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April 14, 2025

City of Ottawa
5th Floor West
110 Laurier Avenue West
Ottawa, Ontario K1P 1J1

Attention: Tess Peterman, Planner

Re: Due-Diligence Human Health and Ecological Risk Evaluation
Future Parking Lot D, The Ottawa Hospital - Riverside Campus
1967 Riverside Drive, Ottawa, Ontario

INTRODUCTION

Parsons Inc. (Parsons) was retained by The Ottawa Hospital to prepare a Due-Diligence Human Health and Ecological Risk Evaluation to support a Site Plan Control Application for constructing a new surface parking lot (Lot D) on The Ottawa Hospital's Riverside Campus, located at 1967 Riverside Drive, Ottawa, Ontario (the "Site"). The location and layout of the Site are presented in Figure 1.

OBJECTIVE

The primary objective of this evaluation is to assess potential human health and ecological risks associated with the known environmental conditions within Lot D and determine the necessity for risk management measures (RMMs) based on current conditions and future land use as a hard-surfaced parking lot.

PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Parsons previously conducted Due-Diligence Phase One and Phase Two Environmental Site Assessments (ESAs) at the Site.

Phase One ESA

The Phase One ESA was completed in June 2024 (finalized in November 2024) in general accordance with Ontario Regulation (O. Reg.) 153/04 (*Records of Site Condition – Part XV.1 of the Act*). The objective was to evaluate the Phase One Property and surrounding lands within a 250 m radius for potentially contaminating activities (PCAs) and identify areas of potential environmental concern (APECs).

In accordance with O. Reg. 153/04, PCAs and APECs were identified through site reconnaissance, interviews, and a records review. The records review included historical environmental reports, aerial photographs, fire insurance plans, a chain-of-title search, a city directory search, and an Environmental Risk Information Services database search.

Based on these activities, Parsons identified three APECs resulting from the following PCAs:

- Potential fill material of unknown quality (on-Site).
- Former Municipal Landfill known as the Closed Billings Street Dump (on-Site).
- Railway tracks on adjacent lands (off-Site)

Based on the findings, Parsons recommended a Phase Two ESA to investigate soil and groundwater quality at the Site.

Phase Two ESA

The Phase Two ESA was completed in December 2024 (finalized in February 2025) in general accordance with O. Reg. 153/04 to investigate the APECs identified during the Phase One ESA.

The Phase Two ESA investigation included advancing five boreholes to a maximum depth of 6.1 metres below ground surface (mbgs), each instrumented with groundwater monitoring wells. Soil and groundwater samples from these locations were analyzed for contaminants of potential concern identified in the Phase One ESA: metals and inorganics, benzene, toluene, ethylbenzene, xylenes (BTEX), petroleum hydrocarbon fractions F1 to F4 (PHC F1 to F4), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and organochlorine (OC) pesticides.

Given the intended use as a parking lot, the Ministry of the Environment, Conservation and Parks (MECP) full-depth generic site condition standards for industrial/commercial/community (ICC) property use, non-potable groundwater condition, and coarse-textured soil (Table 3 SCS) were applied to evaluate soil and groundwater quality.

Key Phase Two ESA findings included:

- Site stratigraphy generally consisted of asphalt or grass, underlain by sand to silty sand fill to 6.1 mbgs. Two localized intermittent clay layers were encountered in one borehole. Evidence of foreign debris, staining, and odour was observed at depths between 0.9 and 4.6 mbgs in three boreholes located within the former landfill area on Lot D.
- Groundwater depth ranged from 3.8 to 4.7 mbgs, inferred to flow westward towards the Rideau River.
- No evidence of free product was observed during monitoring well activities.
- Soil analytical results indicated benzene, ethylbenzene, PHC fractions F1 and F2, and PAH concentrations exceeding Table 3 SCS at varying depths in four sampling locations near the former landfill.
- Groundwater analytical results revealed exceedances of PHC F2, PHC F3, vinyl chloride, and mercury above Table 3 SCS in one monitoring well (screened at 3.0–6.1 mbgs) within the landfill area's northeastern portion.
- Sodium (4,400,000 µg/L) and chloride (7,700,000 µg/L) concentrations exceeded Table 3 SCS; however, these are attributed to de-icing salt applications and not considered contaminants per Section 49.1 of O. Reg. 153/04.

Based on the Phase Two ESA findings, Parsons recommended conducting a Due-Diligence Human Health and Ecological Risk Evaluation to further address identified soil and groundwater impacts for Lot D.

SCOPE OF WORK

The scope of the work assignment included the following components:

- Qualitative Human Health and Ecological Risk Evaluation

  A qualitative assessment of potential on-Site risks to relevant human and ecological receptors from soil and groundwater contaminants identified in the recent Phase Two ESA. This assessment assumes the identified contaminants of concern (COCs) will be managed in place for the foreseeable future.

- Landfill Impact Assessment

  A landfill impact assessment to identify and evaluate potential adverse effects of the former landfill on the proposed development and surrounding lands. This includes proactive consideration of environmental concerns, and health and safety risks from leachate (to groundwater and surface water), ground settlement, visual impacts, soil contamination, and landfill gas generation and migration. Recommended mitigation measures will be provided, if required, to support safe redevelopment and future use of the Site as a surface parking lot (Lot D) for The Ottawa Hospital.

- Preliminary Risk Management Plan

  A Preliminary Risk Management Plan (P-RMP) to identify and describe any RMMs needed to mitigate any potential unacceptable risks to human or ecological receptors identified by the Qualitative Risk Evaluation and the Landfill Impact Assessment.

The risk evaluation was prepared in support of a Site Plan Control Application for the construction of a surface parking lot (Lot D) on The Ottawa Hospital's Riverside Campus. As the filing of a Record of Site Condition (RSC) under O. Reg. 153/04 is not required for the parking lot development, it was agreed by Parsons' Qualified Person (QP_{ESA}) in consultation with the City of Ottawa that the Phase Two ESA sampling program adequately characterized the existing subsurface environmental conditions to support the completion of this risk evaluation.

QUALITATIVE HUMAN HEALTH AND ECOLOGICAL RISK EVALUATION

Contaminants of Concern

Using the soil and groundwater analytical data from the Phase Two ESA, chemical parameters with measured concentrations or elevated reportable detection limits (RDLs) exceeding the Table 3 SCS were identified as COCs to be carried forward for further evaluation in the human health and ecological risk assessment. The identified COCs are summarized below:

Soil COCs

- 1,4-Dichlorobenzene
- 1,2-Dichloroethane
- 1,1-Dichloroethylene
- 1,1,1,2-Tetrachloroethane
- 1,1,2,2-Tetrachloroethane
- 1,1,2-Trichloroethane
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Bromomethane
- Cadmium
- Copper
- Dibenzo[a,h]anthracene
- Ethylene Dibromide
- Fluoranthene
- Indeno(1,2,3-cd)pyrene
- Lead
- PHC F1
- PHC F2
- PHC F3
- Selenium
- Vinyl Chloride
- Zinc

Groundwater COCs

- Chloroform
- Mercury
- PHC F2
- PHC F3
- Vinyl Chloride

Human Health Receptors and Exposure Pathways of Concern

The human receptors anticipated to utilize the Site include subsurface workers and outdoor (maintenance) workers, assuming a generic commercial property use scenario involving the construction and operation of a hard-surfaced parking lot without enclosed buildings or structures for the foreseeable future.

Details regarding each of the human receptors and the relevant contaminant exposure pathways of concern are presented below.

Outdoor Worker

An outdoor worker is represented by an adult employed as a maintenance worker responsible for grounds keeping, lawn maintenance, and gardening. During routine work, the outdoor worker is assumed to be outdoors, exposed to soil via direct contact (incidental ingestion, dermal contact, and inhalation of particulates) and inhalation of soil and groundwater vapours in outdoor air.

Subsurface Worker

A subsurface worker is represented by an adult employed as a worker performing short-term outdoor activities engaged in excavation activities during redevelopment and future utility maintenance. While on-Site, this receptor could be exposed to COCs via direct contact with soil (incidental ingestion, dermal contact, and dust inhalation), via direct contact with groundwater (incidental ingestion and dermal contact), and via the inhalation of soil and groundwater vapours in outdoor air and trench air.

Site Visitor

A Site visitor is assumed to be periodically present both indoors and outdoors at the Site for short durations. These individuals may be exposed to COCs through the inhalation of soil and groundwater vapours in both outdoor and indoor air. The Site visitor is assumed to spend less time at the Site compared to other human receptors.

Ecological Receptors and Exposure Pathways of Concern

Ecological receptors selected for risk evaluation were valued ecosystem components (VECs), representative of groups of species common in natural ecosystems in Southern Ontario.

Terrestrial mammals and birds, plants and soil organisms, and off-site aquatic species were selected as ecological receptors for the risk evaluation. Potential exposure pathways considered included:

- Ingestion and dermal contact for soil organisms,
- direct contact and root uptake for terrestrial plants,
- ingestion of soil, bioaccumulation, and food-chain transfer for mammals and birds,
- dermal contact, ingestion, and dietary uptake for off-site aquatic species.

Human Health and Ecological Component Value Screening

As previously discussed, COCs were identified by comparing maximum concentrations of soil analytical data from the Phase Two ESA to the generic Table 3 SCS. Chemical parameters that exceeded the generic SCSs were then designated as COCs and advanced to the secondary screening process. During this phase, the maximum concentrations were compared to relevant MECP Table 3 human health and ecological component values.

The MECP developed these component values to protect receptors or groups of receptors from contaminants via specific exposure pathways. For any given contaminant, the lowest value among all component values relevant to a specific land use, groundwater use, soil texture, and depth class becomes the generic site condition standard for that contaminant.

If the measured concentration of a COC is below the applicable component value, it is considered that the risks associated with that exposure pathway are acceptable. Conversely, if the measured concentration of a COC exceeds the applicable component value, it is deemed that potential risks may exist unless RMMs are implemented.

Qualitative Screening of Soil COCs

To identify soil COCs that may pose a potential risk to human and ecological health, maximum concentrations were screened against the following pathway-specific component values:

- *Soil Contact (S2)*: soil concentration protective of dermal contact and incidental ingestion at a low-intensity and moderate-frequency by an adult outdoor worker during grounds maintenance and landscaping activities.

- *Soil Contact (S3):* soil concentration protective of dermal contact, incidental ingestion and particulate (dust) inhalation at a low-intensity and high-frequency by an adult subsurface worker during construction excavation activities or while working in an excavation trench.
- *Soil to Indoor Air (S-IA):* soil concentration protective of inhalation of chemical migrating from soil to indoor air by an adult indoor worker. While this exposure pathway is considered incomplete because no enclosed buildings or structures are planned as part of the surface parking lot development, the associated component screening value was used as a surrogate to evaluate potential vapour inhalation risks for a subsurface (construction) worker in an excavation trench.
- *Soil to Outdoor Air (S-OA):* soil concentration protective of inhalation of chemical vapours migrating from soil to outdoor air by an adult outdoor worker.
- *Plants & Soil Organisms (PSO):* soil concentration protective of direct soil contact by plants and soil dwelling organisms.
- *Mammals & Birds (MB):* soil concentration protective of incidental ingestion and dietary uptake by terrestrial mammals and birds.
- *Off-Site Aquatic Organisms (S-GW3):* soil concentration protective of dermal contact, ingestion, and dietary uptake of chemicals leaching from on-Site soils to groundwater subsequently migrating and discharging into an off-Site surface water body.

The results of the human health and ecological component value screening evaluation are provided below in Table 1.

Table 1: Comparison of Maximum Concentrations of Soil COCs to Human Health & Ecological Component Values

Soil COC	Units	MAX Conc	S2	S3	S-IA	S-OA	PSO	MB	S-GW3
Acenaphthylene	µg/g	1	70	2600	12	180	NV	NV	**0.15**
Anthracene	µg/g	1.9	70	2600	270	950	32	470000	**0.67**
Benz[a]anthracene	µg/g	6.3	7	260	1800	600	**1**	NV	5.1E+11
Benzo[a]pyrene	µg/g	6	**0.7**	26	22000	300	72	46000	3.8E+13
Benzo[b]fluoranthene	µg/g	7.3	**7**	260	150000	3800	NV	NV	7.7E+13
Benzo[k]fluoranthene	µg/g	2.8	7	260	180000	3800	15	NV	2.5E+13
Bromomethane	µg/g	0.12	66	660	0.56	71	NV	NV	1.4
Cadmium	µg/g	3	7.9	7.9	NV	NV	24	**1.9**	NV
Copper	µg/g	330	1900	1900	NV	NV	**230**	3100	NV
Dibenz[a h]anthracene	µg/g	0.97	**0.7**	26	880000	790	NV	NV	2.4E+13
Dichloroethylene, 1,1-	µg/g	0.12	11000	11000	**0.064**	3600	100	760	11
Dichlorobenzene, 1,4-	µg/g	0.54	65	2400	**0.2**	18	7.2	NV	59
Ethylene Dibromide	µg/g	0.12	0.31	11	**0.0015**	**0.099**	NV	NV	86
Fluoranthene	µg/g	11	70	2600	6700	4500	180	120000	40000
Indeno[1 2 3-cd]pyrene	µg/g	3.5	7	260	1200000	7300	**0.76**	NV	8.6E+13
Lead [b]	µg/g	640	1000	1000	NV	NV	1100	**32**	NV
Petroleum Hydrocarbons F1	µg/g	100	47000	100000	580	26000	320	NV	**55**
Petroleum Hydrocarbons F2	µg/g	1500	22000	48000	**380**	25000	**260**	NV	**230**
Petroleum Hydrocarbons F3	µg/g	4200	40000	260000	NV	NV	**1700**	NV	NV
Tetrachloroethane, 1,1,1,2-	µg/g	0.12	42	1600	**0.087**	5.1	NV	NV	37
Tetrachloroethane, 1,1,2,2-	µg/g	0.12	5.5	210	**0.019**	1.6	NV	NV	48
Trichloroethane, 1,1,2-	µg/g	0.12	19	720	**0.042**	2.9	160	NV	120
Selenium	µg/g	11	1200	1200	NV	NV	**10**	**5.5**	NV
Vinyl Chloride	µg/g	0.13	0.79	29	**0.032**	14	6.8	12	270
Zinc	µg/g	1200	47000	47000	NV	NV	**600**	**340**	NV

Bold Maximum concentration of soil COC was identified above the MECP (2016; 2019) human health or ecological component values.
NV No value. A component value protective of human or ecological health was not provided by MECP (2016; 2019).

a Component values were obtained from MECP (2016) Approved Model Table 3 human health and ecological component values for industrial/commercial/community property use with coarse textured soils using MECP (2019) revised TRVs.

b Due to the uncertainty surrounding the toxicology of lead, the human health component values presented were not considered. A separate qualitative evaluation was conducted in the SL-HHRA.

Soil Contact (S2):

Three soil COCs (benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene) had maximum concentrations that exceeded their respective 'S2' component value, indicating the potential for unacceptable risks to outdoor workers though direct soil contact.

Soil Contact (S3):

No soil COCs had maximum concentrations that exceeded their respective 'S3' component values, indicating that no unacceptable risks to subsurface workers through direct soil contact.

Soil to Trench Air (Surrogate: S-IA):

As previously noted, MECP does not provide human health component values protective of potential vapour inhalation risks to a subsurface (construction) worker in an excavation trench. Therefore, the soil to indoor air (S-IA) component value was selected as a surrogate to evaluate potential vapour inhalation risks to these workers in an excavation trench.

Eight soil COCs (1,1 dichloroethylene, 1,4 dichlorobenzene, ethylene dibromide, PHC F2, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,1,2 trichloroethane, and vinyl chloride) had maximum concentrations or elevated RDLs that exceeded their respective 'S-IA' component value, indicating these COCs may pose the potential for unacceptable risks to subsurface workers though inhalation of soil COC vapours in an excavation trench.

Only three COCs (1,4-dichlorobenzene, PHC F2, and vinyl chloride) were detected at measurable concentrations in groundwater samples analyzed from the Site. The remaining five COCs were reported with elevated reporting detection limits (RDLs); therefore, their presence at the Site could not be definitively confirmed.

Soil to Outdoor Air (S-OA):

One soil COC (ethylene dibromide) had an elevated RDLs that exceeded its respective 'S-OA' component value, indicating this COCs may pose the potential for unacceptable risks to outdoor workers though inhalation of soil COC vapours in outdoor (ambient) air.

Ethylene dibromide was not detected at measurable concentrations in analyzed groundwater samples, with only one of seven soil samples with an elevated RDL exceeding the Table 3 SCS. Therefore, ethylene dibromide is unlikely to pose an unacceptable risk related to outdoor air inhalation.

Plants and Soil Organisms (PSO):

Seven COCs (benzo(a)anthracene, copper, indeno(1,2,3-cd)pyrene, PHC F2, PHC F3, selenium and zinc) had maximum concentrations that exceeded their respective 'PSO' component values, indicating a potential for unacceptable risks to plants or soil organisms.

Mammals & Birds (MB):

Four COCs (cadmium, lead, selenium and zinc) had maximum concentrations that exceeded their respective 'PSO' component values, indicating a potential for unacceptable risks to terrestrial wildlife and avian species.

'S-GW3' Component Values:

Four COCs (acenaphthylene, anthracene, PHC F1, and PHC F2) had maximum concentrations that exceeded their respective 'S-GW3' component values derived by MECP for protecting off-site aquatic receptors through the soil leaching to groundwater pathway, which may subsequently migrate and discharge into an off-site surface water body.

However, it is unlikely that these soil COCs pose unacceptable risks to off-site aquatic receptors in the nearest surface water body. The nearest surface water body, the Rideau River, is approximately 150 to 200 m west of the Site, significantly exceeding the 30 m separation distance assumed in the MECP GW3 model. Furthermore, the application of a 10-fold dilution factor over 300 years is highly conservative. Moreover, the river's high flow rate, large volume, natural mixing, and riparian buffers would further mitigate potential risks to aquatic receptors. In addition, groundwater sampling completed during the Phase Two ESA did not identify these soil COCs at elevated concentrations in groundwater samples above the Table 3 SCS.

Special Considerations (Lead)

Due to uncertainties in lead toxicology and the absence of current regulatory guidance for evaluating oral and inhalation exposures, potential risks associated with direct contact with lead in soil could not be assessed using MECP human health component values. Instead, the maximum detected concentration of lead in soil was compared to a benchmark.

The maximum lead concentration identified at the Site (640 µg/g) exceeds the Ontario Typical Range value of 120 µg/g, selected as the baseline benchmark by the MECP to represent the upper limit of typical background concentrations in Ontario soils unimpacted by point-source contamination.

Soil COCs without MECP Human Health Component Values

As identified in Table 1, MECP component values for indirect exposure (inhalation) pathways (S-IA; S-OA) were unavailable for PHC F3 and metal parameters. Consequently, further evaluation was conducted to identify which parameters may be sufficiently volatile to pose potential risks via indirect (vapour inhalation) exposure pathways for subsurface (construction) workers.

The MECP (2019) guidance considers a chemical sufficiently volatile if it exhibits either:

- A Henry's Law constant greater than 1×10^{-5} atm·m³/mol, or
- A vapour pressure exceeding 1.0 millimetre of mercury (mmHg, equivalent to 1.0 Torr).

The volatility assessment was limited to parameters with available values for both vapour pressure and Henry's Law constant. Metals were excluded from this assessment as they lack Henry's Law constants and are therefore considered non-volatile.

Table 2 presents the results of the volatility screening to determine if any identified Soil COCs lacking MECP S-IA and S-OA component values could be classified as volatile.

Table 2: Volatility Assessment

Soil COC	Henry's Law Constant (atm-m3/mol)	Vapour Pressure (mmHg)
Petroleum Hydrocarbons F3	**1.20E+02**	8.73E-04
Aliphatic C>16-C21	**1.34E+04**	5.02E-07
Aliphatic C>21-C34	**3.18E-04**	8.73E-04
Aromatic C>16-C21	**1.64E-05**	5.02E-07
Aromatic C>21-C34	**1.20E+02**	8.73E-04

BOLD Vapour pressure is greater than 1.0 mmHg or Henry's Law constant is greater than 1x10-5 atm-m³/mol

A Vapour pressure and Henry's Law Constant obtained from MECP (2016) MGRA Model

Based on the volatility screening results, PHC F3 exhibits aliphatic and aromatic sub-fractions with Henry's Law Constants exceeding the MECP volatility threshold of 1×10^{-5} atm·m³/mol.

CCME (2008) classifies PHC F3 as having very low volatility and limited solubility due to its inherent physical and chemical properties. Consequently, PHC F3 is not anticipated to present unacceptable inhalation risks to subsurface and outdoor workers under the proposed redevelopment scenario.

Soil COCs without MECP Ecological Component Values

MECP ecological component values protective of direct contact exposures for plants and soil organisms (PSO), and mammals and birds (MB), were unavailable for several PAH and VOC parameters. Given that potential unacceptable risks associated with PSO and MB pathways were identified for other soil COCs, it has been conservatively assumed that there is a potential risk to these ecological receptors from exposure to soil COCs for which PSO component values are unavailable.

Additionally, MECP S-GW3 component values were unavailable for PHC F3 and several metals. However, as previously discussed, soil COCs are unlikely to pose unacceptable risks to off-site aquatic receptors in the nearest surface water body, the Rideau River, which is approximately 150 to 200 m west of the Site.

Qualitative Screening of Groundwater COCs

To identify groundwater COCs that may pose a potential risk to human and ecological health, the maximum concentrations of groundwater COCs were screened against pathway-specific component values.

- Groundwater Contact (Modified GW1): groundwater concentration protective of dermal contact and incidental ingestion of potable groundwater, which was used as a surrogate deemed protective of incidental exposure via splashing and hand-to-mouth contact by subsurface (construction) workers while in a trench. GW1 component values were obtained from the MECP Table 2 SCSs for use in this risk evaluation.
- Groundwater to Indoor Air (GW2): groundwater concentration protective of an exposure scenario where volatile COCs migrate directly from groundwater to indoor air inhaled by an indoor worker. While this exposure pathway is considered incomplete because no enclosed buildings or structures are planned as part of the surface parking lot development, the associated component screening value was used as a surrogate to evaluate potential vapour inhalation risks for a subsurface (construction) worker in an excavation trench.
- Off-Site Aquatic Organisms (GW3): groundwater concentration protective of aquatic plants, aquatic invertebrates, fish, and amphibians from chemicals in on-Site groundwater migrating and discharging into an off-Site surface water body.

As groundwater is located at a depth that is not accessible to ecological receptors (i.e., >3 mbgs), direct contact exposure pathways for on-Site ecological receptors are considered incomplete.

The results of the human health and ecological component screening for groundwater COCs are provided in Table 3.

Table 3: Comparison of Maximum Concentrations of Groundwater COCs to Human Health & Ecological Component Values

Groundwater COC	Units	MAX Conc	Modified GW1	Commercial-Industrial GW2	GW3
Chloroform	µg/L	3.5	2500	4700	16000
Mercury	µg/L	0.38	100	6.1	1.3E+13
Petroleum Hydrocarbons F2	µg/L	6400	30000	47000	**970**
Petroleum Hydrocarbons F3	µg/L	4700	100000	NV	NV
Vinyl Chloride	µg/L	0.6	200	3	450000

Human health and ecological component values were obtained from MECP (2016;2019) for industrial/commercial/community property use with coarse textured soil.

BOLD Maximum concentration exceeds component value
NV Human health component value not provided by MECP

No groundwater COCs had maximum concentrations exceeding their respective modified GW1 and commercial/industrial GW2 component values, protective of subsurface and outdoor workers.

One groundwater COC (PHC F2) had a maximum concentration exceeding its GW3 component value; however, similar to the soil COC rationale, the actual distance to the Rideau River (~150–200 m), conservative dilution assumptions, natural attenuation, and lack of significant downgradient migration indicate that risks to off-Site aquatic species are unlikely.

Due-Diligence Risk Evaluation Conclusions

A due-diligence human health and ecological risk evaluation was conducted to assess potential environmental risks to human and ecological receptors from soil and groundwater COCs identified during a Phase Two ESA conducted by Parsons in December 2024 (finalized in February 2025).

The human health risk evaluation assessed potential risks to on-Site human receptors during the construction and future land use of the Site as a surface parking lot for The Ottawa Hospital – Riverside Campus. It was assumed construction activities may include site grading, asphaltic pavement surfacing, soft landscaping, and trench excavations for underground utilities, while post-construction activities encompassed utility repairs, landscaping, groundskeeping, and general road maintenance. Consequently, human receptors including subsurface workers (e.g., those involved in trenching), outdoor workers (e.g., maintenance and landscaping personnel), and site visitors (e.g., patients, visitors, and hospital staff) were identified as the receptors reasonably expected to utilize the Site.

The ecological risk evaluation considered Valued Ecosystem Components (VECs), representing species commonly found in Southern Ontario. This included urban-adapted terrestrial mammals and birds, plants, soil organisms that might utilize the Site, as well as off-Site aquatic receptors in the nearest surface water body, the Rideau River, located approximately 150 to 200 m west of the Site.

Potential contaminant exposure risks for relevant human and ecological receptors were characterized using a qualitative screening-level approach comparing maximum concentrations of soil and groundwater COCs to applicable MECP human health and ecological component values protective of relevant pathway-specific exposure scenarios, based on the future property use of the Site as a surface parking lot.

The qualitative risk evaluation determined that exposure to groundwater contaminants of concern (COCs) via the assessed complete pathways does not pose unacceptable health risks. However, the evaluation identified potential unacceptable health risks associated with the following receptors and exposure scenarios:

- Outdoor workers exposed to PAHs in soil via direct contact (dermal contact and incidental ingestion) during maintenance and landscaping activities.
- Subsurface (construction) workers exposed to lead in soil via direct contact (dermal contact, incidental ingestion, and dust inhalation) while working in excavations or utility trenches.
- Subsurface (construction) workers exposed to PHCs and VOCs in soil via indirect contact (soil vapour inhalation) while working in excavations or utility trenches.
- Terrestrial plants and soil organisms exposed to PAHs, PHCs, and metals in soil via direct contact (dermal contact and root uptake).
- Terrestrial mammals and birds exposed to metals in soil via direct contact (incidental ingestion and dietary uptake).

Potential risks associated with the redevelopment scenario exposure pathways described above can be effectively mitigated or eliminated through the implementation of appropriate RMMs.

LANDFILL IMPACT ASSESSMENT

In support of a Site Plan Control Application to construct a new surface parking lot (Lot D) at The Ottawa Hospital's Riverside Campus (1967 Riverside Drive), the City of Ottawa requested a landfill impact assessment as part of the risk evaluation.

Pursuant to the MECP Guideline D-4: *Land Use On or Near Landfills and Dumps*, the City requires such assessments for proposed land use changes within 500 m of a landfill or dump perimeter. Consequently, this landfill assessment adheres to the City of Ottawa's Terms of Reference for *Impact Assessment Study – Waste Disposal Sites/Former Landfill Sites* (last modified May 23, 2023) and MECP Guideline D-4.

Proposed Parking Lot Development

The proposed development involves constructing a 126-space surface parking lot, including 60 spaces designated for small vehicles, on a 0.63 ha site historically used as a landfill. The design includes a central landscaped area surrounded by paved surfaces with asphalt paving and concrete sidewalks leading to the hospital building east of the Site.

The proposed parking lot will include a stormwater management system with surfaces graded to direct runoff into catch basins and underground detention chambers. These chambers temporarily store runoff, allowing sediment settlement, before discharging controlled flows into municipal storm sewers. The landscaped area will promote infiltration, reduce runoff, and enhance water quality through natural filtration.

Physical Setting

A cursory review of available documentation was conducted to gain a general understanding of the physical setting of the Site and properties within 500 m (the "Study Area"). Details are provided below.

Current and Past Property Uses

The Site is currently undeveloped vegetated land within the overall hospital property, is surrounded by institutional facilities (north), residential areas (east/south), and open space near the Rideau River (west). Historically, a municipal landfill operated in the northern portion of Lot D (~1945-1950). Post-closure, the Site has remained undeveloped under hospital ownership.

Local Geological Conditions

Geological conditions consist of permeable sand, silty sand, and sand/gravel to depths of approximately 6–8 mbgs, with intermittent layers of clay and silt. Paleozoic shale bedrock was encountered at approximately 8 mbgs.

Hydrogeological Conditions

Hydrogeological conditions include a shallow, unconfined aquifer within permeable sands, occasionally perched due to thin clay layers. Groundwater was encountered at depths of 3.8–4.7 mbgs, flowing westward toward the Rideau River. The aquifer is not used for potable purposes as surrounding areas have municipal water services.

Surface Water and Drainage

Surface runoff drains westward toward the Rideau River, with existing vegetation promoting infiltration. Current storm sewer infrastructure manages runoff effectively, with no surface contamination or active leachate seeps identified. Paving the parking lot will significantly reduce infiltration and potential leachate generation while increasing surface runoff. Stormwater infrastructure and erosion/sediment controls will be implemented to minimize environmental impacts.

Landfill Information

The Billings Street landfill (Site UR-15), operational between approximately 1945 and 1950, primarily received household waste and construction debris, covering about 0.2 ha with waste thicknesses up to 5 m. Closure occurred informally around 1950, followed by basic soil capping and landscaping during subsequent hospital construction in the 1960s. As closure occurred prior to the implementation of Ontario Regulation 232/98, the landfill was rehabilitated using standard practices of the time, including basic soil cover and vegetation to limit erosion and runoff.

Engineering controls addressing landfill risks include an active methane gas barrier and extraction system (CoA No. 6970-7YRSYH, 2010), subsurface cutoff barriers, continuous methane monitoring, and automated alarms to maintain methane concentrations below safety thresholds. Surface grading, vegetation, and stormwater drainage controls are also in place, with planned drainage enhancements.

Landfill Conditions

A desktop review of available environmental and geotechnical investigation reports was conducted to determine whether the closed landfill is likely to have an impact on the planned parking lot development and identify appropriate mitigation measures can be implemented to support the safe redevelopment and future use of the site as a surface parking lot (Lot D) for The Ottawa Hospital.

Groundwater Quality

Groundwater analytical results revealed a localized PHC F2, PHC F3, vinyl chloride and mercury concentrations exceeding the Table 3 SCS in a single monitoring well (screened 3.0–6.1 mbgs) in the northern portion of the landfill area on Lot D.

The concentrations of groundwater COCs were below the regulatory limits defined in Table 1 (Leachate Characteristics) of O. Reg. 232/98 (Landfill Sites). Therefore, the groundwater sampling results do not indicate a significant leachate-related risk.

Soil Quality

On-site soil conditions consist of two distinct types: contaminated waste fill within the former landfill area, and uncontaminated native or imported fill in surrounding areas. Phase Two ESA investigations identified exceedances of Table 3 SCS for PAHs, PHC fractions F1–F2, volatile organic compounds (VOCs), and metals (copper, lead, and zinc) at varying depths in four of five sampling locations within the landfill area.

PAH impacts likely originate from ash or cinder waste. Exceedances of PHC fractions F1–F2 indicate contamination from gasoline and/or diesel sources, while VOC exceedances suggest the presence of solvents or associated degradation products within the waste. Metal contamination was widespread but varied significantly between boreholes.

PHC fraction F1 was the only parameter exceeding Table 3 SCS in both soil and groundwater, though at different sampling locations; therefore, soil leaching is not considered a significant environmental concern at the Site.

Surface Water Quality

The closest surface water body is the Rideau River, located approximately 150 to 200 m west of the Site. Based on the intervening distance, the maximum concentrations of soil and groundwater COCs are unlikely to pose a significant risk to surface water quality.

Landfill Leachate

At this historical landfill, leachate generation has occurred due to waste decomposition and infiltration of precipitation, in the absence of an impermeable cap. Groundwater characterization results from the Phase Two ESA confirm the presence of leachate at the Site. However, groundwater analytical results indicate that chemical concentrations are below the regulatory limits for leachate defined in Table 1 (*Leachate Characteristics*) of O. Reg. 232/98 (*Landfill Sites*). Given that groundwater analytical results meet applicable regulatory leachate criteria, leachate is not considered a significant environmental concern for the Site or the surrounding Study Area.

Ground Settlement

The geotechnical investigation for the proposed parking lot development indicates substantial potential for ground settlement. The Site primarily comprises heterogeneous fill material with variable densities and debris (including wood, metal, glass, brick, ash, and rubber), exhibiting inconsistent compaction and water content, which may lead to differential settlement.

During borehole advancement, a layer of highly compressible organic peat was encountered beneath the fill, characterized by a very loose density and elevated water content. Given the variable subsurface conditions, the geotechnical investigation recommends mitigative measures, including engineered fill or ground improvement, to address the settlement concerns.

Visual Impact

The proposed parking lot D at the Ottawa Hospital Riverside Campus is expected to result in minimal visual impacts, given its location adjacent to existing institutional infrastructure and major transportation corridors. The parking lot design will integrate landscaped buffers, strategic vegetation planting, and effective lighting to align aesthetically with the surrounding built environment, effectively screening views and softening its visual prominence.

Landfill Gas

Landfill gas, primarily composed of methane and carbon dioxide, forms through the anaerobic decomposition of organic waste. Methane gas can migrate through porous soils or utility trenches, potentially accumulating in confined spaces and posing significant health hazards, such as explosion or asphyxiation risks.

Historical investigations identified instances of methane migration toward the nearby Riverside Campus hospital buildings. A subsurface landfill gas interception, venting, and monitoring system was constructed in 2005 to mitigate the methane gas migration concerns.

Since 2011, methane concentrations measured during routine monitoring have remained consistently below the off-site regulatory boundary criterion (25,000 ppm [2.5% volume] or 50% of the lower explosive limit [LEL]), as defined by O. Reg. 232/98 (Landfill Sites). Additionally, the automated methane monitoring system has recorded no exceedances of the regulatory limit (10,000 ppm [1.0% volume] or 20% LEL) within on-site buildings or structures.

The proposed paved parking lot on the landfill site could alter methane migration by restricting its upward movement, potentially causing localized methane accumulation beneath paved surfaces. To mitigate this risk, it is recommended to increase the frequency of methane monitoring events until data confirms a stable post-development trend.

PRELIMINARY RISK MANAGEMENT PLAN

Parsons has prepared a P-RMP outlining RMMs to address the potential human health and ecological risks identified by the qualitative human health and ecological risk evaluation and the landfill impact assessment.

The risk evaluation identified potential unacceptable health risks from exposure to soil COCs for outdoor workers through direct contact (dermal contact and incidental ingestion), and for subsurface (construction) workers through direct contact (dermal contact, incidental ingestion, and dust inhalation) and indirect contact (trench air inhalation). Potential unacceptable ecological risks were identified for terrestrial plants and soil organisms, as well as terrestrial mammals and birds, due to direct contact exposures to soil COCs. In response to these findings, the risk evaluation recommended establishing appropriate RMMs, including engineering controls (e.g., physical barriers) and administrative controls (e.g., a Site-Specific Health and Safety Plan), to mitigate the identified potential unacceptable risks.

The landfill impact assessment identified the presence of methane gas attributed to former municipal waste landfilling activities at the Site. Although methane is not classified as a contaminant of concern within the Risk Assessment framework, its presence constitutes a significant hazard. Consequently, this P-RMP incorporates measures to control the associated fire and explosion hazards.

Physical Barriers

For the planned Lot D parking lot development, the new asphaltic concrete surface may serve as a physical barrier to effectively cap contaminated soil for most of the Site. In areas designated for new vegetation as part of the landscaping plan, the planting media (topsoil) could function as a fill cap barrier for risk management.

Fill Cap Barriers

Fill cap barriers generally comprise a minimum depth of at least 500 mm of unimpacted soil of appropriate environmental quality, corresponding to the Table 3 SCS applicable for the Site This thickness is deemed sufficient for shallow and moderately deep rooting vegetation, such as grasses, shrubbery, and other ornamental plantings. For new, deeper-rooted vegetation (e.g., trees), the fill cap would typically be locally extended to a depth of at least 1,500 mm within a radius of at least 2,400 mm surrounding the planting. A Landscape Architect was consulted regarding the conceptual designs and performance-based specifications for any fill cap barriers, based on the specific types and characteristics of any vegetation to be planted as part of the landscape reinstatement work program. The proposed soil volume with a 1 m depth is considered sufficient for the new trees planting. The existing trees at the Site are growing and thriving without any soil remediation. New imported soil at 1 m depth will enhance growing conditions for the new parking lot tree and shrub plantings.

For existing landscaped areas with established vegetation (grass, shrubs, trees, etc.), it is assumed that ecological receptors including plants, soil organisms, and urban-adapted terrestrial wildlife can tolerate exposure to soil contaminants present at the Site. Therefore, additional protections are not anticipated to be necessary for these species to continue thriving.

Hard Cap Barriers

Hard cap barriers generally comprise a total minimum thickness of 225 mm, including at least 75 mm of hot mix asphalt, concrete, or an equivalent material, underlain by a structural base material of at least 150 mm of Granular “A” or equivalent. Hard caps can cover areas of the project including roadways, pedestrian sidewalks, or other hardscape features.

The actual hard cap thickness often depends on its intended use, the characteristics of the surfacing material, and geotechnical and structural design considerations such as engineered fill or ground improvement to mitigate potential ground settlement risks associated with landfill waste debris with very loose density and elevated water content. A geotechnical engineer should be consulted regarding performance-specifications and design drawings prior to construction of the hard cap barrier of the parking lot.

Site-Specific Health and Safety Plan

A Site-Specific Health and Safety Plan (HASP) should be prepared by competent person in accordance with the Occupational Health and Safety Act and its associated Construction Projects regulation (O. Reg. 213/91). The HASP should incorporate appropriate occupational hygiene measures, personal protective equipment (PPE), and administrative controls to ensure the worker safety from potential exposure to soil contaminants while working at the Site. The HASP should be tailored specifically to planned construction activities (e.g., parking lot construction), considering the human and ecological receptors and site-specific exposure pathways of concern identified by the risk evaluation.

Given the concerns regarding methane concentrations at the Site, the HASP shall also specifically consider potential methane intrusions within subgrade excavations and the requirements of O. Reg. 632/05 (Confined Spaces), including any amendments to this regulation.

HASP requirements for managing vapour hazards associated with methane gas should include consideration of monitoring of open excavations and temporary construction related structures for methane gas using portable gas detection instruments, establishing thresholds above which “hot work” (including cutting, grinding, welding, and the use of nonexplosion rated electrical equipment) shall not occur, and thresholds above which entry into a confined space shall not occur until purging of the space is completed.

Prior to the initiation of any project (as defined in the *Occupational Health and Safety Act*), the local Ministry of Labour office shall be notified of the proposed activities and that the Site contains methane gas and volatile contaminants.

Landfill Gas Barrier System

The Site operates a methane gas interception and monitoring system authorized under an MECP Certificate of Approval (CoA) No. 6970-7YRSYH. The monitoring system automatically collects and electronically stores data from a network of methane monitoring probes. The data collected by this system is reviewed monthly by a qualified Professional Engineer (P.Eng.).

The proposed parking lot development will establish a ‘hard cap’ barrier across much of the Site, potentially confining or trapping methane gas beneath paved surfaces and altering methane migration pathways. The existing automated methane monitoring and alarm system constitutes an appropriate RMM to mitigate potential methane migration risks associated with the new hard cap. However, as a precautionary measure, it is recommended that methane gas monitoring data reviews be increased from monthly to weekly immediately following the completion of construction. Weekly reviews should continue until monitoring data demonstrate a stable post-development methane concentration trend, as determined by the qualified P.Eng.

STATEMENT OF LIMITATIONS

This risk evaluation and the work referred to in this report has been undertaken by Parsons for The Ottawa Hospital. It is intended for the sole and exclusive use of The Ottawa Hospital, its affiliated companies and partners and their respective insurers, agents, employees and advisors (collectively, “The Ottawa Hospital”). Any use, reliance on or decision made by any person other than The Ottawa Hospital based on this report is the sole responsibility of such other person. The Ottawa Hospital and Parsons make no representation or warranty to any other person with regard to this report and the work referred to in this report and they accept no duty of care to any other person or any liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm that may be suffered or incurred by any other person as a result of the use of, reliance on, any decision made or any action taken based on this report or the work referred to in this report.

This risk evaluation report has been prepared based on the soil analytical data and site-specific information collected by Thurber during a site characterization work program. By necessity, the findings and observations regarding actual or potential contamination of the property are based solely on the extent of observations and information gathered during the soil characterization work program. The data were collected at discrete locations and conditions may vary at other locations or may change with the passage of time. The assessment was also limited to a study of those chemical parameters specifically addressed in this report.

If Site conditions or applicable standards change or if any additional information becomes available at a future date, modifications to the findings, conclusions and recommendations in this report may be necessary.

Other than by The Ottawa Hospital, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of Parsons. Nothing in this report is intended to constitute or provide a legal opinion.

CLOSURE

We trust the foregoing information is satisfactory for your requirements. Please do not hesitate to contact the undersigned if there are any questions.

PARSONS INC.

Lisa Pensato, P.Eng.

Chris Roach, P.Eng., $QP_{ESA|RA}$

LFP:af

Distribution: Addressee

Attachments

Figure 1 Site Plan

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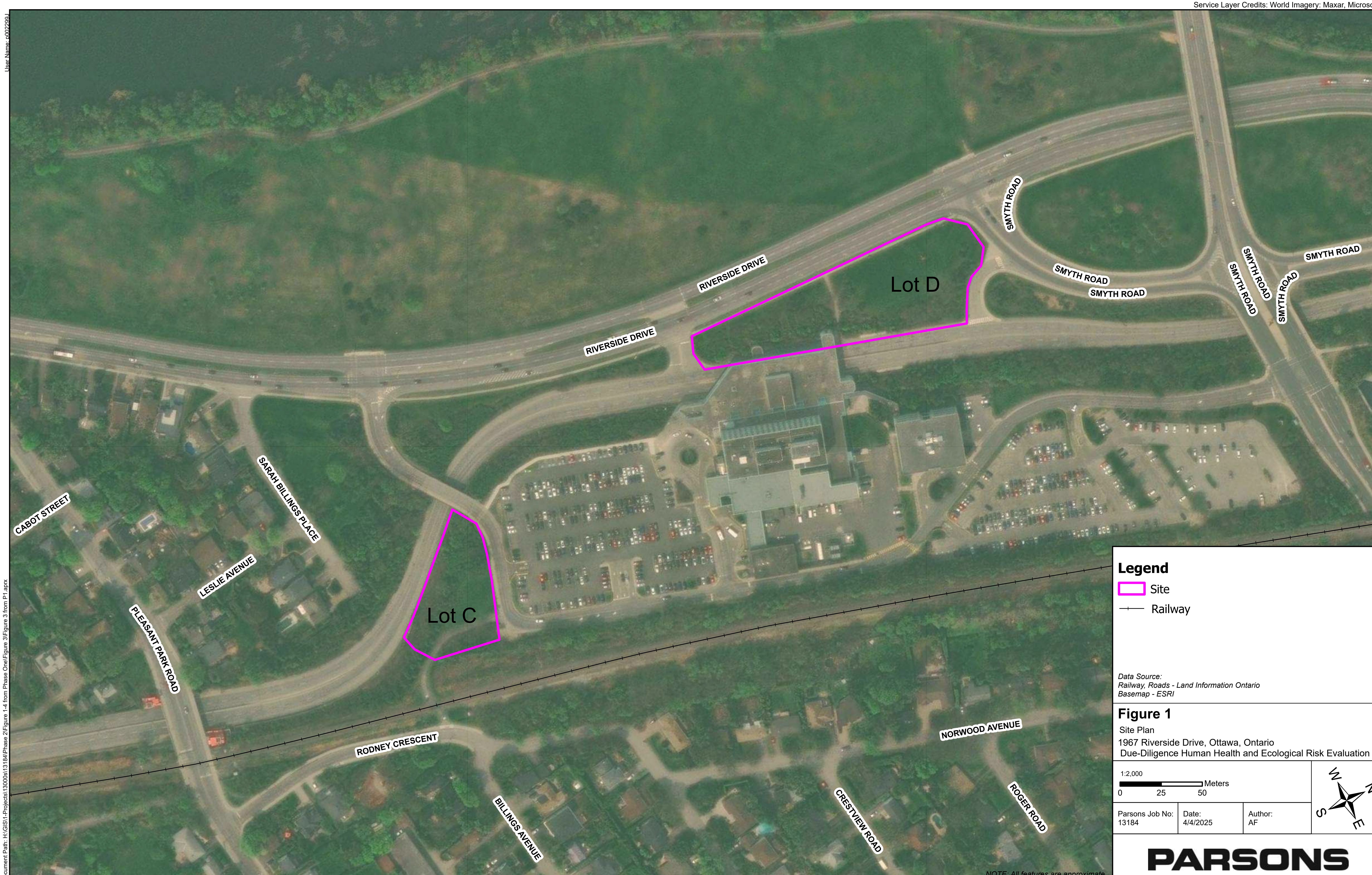
Service Layer Credits: World Imagery: Maxar, Microsoft



Legend

- Site
- Railway

Data Source:
Railway, Roads - Land Information Ontario
Basemap - ESRI

Figure 1

Site Plan
1967 Riverside Drive, Ottawa, Ontario
Due-Diligence Human Health and Ecological Risk Evaluation

1:2,000
0 25 50 Meters

Parsons Job No: 13184	Date: 4/4/2025	Author: AF

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