

March 2021

Volume III

Environmental Assessment of the Proposed W12A Landfill Expansion, City of London



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APPENDIX B

Work Plans

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B.01 Atmospheric (Air and Noise) Work Plan

December 19, 2019

ATMOSPHERE WORK PLAN – Revision 2

Environmental Assessment of the Proposed W12A Landfill Expansion
City of London

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Distribution List

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1.0 Introduction

This document presents the proposed detailed work plan for the atmosphere component of the Environmental Assessment (EA) of the proposed W12A Landfill expansion (the Project). The work plan is being submitted for approval to the Ministry of the Environment, Conservation and Parks (MECP).

This work plan has been developed with consideration of the commitments made for the project within the development of the Terms of Reference (ToR). The relevant commitments are provided below in Table 1.0-1.

Table 1.0-1: Project Commitments from ToR Relevant to Work Plan Development

ID	Commitment
5	Where described in the ToR for the environmental components, detailed work plans for the technical studies will be prepared and provided to the appropriate GRT* agency for review and concurrence.
6	The City will share work plans with Indigenous Communities and post work plans on the project website.
10	During the EA, the preliminary criteria and indicators for each of the environmental components will be refined and described in the EA study report.
11	The preliminary Study Areas will be reviewed and confirmed during the EA and described in the EA study report.
12	A more detailed description of the environmental conditions will be prepared during the EA to reflect the confirmed Study Areas using a combination of sources of existing information and site-specific investigations and studies and provided in the EA study report.

Notes: * Government Review Team (GRT)

2.0 Assessment Framework

2.1 Overall Approach

It is proposed that the EA work will be undertaken in a series of nine steps (further details are provided in Section 4.0) as follows:

- Step 1 – Characterize existing environmental conditions;
- Step 2 – Identify the ‘Alternative Methods’ of landfill expansion;
- Step 3 – Qualitative evaluation of ‘Alternative Methods’;

- Step 4 – Compare the ‘Alternative Methods’ for landfill expansion and identify the preferred alternative;
- Step 5 – Refine the mitigation measures and determine the net effects of the preferred alternative;
- Step 6 – Describe the preferred ‘Alternative Method’;
- Step 7 – Consideration of climate change;
- Step 8 – Cumulative impact assessment; and
- Step 9 – Preparation of the EA Study Report.

Consultation with the public, Indigenous Communities, GRT members, City of London Advisory Committees, and other stakeholders will be ongoing throughout the EA process.

2.2 Project Team Organization

The project tasks will be organized to be completed by the following teams:

- The EA Management Team consists of the project director, project manager and project coordinator for the EA;
- The Design and Operations (D&O) Team consists of landfill design technical staff and AutoCAD technicians; and
- The EA Team consists of technical discipline leads for each of the specified environmental components.

2.3 Study Areas

Data for the EA will be collected and analyzed for preliminary generic study areas presented in the ToR. These will be confirmed and may be refined during the EA. These preliminary generic study areas are as follows:

Site Study Area – The existing W12A Landfill Site, located at 3502 Manning Drive and adjacent lands where landfill expansion may occur.

Site-vicinity Study Area – The lands in the area immediately adjacent to the Site Study Area that have the potential to be directly affected by the landfill expansion and activities with the Site Study Area. The extent of the Site-vicinity Study Area will be determined for each of the environmental components. For most environmental components, a Site-vicinity Study Area of 500 metres from the Site Study Area is appropriate.

Wider Study Area – An area that takes on the broader community generally beyond the immediate site vicinity and for specific environmental components may include the entire Municipality.

The proposed preliminary study areas for the atmosphere component are presented in Table 2.3-1.

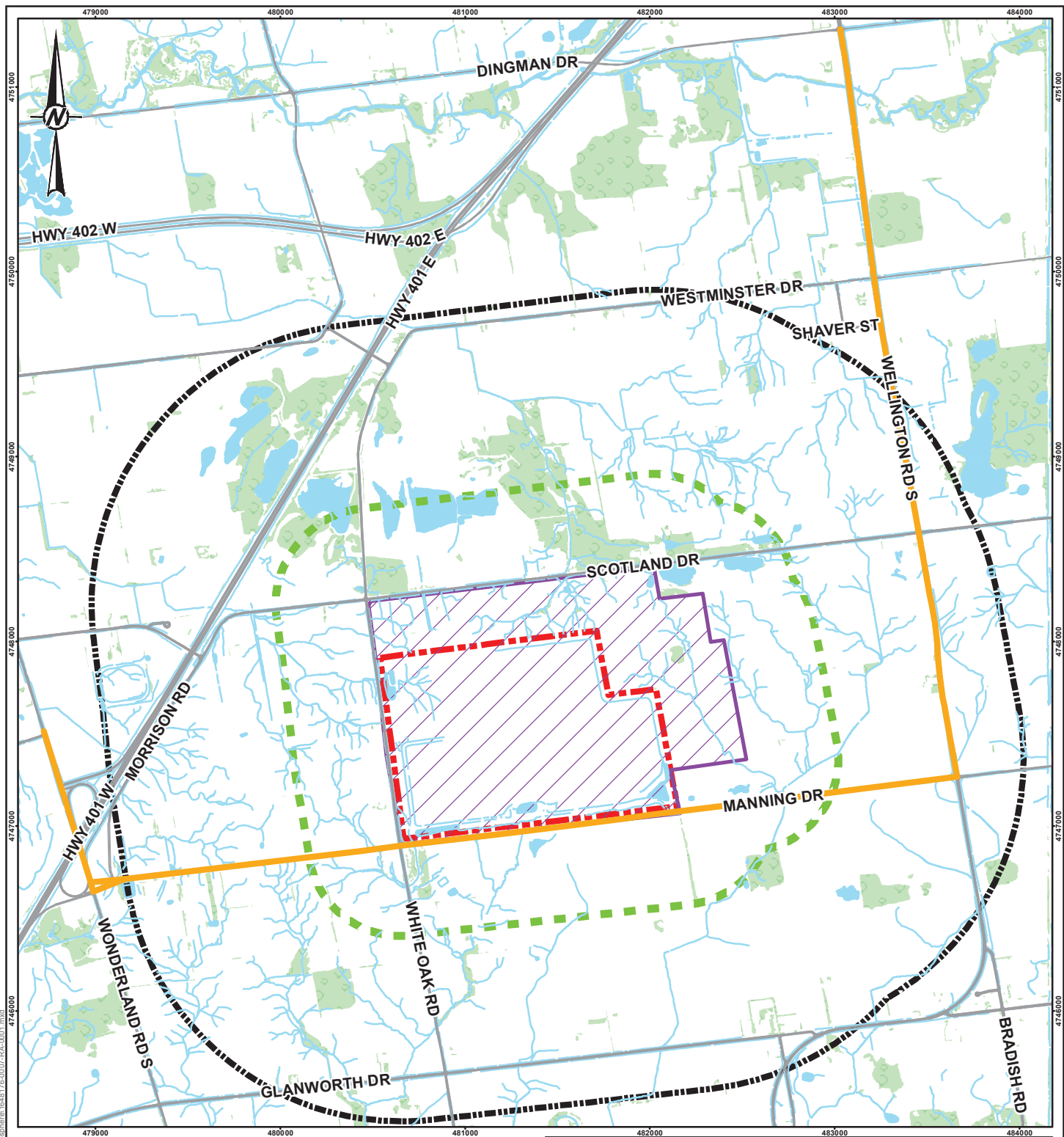
Table 2.3-1: Proposed Preliminary Study Areas for the Atmosphere Component

Environmental Component	Preliminary Area(s) to be Studied	Rationale
Atmosphere	Air Quality – health-related compounds and dust – Site and Site-vicinity	Air (health-related compounds) and dust emissions are required to meet provincial requirements at and beyond the landfill site boundary. Air dispersion modelling will be carried out in accordance with the MECP document “Air Dispersion Modelling Guideline for Ontario”, date February 2017, which includes the use of a receptor grid that meets the requirements of s.14 of Ontario Regulation 419/05.
	Air Quality – Odour – Site and Site-vicinity	Odour emissions are required to meet provincial requirements at off-site sensitive points of reception (PORs). Odour emissions may travel further than 500 m but any effects are expected to be within 1.5 km of the Site Study Area. The locations of the closest PORs in all wind directions will be identified and reviewed for inclusion in the air dispersion model. Consideration will be given to PORs that are greater than 1.5 km from the Study Area but limited to the closest POR for a given wind direction.

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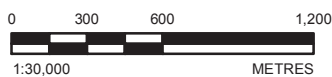
Environmental Assessment of the Proposed W12A Landfill Expansion, City of London

Environmental Component	Preliminary Area(s) to be Studied	Rationale
Atmosphere	Noise – Site and Site- vicinity	Noise emissions are required to meet provincial requirements at off-site points of reception (PORs) from the landfill (which are within 500 m of the landfill) or along the haul routes. The haul routes are to consist of Manning Drive between Wellington Road South and Highway 401 and Wellington Road South between Dingman Drive and Manning Drive. Also, Wonderland Road South between Decker Drive and Manning Drive (as suggested by public feedback received during Open House #2). The Wonderland Road South and Manning Drive intersection / interchange ramps will also be evaluated as part of the EA study. The haul routes to be included in the Site- vicinity Study Area are shown on Figure 2.3-1.



LEGEND

- EXISTING W12A LANDFILL SITE BOUNDARY
- SITE STUDY AREA
- 500 m SITE VICINITY STUDY AREA
- 1500 m SITE VICINITY STUDY AREA
- HAUL ROUTES TO BE ASSESSED



REFERENCE(S)

1. DATA PROVIDED BY THE CITY OF LONDON.
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83

CLIENT
CORPORATION OF THE CITY OF LONDON

PROJECT
ATMOSPHERIC WORKPLAN FOR THE ENVIRONMENTAL
ASSESSMENT OF THE PROPOSED W12A LANDFILL EXPANSION

TITLE
ATMOSPHERIC STUDY AREAS

CONSULTANT

YYYY-MM-DD 2019-08-27

DESIGNED ---

PREPARED JEM

REVIEWED TG

APPROVED PAS



PROJECT NO.
1648176

CONTROL
0007

REV.
0

FIGURE
2.3-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM 25mm

3.0 Assessment Criteria and Indicators

The atmosphere component will be assessed for the potential effects of the undertaking based on two criteria as follows.

The rationale, indicators and data sources for the proposed assessment sub-components are provided in the ToR and are presented in Table 3.0-1 below.

Table: 3.0-1 Component Rationale and Indicators for the EA

Sub-Component	Rationale	Indicator(s)	Data Sources
Air quality (health-related compounds and dust), odour, greenhouse gas [GHG])	Landfill expansion and associated operations can produce gases containing contaminants that degrade air quality if they are emitted to the atmosphere. Construction activities associated with landfill expansion and continued landfill operation can lead to levels of particulates (dust) in the air. Landfill operation can also result in odour effects.	<ul style="list-style-type: none"> • Predicted concentrations of air quality indicator compounds (selected regulated air contaminants to represent this type of project), including dust, at and beyond the property boundary [described further in Section 4.4]. • Expected site-related odour at sensitive receptors. • Expected GHG emissions. 	<ul style="list-style-type: none"> • Environment Canada or MECP's regional air quality data, hourly meteorological data and climate normals. • Published emission factors (including odour). • Site-specific landfill gas (LFG) generation model. • Preferred 'Alternative Method' landfill phasing plan. • Odour complaints history. • Existing site-specific studies. • Applicable provincial regulations, standards and guidelines.

Sub-Component	Rationale	Indicator(s)	Data Sources
Noise	Landfill expansion and associated operations will generate noise that will be emitted into the atmosphere and could impact off-site points of reception (PORs).	<ul style="list-style-type: none"> Noise Levels at off-site PORs, or vacant lots that may accommodate the future construction of PORs. 	<ul style="list-style-type: none"> Landfill equipment list and expected utilization. Preferred 'Alternative Method' landfill phasing plan. Existing site-specific noise studies. Existing noise studies for facilities in the vicinity (if available). Baseline field program Manufacturer's noise data. Consultant's database of similar noise studies. Ministry of Transportation Ontario (MTO) / local municipal traffic count data or newer data collected to support this EA. Applicable provincial guidelines (i.e., Noise Guidelines for Landfill Sites, October 1998, and Publication NPC-300, October 2013)

The criteria and indicators will be refined during the EA as necessary.

4.0 Detailed Workplan

4.1 Step 1: Characterize Existing Environmental Conditions

This section presents an overview of existing environmental conditions for the atmosphere component on and in the area of the W12A Landfill. As described in the *MECP Code of Practice* (MOECC, 2014a), the City of London will present a more detailed description of the environmental conditions in the EA Report. The following is an overview of existing conditions.

The atmosphere component comprises air quality (health-related compounds, dust, odour, GHG) and noise. Within the Site-Vicinity Study Area, the atmospheric environment is typical of southwestern Ontario with transportation and agricultural activities contributing to baseline air quality/odour and noise levels. Due to the proximity to Highway 401, Highway 401 activities are expected to be the dominant source of the existing atmospheric environment in terms of air quality health-related compounds, dust, GHG and noise. The ambient conditions also include current landfill operations, which is an existing source of air, odour, GHG, and noise emissions. It is expected, at times, the existing noise environment could be characterized as a rural setting. For a conservative assessment, to establish the applicable noise limits to assess compliance, the noise emissions of the existing landfill activities will be excluded.

In terms of odour, landfills can emit two types of odours: garbage odour and LFG odour. Garbage odour is generated by recently disposed waste, and LFG odour is generated during the anaerobic decomposition of organic material in the waste. In the general area, other sources of odour emissions include farming operations, waste management facilities (e.g., Orgaworld Canada composting facility, StormFisher Environmental anaerobic digester) and industrial operations (e.g., Ingredion Canada). In 2018, a total of 62 odour complaints were received by the City from local residents; this is higher than in recent years (19 in 2014, 21 in 2015, 17 in 2016 and 34 in 2017).

Ambient air quality data is available from Environment and Climate Change Canada (ECCC) and MECP maintained air monitoring stations located in London. The most recent five year ambient air quality data from the London station that has been reviewed by ECCC at the time of the assessment will be used to prepare a summary of background air quality for the identified indicator compounds. For indicator compounds that are not measured at the London station, or if data is insufficient, data from nearby stations will be used. Concentrations of TSP and PM₁₀, which are not monitored, will be estimated from PM_{2.5} concentrations using typical ratios. For H₂S, the data in ECCC's draft Screening Assessment for H₂S may also be used if monitoring data is not available.

It is not proposed to collect site-specific data. A quantitative assessment of the existing conditions will also be completed for the preferred expansion alternative, as described in Section 4.5.

As part of assessing the existing conditions, historic odour complaints, the locations of the complaints, the recorded weather conditions and operational procedures from the day of the complaint will be reviewed. Based on this review, an assessment will be made in regard to the need for site-specific odour emission measurements to provide source information for the subsequent dispersion modelling work, and for use in assessing possible mitigation measures associated with the expansion. The rationale for and conclusions of this assessment will be documented in the EA study report (Section 4.9).

Existing noise conditions will be established through a combination of a noise field program completed in the vicinity of identified sensitive PORs and noise modelling of existing traffic along local and provincially regulated roadways and existing landfill operations.

4.2 Step 2: Identify ‘Alternative Methods’ of Landfill Expansion

During the initial stage of the EA, a reasonable range of expansion alternatives will be identified and described at a sufficient level of detail (i.e., conceptual designs) so that potential effects of the expanded landfill on each environmental component can be assessed and compared.

This task will involve developing the conceptual site design for the proposed expansion of the W12A Landfill, to gain an additional 25 years of disposal capacity. This task will be completed by the Design and Operations Team.

4.3 Step 3: Qualitative and Quantitative Evaluation of ‘Alternative Methods’

Based on the conceptual site design, and considering mitigation measures, potential impacts of the proposed W12A Landfill expansion on the atmosphere component will be assessed. The atmosphere component technical discipline leads will evaluate each ‘Alternative Method’ qualitatively including:

- Identify the differences in potential air quality (health-related compounds and dust) and odour concentrations from emission sources based on their distance and direction relative to nearest receptors, the property boundary, and site characteristics such as proposed height of the expanded landfill alternatives that will influence dispersion. A limited modelling assessment will be carried out to support the evaluation of the ‘Alternative Methods’. The only source that is expected to change between the different expansion alternatives is the landfill footprint. As a result, a screening assessment will be completed using vinyl chloride. Emission rates of vinyl chloride from the landfill will be modelled using the AERMOD dispersion model for each alternative and the predicted concentrations from each scenario will be compared quantitatively. As a point of reference, the current draft ‘Alternative Methods’ have been attached to this work plan in Appendix A to visually demonstrate the limited potential differences expected with vehicular on-site impacts. The draft Alternative Methods are all relatively similar in location and are not anticipated to change significantly during finalization.

- Qualitatively identify differences among the alternatives that will impact GHG generation such as the landfill configuration that may impact LFG collection efficiency and/or loss of forested area. This comparison will be done qualitatively using the landfill surface area noting that the type of waste accepted and waste acceptance rates will not vary between alternatives, and it is expected that LFG generation and collection efficiency for each landfill expansion ‘Alternative Method’ will not vary significantly; and therefore, neither will the volume of LFG flared. Also, off-site and on-site vehicular movements will be the same and similar, respectively.
- Identify existing and potential PORs in the vicinity of the landfill by means of aerial photographic mapping, zoning maps and site visits, as necessary.
- Identify potential differences in expected noise levels off-site based on the distance and potential line-of-sight exposure of the PORs to the landfilling equipment/activities.
- Review the direct interaction of the proposed alternative method footprints and existing/potential PORs.

In this step, each ‘Alternative Method’ of the W12A Landfill expansion will be examined by the EA Team to determine if it would ultimately be approvable under the Environmental Protection Act (EPA). This screening step is included to eliminate any alternative that would likely not be approvable. Should an alternative be found to not be approvable due to unacceptable net effects (i.e., no further refinement of mitigation is possible) or technical reasons, then the alternative would be eliminated from further consideration. At this point, the EA Management Team may consider additional ‘Alternative Methods’ for the project that may have been identified by the public or other parties during the EA process.

4.4 Step 4: Compare the ‘Alternative Methods’ for Landfill Expansion and Identify the Preferred Alternative

When the alternatives have been finalized, a comparative evaluation of the ‘Alternative Methods’ will be completed. The comparative evaluations would include evaluating the relative importance or ranking of the assessment criteria (i.e., although all criteria are relevant, certain criteria may be considered more important than others¹).

¹ The public has been asked during the consultation on the Terms of Reference and will be asked during consultation on the EA to provide input into the ranking of the relative importance of the components.

The atmosphere component technical discipline leads will complete the following tasks:

- Rank each 'Alternative Method' based on air quality (health-related compounds, dust, odour and GHG) differences.
- Rank each 'Alternative Method' based on noise differences.
- Describe advantages and disadvantages of each 'Alternative Method'.

The EA Management Team will take each discipline's comparison and compile the overall comparison of 'Alternative Methods'.

4.5 Step 5: Refine Mitigation Measures and Determine Net Effects of the Preferred Alternative

In this task, the EA Team will identify linkages between the environmental components (i.e., direct or indirect effects of the proposed expansion on the atmosphere component via another component) and prepare diagrams. The purpose of linkage diagrams, prepared by the technical discipline leads, is to facilitate an integrated assessment of effects.

The prediction of future potential environmental effects associated with the preferred 'Alternative Method' (with conceptual design mitigation measures in place) will be assessed by atmosphere component technical discipline leads.

Upon collection of data required for the assessment of air quality (health-related compounds and dust), odour and noise emissions, the following tasks will be completed:

Air quality and odour assessment – This study will assess emissions from two scenarios:

1. The existing conditions scenario (i.e., currently approved landfill); and
2. The preferred alternative for the expanded landfill.

Emissions will be assessed for the following indicator compounds: particulate matter, including suspended particulate matter [SPM], particles nominally smaller than 10 µm in diameter [PM₁₀] and particles nominally smaller than 2.5 µm in diameter [PM_{2.5}], nitrogen oxides [NO_x], sulphur dioxide [SO₂], carbon monoxide [CO], hydrogen sulphide [H₂S], vinyl chloride [C₂H₃Cl] and odour. Emissions will be estimated using a combination of published emission factors (e.g. US EPA AP42), US EPA MOVES (tailpipe emissions from haul trucks) and LandGEM modelling. The LandGEM model will be run using historical information on waste inputs to estimate landfill gas generation and emission rates of landfill gas constituents. The sources to be assessed will consist of the following:

1. Landfill gas emissions from the landfill mound;
2. Landfill gas combustion emissions from the flaring compound;

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3. Fugitive dust emissions from material handling activities, on-site vehicle movements and stockpile wind erosion;
4. Tailpipe emissions from waste haul trucks and on-site mobile equipment; and
5. Odour from the Landfill and on-site activities, including active face and leachate collection systems.

The LandGEM will be used to identify the future year with the highest LFG generation for modelling. Up to three phases of development of the landfill expansion will be modelled to identify the worst-case emissions scenario for the preferred alternative.

Air dispersion modelling will be completed using an atmospheric dispersion model (AERMOD) to calculate predicted concentrations of relevant indicator compounds at and beyond the property line and at identified sensitive receptors (considered as off-site receptors). Dispersion modelling will be completed in accordance with MECP's Air Dispersion Modelling Guideline for Ontario (February 2017). This will include using the current regulatory version of AERMOD at the time of the assessment, in addition to site specific meteorological data and regional terrain data, both obtained from MECP. Receptors will be identified in accordance with s. 14 of O. Reg. 419/05 with additional sensitive receptors identified for the assessment of odour.

The modelled predictions of NO_x will be used to calculate the concentration of nitrogen dioxide (NO₂) using the Ozone Limiting Method (OLM) suggested by Cole and Summerhays (Cole et al. 1979).

The results of the air quality and odour modelling will be compared against relevant air quality standards and guidelines and used to assess the potential effects associated with the preferred alternative.

A summary of the applicable Ontario and federal objectives and criteria are listed in Table 4.5-1, below.

Table 4.5-1: Relevant Ambient Air Quality Criteria for Indicator Compounds

Compound	Averaging Period	Ontario Ambient Air Quality Criteria ⁽¹⁾ (µg/m ³)	National Ambient Air Quality Standards ⁽²⁾ (µg/m ³)	National Ambient Air Quality Objectives ⁽³⁾	
				Desirable (µg/m ³)	Acceptable (µg/m ³)
SPM ⁽⁴⁾	24-Hour	120	—	—	120
	Annual	60 ⁺⁺	—	60	70
PM ₁₀	24-Hour	50 ⁽⁵⁾	—	—	—
PM _{2.5}	24-Hour	30 ⁽⁶⁾	27 ⁽⁶⁾	—	—
	Annual	—	8.8	—	—

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Compound	Averaging Period	Ontario Ambient Air Quality Criteria ⁽¹⁾ (µg/m ³)	National Ambient Air Quality Standards ⁽²⁾ (µg/m ³)	National Ambient Air Quality Objectives ⁽³⁾	
				Desirable (µg/m ³)	Acceptable (µg/m ³)
NO _x	1-Hour	400	79⁽⁶⁾	—	400
	24-Hour	200	—	—	200
	Annual	—	22.5	60	100
SO ₂	10-min	180			
	1-Hour	100	170.3 ⁽⁷⁾	450	900
	24-Hour	—	—	150	300
	Annual	10	10.5	30	60
CO	1-Hour	36,200	—	15,000	35,000
	8-Hour	15,700	—	6,000	15,000
H ₂ S	10-minute	13	—	—	—
	24-hour	7	—	—	—
Vinyl Chloride	24-Hour	1	—	—	—
	Annual	0.2	—	—	—

Notes:

- (1) MECP 2018.
 - (2) NAAQS published in the Canada Gazette Volume 147, No. 21 - May 25, 2013 (Government of Canada 2013). The values presented in the table are for the 2020 phase-in date.
 - (3) CCME1999.
 - (4) SPM in Ontario is defined as Suspended Particulate Matter (less than 44 µm diameter).
 - (5) Interim Ambient Air Quality Criteria (MECP 2018).
 - (6) Based on the 98th percentile of the annual monitored data averaged over three years of measurements.
 - (7) The 3-year average of the annual 99th percentile of the SO₂ daily maximum 1-hour concentrations.
- ++ Geometric Mean Value.
 — = No guideline available.
 TEQ = Toxics Equivalents.

Bolded values represent the criteria that will be used in the assessment.

Odour impacts will be assessed following the guidance in the MECP Technical Bulletin *Methods for Modeling Assessments of Contaminants with 10-minute average standards and guidelines for Odour under O.Reg. 419/05 (September 2016)* and compared to the guideline of 1 OU/m³.

The air quality and odour assessment will also include the following qualitative component:

- It is anticipated that truck transportation along the haul route associated with the W12A landfill site will have insignificant impacts and will decrease compared to the truck traffic corresponding to the current approved annual maximum waste volumes. The air quality assessment will provide a rationale for the insignificance of truck transportation by comparing the truck traffic associated with the Site to existing daily traffic counts on the surrounding Haul routes.
- Noise assessment – This study will assess emissions from the preferred expansion alternative. Emissions from equipment and vehicles operating will be based on measurements from the existing landfill, manufacturer's or design data, or emissions data from Golder's database of similar noise sources. This will be followed by the execution of a noise prediction model. The results of this study will be predicted worst-case hour operation for various activities associated with the proposed landfill operations. This study will focus on off-site sensitive PORs.

Assessment of potential effects associated with air quality, odour and noise will be done using appropriate objectives, standards, policies and regulations. The remaining net effects, if any, will be documented. Also, a qualitative and/or quantitative comparison will be made between the predicted effects of the preferred alternative and the existing scenario considering the indicators for the atmosphere component; the change in difference between the existing scenario and the preferred expansion Alternative Method can be provided. In addition, the preferred expansion alternative will be assessed and designed to demonstrate compliance with O. Reg. 419/05 and the MECP noise limits to support a future Environmental Compliance Approval amendment application.

4.6 Step 6: Describe the Preferred 'Alternative Method' for Landfill Expansion

A description of the preferred landfill expansion alternative will be detailed following the identification of appropriate mitigation measures. In addition, a leachate management assessment will be completed that will include:

- the quantity of leachate generated from the preferred landfill expansion alternative will be predicted;
- the quality of the leachate associated with the expansion and requiring treatment will be assessed;

- a high level assessment of the capability of the existing forcemain to continue to convey the collected leachate to the municipal sewer system will be completed; and
- a high level assessment of the capability of the Greenway Wastewater Treatment Plant to continue to treat the leachate will be carried out.

The results will be provided in the EA study report (Step 9).

4.7 Step 7: Consideration of Climate Change

Ways in which the project could reduce GHG emissions or remove GHG from the atmosphere will be considered.

The GHG emission estimates, where applicable, will follow quantification guidelines for both provincial and federal reporting:

- Federal reporting under Section 46 of the *Canadian Environmental Protection Act*, (CEPA), SC 1999: Greenhouse Gas Emissions Reporting Program (GHGRP); and
- Provincial reporting under Ontario's Greenhouse Gas Emissions: Quantification, Reporting, and Verification Regulation, O. Reg. 390/18.

The total estimated GHG emissions associated with the expanded landfill will be quantified and compared to the Ontario-wide emissions of GHGs as well as the existing baseline scenario of the existing landfill operation.

4.8 Step 8: Cumulative Impact Assessment

The EA Team will work to identify the predicted effects of other existing or known proposed projects in the area of the site. The atmosphere component technical discipline leads will consider any identified effects together with those predicted during the comparative evaluation of alternative methods to determine if there are any unacceptable predicted cumulative effects.

For air quality, predicted concentrations from the preferred alternative will be added to background concentrations identified as part of Step 1 to assess the cumulative impacts of the Project, relative to existing air quality criteria and guidelines.

For odour, a review of nearby odour sources and complaints filed with the MECP will be conducted. A windrose will be prepared for the area and the review will consider the locations of sensitive receptors relative to prevailing wind direction and historical complaints. This will be summarised to qualitatively assess the likelihood of cumulative impacts at the identified sensitive receptors.

4.9 Step 9: Preparation of EA Study Report

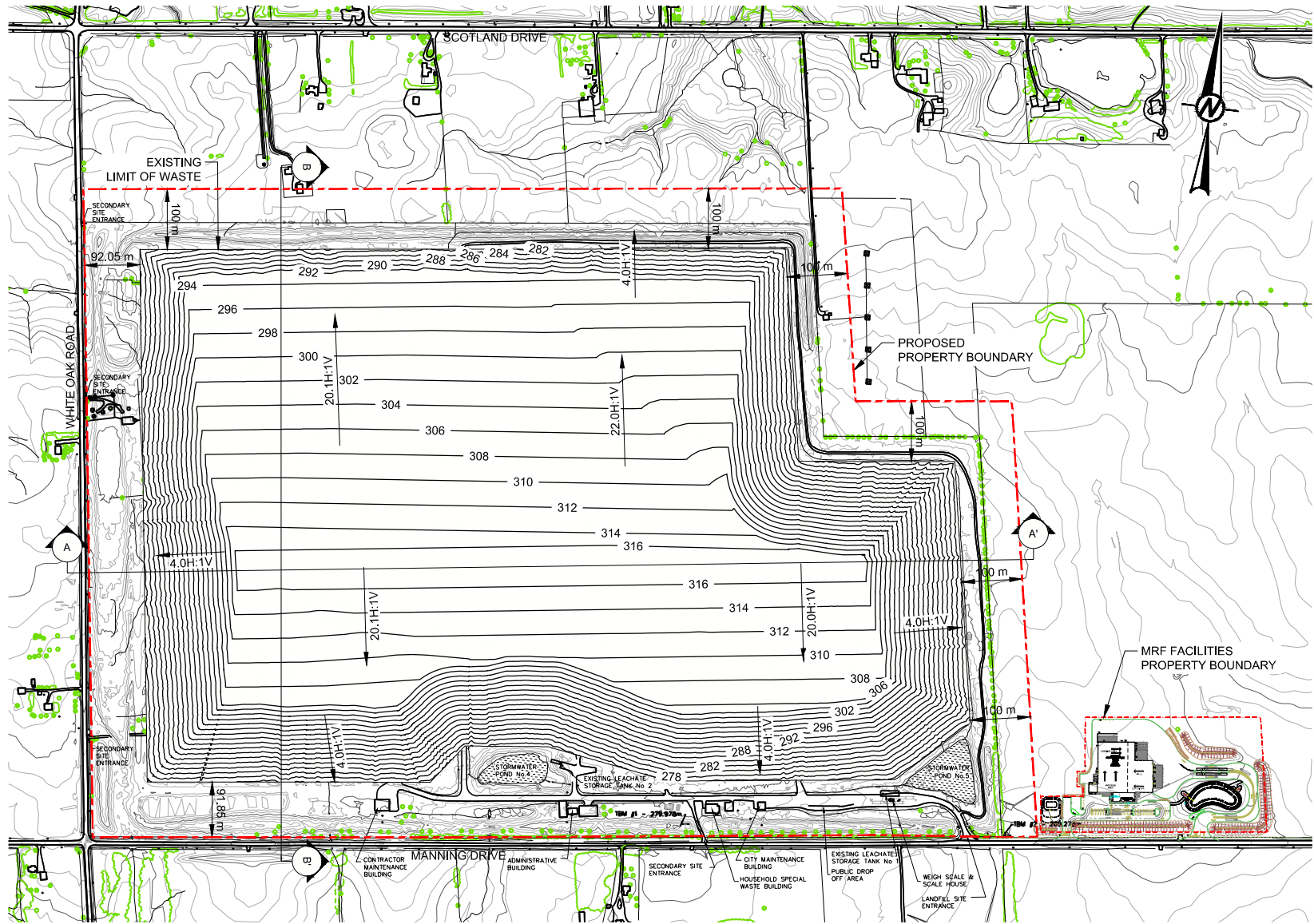
In support of the completion of this task the atmosphere component technical discipline leads will carry out the following tasks:

- document the assessment results in an Atmospheric Supporting Document that will form an appendix to the EA submission;
- participate in meetings with the GRT including upfront consultations with the MECP during the EA to obtain pre-approval of tasks in the work plan, as required;
- support consultation events as required in development of presentation material and/or being at the event; and
- provide technical support during the review of the draft EA by the regulatory agencies and public.

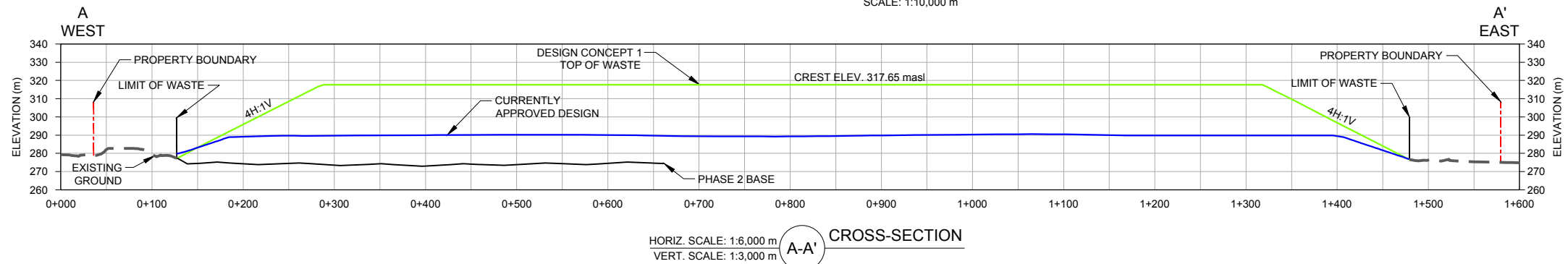
Appendix A

Design Concept Alternatives

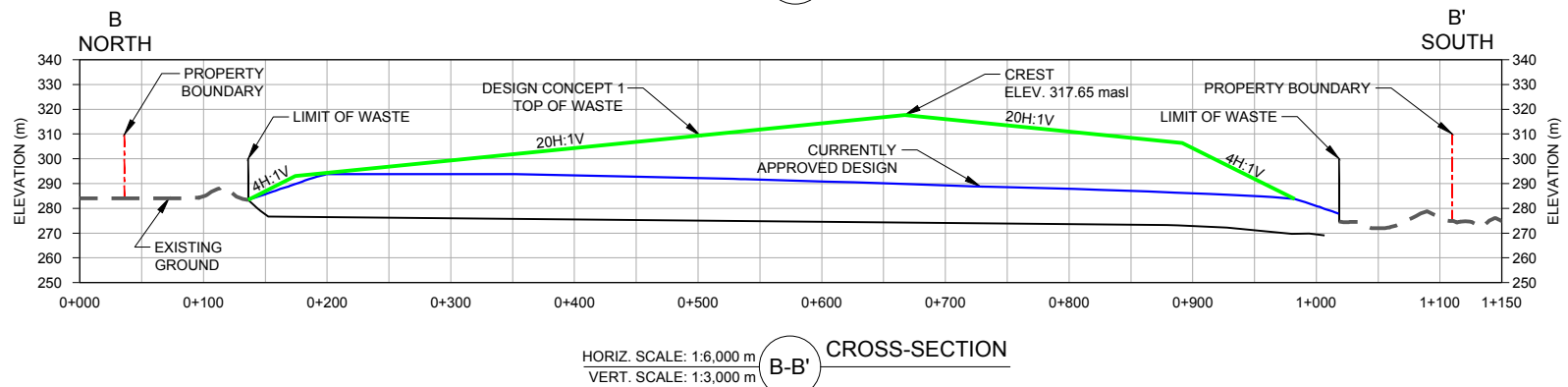
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SITE PLAN
SCALE: 1:10,000 m

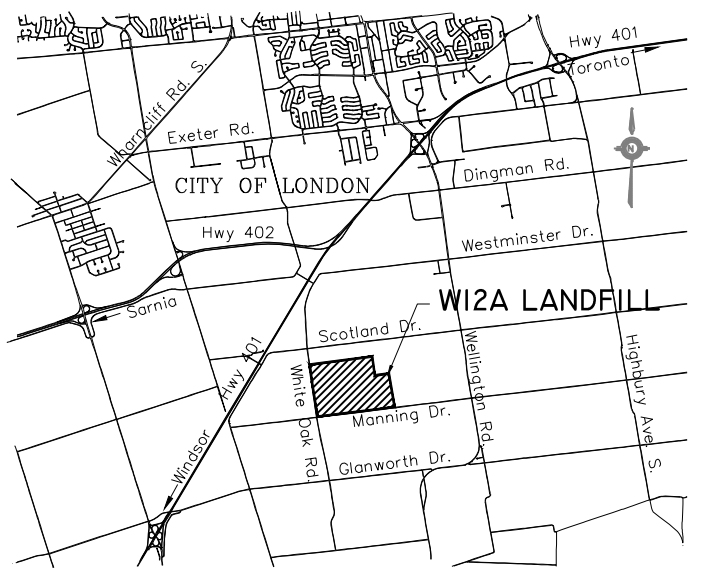


HORIZ. SCALE: 1:6,000 m
VERT. SCALE: 1:3,000 m
A-A' CROSS-SECTION



HORIZ. SCALE: 1:6,000 m
VERT. SCALE: 1:3,000 m
B-B' CROSS-SECTION

KEY MAP



NOTE(S)

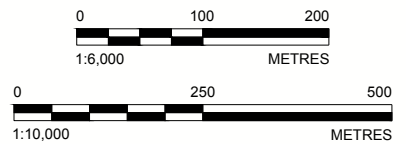
- ELEVATION CONTOURS SHOWN ARE TOP OF WASTE, masl.

REFERENCE(S)

BASE INFORMATION AND EXISTING CONTOURS AS PER CITY OF LONDON SURVEY DATED NOVEMBER 22, 2016.

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CLIENT
CITY OF LONDON
LONDON, ONTARIO
CANADA

PROJECT
INDIVIDUAL EA, RESIDUAL WASTE DISPOSAL STRATEGY
W12A LANDFILL WASTE MOUND CONCEPT DESIGN

TITLE
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FOOTPRINT

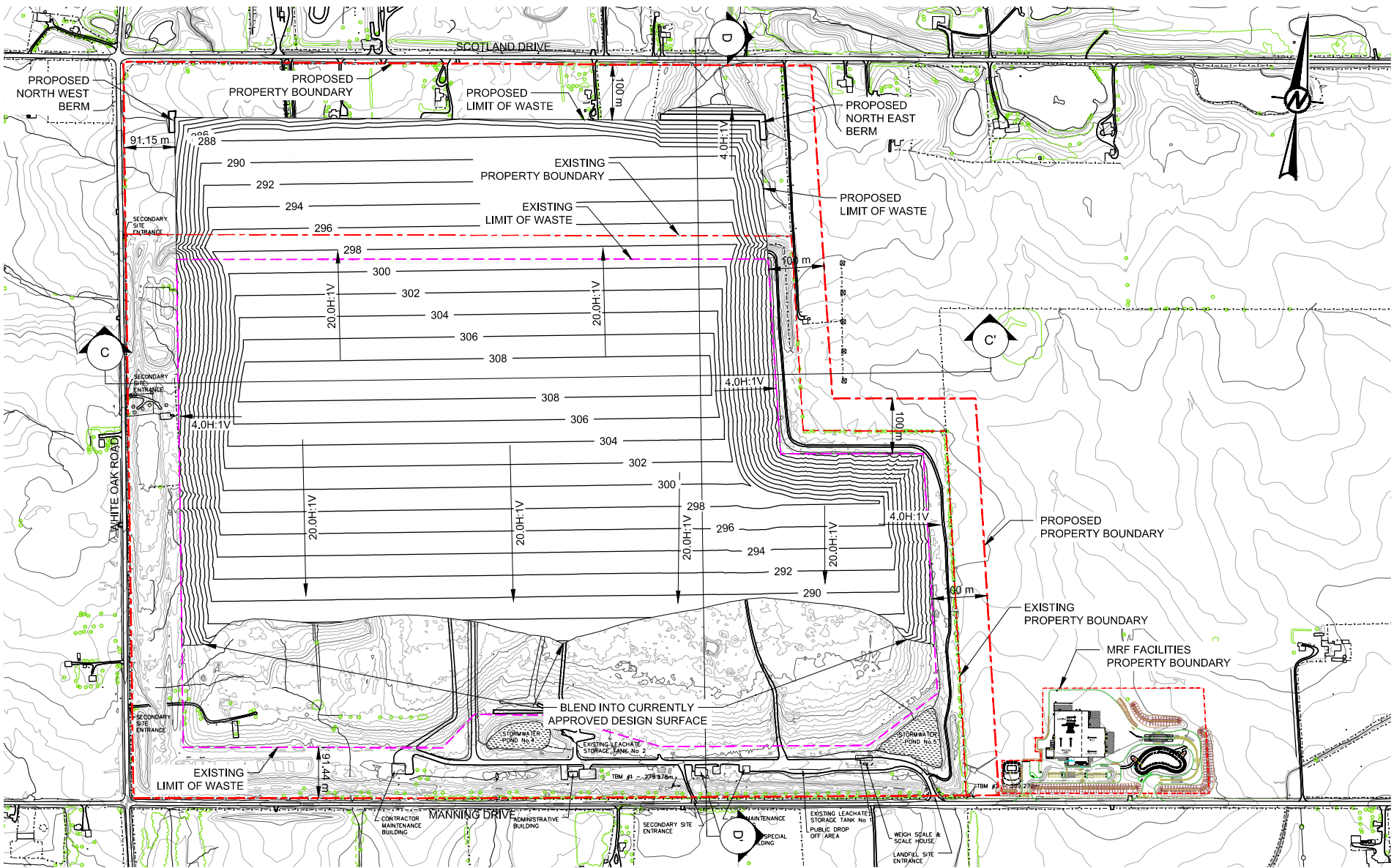
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	DESIGNED	MLF
	PREPARED	MLF
	REVIEWED	PS
	APPROVED	PS



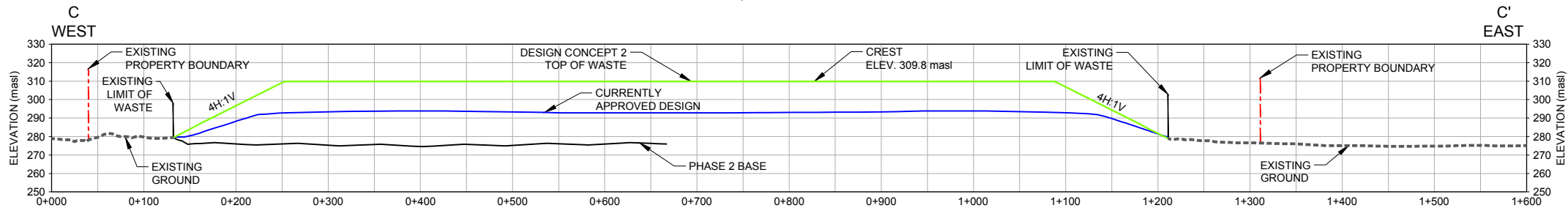
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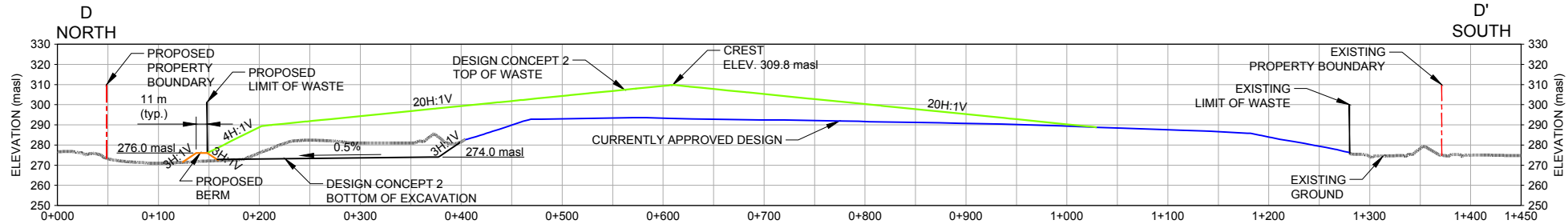
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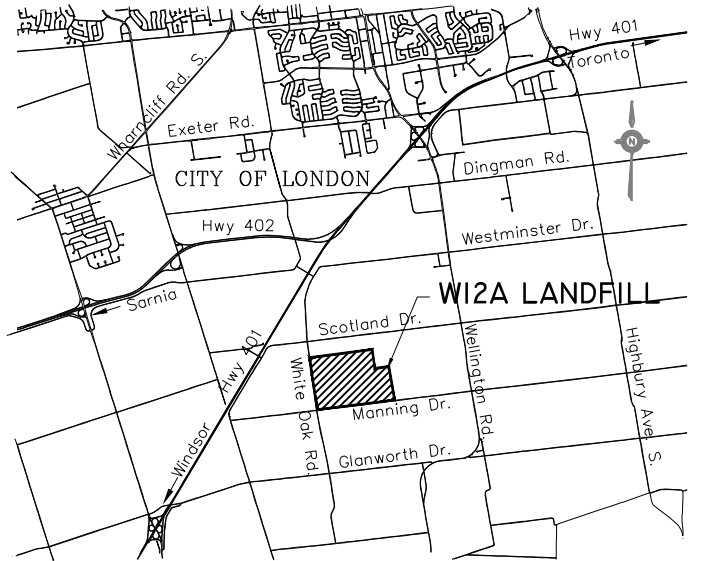


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VERT. SCALE: 1:3,000 m
C-C' CROSS-SECTION



HORIZ. SCALE: 1:6,000 m
VERT. SCALE: 1:3,000 m
D-D' CROSS-SECTION

KEY MAP



NOTE(S)

1. ELEVATION CONTOURS SHOWN ARE TOP OF WASTE, masl.

REFERENCE(S)

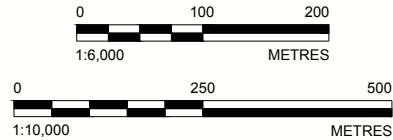
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NOT FOR CONSTRUCTION

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CITY OF LONDON
LONDON, ONTARIO
CANADA

PROJECT

INDIVIDUAL EA, OF THE PROPOSED
W12A LANDFILL EXPANSION

TITLE

DESIGN CONCEPT 2 - HORIZONTAL EXPANSION TO THE NORTH
WITH VERTICAL EXPANSION OVER PART OF EXISTING
FOOTPRINT

CONSULTANT



YYYY-MM-DD	2019-11-05
DESIGNED	MLF
PREPARED	MLF
REVIEWED	PS
APPROVED	PS

PROJECT NO.
1648176

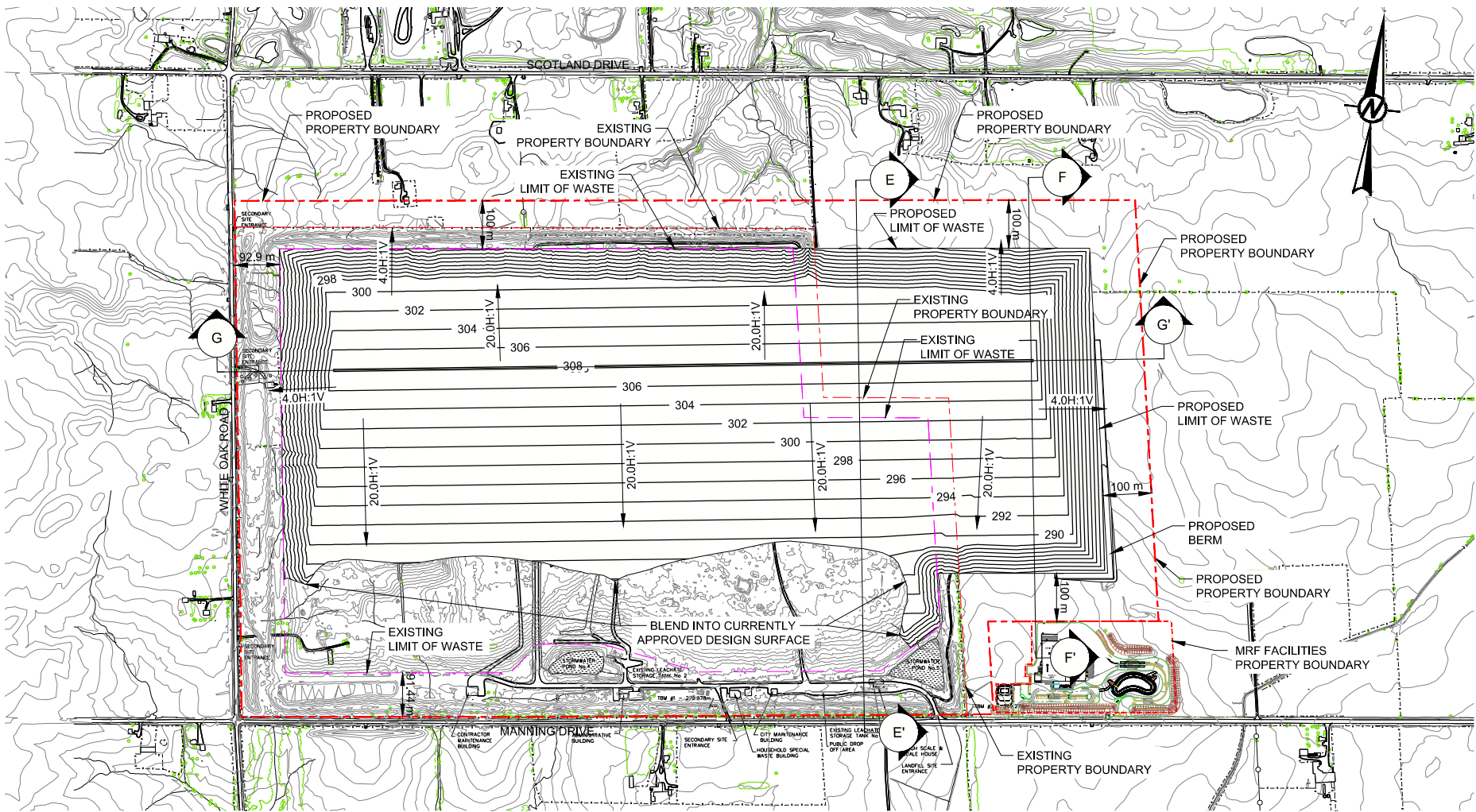
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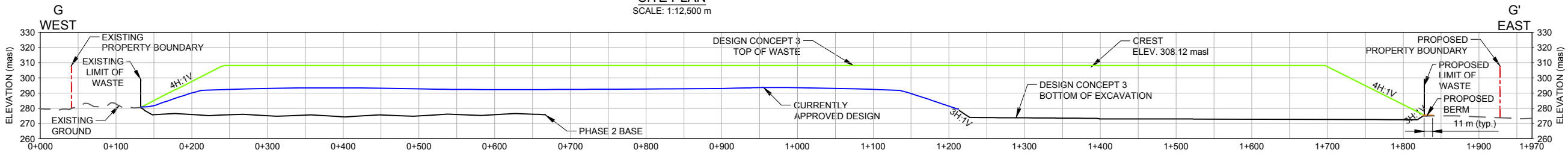
DRAWING
DC2

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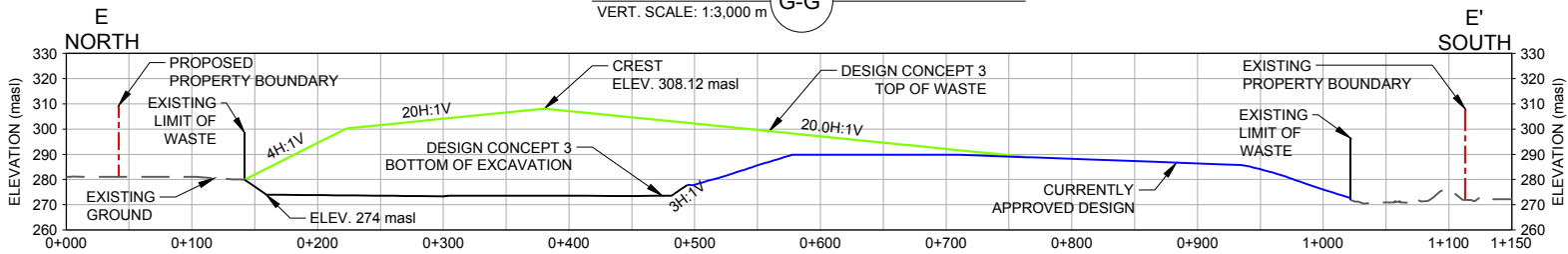
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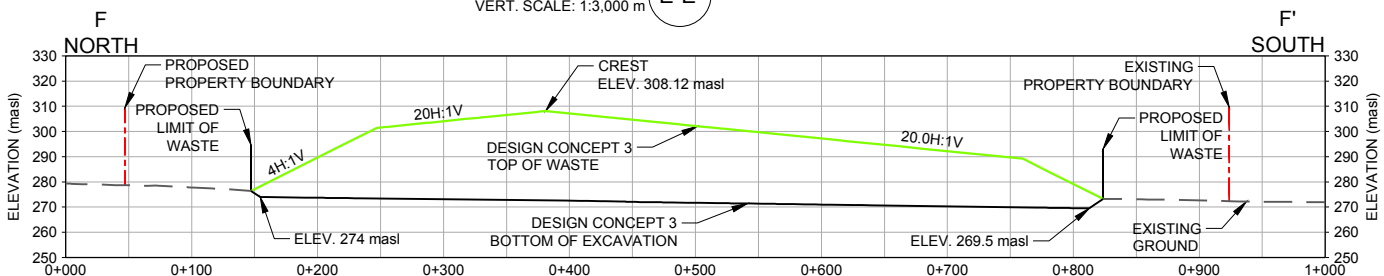
SITE PLAN
SCALE: 1:12,500 m



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G-G' CROSS-SECTION

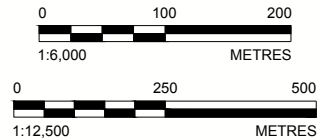


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E-E' CROSS-SECTION

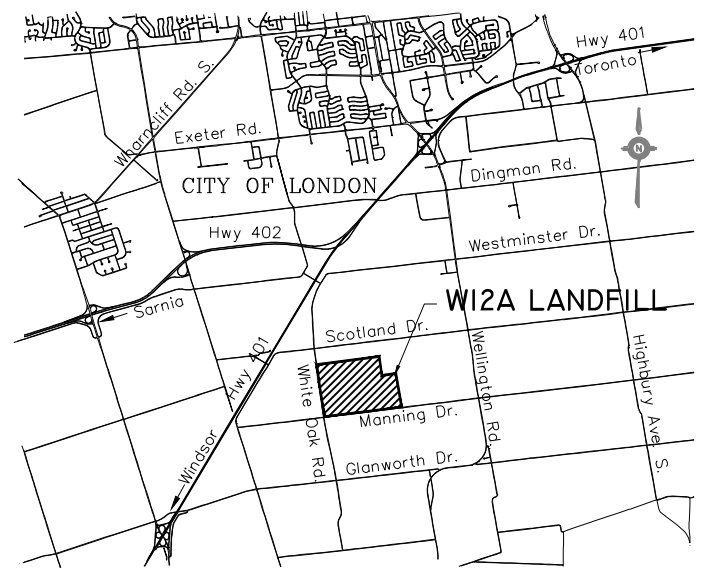


HORIZ. SCALE: 1:6,000 m
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F-F' CROSS-SECTION

NOT FOR CONSTRUCTION
DRAFT



KEY MAP



NOTE(S)

- ELEVATION CONTOURS SHOWN ARE TOP OF WASTE, masl.

REFERENCE(S)

BASE INFORMATION AND EXISTING CONTOURS AS PER CITY OF LONDON SURVEY DATED NOVEMBER 22, 2016.

Cut/Fill Summary

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CLIENT
CITY OF LONDON
LONDON, ONTARIO
CANADA

PROJECT
INDIVIDUAL EA OF THE PROPOSED
W12A LANDFILL EXPANSION

TITLE
**DESIGN CONCEPT 3 - HORIZONTAL EXPANSION TO THE EAST
WITH VERTICA**

CONSULTANT	YYYY-MM-DD	2019-11-07
DESIGNED	MLF	
PREPARED	MLF	
REVIEWED	PS	
APPROVED	PS	

PROJECT NO. 1648176	CONTROL 0001	REV. B	DRAWING DC3
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B.02 Groundwater Work Plan

November 14, 2019

GROUNDWATER WORK PLAN

Environmental Assessment of the Proposed W12A Landfill Expansion
City of London

Submitted to:

City of London
300 Dufferin Avenue
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Submitted by:

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Distribution List

1 e-copy Ministry of the Environment, Conservation and Parks

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1.0 Introduction

This document presents the proposed detailed work plan for the groundwater component of the Environmental Assessment (EA) of the proposed W12A Landfill expansion (project). The work plan is being submitted for approval to the Ministry of the Environment, Conservation and Parks (MECP).

This work plan has been developed with consideration of the commitments made for the project within the development of the Terms of Reference (ToR). The relevant commitments are provided below in Table 1.0-1.

Table 1.0-1: Project Commitments from ToR Relevant to Work Plan Development

ID	Commitment
5	Where described in the ToR for the environmental components, detailed work plans for the technical studies will be prepared and provided to the appropriate GRT* agency for review and concurrence.
6	The City will share work plans with Indigenous Communities and post work plans on the project website.
10	During the EA, the preliminary criteria and indicators for each of the environmental components will be refined and described in the EA study report.
11	The preliminary Study Areas will be reviewed and confirmed during the EA and described in the EA study report.
12	A more detailed description of the environmental conditions will be prepared during the EA to reflect the confirmed Study Areas using a combination of sources of existing information and site-specific investigations and studies and provided in the EA study report.

* Government Review Team (GRT)

2.0 Assessment Framework

2.1 Overall Approach

It is proposed that the EA work will be undertaken in a series of nine steps (further details are provided in Section 4.0) as follows:

- Step 1 – Characterize existing environmental conditions;
- Step 2 – Identify the ‘Alternative Methods’ of landfill expansion;
- Step 3 – Qualitative evaluation of ‘Alternative Methods’;
- Step 4 – Compare the ‘Alternative Methods’ for landfill expansion and identify the preferred alternative;

- Step 5 – Refine the mitigation measures and determine the net effects of the preferred alternative;
- Step 6 – Describe the preferred ‘Alternative Method’;
- Step 7 – Consideration of climate change;
- Step 8 – Cumulative impact assessment; and
- Step 9 – Preparation of the EA Study Report.

Consultation with the public, Indigenous Communities, GRT members, City of London Advisory Committees, and other stakeholders will be ongoing throughout the EA process.

2.2 Project Team Organization

The project tasks will be organized to be completed by the following teams:

- The EA Management Team consists of the project director, project manager and project coordinator for the EA;
- The Design and Operations (D&O) Team consists of landfill design technical staff and AutoCAD technicians; and
- The EA Team consists of technical discipline leads for each of the specified environmental components.

2.3 Study Areas

Data for the EA will be collected and analyzed for preliminary generic study areas presented in the ToR. These will be confirmed and may be refined during the EA. These preliminary generic study areas are as follows:

Site Study Area – The existing W12A Landfill Site, located at 3502 Manning Drive and adjacent lands where landfill expansion may occur.

Site-vicinity Study Area – The lands in the area immediately adjacent to the Site Study Area that have the potential to be directly affected by the landfill expansion and activities with the Site Study Area. The extent of the Site-vicinity Study Area will be determined for each of the environmental components. For most environmental components, a Site-vicinity Study Area of 500 metres from the Site Study Area is appropriate.

Wider Study Area – An area that takes on the broader community generally beyond the immediate site vicinity and for specific environmental components may include the entire Municipality.

The proposed preliminary study area for the groundwater component is presented in Table 2.3-1.

Table 2.3-1: Proposed Preliminary Study Areas for the Groundwater Component

Environmental Component	Preliminary Area(s) to be Studied	Rationale
Geology and Hydrogeology	Site	Potential effects on groundwater quality have to comply with the MECP Reasonable Use Guideline at the landfill site boundary.

3.0 Assessment Criteria and Indicators

The Groundwater component will be assessed for the potential effects of the undertaking based on one criterion as follows.

The rationale, indicators and data sources for the proposed assessment sub-components are provided in the ToR, and are presented in Table 3.0-1 below.

Table 3.0-1: Component Rationale and Indicators for the EA

Sub-Component	Rationale	Indicator(s)	Data Sources
Groundwater quality	Contaminants associated with the landfill expansion and associated operations could enter the groundwater and impact off-site groundwater or surface water.	<ul style="list-style-type: none">Expected effect on groundwater quality at the property boundary.	<ul style="list-style-type: none">Published regional sources and data on regional geological and hydrogeological conditions such as the Middlesex-Elgin Groundwater Study, Source Protection Assessment Reports.Review MNRF petroleum well records.Provincial Quaternary and Bedrock Mapping.Ontario Water Well Records (water supply wells are considered to be sensitive receptors in terms of potential impacts).Landfill Annual Monitoring Reports.Previous site characterization reports.Borehole Logs.Adjacent property assessment reports.Additional intrusive studies/investigations (see section 4.1.2).

The criteria and indicators will be refined during the EA as necessary.

4.0 Detailed Workplan

4.1 Step 1: Characterize Existing Environmental Conditions

This section presents an overview of existing environmental conditions for the groundwater component on and in the area of the W12A Landfill. As described in the *MECP Code of Practice* (MOECC, 2014a), the City of London will present a more detailed description of the environmental conditions in the EA Report. The following is an overview of existing conditions.

4.1.1 Overview of Existing Conditions (Existing Documentation)

Previous investigations over the last 40 years has resulted in a thorough understanding of hydrogeology setting of the existing landfill. In terms of geological setting, the landfill is located on part of the Westminster moraine, which consists of low permeability till soils identified as the Port Stanley Till. Immediately north of the landfill site, gravel and gravelly sand were formed from the older Catfish Creek drift (located under the Port Stanley Till) or were deposited underneath the Port Stanley Till by subglacial streams.

Major hydrostratigraphic units are divided into aquitards and aquifers. An aquitard consists of low permeability soils that inhibit groundwater flow. An aquifer consists of permeable soils that can transmit large enough quantities of water such that when water wells are installed they produce usable quantities of water.

In terms of the hydrogeological setting, the site is underlain by an aquitard, consisting of low permeability Port Stanley Till, referred to as the Surficial Aquitard. The thickness of the Surficial Aquitard varies from as much as 20 m in the northwest corner of the existing W12A Landfill site, to 15 m or greater below much of the existing landfill, and to about 8 m at the southeast corner of the site along Manning Drive. Groundwater moves downward at an estimated velocity of 1 to 2 centimeters (cm) per year in the Surficial Aquitard. The upper portion of the Surficial Aquitard is weathered and fractured. The degree of significant fracturing decreases with depth such that the fractured till is much more hydraulically active than the lower less fractured till soil. Generally, regional studies have indicated that the tills are highly fractured to a depth of 3-4 m, a transitional zone occurs with beneath the highly weathered and fractured soil with isolated vertical fractures occurring at depths of approximately 6 m. The landfill cells will be excavated to depths that will remove most of the naturally weathered soils. Therefore, the landfill will be based on unfractured soil and will be protected from further desiccation and weathering by the overlying waste fill. Studies completed by Dillon and the University of Western Ontario in 2000 indicated that the depth of active fractures beneath the waste fill is less than 2 m and that desiccation fractures in till soils occurring during landfill cell construction are “self-healing”.

The next major hydrogeological feature in the region is an aquifer found beneath the Port Stanley Till, consisting of stratified sand and gravel soils, most likely part of the Catfish Creek Drift. These soil deposits comprise the White Oak Aquifer. The aquifer has an irregular vertical distribution with a maximum thickness of approximately 45 m just north of the landfill

along Scotland Drive. Groundwater flow in the White Oak Aquifer is in a general north to south/southeast direction.

Some local aquifers consisting of sand and gravel soil layers within the low permeability till soils were probably formed by subglacial processes at the time that the till soils were deposited. One such local aquifer is present underneath the landfill (referred to as the Upper Aquifer) and separates the Port Stanley Till into the Surficial Aquitard and a Lower Aquitard, both of which are above the White Oak Aquifer. The Upper Aquifer is indicated not to be present north of Scotland Drive, but extends south of Manning Drive; groundwater flow in the Upper Aquifer is towards the southeast. These aquifers are not regionally extensive and generally thinner than the White Oak Aquifer.

Limestone bedrock is found approximately 80 to 90 m below the landfill and slopes downwards from north-northeast.

Municipal water is available to residences near the landfill on Manning Drive, White Oak Drive, Scotland Drive and Wellington Road South; however, some of the homeowners have not connected to the available municipal services. These residences, as well as residences and farms further away from the landfill area, rely on individual water supply wells for their water supply. Individual water supply wells in the vicinity of the landfill are monitored annually.

Source water protection studies were carried out for the watersheds in which the City of London is located. The resulting Source Water Protection Plans delineate source protection areas with respect to municipal drinking water supplies (Wellhead Protection Areas – WHPAs and Intake Protection Zones – IPZs) as well as groundwater recharge areas, assign vulnerability to these source protection areas and describe appropriate land use planning for their protection. The Thames-Sydenham & Region Drinking Water Source Protection Plan takes in the area of and surrounding the W12A Landfill. The primary source of drinking water for the City is surface water from Lake Huron and Lake Erie, with a stand-by backup supply from groundwater from the Hyde Park and Fanshawe well fields located in the northeast and west parts of the City. All of these sources are distant from the W12A Landfill. There are no source water protection areas identified on or in the area of the W12A Landfill. As such, neither the existing landfill nor the proposed expansion are influenced by planning considerations or requirements related to source water protection.

4.1.2 Additional Studies/Investigations

In addition to reviewing the data sources described in 3.0-1 and despite the thorough understanding of the hydrogeology setting of the existing landfill, there remains some potential areas for further field investigations to the north and east of the existing landfill, related to existing conditions but also landfill expansion.

Area North of Existing Landfill

The main issue at this location is the nature of the hydrogeological connection between the local Upper Aquifer and the regional White Oaks Aquifer. Integral to the connection is the presence and hydraulic conductivity of the till layer separating the aquifer hydrostratigraphic units.

An evaluation of this issue consisted of using a “multiple lines of evidence” approach where borehole data was used to develop physical localized hydrostratigraphic limits coupled with groundwater level data and hydrogeochemistry data. In addition, hydrogeological data that has been obtained over the operating period of the landfill obtained from hydrogeological studies completed on aggregate pits north of the landfill site (north of Scotland Drive) has been used to supplement the hydrogeological understanding of this area. Overall, these sources of information were used to further define aquifer units and identify data gaps that could be addressed by additional investigation.

Figure 4.1-1 (next page) shows the thickness of the Surficial Aquitard based both on borehole logs and water well records as well as surficial topography. The Surficial Aquitard is absent north of Scotland Drive where the gravel pits have intercepted the White Oaks Aquifer. The Upper Aquifer and Lower Aquitard are also absent north of Scotland Drive.

A cross section drawn north-to-south is shown on **Figure 4.1-2** (page 8). This section was drawn approximately 250 m east of White Oak Road and shows the interpreted extent of the major hydrostratigraphic units at the landfill site. This cross-section was developed by interpolating between boreholes and water well records.

There are currently six monitoring well locations located north of the landfill and are shown on **Figure 4.1-1**. At the southeast corner of Scotland Drive and White Oak Road there is a nested monitoring well location: 01-12b (Upper Aquifer monitoring well) and 01-12a (White Oaks Aquifer monitoring well). Also located near this location is 92-12 which is a White Oaks Aquifer monitoring well. Monitoring well 92-10 (a White Oaks Aquifer monitoring well) is on the south side of Scotland Drive, 200 m east of White Oak Road. Another White Oaks Aquifer monitoring well, 01-13, is located approximately 150 m south of 92-10. Monitoring well 92-11, which is installed in the Upper Aquifer, is located 110 m east of White Oak Road along the northern boundary of the current landfill site. Upper Aquifer monitoring well 82-6, located 660m east of 92-1 is also at the northern site boundary. At the northeast corner of the current site are Upper Aquifer monitoring well 01-14, in close vicinity to White Oaks Aquifer monitoring well 92-9.

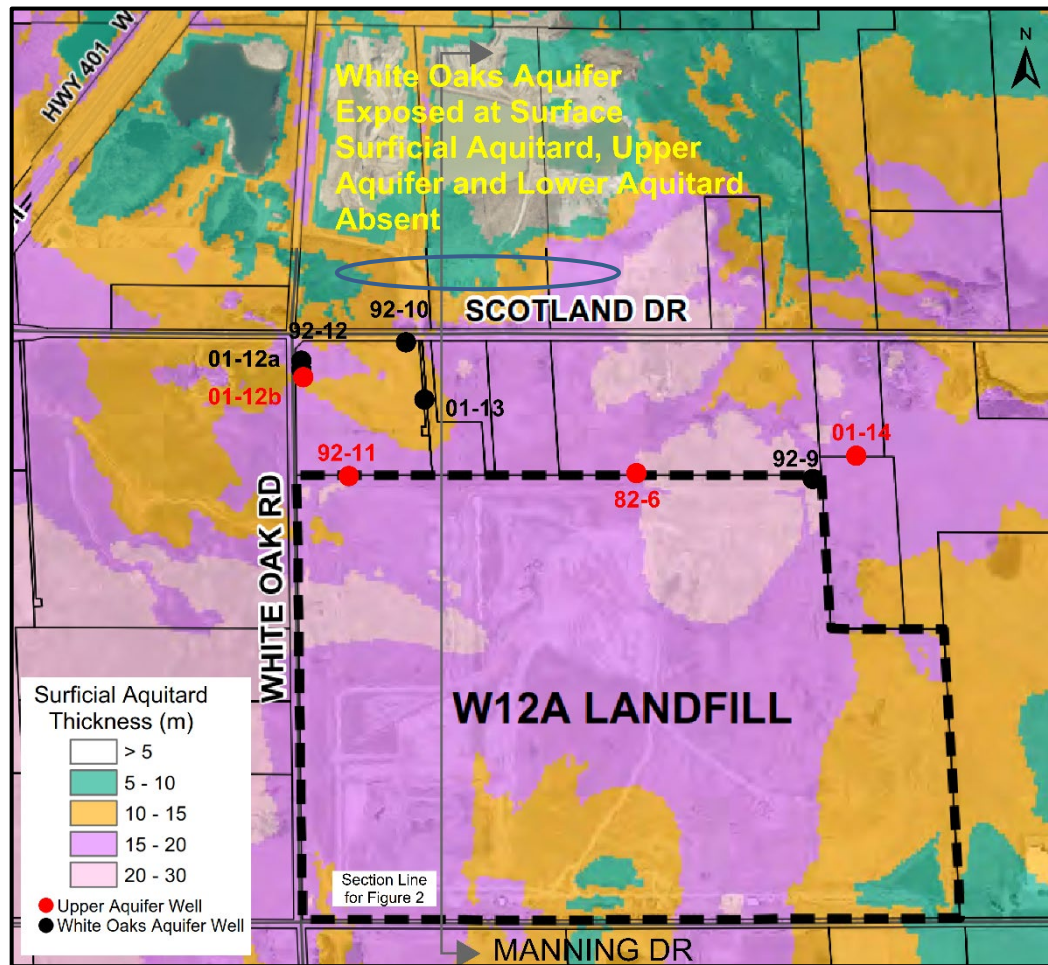


Figure 4.1-1: Surficial Aquitard Thickness

Water levels from nested monitoring wells can be used to determine vertical hydraulic gradients. **Figure 4.1-3** (next page) is an example of water levels of two nested monitoring wells located at the southeast corner of Scotland Drive and White Oak Road: 01-12a installed in the White Oaks Aquifer and 01-12b installed in the Upper Aquifer. Generally, water levels have increased (rebounded) from the effects of municipal groundwater taking in the White Oaks Aquifer until about 2012 where the water levels have levelled off. As shown on **Figure 4.1-3**, there is about a 2 m difference in water levels between the aquifers at this location.

Groundwater Work Plan
Environmental Assessment of the Proposed W12A Landfill Expansion, City of London

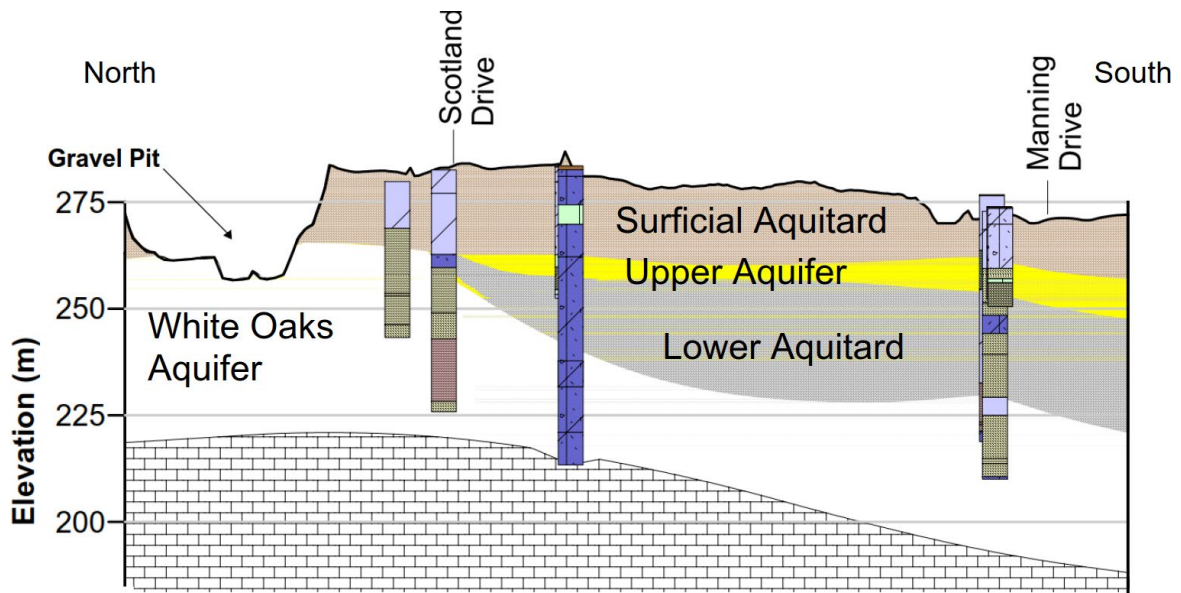


Figure 4.1-2: Hydrostratigraphic Units (north-south)

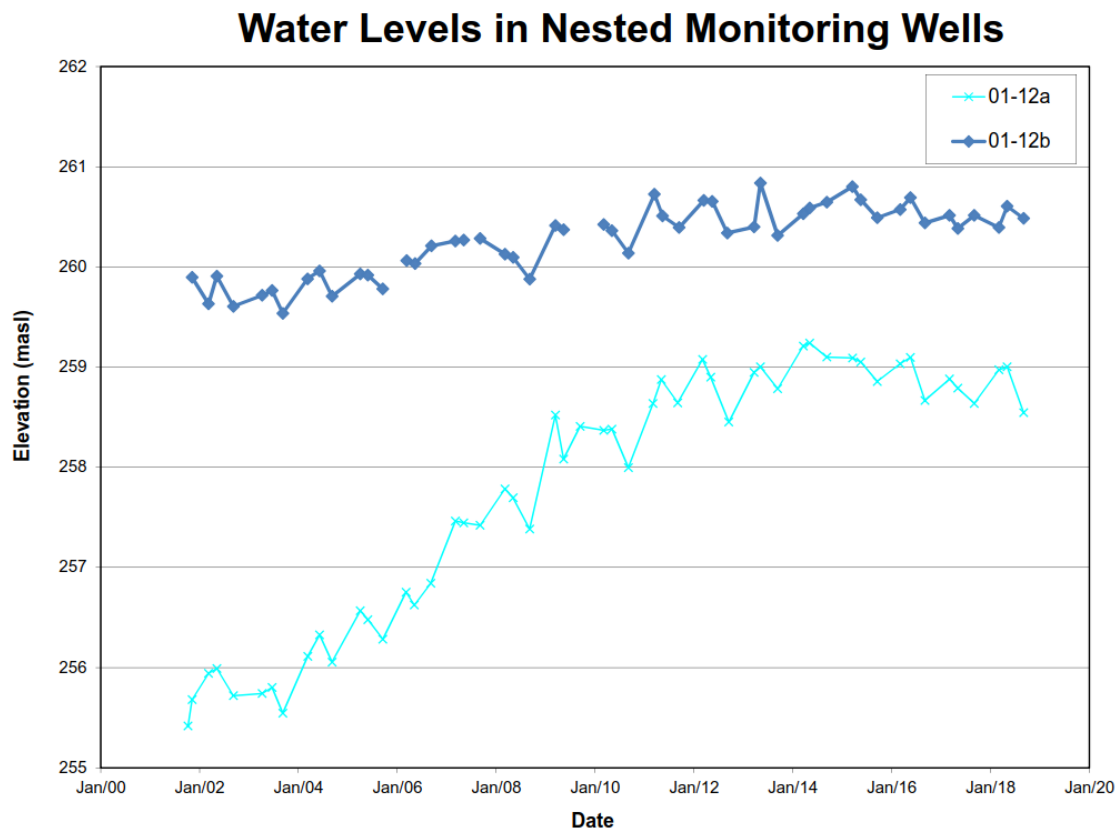


Figure 4.1-3: Vertical Gradient

From a data gap perspective, there is a lack of borehole locations along Scotland Drive as shown with the blue oval on **Figure 4.1-1**. This area has had exploratory water wells drilled (as part of municipal groundwater exploration in the 1950's and 1960's) and information from this source has been included in the hydrostratigraphical model. There is a need for boreholes / monitoring wells in this area to both determine lithology and groundwater levels, to understand existing conditions and also in case of lateral landfill expansion to the north of the existing landfill. Monitoring wells installed at the same location in different hydrostratigraphic units ("nested" monitoring wells) would be particularly useful.

Figure 4.1-4 shows tentative locations of monitoring well nests to address the identified data gap identified along Scotland Drive.

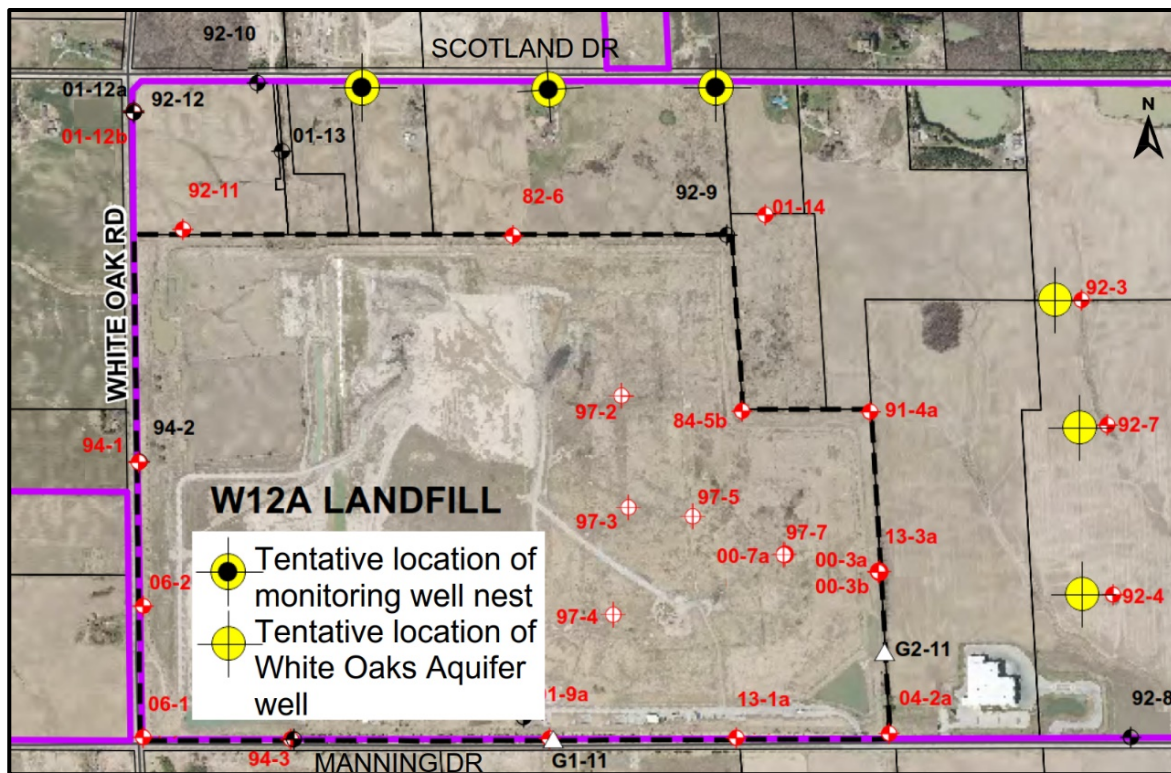


Figure 4.1-4: Preliminary Drilling Locations

At each monitoring well nest location, the deepest well should be drilled to an elevation of approximately 220 to 230 metres above sea level (~50 m deep). Drilling methods for the deep will include a Christenson Core Barrel (CP size) System or the CME Continuous Sample Tube System in order to recover good quality overburden soil cores of the clayey till aquitards at the site. The soil cores will be logged with particular focus on fracturing in the Surficial Aquitard. At each location a shallow monitoring well should be installed in the Upper Aquifer (where identified) or if the Upper Aquifer does not exist at a location, the shallow well should be installed at the top of the White Oak Aquifer. Split spoon sampling

and standard penetration tests will be completed in the borehole of the shallow monitoring wells.

Soil samples from the Upper Aquitard, Upper Aquifer, Lower Aquitard and White Oak Aquifer will be collected and tested for various parameters as listed in Table 4.1-1. Data loggers for water levels will be installed in each of the new monitoring wells and water samples collected to confirm water quality.

Area East of Existing Landfill

One of the proposed landfill development alternatives is possible expansion to the east of the present fill site. The hydrogeology east of the landfill is well understood but additional information of this area would be beneficial in assessing the area for possible future landfilling. Three monitoring well nests are proposed east of the present fill as shown on **Figure 4.1-4**. These nests would consist of existing wells 92-3, 92-4 and 92-7 screened in the Upper Aquifer and new wells at each location screened in the White Oaks Aquifer.

Drilling and sampling methods will be similar to methods used for the wells installed to the north of the landfill with a couple of exceptions including no split spoon sampling or standard penetration tests to be completed.

Soil and Hydrogeological Testing

Soil samples from the Surficial Aquitard, Upper Aquifer, Lower Aquitard and White Oak Aquifer will be collected and tested for various parameters as listed in Table 4.1-1 (next page). In addition, groundwater samples will be taken from the new monitoring wells and analyzed for conventional water quality analysis and isotopic analysis (selected wells only).

Presence of Fractures in the Surficial Aquitard

The presence of fractures within the surficial aquitard is a well known phenomenon. To evaluate the nature of the fractures and their potential to create a preferred pathway for leachate migration from the landfill expansion, a benched test pit measuring approximately 18m x 18 m in plan and 6 m in depth, or deeper if fractures are visible, is proposed. The test pit would give a good indication of fracture spacings and depths. Ideally, the location of the test pit should be outside of any potential future cell so that the aquitard is not disturbed and a preferential pathway for future leachate migration is not created. Tentatively the test pit is proposed on the east side of the existing landfill, but outside any contemplated areas for landfill expansion.

Upon excavation of the test pit, the vertical (1.2 m high) walls at the benched sideslopes will be cut into along apparent fractures using a hand trowel. This step is necessary in order to remove clay material smeared by the excavator bucket and fully expose the fractures for measurement of spacings and depths. The fracture network will be logged and photographs taken.

Once the test pit is complete the results will be evaluated and the need for any further monitoring wells within the surficial aquitard will be considered.

4.2 Step 2: Identify 'Alternative Methods' of Landfill Expansion

During the initial stage of the EA, a reasonable range of expansion alternatives will be identified and described at a sufficient level of detail (i.e., conceptual designs) so that potential effects of the expanded landfill on each environmental component can be assessed and compared.

This task will involve developing the conceptual site design for the proposed expansion of the W12A Landfill, to gain an additional 25 years of disposal capacity. This task will be completed by the Design and Operations Team.

Table 4.2-1: Approximate Number and Type of Soil and Hydrogeological Tests

Test	Hydrostratigraphic Unit			
	Surficial Aquitard	Upper Aquifer	Lower Aquitard	White Oaks Aquifer
Grain Size Analysis, Moisture Content	20	8	12	8
Fraction of Organic Carbon, Cation Exchange Capacity	6		3	
Geotechnical Parameters (Atterburg Limits)	6			
Triaxial Permeability	6			
Single Well Response Tests		6		6
X-Ray Diffraction	2			
Conventional Water Quality Analysis		6		6
Isotope Analysis (porewater extracted from aquitard soil cores, groundwater from monitoring wells installed in aquifers)	8	2	2	4

4.3 Step 3: Qualitative Evaluation of ‘Alternative Methods’

Based on the conceptual site design, and considering mitigation measures, potential impacts of the proposed W12A Landfill expansion on the groundwater component will be assessed. The groundwater component technical discipline lead will evaluate each ‘Alternative Method’ qualitatively including:

- Identify the differences between the alternatives that will affect the potential impact on groundwater quality such as waste footprint configuration, direction of groundwater flow, landfill cover type. A comparative table outlining these differences will be developed.
- Estimate qualitatively how the differences will affect the groundwater quality.

In this step, each ‘Alternative Method’ of the W12A Landfill expansion will be examined by the EA Team to determine if it would ultimately be approvable under the Environmental Protection Act (EPA).

This screening step is included to eliminate any alternative that would likely not be approvable. Should an alternative be found to not be approvable due to unacceptable net effects (i.e., no further refinement of mitigation is possible) or technical reasons, then the alternative would be eliminated from further consideration. At this point, the EA Management Team may consider additional ‘Alternatives Methods’ for the project that may have been identified by the public or other parties during the EA process.

4.4 Step 4: Compare the ‘Alternative Methods’ for Landfill Expansion and Identify the Preferred Alternative

When the alternatives have been finalized, a comparative evaluation of the ‘Alternative Methods’ will be completed. The comparative evaluations would include evaluating the relative importance or ranking of the assessment criteria (i.e., although all criteria are relevant, certain criteria may be considered more important than others¹).

The groundwater component technical discipline lead will complete the following tasks:

- Rank each ‘Alternative Method’ based on groundwater quality differences.
- Describe advantages and disadvantages of each ‘Alternative Method’

Select the preferred ‘Alternative Method’ based on potential to affect groundwater quality.

The EA Management Team will take each disciplines comparison and compile the overall comparison of ‘Alternative Methods’.

¹ The public has been asked during the consultation on the Terms of Reference and will be asked during consultation on the EA to provide input into the ranking of the relative importance of the components.

4.5 Step 5: Refine Mitigation Measures and Determine Net Effects of the Preferred Alternative

In this task, the EA Team will identify linkages between the environmental components (i.e., direct or indirect effects of the proposed expansion on the groundwater component via another component) and prepare diagrams. The purpose of linkage diagrams, prepared by the technical discipline leads, is to facilitate an integrated assessment of effects.

The prediction of future environmental effects associated with the preferred 'Alternative Method' (with conceptual design mitigation measures in place) will be determined by groundwater component technical discipline lead. Predictive modelling of the preferred 'Alternative Method' performance (contaminant modelling) and contaminating lifespan as per Ontario Regulation (O.Reg.) 232/98 using selected key parameters of concern will be conducted. The key parameters are expected to include the parameters listed in O.Reg. 232/98 (chloride, benzene, dichloromethane, vinyl chloride, toluene, lead, 1,4-dichlorobenzene and cadmium) with chloride being the most conservative assessment parameter. Assessment of potential effects will be done using appropriate objectives, standards, policies and regulations. The remaining net effects, if any, will be documented.

Also, a quantitative comparison will be made between the predicted effects of the preferred alternative and the Do-Nothing alternative regarding groundwater quality.

4.6 Step 6: Describe the Preferred 'Alternative Method' for Landfill Expansion

A description of the preferred landfill expansion alternative will be detailed following the identification of appropriate mitigation measures. In addition, a leachate management assessment will be completed that will include;

- the quantity of leachate generated from the preferred landfill expansion alternative will be predicted,
- the quality of the leachate associated with the expansion and requiring treatment will be assessed,
- a high level assessment of the capability of the existing forcemain to continue to convey the collected leachate to the municipal sewer system will be completed; and,
- a high level assessment of the capability of the Greenway Wastewater Treatment Plant to continue to treat the leachate will be carried out.

The results provided in the EA study report (Task 9).

4.7 Step 7: Consideration of Climate Change

The potential effects of climate change on infrastructure associated with the site, as well as ways that the project could reduce greenhouse gas (GHG) emissions or remove GHG from the atmosphere will be considered by the air quality, surface water and geology and hydrogeology component technical discipline leads. As it relates to geology and hydrogeology the greatest potential affect relates to changes (increases) in precipitation events. These changes in precipitation have the potential to influence leachate generation at the site which will be considered.

4.8 Step 8: Cumulative Impact Assessment

The EA Team will work to identify the predicted effects of other existing or known proposed projects in the area of the site. The groundwater component technical discipline lead will consider any identified effects together with those predicted during the comparative evaluation of alternative methods to determine if there are any unacceptable predicted cumulative effects.

4.9 Step 9: Preparation of EA Study Report

In support of the completion of this task the groundwater component technical discipline lead will carry out the following tasks:

- Document the assessment results in a Groundwater Supporting Document that will form an appendix to the EA submission;
- Participate in meetings with the GRT including upfront consultations with the MECP during the EA to obtain pre-approval of tasks in the work plan, as required;
- Support consultation events as required in development of presentation material and/or being at the event; and,
- Provide technical support during the review of the draft EA by the regulatory agencies and public.

B.03 Surface Water Work Plan

August 2019

SURFACE WATER WORK PLAN

Environmental Assessment of the Proposed W12A Landfill Expansion
City of London

Submitted to:

City of London

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1.0 Introduction

This document presents the proposed detailed work plan for the surface water component of the Environmental Assessment (EA) of the proposed W12A Landfill expansion (project). The work plan is being submitted for approval to the Minister of the Environment, Conservation and Parks (MECP) and Conservation Authorities.

This work plan has been developed with consideration of the commitments made for the project within the development of the Terms of Reference (ToR). The relevant commitments are provided below in Table 1.0-1.

Table 1.0-1: Project Commitments from ToR Relevant to Work Plan Development

ID	Commitment
5	Where described in the ToR for the environmental components, detailed work plans for the technical studies will be prepared and provided to the appropriate GRT* agency for review and concurrence.
6	The City will share work plans with Indigenous Communities and post work plans on the project website.
10	During the EA, the preliminary criteria and indicators for each of the environmental components will be refined and described in the EA study report.
11	The preliminary Study Areas will be reviewed and confirmed during the EA and described in the EA study report.
12	A more detailed description of the environmental conditions will be prepared during the EA to reflect the confirmed Study Areas using a combination of sources of existing information and site-specific investigations and studies and provided in the EA study report.

* Government Review Team (GRT)

2.0 Assessment Framework

2.1 Overall Approach

It is proposed that the EA work will be undertaken in a series of nine steps (further details are provided in Section 4.0) as follows:

- Step 1 – Characterize existing environmental conditions;
- Step 2 – Identify the ‘Alternative Methods’ of landfill expansion;
- Step 3 – Qualitative evaluation of ‘Alternative Methods’;
- Step 4 – Compare the ‘Alternative Methods’ for landfill expansion and identify the preferred alternative;

- Step 5 – Refine the mitigation measures and determine the net effects of the preferred alternative;
- Step 6 – Describe the preferred ‘Alternative Method’;
- Step 7 – Consideration of climate change;
- Step 8 – Cumulative impact assessment; and
- Step 9 – Preparation of the EA Study Report.

Consultation with the public, Indigenous Communities, GRT members, City of London Advisory Committees, and other stakeholders will be ongoing throughout the EA process.

2.2 Project Team Organization

The project tasks will be organized to be completed by the following teams:

- The EA Management Team consists of the project director, project manager and project coordinator for the EA;
- The Design and Operations (D&O) Team consists of landfill design technical staff and AutoCAD technicians; and
- The EA Team consists of technical discipline leads for each of the specified environmental components.

2.3 Study Areas

Data for the EA will be collected and analyzed for preliminary generic study areas presented in the ToR. These will be confirmed and may be refined during the EA. These preliminary generic study areas are as follows:

Site Study Area – The existing W12A Landfill Site, located at 3502 Manning Drive and adjacent lands where landfill expansion may occur.

Site-vicinity Study Area – The lands in the area immediately adjacent to the Site Study Area that have the potential to be directly affected by the landfill expansion and activities with the Site Study Area. The extent of the Site-vicinity Study Area will be determined for each of the environmental components. For most environmental components, a Site-vicinity Study Area of 500 metres from the Site Study Area is appropriate.

Wider Study Area – An area that takes on the broader community generally beyond the immediate site vicinity and for specific environmental components may include the entire Municipality.

The proposed preliminary study area for the surface water component is presented in Table 2.3-1.

Table 2.3-1: Proposed Preliminary Study Areas for the Surface Water Component

Environmental Component	Preliminary Area(s) to be Studied	Rationale
Surface Water	Site and Site-vicinity	Necessary to include the drainage boundaries of the two subwatersheds within which the site is located.

3.0 Assessment Criteria and Indicators

The surface water component will be assessed for the potential effects of the undertaking based on two criteria as follows.

The rationale, indicators and data sources for the proposed assessment sub-components are provided in the ToR, and are presented in Table 3.0-1 below.

Table 3.0-1: Component Rationale and Indicators for the EA

Sub-Component	Rationale	Indicator(s)	Data Sources
Surface water quality	Contaminants associated with the landfill expansion and associated operations could seep or runoff into surface water and adversely affect water quality and aquatic life.	<ul style="list-style-type: none"> Expected effect on surface water quality in the stormwater management system (SWMS) and within the site-vicinity. 	<ul style="list-style-type: none"> Topographic maps. Air photos. <i>Stormwater Management Master Plan</i> (Earth Tech, 2002). <i>Surface Water Background Study</i> (Dillon, 2005). Annual water quality Monitoring Reports. Design and Operations Reports. Surface water drainage mapping. Agricultural farm drain mapping. Watershed/subwatershed reports, including the Watershed Report Cards (2013 and 2018) and the 2008 Kettle Creek Watershed Characterization Report.
Surface water quantity	Operations associated with the landfill expansion could alter runoff and peak flows.	<ul style="list-style-type: none"> Expected change in peak flows (within the on-site SWMS and at the property boundary). Expected degree of off-site effects on surface water 	<ul style="list-style-type: none"> Local climate data. Published water quantity and flow information from the MECP,

Sub-Component	Rationale	Indicator(s)	Data Sources
		within the site-vicinity.	<p>Environment Canada and local Conservation Authorities.</p> <ul style="list-style-type: none"> • Site reconnaissance. • Flow observations during sampling program.

The criteria and indicators will be refined during the EA as necessary.

4.0 Detailed Workplan

4.1 Step 1: Characterize Existing Environmental Conditions

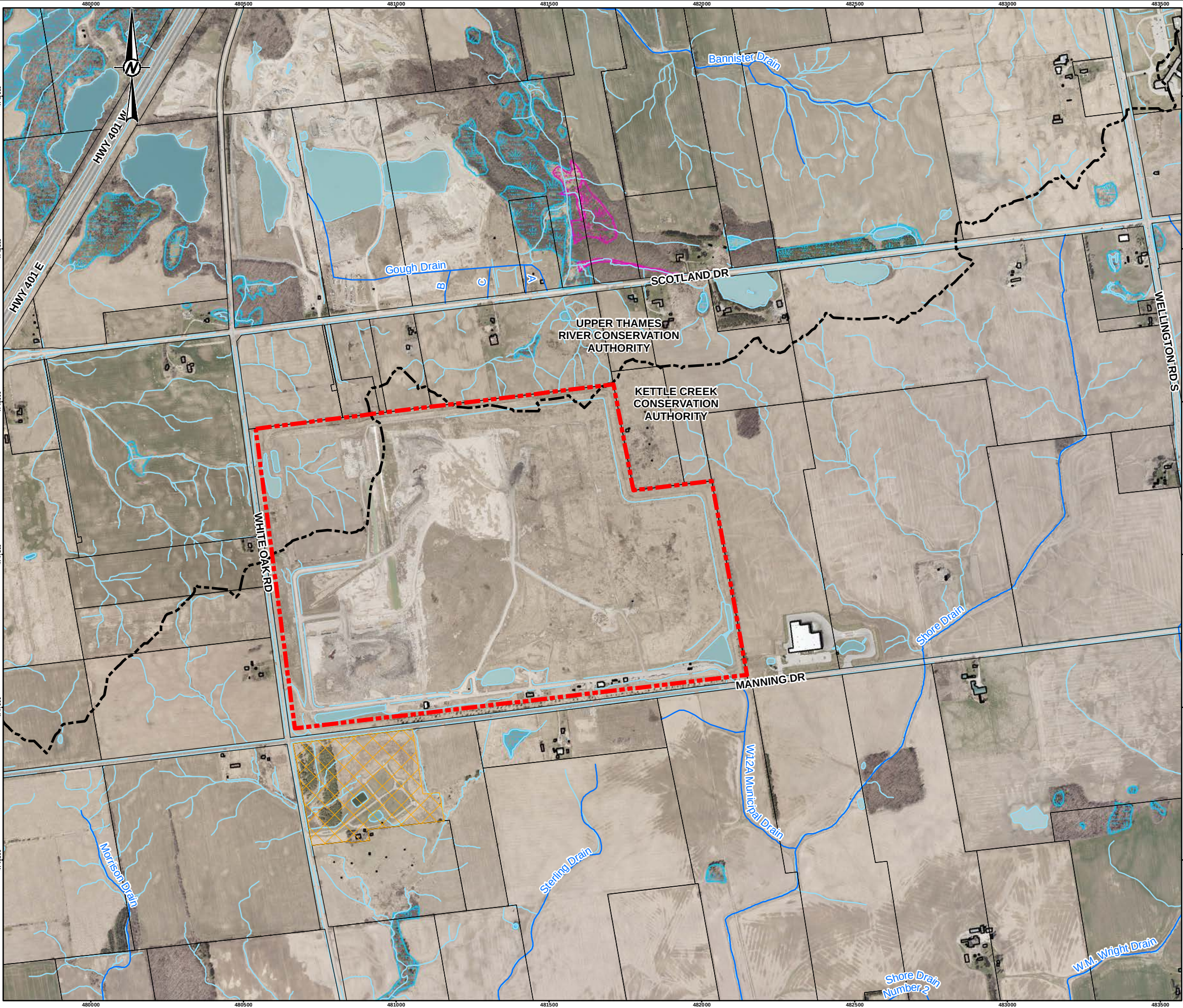
This section presents an overview of existing environmental conditions for the surface water component on and in the area of the W12A Landfill. As described in the *MECP Code of Practice* (MOECC, 2014a), the City of London will present a more detailed description of the environmental conditions in the EA Report. The following is an overview of existing conditions.

4.1.1 Overview of Existing Conditions (Existing Documentation)

W12A Landfill is situated on the boundary between two subwatershed areas, Dingman Creek and Dodd Creek. Dingman Creek is a tributary of the Thames River (Lake St. Clair Basin) watershed and Dodd Creek is part of the Kettle Creek (Lake Erie Basin) watershed. The majority of the landfill property falls within the Dodd Creek watershed and a small northerly portion of the landfill falls within the Dingman Creek watershed. The watershed divide and other surface water features are shown on Figure 4.1-1.

Three surface water features crossing Manning Drive convey runoff from the W12A Landfill property to downstream receiving water systems within the Dodd Creek watershed and one additional surface water feature crossing White Oak Road conveys runoff from the site to a tributary of Dingman Creek. All four tributaries are documented as being seasonally dry, intermittent watercourses with a majority of flow generated as a result of direct runoff during precipitation events.

The on-site drainage network is divided into four general areas with a system of berms, slopes and perimeter drainage ditches directing runoff generated within the W12A Landfill property envelope to four separate stormwater management ponds. Stormwater management ponds 2/3, 4 and 5 are located along the south side of the site and service approximately 130 ha of drainage area within the site. Stormwater management pond 1 is located at the northwest corner of the site and services approximately 15 ha of drainage



LEGEND

- WATERCOURSE
- CONSTRUCTED DRAINAGE
- CONSERVATION AUTHORITY BOUNDARY (WATERSHED DIVIDE)
- PROPERTY FABRIC
- BUILDING FOOTPRINT
- WATERBODY
- LOCALLY SIGNIFICANT WETLAND
- UNEVALUATED WETLAND
- CEMETERY
- EXISTING W12A LANDFILL SITE BOUNDARY

REFERENCE(S)
1. DATA PROVIDED BY THE CITY OF LONDON.
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28



CLIENT
CORPORATION OF THE CITY OF LONDON

PROJECT
SURFACE WATER WORK PLAN ENVIRONMENTAL ASSESSMENT
OF THE PROPOSED W12A LANDFILL EXPANSION

TITLE
OVERVIEW OF EXISTING ENVIRONMENTAL CONDITIONS

CONSULTANT	YYYY-MM-DD	2019-08-20
	DESIGNED	---
	PREPARED	JEM
	REVIEWED	TG
	APPROVED	PAS

 **GOLDER**

PROJECT NO.	CONTROL	REV.	FIGURE
1648176	0009	0	4.1-1

area that falls within the Dingman Creek watershed area. All stormwater management ponds have been designed to provide stormwater quality and quantity control of surface water runoff leaving the W12A Landfill property, as per the requirements outlined by MECP and design criteria published in relevant Subwatershed Studies. The ponds have been designed, or have been retrofitted, to function as standard extended detention wet ponds with over-control of frequent rainfall events to protect downstream features from ongoing erosion and degradation. Three ponds (1, 2/3 and 5) also incorporate sediment forebay areas to aid in settling of suspended solids and improve ease of regularly scheduled maintenance.

Surface water quality is regularly monitored as part of an existing leachate collection system and stormwater management discharge monitoring program. Sampling from all stormwater management ponds is undertaken three times per year after significant rainfall events. Water quality monitoring samples are regularly compared to baseline samples, MECP water quality targets and the specific Provincial Water Quality Objectives included in the Dingman and Dodd Creek Subwatershed Reports or Conservation Authority Subwatershed report cards.

4.1.2 Additional Studies/Investigations

Characterization of the existing environmental conditions will include a comprehensive field investigation, which will focus on confirming overland flow routes, drainage boundaries and outlet locations of all surface water features.

An updated inventory of existing hydraulic structures, including the location, size, material and condition of drainage infrastructure, will be assembled through a field reconnaissance, measurements and GPS data gathering techniques. The characterization will also focus on the physical condition of the receiving water systems, noting changes to stream morphology and bank stability compared to conditions recorded in 2005.

Included in the existing conditions characterization will be an update of water quality and quantity parameters. The assessment will be undertaken to provide information that will be used to determine potential for impacts on water quality indicator parameters such as temperature, suspended sediment and nutrients and potential for impacts on site hydrology such as changes to downstream flooding levels, the timing and duration of peak flows, changes to the quantity of base flow and streambank erosion potential as a result of the proposed landfill expansion. The surface water quality and quantity assessment will be undertaken utilizing the City of London's surface water monitoring/sampling data and previously developed hydrologic modeling of the W12A site. Based on review of the existing information, an assessment will be made of the need to obtain additional water quantity and quality information to supplement the available information. If it is found that additional information is required, it will be obtained during the field program as part of Step 1.

Benthic (macro) Invertebrate surveys are being completed as part of the Biology assessment and the results will be available for the Surface Water assessment. Benthic (macro) Invertebrate Surveys will be completed at four primary sites within the Site and Site-vicinity Study Area. Benthic monitoring will be conducted following protocols established by Dr. Bob Baily (University of Western Ontario, 2001) and involve transverse sweeps or 'kicks' across suitable habitats (i.e., riffles). Sampling will be done during the period between early June to late September avoiding spring and fall spawning activity."

4.2 Step 2: Identify 'Alternative Methods' of Landfill Expansion

During the initial stage of the EA, a reasonable range of expansion alternatives will be identified and described at a sufficient level of detail (i.e., conceptual designs) so that potential effects of the expanded landfill on each environmental component can be assessed and compared.

This task will involve developing the conceptual site design for the proposed expansion of the W12A Landfill, to gain an additional 25 years of disposal capacity. This task will be completed by the Design and Operations Team.

4.3 Step 3: Qualitative Evaluation of 'Alternative Methods'

Based on the conceptual site design, and considering mitigation measures, potential impacts of the proposed W12A Landfill expansion on the surface water component will be assessed. The surface water component technical discipline lead will evaluate each 'Alternative Method' qualitatively including:

- Identify the differences that may impact changes in surface water quality such as expansion area and potential impacts on the existing SWMS.
- Assess any limitations to expand or build new SWM ponds based on landfill expansion designs.
- Identify the differences that may impact changes in surface water quantity such as expansion area, proposed side slopes of the landfill, proposed landfill cover alternatives, potential changes to watershed divides, and potential impacts on the existing SWMS.

In this step, each 'Alternative Method' of the W12A Landfill expansion will be examined by the EA Team to determine if it would ultimately be approvable under the Environmental Protection Act (EPA).

This screening step is included to eliminate any alternative that would likely not be approvable. Should an alternative be found to not be approvable due to unacceptable net effects (i.e., no further refinement of mitigation is possible) or technical reasons, then the alternative would be eliminated from further consideration. At this point, the EA Management Team may consider additional 'Alternatives Methods' for the project that may have been identified by the public or other parties during the EA process.

4.4 Step 4: Compare the ‘Alternative Methods’ for Landfill Expansion and Identify the Preferred Alternative

When the alternatives have been finalized, a comparative evaluation of the ‘Alternative Methods’ will be completed. The comparative evaluations would include evaluating the relative importance or ranking of the assessment criteria (i.e., although all criteria are relevant, certain criteria may be considered more important than others¹).

The surface water component technical discipline lead will complete the following tasks:

- Rank each ‘Alternative Method’ based on surface water quality differences.
- Rank each ‘Alternative Method’ based on surface water quantity differences.
- Describe advantages and disadvantages of each ‘Alternative Method’

The comparison of ‘Alternative Methods’ will focus on the incremental impacts each alternative is expected to have on the peak flow, runoff volume and base flow characteristics at each surface water outlet associated with the W12A site compared to the ‘existing conditions’ hydrologic characteristics . The preferred alternative will be selected on the basis of the alternative’s expected ability to mitigate changes in the hydrologic flow regime.

The EA Management Team will take each disciplines comparison and compile the overall comparison of ‘Alternative Methods’.

4.5 Step 5: Refine Mitigation Measures and Determine Net Effects of the Preferred Alternative

In this task, the EA Team will identify linkages between the environmental components (i.e., direct or indirect effects of the proposed expansion on the surface water component via another component) and prepare diagrams. The purpose of linkage diagrams, prepared by the technical discipline leads, is to facilitate an integrated assessment of effects.

The prediction of future environmental effects associated with the preferred ‘Alternative Method’ (with conceptual design mitigation measures in place) will be determined by the surface water component technical discipline lead. Assessment of potential effects will be done using appropriate objectives, standards, policies and regulations. The remaining net effects, if any, will be documented.

¹ The public has been asked during the consultation of the Terms of Reference and will be asked during consultation on the EA to provide input into the ranking of the relative importance of the components.

The surface water assessment will include detailed hydrologic modeling of the proposed stormwater management system design for the preferred 'Alternative Method' for the purpose of addressing conveyance and management of storm water runoff, suspended solids removal, flood hazards, riparian flow and erosion considerations. The specific tasks required to complete the evaluation will consist of:

- Development of a hydrologic model of the site and surrounding area to a reasonable point downstream of the discharge points. The modeling exercise will be undertaken to determine a range of flows and runoff volumes generated by existing land use conditions, topographic mapping, surface cover and surface drainage features. This task will include the current configuration of the site stormwater management facilities in the hydrologic model.
- A hydrologic models that reflects the preferred landfill expansion alternative in terms of land use, cover, stormwater management design and drainage characteristics.

Using up to date local rainfall information, the hydrologic model will be used to simulate a series of single-event rainfall scenarios (i.e., 2, 5, 10, 25, 50 and 100-year return periods) and the Regional storm event to calculate peak flows and runoff volumes at each of the respective outlet locations leaving the W12A site. The modelling results will be used to assess the potential impacts on off-site surface water quality and quantity and, if required, to refine the proposed stormwater management system design to mitigate these potential impacts. Also, a qualitative comparison will be made between the predicted effects of the preferred alternative and the Do-Nothing alternative considering the indicators for the surface water component.

4.6 Step 6: Describe the Preferred 'Alternative Method' for Landfill Expansion

A description of the preferred landfill expansion alternative will be detailed following the identification of appropriate mitigation measures. In addition, a leachate management assessment will be completed that will include;

- the quantity of leachate generated from the preferred landfill expansion alternative will be predicted,
- the quality of the leachate associated with the expansion and requiring treatment will be assessed,
- a high level assessment of the capability of the existing forcemain to continue to convey the collected leachate to the municipal sewer system will be completed; and,
- a high level assessment of the capability of the Greenway Wastewater Treatment Plant to continue to treat the leachate will be carried out.

The results will be provided in the EA study report (Task 9).

4.7 Step 7: Consideration of Climate Change

The potential effects of climate change on infrastructure associated with the site, as well as ways that the project could reduce greenhouse gas (GHG) emissions or remove GHG from the atmosphere will be considered by the air quality, surface water and geology and hydrogeology component technical discipline leads.

The manner in which climate change has the greatest potential to affect this project is in terms of changes (increases) in precipitation events and associated effects on the performance of the site's SWMS. It is proposed to conceptually design the SWMS for each of the landfill expansion alternatives in compliance with O. Reg. 232/98, which requires their SWMSs to be designed for the 100 year storm event. The City has developed a Climate Change resiliency strategy for use in assessing and designing municipal infrastructure, in particular those components of infrastructure related to flood control and management of storm runoff. For the preferred landfill expansion alternative, it is then proposed to conduct a sensitivity analysis in accordance with the City's resiliency strategy, to assess the performance of the stormwater management system under the 250-year storm event. Depending on the findings of the analysis, the preferred landfill expansion alternative's stormwater management design may then be modified accordingly and will take into consideration the impacts of climate change. Alternatively, if the SWMS design can be easily adapted in future and/or the potential effects of climate change can be acceptably mitigated, then the design may be left as per the O. Reg. 232/98 requirements.

4.8 Step 8: Cumulative Impact Assessment

The EA Team will work to identify the predicted effects of other existing or known proposed projects in the area of the site. The surface water component technical discipline lead will consider any identified effects together with those predicted for the preferred 'Alternative Method' to determine if there are any unacceptable predicted cumulative effects.

4.9 Step 9: Preparation of EA Study Report

In support of the completion of this task the surface water component technical discipline lead will carry out the following tasks:

- document the assessment results in a Surface Water Supporting Document that will form an appendix to the EA submission,
- participate in meetings with the GRT including upfront consultations with the MECP during the EA to obtain pre-approval of tasks in the work plan, as required,
- support consultation events as required in development of presentation material and/or being at the event; and,
- provide technical support during the review of the draft EA by the regulatory agencies and public.

B.04 Biology Work Plan

October 23, 2019

BIOLOGY WORK PLAN

Environmental Assessment of the Proposed W12A Landfill Expansion
City of London

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Appendix A References

1.0 Introduction

This document presents the proposed detailed work plan for the Biology Component of the Environmental Assessment (EA) for the proposed W12A Landfill expansion (project) in London, Ontario. The work plan is being submitted for approval to the Ministry of Environment, Conservation and Parks (MOECP) and the Ministry of Natural Resources and Forestry (MNRF).

This work plan has been developed with consideration of the commitments made for the project within the development of the Terms of Reference (ToR). The relevant commitments are provided below in Table 1.0-1.

Table 1.0-1: Project Commitments from ToR Relevant to Work Plan Development

ID	Commitment
5	Where described in the ToR for the environmental Components, detailed work plans for the technical studies will be prepared and provided to the appropriate GRT* agency for review and concurrence.
6	The City will share work plans with Indigenous Communities and post work plans on the project website.
10	During the EA, the preliminary criteria and indicators for each of the environmental Components will be refined and described in the EA study report.
11	The preliminary Study Areas will be reviewed and confirmed during the EA and described in the EA study report.
12	A more detailed description of the environmental conditions will be prepared during the EA to reflect the confirmed Study Areas using a combination of sources of existing information and site-specific investigations and studies and provided in the EA study report.

* Government Review Team (GRT)

2.0 Assessment Framework

2.1 Overall Approach

It is proposed that the EA work will be undertaken in a series of nine steps (further details are provided in Section 4.0) as follows:

- Step 1 – Characterize existing environmental conditions;
- Step 2 – Identify the ‘Alternative Methods’ of landfill expansion;
- Step 3 – Qualitative evaluation of ‘Alternative Methods’;

- Step 4 – Compare the ‘Alternative Methods’ for landfill expansion and identify the preferred alternative;
- Step 5 – Refine the mitigation measures and determine the net effects of the preferred alternative;
- Step 6 – Describe the preferred ‘Alternative Method’;
- Step 7 – Consideration of climate change;
- Step 8 – Cumulative impact assessment; and
- Step 9 – Preparation of the EA Study Report.

Consultation with the public, Indigenous Communities, GRT members, City of London Advisory Committees, and other stakeholders will be ongoing throughout the EA process.

2.2 Project Team Organization

The project tasks will be organized to be completed by the following teams:

- The EA Management Team consists of the project director, project manager and project coordinator for the EA;
- The Design and Operations (D&O) Team consists of landfill design technical staff and AutoCAD technicians; and
- The EA Team consists of technical discipline leads for each of the specified environmental Components.

2.3 Study Areas

Data for the EA will be collected and analyzed for preliminary generic study areas presented in the ToR. These will be confirmed and may be refined during the EA. These preliminary generic study areas are as follows:

Site Study Area – The existing W12A Landfill Site, located at 3502 Manning Drive and adjacent lands where landfill expansion may occur.

Site-vicinity Study Area – The lands in the area immediately adjacent to the Site Study Area that have the potential to be directly affected by the landfill expansion and activities with the Site Study Area. The extent of the Site-vicinity Study Area will be determined for each of the environmental Components. For most environmental Components, a Site-vicinity Study Area of 500 metres from the Site Study Area is appropriate.

Biology Work Plan

Environmental Assessment of the Proposed W12A Landfill Expansion, City of London

Wider Study Area – An area that takes on the broader community generally beyond the immediate site vicinity and for specific environmental Components may include the entire Municipality.

The proposed preliminary study area for the Biology Component is presented in Table 2.3-1.

Table 2.3-1: Proposed Preliminary Study Areas for the Biology Component

Environmental Component	Preliminary Area(s) to be Studied	Rationale
Biology	Site and Site-vicinity	Potential effects on biological resources are expected to be limited to 500 m from the Site Study Area.

3.0 Assessment Criteria and Indicators

The Biology Component will be assessed for the potential effects of the undertaking based on two criteria as follows.

The rationale, indicators and data sources for the proposed assessment sub-Components are provided in the ToR and are presented in Table 3.0-1 below.

Table 3.0-1: Component Rationale and Indicators for the EA

Sub-Component	Rationale	Indicator(s)	Data Sources
Aquatic ecosystems	Landfill expansion could remove or disturb the functioning of natural aquatic habitats and species, including rare, threatened or endangered species.	<ul style="list-style-type: none"> • Expected change in surface water quality on-site and within the site-vicinity. • Expected impact on aquatic habitat and biota, including rare, threatened or endangered species within on-site and within the site-vicinity. 	<ul style="list-style-type: none"> • <i>W12A Landfill Area Plan Study – Ecological Background Study and Natural Heritage Study</i> (Earth Tech, 2005). • <i>Middlesex Natural Heritage Systems Study</i> (Middlesex County, 2014). • <i>The London Plan</i> (2016) • <i>City of London Inventory and Evaluation of Woodlands</i> (North-South Environmental Inc. (2009). • <i>Dingman Creek Subwatershed Study</i> (Aquafor Beech et.al., 1995) and <i>Dingman Creek Subwatershed Study Update</i> (Delcan, 2005). • <i>Dingman Creek Watershed Report Card</i> (2012). • <i>Dodd Creek Subwatershed Strategy</i> (Wilcox Betsy, 2005). • <i>Department of Fisheries and Oceans (DFO) Drain Classification and Fish Habitat Data</i> from the Upper Thames River Conservation Authority (UTRCA) and Kettle Creek Conservation Authority (KCCA). • Land Information Ontario (LIO). • Ministry of Natural Resources and Forestry (MNRF) SAR List. • Natural Heritage Information Centre.

Biology Work Plan

Environmental Assessment of the Proposed W12A Landfill Expansion, City of London

Sub-Component	Rationale	Indicator(s)	Data Sources
			<ul style="list-style-type: none"> • DFO <i>Drain Classification and Fish Habitat Data</i> from the UTRCA and KCCA. • Aquatic habitat and Benthic Water Quality • Species at Risk screening & habitat assessment
Terrestrial ecosystems	Landfill expansion could remove or disturb the functioning of natural terrestrial habitats and vegetation, including rare, threatened or endangered species.	Expected impact on terrestrial vegetation communities, wildlife habitat, and wildlife, including rare, threatened or endangered species on-site and within the site-vicinity.	<ul style="list-style-type: none"> • W12A Landfill Area Plan Study – Ecological Background Study and Natural Heritage Study (Earth Tech, 2005). • Middlesex Natural Heritage Systems Study (Middlesex County, 2014). • The London Plan (2016). • City of London Inventory and Evaluation of Woodlands (North-South Environmental Inc., 2009). • Dingman Creek Subwatershed Study (Aquafor Beech et. al., 1995) and Dingman Creek Subwatershed Study Update (Delcan, 2005). • Dingman Creek Watershed Report Card (2012). • Dodd Creek Subwatershed Strategy (Wilcox Betsy, 2005). • DFO <i>Drain Classification and Fish Habitat Data</i> from the UTRCA and KCCA. • Land Information Ontario (LIO). • MNR Ontario SAR List. • Natural Heritage Ontario Reptile and Amphibian Atlas. • Ontario Breeding Bird Atlas. • Ontario Butterfly Atlas.

Sub-Component	Rationale	Indicator(s)	Data Sources
			<ul style="list-style-type: none">• Terrestrial and wetland vegetation community investigations, breeding birds surveys, herpetofauna (amphibians and salamanders) surveys, bat habitat surveys, snake cover board and area searches, lepidoptera and odonata (butterfly, dragonfly and damselfly) surveys and wildlife habitat surveys• Complete Species at Risk screening & habitat assessment

The criteria and indicators will be refined during the EA as necessary.

4.0 Detailed Workplan

4.1 Step 1: Characterize Existing Environmental Conditions

This section presents an overview of existing environmental conditions for the Biology Component on and in the area of the W12A Landfill based on existing documentation. As described in the Ministry of the Environment, Conservation and Parks (*MECP Code of Practice* (MOECC, 2014a), the City of London will complete additional studies/investigations to present a more detailed description of the environmental conditions in the EA Report.

4.1.1 Overview of Existing Conditions (Existing Documentation)

The Biology Component of this study is comprised of terrestrial, wetland and aquatic ecosystems.

Natural vegetation in the Middlesex region consists primarily of deciduous forest communities (Middlesex County, 2014) including Dry-fresh Deciduous Forest, Fresh-moist Sugar Maple Deciduous Forest and Fresh-moist Poplar-sassafras Deciduous Forest (North-South Environmental Inc., 2009).

Clay to silt textured soils are the predominant type in the Dingman Creek Subwatershed (Delcan, 2005) and areas of imperfect to poor drainage may contribute to the presence of wetlands in the general area. Several man-made or managed drains are also present. Unevaluated woodlands, unevaluated wetlands and a potential Environmentally Significant Area (ESA) are located in the Site-vicinity Study Area, as well as some successional meadows and thickets.

Previous investigations identified several vegetation community types within the general area of the landfill site, including cultural, forest, marsh, open aquatic and swamp communities.

The primary terrestrial features found within the general area of the W12A Landfill as shown on Figure 2.3-1 include:

- A potential ESA on the north side of Scotland Drive (vegetation patch #10121)
- Significant Woodlands north of Scotland Drive (vegetation patches #10120 and #10122)
- Significant woodland south of Manning Drive (vegetation patch #11068)
- Unevaluated wetlands north of Scotland Drive
- Locally Significant Wetland north of Scotland Drive (Silver Swamp)

The primary aquatic features identified in the area include the Shore Drain, Sterling Drain, Bannister Johnson Drain and C.B. Smith Drain. Most of these watercourses have been altered (e.g., channelized) to facilitate drainage for surrounding land use.

Fish habitat has been identified as either Type 2 (generally important but not critical) or Type 3 (marginal/severely degraded). Fish species previously observed were ranked globally as G5 and provincially as S5 (in each case meaning very common and abundant). The benthic macroinvertebrate community is considered of poor quality and is indicative of shallow, eutrophic aquatic habitat.

Previous studies have identified several species of mammals, birds, amphibians and reptiles in the region. The background review has identified known records of several plant, bird, snake, and mammal Species at Risk (SAR) and Species of Conservation Concern (SOCC), and potential Significant Wildlife Habitat (SWH) including features supporting bat maternity colonies, amphibian breeding, and habitat for SOCC. To determine the presence/absence of any significant species or features within the study areas, site-specific field investigations will be required.

A Biology Assessment (*W12A Landfill Area Plan Study – Ecological Background Study and Natural Heritage Study*) was undertaken in 2005 to fully describe the conditions that existed within the Site and Site-vicinity Study Area. Although a significant amount of fieldwork was completed within the Site and Site-vicinity Study Area, the information is considered dated and requires updating. In addition, previous studies did not include habitat assessments and surveys for Species at Risk.

4.1.2 Additional Studies/Investigations

This work consists of a three (3) season inventory of the natural heritage features within the Site and Site-vicinity Study Area and will follow City of London data collection guidelines as per the City of London Environmental Management Guidelines (2007).

Species at Risk Screening

To determine the potential for Species at Risk (SAR) within the study area, a habitat screening will first be conducted whereby an Ecologist will review available background documents such as MNRF's online database, Amphibian and Reptiles Atlas, the Ontario Breeding Bird Atlas, Agency correspondence, etc. to create a complete list of potential SAR within the area. The listed species habitat preferences will then be compared to habitat characteristics to determine if the Site and Site-vicinity study areas may potentially contain preferred habitat for the potential SAR.

Aquatic Ecosystems Studies/Investigations

Aquatic habitat and benthic (macro) invertebrate studies will be required to further the understanding of existing conditions of the aquatic ecosystems. All of the studies described below were completed in 2018.

Aquatic Habitat Assessments

Aquatic biologists will conduct aquatic habitat assessments of the four (4) watercourses within the Site-vicinity Study Area where property is access allowed. Investigations include the determination of drainage patterns and determination of the status of watercourses.

Data collection includes:

- Channel type (natural or channelized)
- Channel morphology (width, depth)
- Flow characteristics
- Substrates
- Instream cover
- Specialized habitat present
- Bank and riparian community characteristics
- Valley form characteristics

Benthic (macro) Invertebrate Surveys

Benthic monitoring will be conducted using the BioMap Protocol which uses two quantitative samples and one qualitative sample. The quantitative samples each cover an area of 0.05 m² and the qualitative sample is a kick and sweep method covering all areas and substrate characteristics of the waterway. Samples will be identified to a set taxonomic level; mainly genus and species level. The BioMap protocol measures anthropogenic change as well as a set of metrics such as Family Biotic Index, Simpsons Diversity, Percent EPT etc.

Surveys are to be completed at four primary sites within the Site and Site-vicinity Study Areas. Sampling will be done during the period between early June to late September avoiding spring and fall spawning activity.

Terrestrial Ecosystem Studies/Investigations

Terrestrial and wetland vegetation community investigations, breeding birds surveys, herpetofauna (amphibians and salamanders) surveys, bat habitat surveys, snake cover board and area searches, lepidoptera and odonata (butterfly, dragonfly and damselfly) surveys and wildlife habitat surveys will be completed to further the understanding of existing conditions of the terrestrial ecosystems.

Ecological Land Classification Confirmation & Floral Inventory

Vegetation communities will be delineated and assessed according to the protocols outlined in the Ecological Land Classification (ELC) system for Southern Ontario (Lee et al., 1998) to Vegetation Community Type where possible. A three-season plant inventory will be completed to ensure that spring ephemerals and seasonally significant species are documented. Vegetation communities will be mapped and used to further refine the results of the SAR and SWH screening exercises.

Wetland Community Boundary Delineation

Where wetland communities are observed, wetland community boundaries and descriptions will be documented following protocols outlined in the Ontario Ministry of Natural Resources Ontario Wetland Evaluation System (OWES) for Southern Ontario (MNR 2014).

Breeding Bird Surveys

Breeding bird surveys should typically be conducted over a minimum of two (2) site visits during peak calling season and peak calling hours. However, given the identification of grassland bird SAR species during the preliminary SAR Screening, and the presence of candidate habitat, three rounds of surveys are required to satisfy survey requirements for SAR grassland birds (i.e., Bobolink and Eastern Meadowlark). For the majority of Ontario's breeding birds this occurs between a half-hour before sunrise to approximately 10:00 a.m. from May 24th to July 10th. Birds observed exhibiting various breeding behaviors in suitable habitat on or adjacent to the Site-vicinity Study Area will be recorded. Incidental observations of other wildlife, including amphibians and mammals, will also be recorded on each field visit.

Herpetofauna Surveys

To survey for the presence of breeding amphibians and salamanders, daytime site visits will be conducted to examine the suitability of vegetation communities present within the Site and Site-vicinity Study Area for the presence of vernal pools. The following parameters will be used to identify potential viable vernal pools:

- Small, isolated pools (lacking the presence of fish populations);
- The potential to hold water at least until July;
- Have water depths of at least 30 cm in early spring to be considered suitable amphibian breeding habitat. The 30 cm depth criterion is consistent with the recommendations of Calhoun and deMaynadier (2004);
- Good surrounding upland forested habitat;
- Each viable vernal pool would be mapped and marked using GPS, as the identified pools will serve as the amphibian/salamander survey stations; and
- Water depth, classification of surrounding vegetation, in-water characteristics (i.e., %vegetation vs % open water), evidence of breeding amphibians (egg masses) would be recorded.

Following the identification of viable vernal pools, the following additional amphibian and salamander surveys will be conducted:

- Auditory Amphibian Surveys following the protocols as outlined in the Marsh Monitoring Protocol, the standardized field methodology for audio-surveying breeding frogs and toads. Amphibian surveys will be completed at each of the pre-determined survey stations established during the amphibian/salamander habitat surveys.
- Visual Amphibian/Salamander surveys will be conducted within suitable habitat identified during the vernal pool surveys. Area searches were conducted in conjunction with other surveys completed for the Site and Site-vicinity Study Area.

Bat Habitat Suitability Assessment

To survey for the presence of bat habitat, a bat habitat suitability assessment will be completed within the Site and Site-vicinity Study Area during the leaf-off and leaf-on period. This assessment will be conducted within identified ELC areas of candidate habitat (i.e., CUW, FOD, FOM, FOC, SWD, SWM and SWC) following the MNRF Survey Protocol for Species at Risk within Treed Habitats – Little Brown, Northern Myotis, and Tri-Colored Bat (April 2017).

Snake Cover Board and Area Searches

To survey for the presence of snakes and identify candidate habitat within the Site Area, a combination of cover board surveys and area searches will be completed. These surveys will be completed during daytime bat habitat assessments, ELC investigations, as well as breeding bird surveys. Five (5) daytime searches will be conducted, to survey potential habitat including hibernacula (rock or debris piles) and installed cover boards.

Lepidoptera and Odonata Surveys

Butterfly, dragonfly and damselfly surveys will be conducted in conjunction with ELC and SWH surveys within the study area. These will be conducted by walking the entire Site and Site-vicinity Study Areas capturing and identifying species as they are seen. Once identified, the species will be released.

Significant Wildlife Habitat Surveys

A Significant Wildlife Habitat screening exercise will be conducted using the Wildlife Habitat Ecoregion Criteria Schedule 7E (OMNR 2015) to determine the presence of Candidate SWH within the Site and Site-vicinity Study Areas. The presence of candidate habitat for all five SWH categories will be determined by comparing existing conditions, based on ELC site investigations, to criterion listed within the 7E schedule.

4.2 Step 2: Identify ‘Alternative Methods’ of Landfill Expansion

During the initial stage of the EA, a reasonable range of expansion alternatives will be identified and described at a sufficient level of detail (i.e., conceptual designs) so that potential effects of the expanded landfill on each environmental Component can be assessed and compared.

This task will involve developing the conceptual site design for the proposed expansion of the W12A Landfill, to gain an additional 25 years of disposal capacity. This task will be completed by the Design and Operations Team.

4.3 Step 3: Qualitative Evaluation of ‘Alternative Methods’

Based on the conceptual site design, and considering mitigation measures, potential impacts of the proposed W12A Landfill expansion on the Biology Component will be assessed. The Biology Component technical discipline lead will evaluate each ‘Alternative Method’ qualitatively and quantitatively including:

- Identify differences in potential impacts to watercourse
 - temperature
 - sedimentation
 - fish habitat: quality of fish habitat lost or affected; and area of fish habitat lost or affected
- Identify differences in the ‘Alternative Methods’ that will impact terrestrial features (removal of habitat, harm or harassment of species, sedimentation, dust, spills and potential contamination)
 - Woodlands: area of woodland lost or affected
 - Significant Wildlife Habitat (SWH): area of habitat lost or affected
 - Species at Risk (SAR) and their habitat: area of habitat lost or affected
 - unevaluated wetlands: area of wetland lost or affected
 - potential ESA north of Scotland Drive
 - locally significant wetland (Silver Swamp)

In this step, each ‘Alternative Method’ of the W12A Landfill expansion will be examined by the EA Team to determine if it would ultimately be approvable under the Environmental Protection Act (EPA).

This screening step is included to eliminate any alternative that would likely not be approvable. Should an alternative be found to not be approvable due to unacceptable net effects (i.e., no further refinement of mitigation is possible) or technical reasons, then the alternative would be eliminated from further consideration. At this point, the EA Management Team may consider additional 'Alternative Methods' for the project that may have been identified by the public or other parties during the EA process.

4.4 Step 4: Compare the 'Alternative Methods' for Landfill Expansion and Identify the Preferred Alternative

A comparative evaluation of the 'Alternative Methods' will be completed and would consist of evaluating the relative importance or ranking of the assessment criteria (i.e., although all criteria are relevant, certain criteria may be considered more important than others¹).

The Biology Component technical discipline lead will complete the following tasks:

- Rank each 'Alternative Method' based on aquatic ecosystem differences.
- Rank each 'Alternative Method' based on terrestrial ecosystem differences.
- Describe advantages and disadvantages of each 'Alternative Method'.

The EA Management Team will take each discipline's comparison and compile the overall comparison of 'Alternative Methods'.

4.5 Step 5: Refine Mitigation Measures and Determine Net Effects of the Preferred Alternative

In this task, the EA Team will identify linkages between the environmental Components (i.e., direct or indirect effects of the proposed expansion on the Biology Component via another Component) and prepare diagrams. The purpose of linkage diagrams, prepared by the technical discipline leads, is to facilitate an integrated assessment of effects.

The prediction of future environmental effects associated with the preferred 'Alternative Method' (with conceptual design mitigation measures in place) will be determined by the Biology Component technical discipline lead. Assessment of potential effects will be done using appropriate objectives, standards, policies and regulations. The remaining net effects, if any, will be documented.

¹ The public has been asked during the consultation on the Terms of Reference and will be asked during consultation on the EA to provide input into the ranking of the relative importance of the Components.

Also, a qualitative comparison will be made between the predicted effects of the preferred alternative and the Do-Nothing alternative considering the indicators for the Biology Component.

4.6 Step 6: Describe the Preferred ‘Alternative Method’ for Landfill Expansion

A description of the preferred landfill expansion alternative will be detailed following the identification of appropriate mitigation measures. In addition, a leachate management assessment will be completed that will include:

- The quantity of leachate generated from the preferred landfill expansion alternative will be predicted;
- The quality of the leachate associated with the expansion and requiring treatment will be assessed;
- A high level assessment of the capability of the existing forcemain to continue to convey the collected leachate to the municipal sewer system will be completed; and
- A high level assessment of the capability of the Greenway Wastewater Treatment Plant to continue to treat the leachate will be carried out.

The results will be provided in the EA study report (Task 9).

4.7 Step 7: Consideration of Climate Change

The potential effects of climate change on infrastructure associated with the site, as well as ways that the project could reduce greenhouse gas (GHG) emissions or remove GHG from the atmosphere will be considered by the air quality, surface water and geology and hydrogeology Component technical discipline leads.

4.8 Step 8: Cumulative Impact Assessment

The EA Team will work to identify the predicted effects of other existing or known proposed projects in the area of the site. The Biology Component technical discipline lead will consider any identified effects together with those predicted during the comparative evaluation of ‘Alternative Methods’ to determine if there are any unacceptable predicted cumulative effects.

4.9 Step 9: Preparation of EA Study Report

In support of the completion of this task, the Biology Component technical discipline lead will carry out the following tasks:

- Document the assessment results in a Biology Supporting Document that will form an appendix to the EA submission;
- Participate in meetings with the GRT including upfront consultations with the MNRF during the EA to obtain pre-approval of tasks in the work plan, as required;
- Support consultation events as required in development of presentation material and/or being at the event; and
- Provide technical support during the review of the draft EA by the regulatory agencies and public.

Appendix A

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APPENDIX C

**2019 Updated Residual Waste Projections and
Landfill Capacity Assessment**



Environmental Assessment of the Proposed W12A Landfill Expansion

2019 Updated Residual Waste Projections & Landfill Capacity Assessment

Prepared by

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September 2019



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Executive Summary

Overview

To plan for the future, the City of London is developing a long-term Resource Recovery Strategy and a Residual Waste Disposal Strategy. The Resource Recovery Strategy involves the development of a plan to maximize waste reduction, reuse, recycling, resource recovery, energy recovery and/or waste conversion in an economically viable and environmentally responsible manner. The Residual Waste Disposal Strategy involves the development of a long-term plan to manage the remaining Residual Waste and includes an environmental assessment (EA) for the proposed expansion of the W12A Landfill.

Key to developing a long-term Resource Recovery Strategy and a Residual Waste Disposal Strategy is understanding the types, quantities and composition of future resources and waste to be managed. This information was previously documented in *Residual Waste Projections & Landfill Capacity Assessment* (City of London, 2018).

The *Residual Waste Projections & Landfill Capacity Assessment* report also served as one of the supporting documents for the *Amended Terms of Reference for the Environmental Assessment of the Proposed W12A Landfill Expansion, City of London*. The Amended Terms of Reference (ToR) is the work plan for carrying out the EA and was submitted to the Ministry of Environment, Conservation and Parks (MECP) on February 7, 2019. The Amended ToR was approved by the Minister of Environment, Conservation and Parks on July 30, 2019.

The Amended ToR contained commitments to update the information in the report *Residual Waste Projections & Landfill Capacity Assessment* as part of the EA. These commitments are listed in Table E-1.

Table E-1 ToR Commitments

ID	ToR Commitment
8	During the EA, assumptions used in determining the projected residual waste from the existing service area will be refined and assessed. This will be described in the EA study report.
9	During the EA the proposed regional service area will be confirmed and further assessed. This will be described in the EA study report.

The information and assumptions in the *Residual Waste Projections & Landfill Capacity Assessment* have been reviewed and, where appropriate, updated in order to satisfy commitments 8 and 9 in the Amended ToR.

These updates are documented in this report and summarized in Table E-2 (next page).

Table E-2 Report Updates

Update	Comment
Change in the 25 year planning period for the landfill expansion from start of 2025 to end of 2049 to the start of 2024 to end of 2048.	An increase in the amount of waste coming to the W12A Landfill is expected to result in the landfill using its approved capacity sooner.
New population projections for the City of London	New population projections were approved by City Council in 2018. The new projections have faster population growth than the previous projections.
Inclusion of 2018 waste disposal and diversion data for the City of London and proposed regional service area.	The 2018 waste disposal and diversion data was used to update waste generation and diversion rates. In most cases the waste generation and diversion estimates are based on a five year average (2014 to 2018).
Municipalities in the proposed regional service area were contacted to determine if they were still interested in being included in the expanded regional service area for the W12A Landfill.	There were no changes proposed to the regional service area as a result of contacting municipalities.
Estimated remaining site life for landfills in the expanded service area were updated where changes had occurred.	Changes were made to the remaining site life for two landfills (West Elgin Landfill and Stratford Landfill).
Disposal locations for municipalities in the expanded regional service area were updated where changes had occurred.	Three landfills that service four municipalities have closed since 2018.

Existing Service Area of W12A Landfill

The report examines the different types of waste from the existing service area of the W12A Landfill. This includes waste that the City is responsible for as well as waste not controlled by the City but accepted at its landfill for disposal.

The waste has been broken down into nine types based on their characteristics. The nine waste types are residential; industrial, commercial & institutional (IC&I); construction, renovation & demolition (CR&D); sewage sludge ash; biosolids; street sweepings & road work waste; other municipal operations waste; water treatment plant process residuals; and contaminated soil.

Service Area

The service area is the area from which a landfill is legally allowed to accept waste. The existing service area for the City's W12A Landfill is the City of London, Municipality of Thames Centre, TRY Recycling's Facilities on Clarke Road, Lake Huron Primary Water Treatment Plant and Elgin Area Water Treatment Plant.

Current and future generation, diversion and disposal rates for each waste type from the *Residual Waste Projections & Landfill Capacity Assessment* report have been updated using the most recent (2018) waste quantity data.

Residual waste quantity (by weight) projections were developed for the existing service area taking into account the City's updated population projections coupled with the projected generation and diversion rates for each of the waste types.

For the 25 year planning period, it is estimated that the expansion of the W12A Landfill may need to accommodate an average of approximately 376,000 tonnes per year of Residual Waste from the existing service area or 9,400,000 tonnes in total. This is 200,000 tonnes more in total than what was projected in the previous 2018 report.

Regional Service Area

The City approached nearby lower and upper tier municipalities in March 2017 to determine their interest in being included in the service area of the expanded W12A Landfill. Based on their responses, a service area consisting of the City of London plus Elgin County, Middlesex County, Huron County, Lambton County and Perth County was proposed in the Amended ToR.

Municipalities in the proposed regional service area were contacted in September 2019 to determine if they were still interested in being included in the expanded service area. There were no municipalities that requested to be removed from the regional service area and therefore there will be no changes to the previously proposed regional service area. The population of Elgin, Middlesex, Huron, Lambton and Perth Counties (including separated cities) is approximately 420,000, which is about the same as London's population. Only a fraction of the waste from this area is expected to be disposed of at the W12A Landfill in the future because of existing remaining capacity in their landfills, travel distance and other factors.

The site life of existing landfills within the proposed regional service area were confirmed and updated where changes had occurred (West Elgin Landfill and Stratford Landfill).

The residual waste disposal location for municipalities within the proposed regional service area were confirmed and updated where changes had occurred. The disposal locations for four municipalities (Central Huron, Goderich, Huron East and Southwest Middlesex) were updated as the result of the closure of the Limerick Landfill, Trillium Drive Landfill and Mid-Huron Landfill in 2018.

It is estimated that the expansion of the W12A Landfill may need to accommodate approximately 500,000 tonnes of Residual Waste from the regional service area over the 25 year planning period. This is 100,000 tonnes less than what was projected in the previous 2018 report.

Required Additional Landfill Capacity for Expansion of the W12A Landfill

The volume of landfill airspace required to accommodate waste is typically calculated by multiplying the number of tonnes of waste to be disposed by the landfill utilization rate.

The landfill utilization rate is the amount of space (cubic metres, m³) needed to manage an average tonne of waste including daily and intermediate cover material. A landfill utilization rate of 0.72

tonnes/m³ was determined to be appropriate for the proposed W12A Landfill expansion.

Daily/Intermediate Cover Material

Daily/intermediate cover material is the material placed on garbage at the end of the day to reduce odours and litter from a landfill. Cover material is typically soil but other materials can be used such as wood chips. Daily/intermediate cover material typically consumes 15% to 20% of the total disposal volume at a landfill.

There is a need for an additional disposal volume of 13,800,000 m³ at the W12A Landfill site for the 25 year planning period (excluding final cover).