chloride	1.06E-01	1.23E-06	1.14E+00
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benzo[a]pyrene	4.30E-02	9.00E-06	1.87E-05
Benzo[b]fluoranthene	2.26E-02	5.56E-06	2.69E-05
Benzo[g,h,i]perylene	NA	NA	NA
Benzo[k]fluoranthene	2.26E-02	5.56E-06	2.39E-05
Chrysene	2.48E-02	6.21E-06	2.14E-04
Indeno[1,2,3-cd]pyrene	1.90E-02	5.66E-06	1.42E-05

NA Not applicable. This chemical is insufficiently volatile to represent a potential concern *via* the inhalation of vapours.

A-3.2 Exposure via Inhalation of Vapours Migrating from Subsurface Groundwater to Outdoor Ambient Air

A groundwater volatilization factor (VF_{wamb}) was calculated based on the methodologies recommended by the Atlantic Partnership in RBCA (Risk-Based Corrective Action) Implementation (PIRI) (RBCA, 1995). The groundwater volatilization factor is the steady-state ratio of the concentration of a chemical in ambient air to the concentration in underlying impacted groundwater. Vapour flux rates from groundwater to soil vapour and subsequently from soil vapour to ambient air are typically lower than the flux rates associated with volatilization directly from impacted soils (RBCA, 1995). The VF_{wamb} factor accounts for the steady state partitioning of dissolved chemicals in groundwater to the soil vapour phase, the flux rate of soil vapour to ground surface, and the mixing of soil vapours in the breathing zone of a receptor (RBCA, 1995).

The VF_{wamb} was calculated as follows:

$$VF_{wamb} = \frac{H \; x \; C}{1 + \left(\frac{(U_{air} \; x \; \delta_{air} \; x \; L_{GW})}{D_{eff\,GW} \; x \; W} \right)}$$

where:

VF_{wamb}	=	Groundwater volatilization factor (mg/m^3-air/mg/L-water)
H	=	Henry's law constant (unitless)
C	=	Conversion factor (1,000 cm^3-kg/m^3-g)
U_{air}	=	Wind speed above ground surface (410 cm/s)
δ_{air}	=	Mixing zone height (200 cm)

L_{GW}	=	Depth to groundwater from ground surface (157 cm)
$D_{eff\ GW}$	=	Effective molecular diffusion above groundwater table (cm^2/s)
W	=	Width of source area parallel to wind (1,000 cm)

From the above equation, the effective molecular diffusion above the groundwater table was calculated as follows:

$$D_{eff\ GW} = \left(h_{cap} + h_v\right) x \left(\frac{h_{cap}}{D_{eff\ cap}} + \frac{h_v}{D_{eff}}\right)^{-1}$$

where:

$D_{eff\ GW}$	=	Effective molecular diffusion above groundwater table (cm^2/s)
h_{cap}	=	Thickness of capillary fringe (17.05 cm (reflective of coarse soil))
h_v	=	Thickness of vadose zone (139.95 cm (depth to groundwater (157 cm) – thickness of capillary fringe (17.05 cm))
$D_{eff\ cap}$	=	Effective diffusivity in the capillary zone (cm^2/s)
D_{eff}	=	Effective diffusivity in the vadose zone soil (cm^2/s)

From the above equation, D_{eff} is calculated as follows:

$$D_{eff} = D^{air} * \frac{\theta_{as}^{3.33}}{\theta_T^{2}} + \left[\frac{D^{wat}}{H} * \frac{\theta_{ws}^{3.33}}{\theta_T^{2}}\right]$$

where:

D_{eff}	=	Effective molecular diffusion through soil (cm^2/s);
D^{air}	=	Diffusion coefficient in air (cm^2/s);
θ_{as}	=	Volumetric air content in vadose zone soils (0.241 cm^3-air/cm^3-soil (reflective of coarse soil));
θ_T	=	Total soil porosity (0.36 cm^3-pore space/cm^3-soil (reflective of coarse soil));
D^{wat}	=	Diffusion coefficient in water (cm^2/s);
H	=	Henry's law constant (unitless); and
θ_{ws}	=	Volumetric water content in vadose zone soil (0.119 cm^3-water/cm^3-soil (reflective of coarse soil)).

Since it was conservatively assumed that all soils between groundwater and the ground surface were coarse textured, the $D_{eff\ cap}$ value is the same as the D_{eff} value.

The concentration of COCs in ambient outdoor air as a result of volatilization from groundwater was then calculated as follows:

$$C_{air-ambient} = C_{GW} * VF_{wamb} * CF$$

where:

$C_{air\text{-}ambient}$	=	Concentration of contaminant in ambient outdoor air (µg/m^3)
C_{GW}	=	Concentration of contaminant in groundwater (mg/L)
VF_{wamb}	=	Groundwater volatilization factor for ambient air (mg/m^3-air/mg/L-water)
CF	=	Conversion factor (1,000 µg/mg)

A-3.3 Exposure via Direct Dermal Contact with Groundwater in On-Site Trench

A construction worker conducting subsurface activities in a trench was assumed to be dermally exposed to COCs in ground water that has pooled within the bottom of an open trench. The hands (surface area of 890 cm^2) of this receptor were assumed to be exposed and subject to dermal absorption through direct contact with impacted ground water as a result of continuous submersion. Dermal exposure occurs as a result of continuous submersion of the hands in ground water for four 15-minute events per day, 195 days per year, for 1.5 years. The method used to predict dermal absorption was taken from the US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment) (US EPA, 2004). The MECP does not include the dermal contact with groundwater pathway in its current guidance. In this method, the absorption of chemicals from water is a function of the thickness of the stratum corneum and the duration of the exposure event. This model assumes that absorption continues after the exposure event has ended. The final absorbed dose (DA_{event}) considers the net fraction available for absorption on the stratum corneum after the exposure event (FA). Since the length of the daily exposure events are relatively short (four 15 minutes events), it was assumed that a steady-state would not be reached and that neither the viable epidermis nor the cutaneous blood flow would limit the dermal absorption of the COC (US EPA, 2004).

The permeability coefficient (K_p) of an organic chemical is a function of the path length of chemical diffusion (*i.e.*, the thickness of the stratum corneum), the chemical-specific membrane/vehicle partition coefficient (*i.e.*, the octanol/water partition coefficient), and the effective diffusion coefficient of the chemical in the stratum corneum (US EPA, 2004). The US EPA (2004) provides updated K_p values for over 200 organic compounds.

$$DA_{event} = 2 * FA * K_p * C_{GW} * \sqrt{\frac{6 * \tau_{event} * t_{event}}{\pi}} * CF$$

where:

DA_{event}	=	Absorbed dose per event (µg/cm^2-event)
FA	=	Fraction absorbed water (unitless)
K_p	=	Dermal permeability coefficient of contaminant in water (cm/hr)
C_{GW}	=	Concentration of chemical in ground water (mg/cm^3)
T_{event}	=	Lag time per event (hr/event)
t_{event}	=	Event duration (0.25 hr/event)
π	=	pi (3.14)
CF	=	Conversion factor (1000 µg/mg)

Table A-4 provides the standard fraction absorbed water (FA), permeability coefficient (Kp) and lag time (T_{event}) values adopted in the RA. Values were obtained from Appendix B of U.S. EPA (2004). These were used to calculate DA_{event} in the current assessment.

Table A-4 Chemical-Specific Factors used for Calculating Absorption through Direct Contact with Groundwater

COC	***Permeability Coefficient (cm/hr)***	***Lag Time per Event (hr/event)***	***Fraction Absorbed Water (unitless)***
Volatile Organic Compounds (VOCs)			
Dichloroethylene, 1,1-	1.59E-02	0.37	1
Vinyl chloride	1.13E-02	0.24	1
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benzo(a)pyrene	1.24	2.69	1

Table A-4	Chemical-Specific Factors used for Calculating Absorption through Direct Contact with Groundwater		
COC	***Permeability Coefficient (cm/hr)***	***Lag Time per Event (hr/event)***	***Fraction Absorbed Water (unitless)***
Benzo[b]fluoranthene	6.99E-01	2.77	1
Benzo[g,h,i]perylene	2.00	3.70	1
Benzo[k]fluoranthene	1.20	2.72	1
Chrysene	1.03	2.03	1
Indeno[1,2,3-cd]pyrene	2.23	3.78	1

The total daily exposure to COCs *via* absorption from dermal contact with groundwater during construction activities within the trench were predicted as follows:

$$EXP_{Derm\,Trench} = \frac{DA_{event} * SA * EV * EF}{BW * DPY}$$

where:

$EXP_{Derm\ Trench}$ = Daily dermal exposure *via* direct contact with ground water within the trench (µg/kg/day)
DA_{event} = Absorbed dose per event (µg/cm^2-event)
SA = Exposed surface area (890 cm^2)
EV = Event frequency (4 event/day)
EF = Exposure frequency (195 working days/year)
BW = Body weight (70.7 kg)
DPY = Days per year (365 days/year)

A-3.4 Incidental Ingestion of Groundwater while in an On-Site Trench

The incidental ingestion rate of groundwater is based on the incidental ingestion of surface water while swimming (L/hour) taken from the US EPA (1989). A construction worker was assumed to ingestion 0.05 L for each day on-site.

$$EXP_{ING} = \frac{ING \times C_{GW} \times EF}{BW \times DPY}$$

where:

EXP_{ING} = Exposure from incidental ingestion of groundwater (µg/kg/day)
ING = Amount of groundwater ingested (0.05 L/day)
C_{GW} = Concentration of chemical in groundwater (µg/L)
EF = Number of days spent on-site per year (195 days/year)
BW = Body weight (70.7 kg)
DPY = Days per year (365)

A-4.0 TOXICITY ASSESSMENT

The selected exposure limits are those endorsed by the MECP within the 2011 Rationale Document for the Site Condition Standards and recent updates provided in MECP (2021). Consistent with MECP (2011), when available, sub-chronic exposure limits were used to assess risks to the construction/trench worker (Table A-5).

Table A-5 Summary of Human Health Exposure Limits

COC	Oral		Inhalation	
	RfD	SF	RFC	IUR
Benzo(a)pyrene	5.0 µg/kg/day	1.0×10^{-3} (µg/kg/day)$^{-1}$	0.002 µg/m^3	6.0×10^{-4} (µg/m^3)$^{-1}$
Benzo[b]fluoranthene	-	1.0×10^{-4} (µg/kg/day)$^{-1}$	-	6.0×10^{-5} (µg/m^3)$^{-1}$
Benzo[g,h,i]perylene	-	1.0×10^{-5} (µg/kg/day)$^{-1}$	-	6.0×10^{-6} (µg/m^3)$^{-1}$
Benzo[k]fluoranthene	-	1.0×10^{-4} (µg/kg/day)$^{-1}$	-	6.0×10^{-5} (µg/m^3)$^{-1}$
Chrysene	-	1.0×10^{-5} (µg/kg/day)$^{-1}$	-	6.0×10^{-6} (µg/m^3)$^{-1}$
Dichloroethylene, 1,1-	50 µg/kg/day	-	200 µg/m^3	-
Indeno[1,2,3-cd]pyrene	-	1.0×10^{-4} (µg/kg/day)$^{-1}$	-	6.0×10^{-5} (µg/m^3)$^{-1}$
Vinyl chloride	3 µg/kg/day	1.4×10^{-3} (µg/kg/day)$^{-1}$	60 µg/m^3	8.8×10^{-6} (µg/m^3)$^{-1}$

RfD= Reference Dose; SF= Slope Factor; RfC= Reference Concentration; IUR= Inhalation Unit Risk.
\- Indicates that an appropriate TRV is not available

A-5.0 RISK CHARACTERIZATION

Typically, the risk characterization stage of a human health risk assessment consists of a comparison between estimated exposures and the acceptable or “safe” intake level for each chemical of concern or acceptable daily dose. The numerical value associated with this comparison for non-carcinogenic chemicals through oral and dermal exposure is called the Exposure Ratio (ER) and is calculated as follows:

$$\text{Exposure Ratio (ER)} = \frac{\text{Estimated Exposure (µg/kg/day)}}{\text{Exposure Limit (µg/kg/day)}}$$

The Exposure Ratio is an indicator used to:

- Identify situations where the exposure received by a human receptor under a specified set of conditions is greater than the maximum allowable dose;
- Compare potential adverse human health effects between different exposure scenarios and receptors; and,
- Simplify the presentation of the human health risk assessment results so that the reader may have a clear understanding of these results, and an appreciation of their significance.

For exposure *via* the inhalation route, risks were estimated by comparing the predicted air concentrations to the reference concentration (RfC) to produce a concentration ratio (CR) as follows:

$$\text{Concentration Ratio (CR)} = \frac{\text{Air Concentration (µg/m}^3\text{) x AF}}{\text{Exposure Limit (µg/m}^3\text{)}}$$

Since receptors are not assumed to spend 100% of their time on-site, the average daily air concentration to which they are exposed is adjusted accordingly. For the construction worker conducting subsurface activities in a trench, predicted air concentrations within the trench were adjusted by a factor of 0.045 (2/24 hours per day x 5/7 days per week, 39/52 weeks per year).

For chemicals considered to be non-threshold carcinogens, such as benzo[a]pyrene, incremental lifetime cancer risks (ILCRs) were estimated using the equation below. In the case of a construction worker, it was assumed they would be working at the Site for 1.5 years. These durations were used to appropriately amortize the risks to receptors when considering exposure to carcinogenic, non-threshold chemicals.

For oral and dermal exposure, the ILCR was calculated as follows:

$$ILCR = EXP \times SL \times AP$$

where:

ILCR	=	Incremental Lifetime Cancer Risk (unitless)
EXP	=	Total daily exposure (μg/kg/day)
SL	=	Slope factor $(\mu g/kg/day)^{-1}$
AP	=	Amortization Period (1.5/56 for the construction worker)

For inhalation exposure, the ILCR was calculated as follows:

$$ILCR = C_{air} \times UR \times AF \times AP$$

where:

ILCR	=	Incremental Lifetime Cancer Risk (unitless)
C_{air}	=	Concentration in air $(\mu g/m^3)$
UR	=	Cancer unit risk value $(\mu g/\ m^3)^{-1}$
AF	=	Time on-site adjustment factor (0.22 for the construction worker for ambient air, 0.045 for the construction worker for trench air)
AP	=	Amortization Period (1.5/56 for the construction worker)

A-6.0 DERIVATION OF RISK-BASED CONCENTRATIONS

Risk-based concentrations (RBCs) were derived for groundwater COCs that would be protective of human health for these exposure pathways. For carcinogens, the RBCs ensured that the construction worker does not experience an increased cancer risk level of greater than $1.0x10^{-6}$ from exposure to each environmental medium. Example calculations for COCs in groundwater are shown below.

$$RBC_{GW-C} = \frac{C_{GW}\ x\ 1.0x10^{-6}}{ILCR}$$

where:

RBC_{GW-C}	=	Risk-based concentration for carcinogenic COC in groundwater (μg/L)
C_{GW}	=	Concentration of COC in groundwater used to predict exposure in the current assessment (μg/L)
$1.0x10^{-6}$	=	Acceptable ILCR per environmental medium
ILCR	=	Total estimated ILCR for the construction worker from inhalation of vapours in trench air, inhalation of vapours in ambient air, and direct dermal contact with groundwater (unitless)

For non-carcinogens, RBCs were derived to ensure that receptors do not receive an estimated dose exceeding 20% of the RfD for each environmental medium as follows:

$$RBC_{GW-NC} = \frac{C_{GW} \times 0.2}{(ER + CR)}$$

where:

RBC_{GW-NC}	=	Risk-based concentration for non-carcinogenic COC in groundwater (µg/L)
C_{GW}	=	Concentration of COC in groundwater used to predict exposure in the current assessment (µg/L)
0.2	=	Acceptable ER/CR per environmental medium (0.2)
ER+CR	=	Total estimated ER and CR for the construction worker from inhalation of vapours in trench air, inhalation of vapours in ambient air, and direct dermal contact with groundwater (unitless)

The lowest of the non-carcinogenic and carcinogenic RBCs for each groundwater COC was selected for comparison against the maximum groundwater COC concentration to determine whether unacceptable risks are anticipated to occur for the construction worker *via* these exposure pathways. This comparison is presented in Tables A-6.

Table A-6 Comparison of Maximum Groundwater COC Concentrations to Risk-Based Concentrations Protective of Construction Worker *via* Groundwater Exposure Pathways (µg/L)

COC	***Maximum Concentration***	***RBC Protective of Non-Cancer Endpoints***	***RBC Protective of Cancer Endpoints***
Volatile Organic Compounds (VOCs)			
Dichloroethylene, 1,1-	7.4	9,000	-
Vinyl chloride (future condition)[a]	1.1	880	87
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benzo[a]pyrene	1.43	13	**0.49**
Benzo(a)pyrene TPE	2.1	13	**0.49**
Benzo[b]fluoranthene	1.50	-	8.5
Benzo[g,h,i]perylene	0.5	-	26
Benzo[k]fluoranthene	0.95	-	5.0
Chrysene	1.90	-	68
Indeno[1,2,3-cd]pyrene	0.5	-	2.3

BOLDED values shaded in grey indicate that the maximum concentration exceeds the RBC.

[a] The future concentration of vinyl chloride presented is based on the maximum measured concentration in groundwater (<0.2 µg/L) plus 10% of the maximum concentration of each parent compound (*i.e.,* tetrachloroethylene, trichloroethylene, 1,1-dichloroethylene, *cis*-1,2-dichloroethylene, and *trans*-1,2-dichloroethylene) protective of future degradation to vinyl chloride.

\- Indicates that an appropriate TRV is not available to derive an RBC to be protective of this endpoint.

As shown in Table A-6, concentrations of benzo(a)pyrene and benzo(a)pyrene TPE in groundwater exceeded the RBCs protective of the construction/trench worker. Given that benzo(a)pyrene and other high molecular weight PAHs have limited volatility, exposure and risks related to the inhalation of vapours within a trench or in ambient ground-level are negligible. The primary pathway of concern for these PAHs is direct dermal contact with impacted groundwater. To prevent the occurrence of potential unacceptable risks, RMMs are recommended to mitigate direct exposure to PAHs in groundwater for the construction/trench worker.

A-7.0 References

MECP. 2011. Rationale for the Development of Generic Soil and Groundwater Standards for Use at Contaminated Sites in Ontario. Standards Development Branch. Ontario Ministry of the Environment, Conservation, and Parks (formerly the Ministry of the Environment and Climate Change). April 15, 2011.

MECP. 2021. Human Health Toxicity Reference Values (TRVs) Selected for Use at Contaminated Sites in Ontario. Prepared by: Human Toxicology and Air Standards Section, Technical Assessment and Standards Development Branch, Ontario Ministry of the Environment, Conservation and Parks. May 2021.

RBCA. 1995. Guidance Manual for Risk-Based Corrective Action. Tier 2 RBCA Spreadsheet System and Modelling Guidelines. Appendix A. Partnership in RBCA Implementation.

Richardson, M.G. 1997. Compendium of Canadian Human Exposure Factors for Risk Assessment.1155-2720 Queensview Dr., Ottawa, Ontario. Ottawa, ON. O'Connor Associates Environmental Inc. Revised July 5, 1996.

U.S. EPA. 1989. Risk Assessment Guidance for Superfund. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Final Office of Superfund Remediation and Technology Innovation. U.S. Environmental Protection Agency, Washington D.C. July 2004.

APPENDIX B

SITE CHARACTERIZATION FIGURES

FIGURE 1: LOCATION MAP

greenstone ENVIRONMENTAL ENGINEERING	Address: 10, 29 and 35 Canal Road, Sault Ste. Marie, Ontario	Approximate Scale: 1 : 200,000
	Project Number: E23013	Date: December 2023
	Report Name: Phase II ESA	Client: SIS Group

FIGURE 2: SITE PLAN

greenstone ENVIRONMENTAL ENGINEERING	Address: 10, 29 and 35 Canal Road, Sault Ste. Marie, Ontario	Approximate Scale: 1 : 1,700
	Project Number: E23013	Date: December 2023
	Report Name: Phase II ESA	Client: SIS Group

FIGURE 3: SURROUNDING LAND USE PLAN

greenstone ENVIRONMENTAL ENGINEERING	Address: 10, 29 and 35 Canal Road, Sault Ste. Marie, Ontario	Approximate Scale: 1 : 6,000
	Project Number: E23013	Date: December 2023
	Report Name: Phase II ESA	Client: SIS Group

FIGURE 4: AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

greenstone ENVIRONMENTAL ENGINEERING	Address: 10, 29 and 35 Canal Road, Sault Ste. Marie, Ontario	Approximate Scale: 1 : 1,700
	Project Number: E23013	Date: December 2023
	Report Name: Phase II ESA	Client: SIS Group

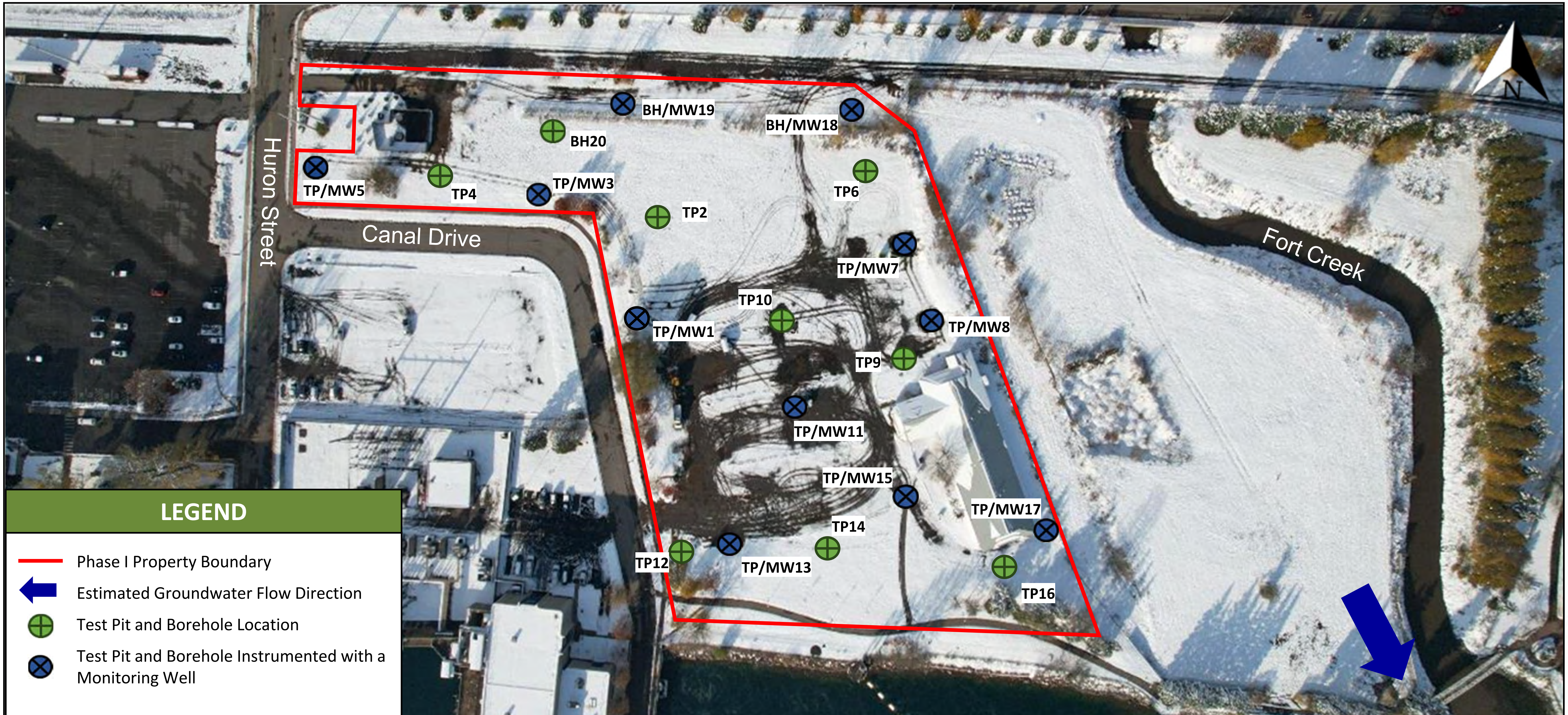

FIGURE 5: BOREHOLE, TEST PIT AND MONITORING WELL LOCATION PLAN

greenstone ENVIRONMENTAL ENGINEERING	Address: 10, 29 and 35 Canal Road, Sault Ste. Marie, Ontario	Approximate Scale: 1 : 1,700
	Project Number: E23013	Date: December 2023
	Report Name: Phase II ESA	Client: SIS Group

FIGURE 6: GROUNDWATER ELEVATION CONTOUR PLAN

greenstone ENVIRONMENTAL ENGINEERING	Address: 10, 29 and 35 Canal Road, Sault Ste. Marie, Ontario	Approximate Scale: 1 : 1,700
	Project Number: E23013	Date: December 2023
	Report Name: Phase II ESA	Client: SIS Group