Terms of Reference

Twin Creeks Environmental Centre Landfill Optimization Project Environmental Assessment

Waste Management of Canada Corporation

Watford, Ontario

January 7, 2022 (Original)
March 30, 2022 (Amended)

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Executive Summary

Waste Management of Canada Corporation (WM) is proposing to undertake an Environmental Assessment (EA) for the optimization of the design and operation of the Twin Creeks Environmental Centre (TCEC) landfill. The TCEC is located is located in the Township of Warwick near the Village of Watford, at the corner of Nauvoo Road and Zion Line, within the County of Lambton. The municipal street address for the facility is 5768 Nauvoo Road, Watford, Ontario. The site began operating as a landfill in 1972.

WM has owned and operated the TCEC since 1996. The landfill was approved under the *Environmental Assessment Act* (EAA) for expansion in 2007, and has total airspace capacity of 26,508,000 m³ over an area of 101.8 ha, within a total site area of 301 ha. The landfill provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. This landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes, including non-hazardous contaminated soil. The TCEC is permitted to receive up to a maximum of 1,400,000 tonnes per year of waste including contaminated soil for disposal at the site.

WM has prepared these Terms of Reference (ToR) in accordance with subsection 6(2)(c) of the EAA which allows WM to set out in detail the requirements for preparation of the Environmental Assessment (EA). WM plans to proceed under subsection 6(2)(c) and 6.1(3) of the EAA, which allows proponents to focus the EA and consideration of alternatives to address their specific needs and circumstances. The ToR was prepared following consultation with Indigenous communities and stakeholders as required by Section 6(3) of the EAA. The proposed undertaking is designated under Regulation 101/07 of the EAA.

The purpose of the undertaking is to provide additional landfill airspace capacity for up to approximately 14,000,000 m³ of waste through the optimization of the approved landfill, which could extend the site life by approximately 12 years (from 2031 to 2043). There is approximately 13,200,000 m³ or 10 years of approved airspace capacity remaining at the TCEC (i.e., capacity will be reached in approximately 2031). There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs. This project will also provide longer-term certainty of service continuity to WM's customers beyond the remaining 10 years of capacity.

The rationale for the undertaking is twofold: first, there is a need for additional landfill capacity at the TCEC as it is a significant component of the provincial waste management network and infrastructure serving a broad area and customer base across Southern Ontario; and second, WM is providing waste management services and facilities that are well positioned to continue to support Ontario's transition to becoming waste-free and achieving a circular economy, while supporting a reduction in greenhouse gas (GHG) production and the amount of waste going to landfill, consistent with provincial legislation.

The proposed optimization may be achieved through alternative landfill configurations or alternative methods within the existing TCEC site area. WM has identified a preference for

a vertical alternative method although both vertical and horizontal alternative methods will be considered in the EA. The alternatives will be assessed using criteria related to the natural, built, cultural, and socio-economic environments within the on-site study area and the off-site study area (generally within approximately 1 km of the on-site study area). The off-site study area may be refined during the EA to suit the requirements of a specific environmental component or based on the spatial extent of predicted effects.

WM is committed to carrying out meaningful consultation and engagement on the project with a broad range of stakeholders. The ToR outlines a consultation and engagement program to be implemented during the preparation of the EA to engage the public, Indigenous communities, government agencies, and other interested parties in the EA process.

The EA will contain a list of commitments made by WM during the ToR process and indicate how such commitments have been addressed in the EA. A list of commitments made by WM during the preparation of the EA will also be included in the EA along with a framework for monitoring when and how all commitments will be fulfilled. In addition, a strategy and schedule for compliance and effects monitoring will be developed and included in the EA.

In addition to the approval under the EAA, certain other approvals may be required under provincial legislation. A complete list of the specific approvals required for the proposed undertaking will be provided in the EA. The proposed undertaking is not identified as a designated project under the *Impact Assessment Act*, and this has been confirmed with the Impact Assessment Agency of Canada.

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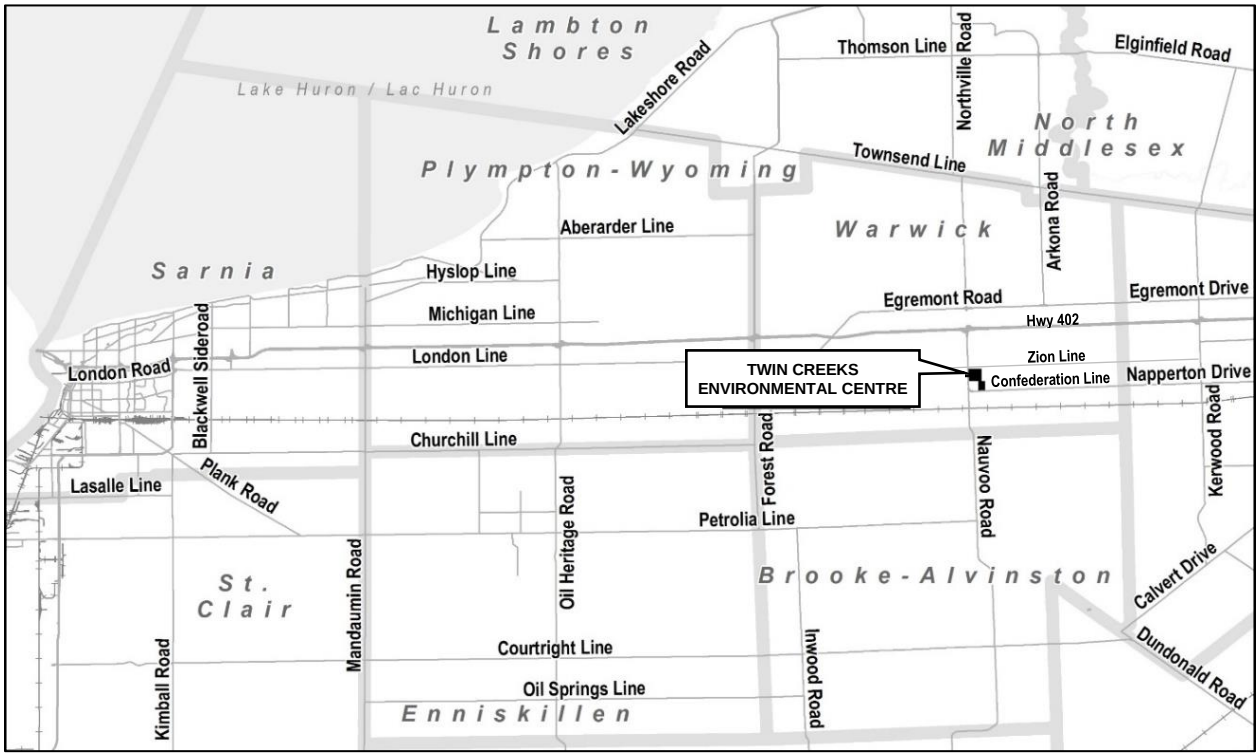
1 Introduction and Background

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an Environmental Assessment (EA) seeking approval for increasing the landfill airspace capacity including optimizing the existing landfill design and operation, maximizing the use of the constructed infrastructure and the significant investment made at the TCEC.

The TCEC is a regional landfill facility located in the Township of Warwick at the corner of Nauvoo Road and Zion Line (**Figure 1-1**), which originally began operation in 1972. WM acknowledges that the Twin Creeks Environmental Centre is situated within the traditional and Treaty lands of Walpole Island First Nation. The landfill provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. This landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes, including non-hazardous contaminated soil.

Figure 1-1. Site Location



The landfill is engineered with environmental protection systems that meet or exceed regulatory requirements and is subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and management, landfill gas collection and control, and on-site leachate disposal through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM has owned and operated the TCEC since 1996. The landfill was approved under the *Environmental Assessment Act* (EAA) for expansion in 2007, and waste was first deposited into the expansion in November 2009. The pre-existing site was originally approved for a waste capacity of 3,072,000 m³ within an area of 32.4 ha. The approval of the expansion landfill increased the total airspace capacity to 26,508,000 m³ over an area of 101.8 ha, within a total site area of 301 ha.

The Environmental Compliance Approval (ECA) A032203 for the Twin Creeks Environmental Centre allows the landfill to receive up to a maximum of 1,400,000 tonnes per year of waste including contaminated soil for disposal at the site. The TCEC typically receives between 5,000 to 7,500 tonnes of residual waste, with an average of 200 waste hauling vehicles, per week day. There is approximately 10 years of approved airspace capacity remaining at the expansion landfill (i.e., capacity will be reached in approximately 2031). The remaining approved capacity was approximately 13,200,000 m³ at the end of September 2021.

The optimization of the TCEC could provide additional airspace of up to approximately 14,000,000 m³, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

In accordance with Ontario Regulation 101/07 under the *Ontario Environmental Assessment Act* and the *Guide to Environmental Assessment Requirements for Waste Management Projects*, the proposed project is designated as an undertaking to which the Act applies. It is essential for WM to start the Environmental Assessment (EA) approvals process now so that the necessary approvals are in place to allow an efficient implementation of the landfill optimization project. This project will also provide longer-term certainty of service continuity to WM's customers beyond the remaining 10 years of capacity.

2 Proponent

The proponent for the proposed undertaking is Waste Management of Canada Corporation (WM). Waste Management, based in Houston, Texas, is the leading provider of comprehensive waste management services in North America. WM provides a broad range of comprehensive waste management related services across North America, including collection, transfer, recycling and resource recovery, and disposal services throughout Canada.

WM employs over 1,500 skilled workers and qualified professionals across six provinces and manages its Canadian operations from its head office, located in Kitchener, Ontario. Within Ontario, WM's operations include seven natural gas fueling stations, five materials recovery / baling facilities, 15 transfer stations, 16 hauling sites, and two active landfills.

Over the past 50 years, the company has provided services to over 250,000 residential, commercial, and industrial customers in Ontario alone.

WM is a local company and primary service provider for the collection and disposal of waste generated in the Township of Warwick, Lambton County and throughout Ontario. The company's mission is to maximize resource value while minimizing environmental impact to improve economic and environmental sustainability for its stakeholders, including municipal partners, and residential and commercial customers. To learn more, visit www.wm.com.

WM is proud to be an active supporter of community events and programs that make the Township of Warwick and surrounding areas a strong and healthy place to live, work, and play. Community benefits include host community fees, local sports club donations, downtown amenities, arena upgrades, a dog park addition, Watford and Warwick fire department donations, and various other charitable contributions and community events.

The WM contact for this project is:

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3 Preparation of the Environmental Assessment

The following sections describe how the Draft Terms of Reference (ToR) was prepared, the flexibility of the ToR and the preparation of the EA.

3.1 Preparation of the Terms of Reference

WM has complied with the Ministry of Environment, Conservation and Parks (MECP)'s Code of Practice for *Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario* (January 2014) when preparing this ToR. The consultation and engagement program has been undertaken in accordance with the MECP's Code of Practice, *Consultation in Ontario's Environmental Assessment Process* (January 2014). In addition, the requirements of the MECP's *Guide to Environmental Assessment Requirements for Waste Management Projects in Ontario* (March 2007) has also been addressed.

The Notice of Commencement for the ToR was published on November 17, 2020.

WM has prepared this ToR in accordance with subsection 6(2)(c) of the EAA, which allows WM to set out in detail the requirements for preparation of the EA. WM plans to proceed under subsection 6(2)(c) and 6.1(3) of the EAA, which allows proponents to focus the EA and consideration of alternatives to address their specific needs and circumstances. The ToR was prepared following consultation with Indigenous communities and stakeholders

as required by Section 6(3) of the EAA. The proposed undertaking is designated under Regulation 101/07 of the EAA.

WM has completed an assessment of the rationale and need for the optimization of the landfill at the TCEC. There is a need for the continued development of the TCEC – the TCEC is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. There are three large private landfill sites in southern Ontario, including the TCEC, which are all operating at their approved annual limits, and the Ontario Waste Management Association has estimated that there are only 15.5 years of disposal capacity remaining in Ontario.

The continued operation of the TCEC aligns with the Province of Ontario's Strategy for a Waste Free Ontario, Climate Change Action Plan goal of reducing greenhouse gas (GHG) emissions, and the Made in Ontario Environment Plan to reduce litter and waste in communities. Approximately 2.5 million to over 3 million tonnes of post recycling and diversion residual waste generated in Ontario is disposed of in Michigan each year. The TCEC receives 1.4 million tonnes of post recycling and diversion residual waste, approximately 20% of which is managed directly by WM with the remainder controlled by third parties.

Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

Additional details regarding the rationale for the project are provided in **Section 5** and **Supporting Document 1** (Rationale for the Undertaking). Information on the rationale and need for the landfill optimization was included in consultation and engagement with the public, interested stakeholders, Indigenous communities, and government agencies during the development of the ToR. The final description of the proposed undertaking and rationale for the project will be confirmed during the EA.

As noted, WM intends to proceed under subsections 6(2)(c) and 6.1(3) of the EAA, which allow the proponent to focus the EA. Specifically, WM intends to exclude the 'alternatives to' assessment during the EA studies because an evaluation of waste management alternatives was carried out separately. The assessment of the 'alternatives to', including consideration of the do nothing scenario, have been further assessed during the preparation of this ToR as presented in **Section 6.1** and **Supporting Document 2** (Alternatives to the Undertaking).

This ToR identifies a preferred 'Alternative To' and identifies the 'alternative methods' that will be examined during the preparation of the EA. This approach is consistent with the MECP *Code of Practice: Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario* (January 2014), which describes how a Proponent can proceed under subsection 6(2)(c) and 6.1(3) if the Proponent is further along in the defined planning process and additional detail is known regarding its proposal.

The consideration of 'alternatives to' the undertaking was included as part of consultation and engagement with the public, interested stakeholders, Indigenous communities, and government agencies and is documented in **Section 6.1** and in the Record of Consultation and Engagement (**Supporting Document 4**). No additional assessment of 'alternatives to' the undertaking will be included in the EA. The 'Do Nothing' alternative will be carried

into the EA and considered against the preferred undertaking for assessing potential effects.

The ToR further identifies the 'alternative methods' that will be considered in the EA. These 'alternative methods' will be reviewed during the EA and modified if appropriate. Additional alternatives may be identified if warranted. The alternative methods are outlined in **Section 6.2**.

This Terms of Reference was originally submitted on January 7, 2022 and was subsequently amended in March 2022 to include consideration of Policy 6.8 of the Food and Organic Waste Policy Statement as part of the EA (**Section 5.1.2**), outline how future leachate management requirements for the landfill will be considered in the EA (**Section 8.2**), and provide additional details on the consultation and engagement plan for the EA (**Section 9.2**).

3.2 Flexibility of the Terms of Reference

If approved by the Minister of Environment, Conservation and Parks, this ToR will provide the framework for preparing the EA Study Report. The ToR is not intended to present every detail of all the activities that will occur when preparing the EA. It is possible that, in carrying out the work described in this ToR, minor variations to methodologies may be necessary. These variations may include, but are not limited to:

- modifications to the local study area to suit the requirements of each environmental component;
- modifications to the alternatives, or identification of additional alternatives, considered;
- modifications to studies or additional/expanded studies due to variations in the degree of environmental impact assumed at the time of preparation of this ToR or due to content and quality of information available;
- modifications/refinements to the work plans for the technical studies;
- modifications to the consultation and engagement plan; and
- any other modifications required or available through changes to Acts or Regulations.

These examples are not intended to be exhaustive; rather, they are meant to set out the types of changes that may be considered minor and that could be accommodated within the framework of the ToR. The MECP will be consulted in the event of uncertainty as to whether a proposed change should be considered minor and accommodated within the approved ToR.

The flexibility to accommodate new circumstances is also described in **Section 11**.

3.3 Preparation of the Environmental Assessment

Following approval of the ToR by the Minister of Environment, Conservation and Parks (the Minister), WM will prepare the EA in accordance with the requirements of the approved ToR and EAA and submit to the Minister for review and approval. The EA will include:

- a description of the purpose of the undertaking, as described in **Section 4** of this ToR;

- the rationale for the undertaking, as described in **Section 5** of this ToR;
- a description of the undertaking based on the consideration of alternative methods, as described in **Section 6** of this ToR;
- a description of the environment potentially affected by the undertaking (the description in **Section 7** of the ToR will be expanded);
- an assessment of the alternative methods of carrying out the undertaking based on the method outlined in **Section 8** of this ToR. WM intends to consider the alternatives described in **Section 6** including:
    - a description of the effects that will be caused or that might reasonably be expected to be caused on the environment by the undertaking or the alternative methods;
    - a description of the mitigation measures that are necessary to prevent or reduce significant adverse effects on the environment;
    - an evaluation of the advantages and disadvantages to the environment as a result of the undertaking; and
- a description of the consultation and engagement process undertaken by WM for the EA following the plan described in **Section 9** of this ToR.

4 Purpose of the Undertaking

The purpose of the undertaking is to provide additional airspace for up to approximately 14,000,000 m³ of waste through the optimization of the TCEC, which could extend the site life by approximately 12 years (from 2031 to 2043).

There is approximately 10 years of approved airspace capacity remaining at the expansion landfill (i.e., capacity will be reached in approximately 2031). There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs. This project will also provide longer-term certainty of service continuity to WM's customers beyond the remaining 10 years of capacity.

The renewable bio-gas (landfill gas) produced by the landfill is provided to a neighbouring greenhouse to grow produce, which is sold throughout Ontario and Quebec, creating employment opportunities for the local community. WM's intent is for the landfill to continue to supply gas to the greenhouses for heating purposes for the next 25 years.

The purpose of the undertaking may be refined during the EA process and will be included in the EA Study Report.

5 Rationale for and Description of the Undertaking

The rationale for and description of the undertaking are presented below. The rationale for and description of the undertaking may evolve during the preparation of the EA and will be included in the EA Study Report.

5.1 Rationale for the Undertaking

A summary of the rationale for the undertaking is presented below. Additional details are provided in **Supporting Document 1**.

The rationale for the undertaking is twofold:

1. There is a need for additional landfill capacity at the TCEC as it is a significant component of the provincial waste management network and infrastructure, both now and in the future, serving a broad area and customer base across Southern Ontario; and
2. WM is providing waste management services and facilities that support Ontario's climate change strategy and the reduction of greenhouse gas emissions through management of landfill gas, supporting closure of smaller landfill sites and an overall reduction in vehicles travelling to waste management facilities, consistent with provincial legislation.

5.1.1 Need for the Undertaking

The TCEC landfill provides cost effective services to a broad customer base largely across Southern Ontario. This includes a range of municipalities and Indigenous communities without their own disposal capacity along with numerous industrial, commercial, and institutional businesses.

Approximately 28% of the waste received at the TCEC is post-recycling and post-diversion residential residual waste from municipalities. Most municipal customers have long term (e.g., 10 years or greater) waste disposal contracts with WM to provide certainty of disposal capacity at the TCEC. Many of these municipalities have been faced with the need to close their own landfill sites due to various factors including increased regulatory requirements and associated costs, the risks and costs associated with long term liabilities, and encroaching urban development. Faced with these uncertainties, WM provides these municipalities and communities with secure access to an essential service within Ontario and in a cost-effective manner into the future.

Since 2017 and the increase in the annual fill rate, TCEC has effectively been operating at the approved annual limit of 1,400,000 tonnes. In 2019, an additional quantity of waste was received at the landfill following an emergency request, approved by the MECP, to address increased waste generated by municipal customers due to population growth, issues in the recycling market, and the challenges encountered in directing waste to alternate disposal facilities in Michigan.

The majority of the waste received at the TCEC is from the IC&I sector within Ontario, including third-party waste management companies and haulers who do not typically own a landfill. These companies provide their customers with a range of waste management services including collection, business and industry specific recycling and diversion programs, and disposal. Provision of disposal capacity for post-recycling/post-diversion (i.e., residual) waste to these businesses in a cost-effective and secure manner ensures these companies can continue operating competitively. WM estimates that the TCEC manages approximately 25% of IC&I waste generated within Southern Ontario.

The projected significant growth in Ontario's population, projected to increase by approximately 31.5% or almost 4.6 million people by 2046, with its associated economic and business growth to support a larger work force, will result in a continued demand for WM to provide service to existing and new municipal and IC&I customers.

In January 2021, the Ontario Waste Management Association (OWMA) released their State of Waste in Ontario: Landfill Report (3rd Landfill Report) which provides an assessment of landfill disposal capacity in Ontario. It is estimated that there is only about 15.5 years of remaining capacity in the Province as a whole. The OWMA report also notes that the majority of the remaining capacity is held by private sector landfills (53%), and that the remaining municipal landfill capacity, which is effectively restricted by service area, has decreased to 47% from 64% in 2017.

The remaining disposal capacity in Ontario is becoming concentrated in a fewer number of large regional sites. The OWMA reports that the trend may be for smaller open landfills to continue to close, directing increased waste volumes to a fewer number of large regional sites in the future. Since 2017, there have only been two approvals for significant additional landfill capacity in Southern Ontario: the Essex-Windsor Solid Waste Authority municipal landfill received approval for additional capacity in 2017; and in 2020, Waste Connections received approval for the expansion of the Ridge Landfill, extending the operating life of the landfill for a further 20 years[1]. The City of London is currently pursuing approval to expand the capacity of their W12A Landfill. A new private landfill proposed for development in Oxford County was put on hold in July 2021 after nine years of study and assessment.

Most municipalities are now focused on conserving their landfill capacity for residential waste and limiting the amount of IC&I and/or construction and demolition (C&D) waste accepted. Siting new landfill capacity within municipal boundaries continues to be challenging as the population and density of municipalities in Southern Ontario increases.

Access to landfill disposal capacity in Ontario is restricted by daily and/or annual fill rates and service area. With a few exceptions, municipal landfill sites have service areas which restrict the landfill to serve only waste generators within the municipality. Private landfills typically have broader, but still restricted, service areas and fill rates. All three large private landfill sites in southern Ontario, including the TCEC, are operating at their approved annual limits.

In summary, it is evident that the TCEC landfill is a significant component of the provincial waste management network and infrastructure, serving a broad area and customer base

[1] It should be noted that as part of the recent EA approval to expand the Ridge Landfill, the landfill service area for residential waste was restricted to only the municipality of Chatham-Kent.

across Southern Ontario. With a lack of sufficient and secure long-term disposal capacity available in Ontario, there is an on-going requirement for the TCEC to continue to provide this landfill disposal service, supporting stable operation and growth for municipalities and businesses across Southern Ontario. The projected significant growth in population, with its associated economic and business growth to support a larger work force, will also result in a continued demand for WM to provide service to existing and new municipal and IC&I customers. The on-going development and operation of the TCEC will allow WM to provide these customers with secure access to an essential service within Ontario in a cost-effective manner for the long term.

5.1.2 Consistency with Provincial Legislation

In June 2016, the Ontario government passed the *Waste Free Ontario Act*, which enacted two Acts: the *Resource Recovery and Circular Economy Act*, 2016, and the *Waste Diversion Transition Act*, 2016. Under the new legislation, the province is moving toward a circular economy framework by establishing a producer responsibility regime. It is anticipated that extended producer responsibility for the Blue Box program will come into effect in 2023.

Subsequently in 2017, the MECP released the Strategy for a Waste-Free Ontario: Building the Circular Economy (the Strategy). The Strategy outlines a vision for Ontario where waste is considered a resource that can be recovered, reused, and reintegrated to achieve a circular economy. The ultimate goal of the Strategy is to achieve zero waste and zero greenhouse gas (GHG) emissions from the waste sector. The Strategy further identifies four overall objectives which include a total of 15 actions to be taken and implemented by 2050. A number of the actions relate to the need for landfill including increased resource recovery, disposal bans, reduction of food and organic wastes, and ensuring landfills are well planned and managed to minimize their need and reduce GHG emissions.

In November 2018, the MECP released Preserving and Protecting our Environment for Future Generations: A Made-in-Ontario Environment Plan which outlined various commitments to reduce litter and waste in Ontario communities. Subsequently in March 2019, the Ministry released the Reducing Litter and Waste in Our Communities: Discussion Paper identifying three waste management goals for Ontario, including:

1. Decrease the amount of waste going to landfill;
2. Increase the Province's overall diversion rate; and
3. Reduce GHGs from the waste sector.

The Province of Ontario is also beginning to shift its legislation and economics towards a Circular Economy through the Strategy for a Waste Free Ontario: Building a Circular Economy and Ontario's Food and Organic Waste Framework. The Framework lays out a broad-based approach to attempt to achieve a vision of a circular economy that moves towards zero food and organic waste and zero GHG emissions from the waste sector. The Food and Organic Waste Policy Statement provides further direction for increasing waste reduction and resource recovery of food and organic waste in Ontario. In consideration of Policy 6.8 of the Food and Organic Waste Policy Statement, which directs that "proponents of new or expanded waste management systems for disposal should consider resource

recovery opportunities for food and organic waste", WM will examine options for food and organic waste resource recovery and/or diversion opportunities as part of the EA.

Continued operation of the Twin Creeks landfill aligns with the Province of Ontario's Strategy for a Waste Free Ontario, Climate Change Action Plan goal of reducing GHG emissions, and the Made in Ontario Environment Plan to reduce litter and waste in communities. WM has invested in many initiatives to reduce GHG emissions and divert more materials, including:

- A recycling drop-off area is provided for local community (Township of Warwick) residents and businesses in an on-site area near the scale house. A series of bins are available for the collection of typical blue box materials (i.e., glass, plastic and metal containers, and fibre), cardboard, metal, white goods and yard waste. When a bin is full it is removed and transferred off-site for processing or directly to a market for the material. WM will continue to work with the Township of Warwick to address future diversion opportunities and their implementation if feasible.
- An on-site waste processing and diversion area is approved in the southeast corner of the approved landfill footprint. This 1 ha area supports waste screening and diversion activities for specific waste types that have been identified to have a beneficial use on site. Concrete, asphalt, tires and wood are approved to be separated from the waste stream and processed on-site for use. The TCEC is permitted for processing up to 36,000 tonnes/year of this material. Uses of these diverted materials include road base, daily cover or pipe bedding. This program removes diverted materials from the landfill and reduces the requirement to import granular material, while some materials can be beneficially reused for cover material and landscaping amongst other uses.
- The approvals are in place for WM to develop an on-site aerobic composting facility for leaf and yard waste, agricultural waste and wood. The TCEC is permitted to compost up to 7,500 tonnes/year. WM monitors the quantity of material received annually as part of its recycling drop-off area while planning for implementation of this facility.
- Installing a landfill gas (LFG) collection system at the landfill to collect methane gas (a major source of GHGs) which is converted to produce green energy. The TCEC is providing landfill gas to heat 40 acres of greenhouses located adjacent to the landfill site. Prior to the LFG being used by the greenhouses it was flared. The intent is for the landfill to supply LFG for heating to the greenhouses for 25 years.
- Providing long-term residential waste disposal capacity to Lambton County and other Ontario municipalities. Over time, this has allowed the County and other Ontario municipalities to close a number of smaller landfill sites which did not have control systems to manage GHG emissions associated with LFG.
- Providing a network of regional transfer stations across Southern Ontario to collect material from a larger number of small generators and consolidate the material for transport. This results in a significant reduction in the number of vehicles travelling long distances to appropriate processing and disposal facilities and supports a substantial decrease in the emission of GHGs associated with the transportation of waste. The TCEC landfill receives waste from these transfer stations.

5.2 Description of the Undertaking

The proposed undertaking will provide additional airspace for up to approximately 14,000,000 m³ of waste through the on-going development of the approved TCEC landfill, which could extend the site life by approximately 12 years (from 2031 to 2043). There would be no change to the current 301 ha total site area, the approved service area, or the annual fill rate. The proposed undertaking will occur within the TCEC site area shown on **Figure 5-1**.

Figure 5-1. Project Location

6 Rationale and Description of Alternatives

The EAA identifies two types of alternatives: 'alternatives to' an undertaking and 'alternative methods' of carrying out an undertaking. 'Alternatives to' an undertaking are the different ways of addressing a problem or opportunity, while 'alternative methods' are different ways of carrying out the same activity. The 'alternatives to' and 'alternative methods' for the TCEC landfill optimization are discussed below.

6.1 Alternatives to the Undertaking

"Alternatives to" the undertaking are functionally different ways of addressing the sustainable business opportunity and need for the TCEC landfill to continue to provide disposal capacity over the long term. WM has identified and considered specific "alternatives to" the proposed undertaking that address the opportunity and are within the company's business mandate and ability to implement.

Consistent with the MECP Code of Practice for *Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario* (January 2014), WM identified a range of 'alternatives to' for providing long-term disposal capacity that are appropriate and reasonable for them (a private sector company) to implement.

The following four alternatives were identified:

1. Do nothing;
2. Redirect waste to a disposal facility elsewhere;
3. Develop a new WM disposal facility; and
4. Develop additional disposal capacity within the TCEC site area.

WM does not own or operate any thermal treatment facilities. This type of alternative is not within the company's business mandate and ability to implement.

Each of the 'alternatives to' were considered in the context of their ability to meet the need for long term disposal capacity to serve Ontario municipalities and the IC&I sector, and the business opportunity identified by WM. A summary description of each 'alternative to' and an assessment of how each addresses the opportunity are presented below and detailed in **Supporting Document 2**.

Alternative 1 – Do Nothing

The "do nothing" alternative implies that WM would not undertake the development of new long term disposal capacity. WM would only be able to continue with their current business operations at the Twin Creeks Environmental Centre for approximately 10 years based on current landfilling rates (i.e., until approximately 2031). Landfill operations would have to cease once the existing landfill is at capacity.

The Twin Creeks landfill provides cost effective services to a broad customer base largely across Southern Ontario, which includes a range of municipalities and Indigenous communities without their own disposal capacity along with numerous industrial, commercial, and institutional businesses. Most municipal customers have long-term (e.g., 10 years or greater) waste disposal contracts with WM to provide certainty of disposal capacity at the TCEC. Many of these municipalities have been faced with the need to close their own landfill sites. WM provides these municipalities and communities with secure access to an essential service within Ontario and in a cost-effective manner.

The majority of the waste (approximately 72%) received at the TCEC is from the IC&I sector within Ontario, including third-party waste management companies and haulers who do not typically own a landfill. These companies provide their customers with a range of waste management services including collection, business and industry specific recycling and diversion programs, and disposal. Provision of disposal capacity for post-

recycling/post-diversion (i.e., residual) waste to these businesses in a cost-effective and secure manner ensures these companies can continue operating competitively. WM estimates that the TCEC manages approximately 25% of IC&I waste generated within Southern Ontario.

The TCEC landfill, like the other private landfills in the region, is operating at its annual limit. With a lack of sufficient and secure long-term disposal capacity available in Ontario, there is an on-going requirement for the TCEC to continue to provide this landfill disposal service, supporting stable operation and growth for municipalities and businesses across Southern Ontario.

The closure of the TCEC landfill would result in the loss of local employment and indirect employment, as well reduced municipal and third-party business revenues related to discontinued TCEC annual operating expenditures.

The “do nothing” alternative would not allow WM to continue to provide disposal services to its customers and fulfill long-term contractual commitments within Ontario. These customers, including a number of municipalities across Southern Ontario, would need to find alternate ways to manage their waste. The opportunity to optimize the investment in the facility infrastructure would be lost along with the economic contributions to the local economy. This alternative is not a viable option for WM’s on-going business, its customers, and the Province of Ontario. It has been included to provide a benchmark against which to measure the other alternatives and to assess the advantages and disadvantages of the preferred alternative.

Alternative 2 – Redirect Waste to a Disposal Facility Elsewhere

This alternative involves WM redirecting waste to a disposal facility elsewhere (transport material to other approved disposal facilities in Ontario and/or the U.S.). There would be no development of new long term disposal capacity at the TCEC. WM does not own or control any other landfills currently operating within Southern Ontario.

The TCEC landfill has an all Ontario service area and an annual fill rate of 1.4 million tonnes. The landfill is effectively operating at its approved annual limit. Access to landfill disposal capacity in Ontario is restricted by daily and/or annual fill rates and service area. With a few exceptions (e.g., City of Toronto’s Green Lane Landfill) municipal landfill sites have service areas which restrict the landfill to serve only waste generators within the municipality. Private landfills typically have broader, but still restricted, service areas and fill rates. The other large private landfills in Southern Ontario, including the Waste Connections Ridge Landfill and Walker South Landfill, are reported to operate at their annual capacity.

The Michigan Department of Environment, Great Lakes and Energy (EGLE) reports that historically the total quantity of waste exported from Ontario to that state has generally been in the order of 2.5 million to over 3 million tonnes annually. In 2020, the WM Pine Tree Acres Landfill in Michigan received approximately 1.54 million tonnes of waste from Ontario.

At a minimum, with virtually no excess landfill disposal capacity available within Southern Ontario for the 1.4 million tonnes managed at TCEC, WM would need to redirect the waste volume it controls (20-30% of the waste managed at the TCEC) to its landfill in Michigan.

The remaining 70-80% of waste from external sources would also need to be redirected to landfill sites largely located in the U.S.

This alternative would not allow WM to continue to provide disposal services to its customers and fulfill long-term contractual commitments within Ontario. These customers, including a number of municipalities across Southern Ontario, would need to find alternate ways to manage their waste. This will likely require export to the US since landfill capacity within Southern Ontario is both restricted and limited. The opportunity to optimize the investment in the TCEC facility infrastructure would be lost along with the economic contributions to the local economy. This alternative is not a viable option for WM's on-going business, its customers, and the Province of Ontario.

Alternative 3 – Develop a New Disposal Facility

This alternative requires WM to develop a new waste disposal facility at a location within Southern Ontario capable of continuing to service the customer base for the TCEC. The ability to develop a new disposal facility is limited to those properties owned by WM including the potential expansion of an existing landfill.

WM owns a number of closed landfill sites in Southern Ontario, and other properties such as transfer stations and hauling yard sites, which do not have the property area, site infrastructure and environmental controls to manage 1.4 million tonnes of waste annually over a period of approximately 12 years. In addition, significant financial investment would be required to enhance and upgrade off-site infrastructure including access roads and, in some cases, the site has been transitioned to alternative land uses.

This alternative would not allow WM to continue to provide disposal services to its customers and fulfill long term contractual commitments within Ontario; as such, these customers, including a number of municipalities across Southern Ontario, would need to find alternate ways to manage their waste. The opportunity to optimize the investment in the TCEC facility infrastructure would be lost along with the economic contributions to the local economy. This alternative is not a viable option for WM's on-going business, its customers, and the Province of Ontario.

Alternative 4 – Develop within the TCEC Site Area

This alternative would involve WM developing additional landfill capacity within the 301 ha TCEC site area. The additional capacity would be developed through either a vertical expansion of the currently approved 101.8 ha expansion landfill footprint or a horizontal expansion into other areas of the TCEC site. Within the TCEC site a range of existing land uses and development opportunities may potentially exist. This alternative would be able to optimize and utilize the extensive existing infrastructure constructed at the TCEC including site features for leachate and gas management, stormwater management, roads, administration and maintenance, etc.

A vertical expansion would involve redesigning the originally planned and approved final contours of the 101.8 ha expansion landfill including potential changes to the grade of the side slopes and the peak elevation.

A horizontal expansion within the overall 301 ha TCEC site area may require that development occur on the partially-lined existing closed landfill area at the east of the site. The southern portion of the TCEC site currently includes a 28.3 ha poplar plantation used

to dispose on-site treated leachate, and approximately 36 ha currently used for agriculture and recreation.

Development within the TCEC site area is the only practical, environmentally sound, and cost-effective option to address the identified business opportunity to allow WM to operate in the long-term. WM has been successfully operating the TCEC landfill since 1996 and it has become an important addition to the local community by creating employment opportunities, contributing financially to the Township of Warwick, and supporting local initiatives within the community. This alternative is the most financially and economically viable option to both WM and its customers; utilizing land already owned by WM and optimizing the significant investment that has been made in the supporting site infrastructure that has already been developed, including environmental controls.

Preferred Alternative to the Undertaking

WM has determined that development of additional landfill capacity within the TCEC site area (Alternative 4) is the only reasonable alternative for the company, its customers, and the Province of Ontario. The other alternatives do not address WM's business opportunity to meet long-term customer commitments, avoid business risks or maximize the financial investment in the facility, and limit the benefits provided to the local community. A summary of the advantages and disadvantages of the alternatives in addressing the opportunity identified by WM is provided in the following table.

Alternative To	Advantages	Disadvantages
Alternative 1 – Do Nothing	• Provides a benchmark against which to assess potential effects of the project.	• Does not allow WM to continue to provide disposal services and meet commitments. • No opportunity for WM to optimize the investment in the TCEC site infrastructure. • Economic contributions to the local economy end. • Lack of sufficient and long-term disposal capacity in Ontario.
Alternative 2 – Redirect Waste Elsewhere	• No advantages identified.	• Would require the potential export of an additional 1.4 million tonnes of waste to Michigan. • No opportunity for WM to optimize the investment in the TCEC site infrastructure. • Economic contributions to the local economy end. • Lack of sufficient and long-term disposal capacity in Ontario.
Alternative 3 – Develop a New Facility	• No advantages identified.	• WM does not own any other suitable properties in Southern Ontario. • Would require the potential export of an additional 1.4 million tonnes of waste to Michigan. • No opportunity for WM to optimize the investment in the TCEC site infrastructure. • Economic contributions to the local economy end.

Alternative To	Advantages	Disadvantages
		• Lack of sufficient and long-term disposal capacity in Ontario.
Alternative 4 – Develop within the TCEC Site Area	• Allows WM to continue to provide disposal services within Southern Ontario and meet their business commitments. • Allows WM to optimize the investment in the TCEC site infrastructure. • Economic contributions to the local economy will continue for an extended period of time. • Provides Ontario with additional long-term disposal capacity.	• No disadvantages identified.

These alternatives, and the identification of the preferred "alternative to", were presented to the public during the consultation and engagement on the development of the ToR. Based on the comments received the description of Alternative 4 was more broadly defined to include all development options within the TCEC site area and a summary of the advantages and disadvantages of the alternatives was included.

The "do nothing" alternative will be carried forward in the EA for comparison against the preferred undertaking to assess its potential effects on the existing environment.

6.2 Identification of Alternative Methods

'Alternative methods' of carrying out the undertaking are different ways of implementing the proposed undertaking. The development of additional landfill capacity within the TCEC site area can be achieved through a vertical expansion of the currently approved expansion landfill footprint of 101.8 ha or a horizontal expansion into other areas of the TCEC site based on the preferred alternative to the undertaking identified in **Section 6.1**. Through the consideration of "alternatives to" the undertaking, WM has determined that developing additional landfill capacity within the TCEC site area is the only reasonable alternative for the company, its customers, and the Province of Ontario.

The existing ground elevation in the area of the TCEC site is approximately 245 metres above sea level (masl). The approved expansion landfill utilizes 4:1 exterior sideslopes to an elevation of 265.7 masl, and then transitions to 20:1 sideslopes to the landfill peak elevation of 278 masl. A two-metre thick final cover results in a landfill peak at 280 masl. A vertical expansion would involve redesigning the originally planned and approved final contours of the 101.8 ha expansion landfill including potential changes to the grade of the side slopes and the peak elevation. A range of variations and combinations of potential changes, or alternative methods, to the side slopes and peak elevation exist. A horizontal expansion within the overall TCEC site area would likely require that development occur on the existing closed landfill area at the east of the site or within the southern portion of the site.

The existing closed landfill is situated east of the expansion landfill and covers an area of approximately 30.9 ha. The existing closed landfill is a partially lined landfill under final

cover. Poplar trees planted on 9.3 ha of the final cover, referred to as the Poplar System, are utilized for the on-site management of leachate. Horizontal expansion in this area may require that development occur over the existing partially-lined landfill area, or excavation of landfilled waste to line the landfill area, with limited buffer from the eastern site boundary and the neighbouring land use (i.e., greenhouse). This alternative would require significant cost associated with remediation and/or engineering of the area in order to comply with applicable landfill design standards.

Within the southern portion of the TCEC site are the excess soil stockpile, a 28.3 ha area to dispose on-site treated leachate referred to as the Poplar Plantation, and approximately 36 ha currently used for agriculture and recreation. The southern portion of the site area is in close proximity to the Village of Watford and sensitive land uses within the community. This alternative would require the development of extensive additional site infrastructure including perimeter screening berms, stormwater works, roads, and landfill liner. On-going consultation and engagement with the local community and the Township of Warwick has consistently identified concerns with respect to the landfill or landfill-related activities encroaching on the Village and associated built up areas.

Based on a qualitative consideration of the potential vertical and horizontal expansion methods available within the site area, in addition to potentially locating waste in close proximity to the Village, the horizontal alternatives result in significant additional costs and do not optimize the use of the available and constructed infrastructure at the site to the extent possible. Given the financial, technological, and community risks and concerns associated with the horizontal alternative methods, WM has identified a preference for a vertical alternative method. A screening of the vertical and horizontal alternative methods will be carried out in the EA to confirm this conclusion.

Based on the preference for a vertical alternative method, four preliminary vertical alternative methods have been identified which may be refined and confirmed, as appropriate, during the EA. The preliminary vertical alternative methods include the following modifications to the expansion landfill final contours:

- 4:1 side slopes to an elevation of 300 masl, then 20:1 slope to a peak elevation of 304 masl;
- 3:1 side slopes to an elevation of 300 masl, then 20:1 slope to a peak elevation of 307 masl;
- 4:1 side slopes to a peak elevation of 320 masl; and
- 3:1 side slopes to an elevation of 320 masl, then 20:1 slope to a peak elevation of 324 masl.

During consultation and engagement on the development of the ToR, WM received comments regarding the feasibility of increasing the height of the expansion landfill; specifically, the comments were focused on the strength of the underlying leachate collection system pipes and if they could withstand the weight of the additional landfilled waste. To address these comments, WM completed a geotechnical feasibility review of the vertical alternative methods focused on the following design aspects:

- Settlement/deformation of the landfill base due to the increased weight of waste and cover material;

- Stability of the exterior side slopes if they are increased from 4:1 to 3:1; and
- Effects of the added weight on the leachate drainage systems, specifically drainage pipe deformation/deflection in the primary drainage layer and geonet compression within the secondary drainage layer.

The feasibility assessment, including the detailed analyses completed, is provided as **Supporting Document 3** (Geotechnical Feasibility Review). The assessment focused on the potential alternatives with a proposed increase in the side slopes (i.e., steeper, at 3:1) and peak elevation. As outlined in **Supporting Document 3**, the feasibility assessment confirmed the range of vertical alternative methods are acceptable as follows:

- Post-settlement landfill base grades meet O.Reg. 232/98 requirements and maintain acceptable leachate collection in the primary leachate drainage layer;
- The combination of 3:1 final side slopes and proposed peak elevation are stable;
- The strength of the primary drainage layer collection pipes is acceptable for the landfill optimization alternatives; and
- The flow capacity of the geonet within the secondary drainage layer will meet the design requirements for the landfill optimization alternatives.

The requirement for a more detailed geotechnical assessment for the assessment of the preferred alternative will be determined once it is identified.

WM will qualitatively predict the effects for each alternative method on the environment. The assessment will be completed for each component based on the locations and conceptual designs for each alternative, including mitigation and the existing environmental conditions. Leachate management considerations for the EA are outlined in **Section 8.2**.

7 Description of Existing Environment and Potential Effects of the Undertaking

A brief description of the existing environmental conditions at the TCEC and surrounding areas is presented in this section. This description is based on previous environmental studies completed for the TCEC (e.g., annual monitoring reports, compliance monitoring, previous environmental assessments) and on the additional work and studies underway to support the EA for the TCEC landfill optimization. A more detailed description of the existing environmental conditions will be prepared as part of the EA. The existing conditions will be used to assess the potential effects of the alternatives on the environment. The actual determination of the anticipated potential environmental effects of the undertaking, potential mitigation/management measures, and net effects are not included in this ToR; however, these will be identified in the EA Study Report.

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The proposed studies to support the EA are detailed in the discipline work plans presented in **Appendix C**.

The following sections describe the study areas and the existing environmental conditions within these study areas.

7.1 Study Areas

The proposed on-site and off-site study areas for the EA are as follows (**Figure 7-1**):

- **On-site study area**: the existing TCEC;
- **Off-site study area**: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area.

The off-site study area may be refined during the EA to suit the requirements of a specific environmental component or based on the spatial extent of predicted effects. Proposed refinements to the off-site study area are identified in the discipline work plans.

Figure 7-1. General On-Site and Off-Site Study Areas

7.2 Existing Conditions by Environmental Component

The EAA defines the environment in a broad, general sense that comprises physical, biological, and human considerations. In this EA the environment has been separated broadly into natural, socio-economic, cultural, and built components. The following

sections present preliminary descriptions of the existing environmental conditions by environmental component. The EA Study Report will include more detailed descriptions of existing environmental conditions. The characterization of the existing environment for the EA will incorporate the results of past studies, field reconnaissance, additional baseline studies, and information from the data sources outlined in **Appendix B**, as applicable.

7.2.1 Natural Environment

The natural environment, as defined for the EA, includes the atmospheric environment, geology and hydrogeology, the surface water environment, and the ecological environment.

7.2.1.1 Atmospheric Environment

The atmospheric environment includes air quality, odour, noise, and litter.

Air Quality

The area surrounding the TCEC comprises mostly agricultural lands as well as portions of Hwy 402, Nauvoo Road, and Confederation Line, and the village of Watford including a number of small businesses. Sources of air emissions include on-site operations and activities from the surrounding agricultural operations, as well as traffic on local roads.

On-site sources of dust at TCEC include vehicle traffic on paved and unpaved roadways, material handling of soil, wind erosion of exposed areas, construction activities, and combustion. Off-site sources of dust include agricultural activities and traffic on local roads. WM has implemented a dust management plan at the TCEC.

Since 2009, total suspended particulate (TSP) sampling has been completed at three MECP-approved locations around the landfill footprint. Between 2009 and 2020, only about 4% of samples exceeded the TSP Ambient Air Quality Criterion of 120 µg/m^3. Although some of these measured exceedances were found to be the result of off-site sources, the majority of these exceedance events were attributable in whole or in part to the landfill operations. Measured metal concentrations were consistently below the applicable criteria.

Only one dust complaint was received at the landfill between 2009 and 2020. This complaint was received in 2015 and was related to dirt tracked out on the road, rather than airborne dust.

Landfill gas is generated by the decomposition of waste within the landfill. This landfill gas consists mainly of methane and carbon dioxide; however, it also contains trace amounts of volatile organic compounds (VOCs) and reduced sulphur compounds (RS). The majority of the landfill gas generated by the existing TCEC is collected by the landfill gas collection system and sent for destruction or for utilization; however, a portion of the landfill gas is released through the landfill surface as fugitive emissions.

Combustion by-product impacts may result from on-site combustion equipment such as landfill gas flares and diesel-fired generators as well as tailpipe emissions from on-site traffic and mobile equipment. Common contaminants include combustion by-products such as nitrogen oxides (NO_X), carbon monoxide (CO), sulphur dioxide (SO_2), certain VOCs, benzo(a)pyrene, and dioxins and furans.

VOC sampling has been completed through the summer months (July, August, and September) since 2009. In general, the VOC concentrations measured since the onset of the monitoring program have been generally quite low. All concentrations measured have consistently been less than their respective air quality standards.

No ambient monitoring of combustion by-product contaminants resulting from traffic has been conducted in the vicinity of TCEC. The background concentration is expected to be similar to other locations throughout Southwestern Ontario. Overall, the landfill traffic represents a small proportion of the traffic along the external haul route.

No landfill gas-related complaints, other than those that may have been denoted as odour issues by the complainant, have been received at the landfill between 2009 and 2020. Similarly, no complaints related to combustion by-products have been received at the landfill between 2009 and 2020.

Odour

On-site sources of odour at TCEC include fugitive emissions from the landfill mound (final cover areas, interim cover areas, and working face), waste soil piles, and leachate collection and treatment systems. Off-site sources of odour in the area are predominantly agricultural. WM has implemented an odour management plan at the TCEC.

Ambient monitoring for odour is not completed at the facility; ambient monitoring of odour as a mixture of compounds is not possible. In 2019, odour surveys were completed in the community, around the landfill, and in response to odour events. Odour-related complaints received during the 2019 operating period were reviewed to identify any trends and to identify corrective actions. Overall, no trends were identified as a result of the surveys. Of the odours that were identified as being related to site operations, it was determined that the majority were related to a reduction in the efficiency of the landfill gas (LFG) collection system. The lower collection efficiency was related to uneven settling of waste that resulted in pinched collection lines, which were subsequently repaired within Cell 1 and Cell 2 between the third quarter of 2019 and the first quarter of 2020.

A total of 105 odour complaints were received at the landfill between 2009 and 2020. The greatest number of complaints were received in 2019 (51). During 2020 there was a reduction in odour complaints (30) compared to 2019. This reduction may be attributed to the previously-noted repair of the LFG collection system. Prior to 2019, odour complaints were generally low.

When a complaint is received, WM follows the documented complaint procedure, which includes notification to the MECP and stakeholders, logging and investigating the complaint, and implementing corrective action or mitigation to resolve the issue. WM has been working to obtain and enhance the review and documentation related to the odour complaints and follow-up activities.

Noise

The acoustic environment in the area of the TCEC is influenced by nearby businesses and agricultural operations, Highway 402, which runs roughly parallel to Zion Line and is located approximately 1.4 km from Zion Line to the north, and a major rail line that runs through the Village of Watford roughly parallel to Confederation Line and located approximately 1.1 km south of Confederation Line.

The TCEC operates from 07:00 to 17:00 during the week and from 08:00 to 11:00 on Saturdays. Normal operation includes typical landfilling and construction activity along with the gas flare system running. On-site equipment for landfilling includes bulldozers, haul trucks, excavators, compactors, compressors, and portable generators. The gas management system includes a flare site with a continuously operating flare and a fixed-in-place generator.

The TCEC has a Noise Monitoring Program that includes quarterly on-site monitoring, completed at four MECP-approved locations around the landfill, off-site confirmation at transition to subsequent landfill phase, and a complaints evaluation process. The on-site part of the program involves regular sound level measurements at the TCEC perimeter as a proxy for compliance at surrounding receptors, with reporting on a quarterly and annual basis. The use of a proxy has value when there are no other sources of noise in the area; however, this is not currently the case. The development of the industrial park to the southwest of the landfill has introduced a number of sources closer to the two southern perimeter monitoring receptors than certain stages of landfilling. Recreational activities in the area, specifically the trail adjacent to these two perimeter receptors, include walking, running, dog-walking, and snowmobiling. Sounds of nature are also prevalent due to the wooded area in which one of the perimeter receptors is located. The industrial park, recreational activities, and sounds of nature all cause exceedances at the monitors that are not related to landfilling – this is demonstrated by the prevalence of exceedance-level sound even during periods when the TCEC is closed. TCEC landfill operations are in compliance with landfilling sound level limits at all points of reception.

The TCEC documents complaints on-site. There have not been any noise complaints since 2012. An absence of noise complaints during construction and landfilling may be indicative of limited impact from noise levels in the study area.

Litter

Litter is considered a potential nuisance, which may be transported off-site during events with above average wind speeds. In 2005, a review of the wind conditions in the area was conducted, which concluded that the potential for light blowing litter events occurred less than 13% of the time and the potential for moderate and heavy blowing litter events combined is less than 2% of the time. Therefore, light blowing litter events will have the potential to occur on an occasional basis, and moderate and heavy blowing litter events will be very infrequent. The potential for off-site litter impacts are mitigated through the use of portable and permanent litter fencing – permanent litter fencing has been installed and portable litter fencing is in use at the working face.

Only eight litter complaints were received at the landfill between 2009 and 2020.

7.2.1.2 Geology and Hydrogeology

Geology and hydrogeology includes geology, hydrogeology, and groundwater quality and quantity.

Geology

The regional geologic stratigraphy consists of about 10 m to 45 m of dominantly clayey silt to silty clay soil overlying bedrock. This overburden is generally thinner within the western

portion of the area, near Bear Creek, and thicker in the east. The shallow soil varies within the regional area. The Seaforth Moraine extends across most of the regional area and is typified by shallow clayey silt textured till (Southern Till). Localized deposits of surficial sand and gravel, as well as modern alluvial aim occur over the till. Where sufficient surficial sand and gravel resources occur, sand and gravel pits have been developed.

Lacustrine deep-water deposits of sand, silt, and clay occur within the western portion of the regional area. Thin discontinuous deposits of clay, silt, and sand (interstadial deposits) occur between the Southern Till and the underlying Rannoch Till, which is a silt till, with discontinuous occurrences of silt and sand lenses. A discontinuous sand to gravel deposit underlies the Rannoch Till and overlies the shale bedrock of the Kettle Point Formation and the alternating grey shale and argillaceous limestone of the Widder Formation. The bedrock topography ranges between about 195 masl and 220 masl, with a general slope toward the southeast and the southwest.

The stratigraphy below and around the TCEC includes the clayey silt to silty clay till (Southern Till) and lacustrine deep-water deposits to depths of up to 12.5 m. The upper 2 m to 5 m is brown and weathered with soil fractures, and grades into the underlying soil, which is grey and unweathered with infrequent soil fractures. Shallow alluvial deposits also occur near Brown Creek. The stratigraphy below the TCEC is subdivided into the following main units:

- Southern Till, 1.6 m to 12.5 m thick;
- interstadial deposits, 4.0 m to 10.7 m thick;
- the Rannoch Till, approximately 21.4 m thick; and
- bedrock and the overlying basal sand.

The economic geology within the region relates to aggregate resources (i.e., sand and gravel), as well as oil and gas resources. Most sand and gravel pits were developed within localized features that were mined out and closed. Active licences exist for sand and gravel pit operations northeast of Wisbeach and north of the TCEC.

There are a number of oil well licences in the regional area that tend to show three groupings around the Village of Watford. One grouping is to the southwest, one to the southeast, and one to the northeast. Scattered oil wells also occur throughout the regional area, although none are documented within the TCEC or vicinity. Most of the oil wells are developed within the reef structures of the Guelph Formation, which is separated from the regional aquifer by low permeability formations. The upper fractured portion of the bedrock and the overlying basal sand form the local bedrock aquifer.

Hydrogeology

The regional groundwater aquifer occurs at the interface of the discontinuous sand and gravel deposits at the base of the Rannoch Till and within the underlying weathered and fractured portion of the bedrock, which as introduced below is termed the interface aquifer. Groundwater flow for the interface aquifer is toward the west, although historic domestic use of the interface aquifer likely influenced the direction of groundwater movement, especially in the vicinity of Watford to the southwest.

Groundwater movement at the TCEC and vicinity is generally controlled by the low permeability lacustrine deep-water deposits, Southern Till, and Rannoch Till, which represent aquitards within the regional area.

Within overburden, the groundwater flow velocities are slow and typically in a downward direction. Lateral shallow groundwater movement occurs within the upper weathered and fractured portion of the Southern Till, as well as within the surficial sand, gravel, and alluvial deposits. The local drains, ditches, and creeks influence the direction of this shallow groundwater movement within the Southern Till, and to a lesser extent within the interstadial deposits, depth dependent. Groundwater movement within the discontinuous interstadial sand is controlled by the surrounding low permeability soil.

The TCEC is not within a Wellhead Protection Zone or an Intake Protection Zone (1 through 3). The southwestern portion of the TCEC is within a low significance groundwater recharge area, approximating the Brown Creek surface watershed area (a Tier 1 Low Groundwater Sub-watershed); however, the landfill optimization project is not within the Brown Creek watershed. Overall, the TCEC is developed in a hydrogeologic setting that is a low significance groundwater resource.

To define the local groundwater setting below the TCEC, the stratigraphic sequence described above can be associated with hydrostratigraphic units, as follows:

- Active Aquitard: Southern Till (Brown Zone) at a depth of 0 to 1.6 m below ground;
- Upper Aquitard: Southern Till (Grey Zone) and Interstadial Deposits (Clay and Silt) at a depth of 1.6 to 7.9 m below ground;
- Interstadial Silt & Sand: Interstadial Deposits (Silt and Sand) at a depth of 4.0 to 10.7 m below ground;
- Lower Aquitard: Rannoch Till at a depth of 4.5 to 12.5 m below ground; and
- Interface Aquifer: Fractured Bedrock and Basal Sand at 22.8 to 29.3 m below ground.

The Active Aquitard represents the best shallow flow system for evaluating potential landfill leachate effects, such as lateral migration. The hydrostratigraphic units assessed for potential landfill leachate effects on groundwater quality are:

1. Active Aquitard;
2. Interstadial Silt and Sand; and
3. Interface Aquifer.

The groundwater within each of the aforementioned hydrostratigraphic units has shown acceptable quality at the TCEC since monitoring began.

Groundwater Quality and Quantity

Groundwater was historically used for domestic and agricultural purposes. Water was obtained from water supply wells typically developed within the interface aquifer. Shallower water supply wells are also developed within the interstadial sand and within the surficial sand and gravel deposits. A piped municipal water supply is provided by Lambton Area Water Supply System, which sources its water from a surface water source – Lake Huron. This same system services the Town of Watford and is available along

many of the rural roads in the vicinity of the Site. The increasing reliance on the municipal water supply has resulted in a reduction in the use of the groundwater resources.

Groundwater is mineralized owing to the slow movement through the aquitards. Chemical characteristics within the overburden elute to a hard and bicarbonate groundwater quality. Within the interface aquifer, the water quality is also bicarbonate with sodium as the dominant cation; however, the groundwater chemical characteristics naturally vary within the interface aquifer with the occurrence of natural gas and hydrocarbons at some locations.

There has not been any detected, or reported, impact on groundwater resources in the area as a result of the landfill. On-going groundwater quality monitoring at the Site has confirmed this since monitoring began. Groundwater is monitored semi-annually in the spring and fall as per the Environmental Monitoring Plan. Groundwater compliance is assessed based on criteria calculated with respect to the MECP's Guideline B-7 Reasonable Use Concept and evaluated at the Site boundaries. The groundwater within each hydrostratigraphic unit has shown acceptable quality since monitoring began.

7.2.1.3 Surface Water Environment

The surface water environment includes surface water quantity and quality.

Surface Water Quantity

The surficial drainage within the Brown Creek and Bear Creek watersheds has been enhanced with ditches and drains, which direct surface water toward Brown Creek and Bear Creek. Both creeks flow in a southerly direction toward the Sydenham River.

To the east of the site is an artificial open drain identified as the Kersey Drain. This drain forms the eastern boundary of the southern portion of the Site and flows in a southward direction where it connects with Brown Creek at County Road 39. Within historic documentation for the Existing Landfill, the Kersey Drain was identified as Brown Creek. Bear Creek, which is located about 8.7 km west of the site, has its natural headwaters north of the site's vicinity. Kersey Drain captures the eastern portion of the study area which includes a greenhouse property located east from the TCEC and beside the Existing Landfill footprint. Kersey Drain, near the site, receives flow from several tributaries draining agricultural lands on the east side of the property. Near Confederation Line, Kersey Drain merges into Brown Creek which runs easterly of Watford.

To the west of the TCEC the Gilliland-Geerts Drain, with several of its branches receiving runoff from the site, forms a tributary to Bear Creek. The Gilliland-Geerts Drain receives its headwater runoff from various portions of the Site.

Ditches and drains within the site and vicinity are typically intermittent. Surface water flow occurs during periods of snowmelt and after intense or prolonged periods of precipitation. Historic information indicates that Brown Creek and Bear Creek are perennial watercourses, although during prolonged dry periods the portions of Kersey Drain (Brown Creek) are dry, while the head portions of Gilliland-Geerts Drain are ephemeral in nature and only show flow after periods of snowmelt, prolonged and/or intense precipitation events.

Surface water runoff from the TCEC flows toward the Kersey Drain (Brown Creek) to the east and toward drains and ditches associated with Bear Creek to the west. Surface water flow on TCEC is entirely ephemeral by nature, with flow that typically occurs after snowmelt or prolonged and/or intense periods of precipitation. Runoff originating from waste disposal areas drains as sheet flow into the landfill perimeter ditching and is conveyed into one of four ponds through a strategically located network of manmade channels and culverts. Sedimentation Ponds 1 through 4 are four (4) on-site Sedimentation Ponds, fully constructed in 2009, to manage surface water for the TCEC. These ponds control flows such that they do not exceed pre-development conditions.

Sedimentation Pond 1 discharges water through twin culverts to an open drainage ditch on-site, which flows westward until it enters a municipal drainage tile at a catch basin situated 60 m east of the western site boundary. The municipal drainage tile subsequently drains into one of the headwater branches of the Gilliland-Geerts Drain on the east site Lambton County Road 79 (Nauvoo Road).

Sedimentation Pond 2 receives most of the stormwater runoff for the site and discharges through twin culverts and then to an open drainage ditch that flows to the western site boundary and into one of the headwater branches of the Gilliland-Geerts Drain on the east side of Lambton County Road 79 (Nauvoo Road).

Sedimentation Pond 3 receives stormwater runoff from the northwestern portion of the site, and discharges through one of three culverts that flow to the eastern roadside ditch of Nauvoo Road, which in-turn directs the runoff to two additional headwater branches of the Gilliland-Geerts Drain.

Sedimentation Pond 4 discharges stormwater through a culvert then into an open drainage ditch that flows westward until it enters a series of culverts that direct water under a screening berm and then under Zion Line to flow into one of the headwater branches of the Gilliland-Geerts Drain.

Surface Water Quality

Surface water flow patterns in the regional area are typically from northeast to southwest towards Lake St. Clair, which connects Lake Erie and Lake Huron at the Michigan-Ontario border. There were numerous low-grade historically produced wetlands in this area that were drained at the turn of the century to enhance agricultural practices.

The majority of the streams within Lambton County are impacted from land use practices such as, but not limited to, soil erosion effects. This, in combination with the loss of natural vegetation to buffer these watercourses, has led to generally unnaturally poor water quality that experience both nutrient enhancement and turbid water clarity.

Trace metals including aluminum (Al), iron (Fe), and zinc (Zn), are naturally bound to the suspended solids (dominantly clays and silts) entering the water courses. The trace metals are naturally present within the clayey soil minerology. Nutrients including phosphorus and nitrogen typically abound in waters receiving inputs from manure fertilizer effects to runoff quality, as well as suspended solids from erosion. Consequently, minerally and nutrient enriched waters are part of the environmental baseline of the area and any landfill influences are interpreted against these reference conditions. Runoff and groundwater inputs to surface drainage are minimal in the vicinity of the TCEC, leaving water quality in

the water courses stagnant. Interpretation of water quality results must factor in the intermittent and agricultural influenced nature of these waterways.

The TCEC is part of the Sydenham River drainage system whose headwaters are found within the Bear, Black, and Brown Creeks. Bear Creek flows southwesterly from north of the TCEC, for approximately 11 km to form the North Sydenham River at the confluence of Bear and Black Creek. The landfill area is drained by the more southerly headwaters of Bear Creek, from within the TCEC to County Road 79 (Nauvoo Rd.), which runs adjacent to the western limit of the TCEC.

Downstream of the TCEC, the channel size and definition of Bear Creek increases. Numerous small tributaries enter the creek along its 11 km path to the Sydenham River. The land use downstream consists mainly of agricultural lands used for crop harvesting and livestock.

Bear Creek, from upstream of and to approximately 3.5 km downstream of County Road 79, is ephemeral in nature, with visible flow only during the spring freshet and following intense storms. There are localized areas within the approximate 3.5 km downstream of Bear Creek that hold water as a result of unnatural dams or ponds being developed within the water course for what appears to be agricultural purposes.

Brown Creek's headwaters originate northeast of the TCEC. Brown Creek runs in a southerly direction along the eastern border of the southern half of the TCEC. Brown Creek runs for a distance of 37.5 km before joining the Sydenham River. Large portions of the first and second order tributaries connected to the creek appear to be channelized, which is attributable to drainage alterations from historical agricultural practices. The section of Brown Creek paralleling the eastern portion of the TCEC typically experiences continuous flow conditions.

The surface water is naturally turbid as a result of soil erosion, overland flow, and agricultural drainage from the surrounding land. Metal and nutrient concentrations within the surface water are naturally elevated as a result of the sediment load within the surface water. After intense or prolonged precipitation events the water turbidity as well as metal and nutrient concentrations generally increases. As a result, the quality of the surface water that flows off-site is generally similar to that of surface water observed from other areas in the vicinity of the TCEC.

Since the development of the expansion landfill, beginning in 2008, overall site improvements to protect the surface water were implemented to further protect downstream watercourses from runoff from the TCEC. These improvements include an extensive watercourse drainage network consisting of grasses, drainage ditches with rock-check dams, numerous straw bale check dams, drainage berms, as wells as four (4) stormwater management ponds. Additionally, temporary water storage areas are developed as part of landfill cell expansion/construction needs. During the drier months, in addition to water utilized from within temporary storage areas, WM is able to use the stormwater from the stormwater management ponds in compliance with the TCEC's Permit to Take Water (PTTW) to reduce the amount of stormwater discharge through on-site road watering activities for dust control. These activities would not alter the ephemeral nature of the receiving watercourses as they normally have a dry ditch base or areas with stagnant water during drier months. It is also noted that the TCEC's stormwater drainage network is similarly unnatural to much of the surrounding area.

Surface water runoff from the TCEC flows toward: 1) Kersey Drain (Brown Creek) to the east; and 2) to drains and ditches associated with Bear Creek to the west. Monitoring stations are situated at 10 locations surrounding the site.

The surface water monitoring program adheres to the relevant Waste ECA, the Sewage ECA, as well as conditions stipulated by the MECP. Surface water sampling is initiated and is dependent on precipitation events, with sampling completed quarterly when there is flowing conditions after a precipitation event. There are two (2) types of surface water monitoring stations at the TCEC. The first type of station consists of an open drainage ditch where surface water flowing conditions are precipitation duration/intensity dependent (ephemeral). The second type of station consists of Sedimentation Ponds, which typically have water available for sampling except during the late spring to early fall where water may not be available. An exceedance of a trigger concentration at one of the surface water monitoring compliance points would initiate verification monitoring.

Surface water quality monitoring has been completed at the TCEC since 2003. Since that time, monitoring has shown periodic site influences such as soil erosion effects on surface water quality; however, effects from landfill leachate have not been observed in the discharge from the site. The MECP-approved monitoring program of chemical and biological monitoring has shown that acceptable surface water quality has been discharging from the site since monitoring began.

7.2.1.4 Ecological Environment

The ecological environment includes both terrestrial and aquatic ecosystems.

Natural features are present within the On-site Study Area, and include woodlands identified by the County of Lambton Official Plan (2020) and Township of Warwick Official Plan (2010), and wetland and watercourse features regulated by the St. Clair River Conservation Authority (SCRCA).

The TCEC is located within two subwatersheds: the western portion of the on-site study area falls within a headwater area for Bear Creek, flowing west; and the eastern portion of the on-site study area forms part of a drainage catchment of Brown Creek, flowing to the south. Two watercourses, Brown Creek and a tributary to Bear Creek, are present along the southeastern property boundary and the extreme western portion of the on-site study area, respectively.

The study area falls within Ecoregion 7E. Much of the off-site study area comprises agricultural lands (row crops, dominated by corn and soy), with scattered residential houses. A portion of the Village of Watford is located in the southwestern portion of the off-site study area. The greatest area of natural cover is found in the central portion of the on-site and off-site study areas, comprised of a series of scattered deciduous woodlands.

The majority of the species documented within the on-site and off-site study areas are species that are common in southern Ontario and found in a mixture of agricultural landscapes interspersed with scattered deciduous woodlots, representative of the area.

Background review of the study area has identified Brown Creek and a tributary to Bear Creek, as well as some additional aquatic features that may be protected and/or have regulations associated with them as occurring within the on-site and off-site study areas.

The tributary to Bear Creek provides intermittent aquatic habitat that occurs during times of the year when water is flowing in response to the spring freshet (melting snow) and precipitation events. Brown Creek is a permanent feature that provides continuous aquatic habitat conditions throughout the year; however, water flow is strongly correlated to precipitation events. Species captured during past surveying include coolwater and warmwater species, which could indicate potential groundwater input to the aquatic features within the study area; however, previous studies did not identify areas of groundwater discharge or groundwater indicators (e.g., watercress or iron staining).

There are no Provincially or Locally Significant Wetlands identified within the study areas, as per Schedule 'A' to the Township of Warwick Official Plan (2010) and the Natural Heritage Information Centre (NHIC; MNRF 2021). A series of small unevaluated wetland units are located within the on-site study area, in proximity to the watercourses present. The tributary to Bear Creek and Brown Creek provides fish habitat, although the Bear Creek tributary may only provide seasonal habitat since background information indicates that it exhibits ephemeral/intermittent characteristics. A series of woodlands within the On-site and Off-site Study Areas are identified as significant under Lambton County's Official Plan (2020).

Based on a review of background material and air photos, a preliminary Significant Wildlife Habitat (SWH) screening was undertaken to identify what SWH may be present within the study area. A total of 15 candidate habitat types are potentially present within the on-site and off-site study areas. A review of existing reports, online resources, and wildlife atlases was undertaken to identify species that are reported from the study area. A total of 17 Species at Risk (SAR) and Species of Conservation Concern (SCC) have suitable habitat within the study area. Field work to be completed will confirm which species are present within the study area and may identify additional species. There are no provincially significant Areas of Natural and Scientific Interest within the study area.

7.2.2 Socio-Economic Environment

The socio-economic environment comprises the economic and social environments.

7.2.2.1 Economic Environment

The Township of Warwick (the Township) is a rural township located in the County of Lambton, midway between London and Sarnia on Hwy 402. The village of Watford is the main population centre of the Township, located south of Hwy 402 at the intersection of Nauvoo Road and Confederation Line. Based on the 2016 Census, approximately 34% of the Township's labour force (i.e., employable population) resides in Watford.

The top five employment sectors in the Township are: agriculture, forestry, fishing, and hunting; health care and social assistance; construction; retail trade; and manufacturing. The unemployment rate is low at 4.1% (2016), with the majority of individuals occupied in trades, transport and equipment operations, management, sales and service, business, finance, and administration.

The TCEC is not a significant source of employment in the off-site study area due to the scale of its operations and the proximity of the Township to the major urban centres of Strathroy, Sarnia, and London (approximately 20, 25, and 35 mins away, respectively). Based on 2016 Census results, approximately 66% of employed individuals within the

Township commute outside of the Township for work. The TCEC provides stable employment for 25 staff, the majority of which are operators.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. WM strives to be a good neighbour and a responsible partner in the community. Day-to-day operations, from the wages and benefits provided to the income taxes paid, boost economic growth in the community. The TCEC supports local businesses through the purchase of materials and services, and provides annual host community fees to the Township. Since 2009, when the TCEC expansion landfill began receiving waste, WM has contributed over $24 million in host community fees and municipal property taxes to the Township. These host community contributions are a key component of the Township's annual municipal budget and are placed into general funds to keep taxes low and provide for community projects. Over the past 10 years, WM has provided additional support for community projects such as walking trails, soccer fields, arena upgrades, dog park, yard waste and recycling depots, and local festivals and events.

7.2.2.2 Social Environment

The social environment includes the local community and visual aesthetics.

Local Community

The TCEC is located south of Hwy 402 in a predominantly rural area with few neighbours with the exception of the village of Watford, which is located approximately 1.5 km southwest of the expansion landfill area (this is the area of the site where the landfill optimization project is anticipated to occur). The area surrounding the landfill and Watford is predominantly used for agricultural activities. The two main roads in the area are Nauvoo Road, which runs north-south along the west side of the TCEC and is used as the primary haul route to the TCEC from Hwy 402, and Confederation Line, which runs east-west along the south end of the TCEC. The village of Watford is located at the intersection of Nauvoo Road and south of Confederation Line.

Watford has a population of approximately 1,536 (2016) and has experienced minimal population growth over the past 5 years (an increase of 3% since 2011). The Township of Warwick is home to approximately 3,692 residents (2016) and has experienced a minor decrease during the same time period (0.7%). Approximately 640 individual residences are located within Watford, and it is estimated that approximately 40 residences are located outside of Watford within the off-site study area. The Township's most recently approved Official Plan (2010) identifies future residential lands to the west and southeast of Watford, which may allow for future residential development and population growth.

Local businesses in the off-site study area are primarily in the industries of manufacturing, retail trade, and construction, and are predominantly located along Nauvoo Road, Confederation Line, or on the edges of the residential developments in Watford. The Township owns the Warwick Industrial Park, a fully serviced 16 ha site (with potential to expand to 64 ha) on Nauvoo Road, 3 km south of Hwy 402, that borders the TCEC to the southwest. The Township is actively working with the Sarnia-Lambton Economic Partnership to promote the industrial park and bring business to the area. The Official Plan identifies additional commercial lands at the corner of Nauvoo Road and Hwy 402,

along the west side of Nauvoo Road north of Confederation Line, and along Confederation Line at the east end of Watford.

Several recreational facilities are located in Watford including the Watford Community Arena (which includes ice surface, community hall, and meeting rooms) and Centennial Park (which houses softball diamonds with lights, playground equipment, splashpad, basketball nets, ball hockey court, outdoor pavilion, BMX Park, tennis courts, running track, and horseshoe pits). Watford Arena and Centennial Park are located south of Confederation Line, approximately 1.5 km from the expansion landfill area at the TCEC. In late 2020, Warwick Township Council approved a $10M expansion and renovation of the Watford Arena to include a fitness area, large multipurpose gym, kitchen, additional parking, and improved accessibility. Three other small greenspace parks are located in Watford: Memorial Park; Sunken Gardens; and Bluebird Parkette.

Watford has two elementary schools: East Lambton Elementary and St. Peter Canisius Catholic School, both located approximately 2 km south of the expansion landfill area at the TCEC. The closest secondary schools are located in Forest, Petrolia, and Strathroy. Four churches are located in Watford, the closest of which is located approximately 1.8 km south of the expansion landfill area at the TCEC. Three retirement homes are located in Watford, the closest of which is located on Confederation Line west of Nauvoo Road, approximately 1.6 km from the expansion landfill area at the TCEC.

Visual Aesthetics

The TCEC active landfilling area is located approximately 1.5 km northeast of the Village of Watford in the Township of Warwick. The facility is situated southeast of the intersection of Zion Line and Nauvoo Road and the main entrance to the facility is located approximately 300 m south of Zion Line on the east side of Nauvoo Road. The north and east perimeters of the site comprise high berms with established coniferous and deciduous trees that perform an effective visual screening function. The recently constructed Twin Creeks Greenhouses complex is effective in screening views from the receptors that are located northeast of the TCEC. The west side of the TCEC is screened from view by the existing woodlots that are located west of TCEC. To the south of the TCEC, a soil stockpile functions as an effective visual barrier for the receptors that are located along Confederation Line.

The TCEC site entrance is located approximately 1.6 km south of Highway 402. The site is visible from just south of the intersection of Hwy 402 and Nauvoo Road. Existing buildings do not afford a direct view of the TCEC from the Watford village centre. Land uses to the east of the site are primarily agricultural. Several residences and businesses are located along Confederation Line, to the south of the TCEC. Since the time that the TCEC was constructed, several new buildings/developments have been erected, including the Twin Creeks Greenhouses complex. These facilities function as visual screening elements. Significant public amenities in the vicinity of the TCEC include the Watford Arena, the Watford cemetery, Centennial Park and Confederation Park, which was constructed as a component of the development of the TCEC. Confederation Park includes a dogs-off-leash park and a trailhead.

The lands that are owned by WM include the TCEC, adjacent agricultural lands and a significant woodland. The existing visual/landscape conditions are described as follows:

- The existing TCEC is framed on its west and north sides by 7 m high berms that are vegetated with coniferous and deciduous trees, which effectively screen the landfill operation from Zion Line and Nauvoo Road, respectively. These vegetated berms are visually dominant within the local landscape but are aesthetically pleasing.
- From the southern view, the soil stockpile and the existing woodland are the dominant landscape features.
- The recently constructed Twin Creeks Greenhouses facility comprises a 16 ha campus of large buildings that dominate the landscape on the northeastern side of the TCEC.
- The property beyond the limit of the TCEC has relatively flat topography that supports agricultural uses, including croplands and poultry farms.

Nauvoo Road accommodates most of the traffic into the TCEC. Nauvoo Road has a rural cross-section with paved shoulders and ditches on both sides from Highway 402 to the site entrance. The road has gravel shoulders north of Highway 402 and south of the site entrance. Approaching the TCEC from the north, the existing vegetated berm is the dominant visual element. The entrance driveway represents a perforation in the continuous perimeter berm. However, view corridor that is afforded by the entrance driveway does not expose the landfill. The main entrance to the TCEC that was formerly located on the south side of Zion Line has been closed and Zion Line is no longer a major haul route.

7.2.3 Cultural Environment

The cultural environment comprises archaeological and cultural heritage resources.

7.2.3.1 Archaeological Resources

The archaeological potential of the entire TCEC was assessed as part of previous archaeological assessments. Between 1999 and 2008, 12 archaeological sites were identified within the TCEC, including one in the south half of the TCEC, which was protected within a tree plantation in association with the St. Clair Conservation Authority following a Stage 3 archaeological assessment in conjunction with Walpole Island First Nation. No further archaeological assessment is required at the one remaining identified archaeological site as long as the site continues to be protected and avoided. The remaining 11 sites in the north half of the TCEC no longer have cultural heritage value or interest and are cleared of archaeological concern.

One historic cemetery is located directly adjacent to the TCEC. This feature was not addressed in previous archaeological assessments. Due to the current expectations from the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI), further research and an archaeological assessment report is required, including review of any burial plot maps and cemetery property plans, in order to determine whether there is archaeological potential for unmarked graves outside of the present property limits. Any impacts within approximately 10 m adjacent to a historic cemetery property may trigger Stage 3 Cemetery Investigation.

7.2.3.2 Cultural Heritage Resources

Based on the results of municipal and provincial consultation, background research and historical mapping review, two potential built heritage resources (BHRs) and 19 potential

cultural heritage landscapes (CHLs) were identified within 1 km of the TCEC. Only one CHL was identified within the TCEC – Lot 20-21, Concession 4, which are active agricultural lands suspected of being in continuous operation since the late nineteenth century. No known BHRs or CHLs that are listed by the Township of Warwick or designated under Part IV of the *Ontario Heritage Act* were identified.

7.2.4 Built Environment

The built environment includes transportation and land use.

7.2.4.1 Transportation

The TCEC site entrance is directly from Nauvoo Road, south of Zion Line. The primary haul route to and from the site extends from Highway 402 (inclusive of the interchange intersections) south along Nauvoo Road to the landfill site entrance. Waste is typically hauled to the site in waste transfer trailers with a smaller portion transported in small and medium trucks (i.e., front or rear compactors, roll off bins, etc.). Only minor amounts of waste arrive at the TCEC from the south.

Nauvoo Road (County Road 79) is under the jurisdiction of the County of Lambton and is a north-south rural road with a posted speed of 80 km/h. It has a two-lane rural cross-section with no sidewalk on either side. Nauvoo Road is free-flow within the study area at the Highway 402 interchange intersections, Zion Line, and Confederation Line. These intersections are under east-west stop control.

A previous Traffic Impact Study completed in March 2017 in support of the fill rate increase concluded that, under 2022 background conditions (i.e., without landfill generated traffic), the individual movements for intersections in the study area will operate with acceptable level of service and with reserve capacity (Level of Service (LOS) 'D' or better, and volume-to-capacity ratios of 0.50 or lower). The study further concluded that with the addition of landfill generated traffic under 2022 total traffic conditions, study intersections would continue to operate at these acceptable levels.

Two on-site weight scales (inbound and outbound) at the Twin Creeks Landfill are located approximately 330 m southeast of the site entrance/driveway. The roadway leading to the weight scales has two lanes in each direction, and has an available combined vehicle storage capacity of 660 m. All waste hauling trucks proceed across the weight scale before unloading. An on-site staging and queuing area is available on-site for vehicles waiting to access the landfill tipping area.

Road safety was assessed in 2017 along the length of the landfill haul route from the site entrance to Highway 402. This assessment considered the operation of the existing northbound acceleration lane from the site entrance to Zion Line, collision history along the haul route, and potential cyclist exposure to conflicts with landfill related traffic since Nauvoo Road is identified as a Linkage Trail Corridor (with on-road shared access) as part of the Lambton County Trails. The northbound acceleration lane was found to satisfy the design standards specified by the Ministry of Transportation. The acceleration lane was also found to operate satisfactorily and there is little opportunity for merge conflicts. Historical collision records along the length of the haul route indicated that the haul route is not a collision-prone location. The risk of collision with trucks or cyclists was considered to be minimal due to the low exposure and cyclist demands along the haul route.

7.2.4.2 Land Use

The on-site and off-site study areas are located within the County of Lambton, which utilizes a two-tier governance system for land-use planning. The County of Lambton Official Plan provides a general policy framework for land use, with the Township of Warwick Official Plan providing more detailed planning policies on a local level. These planning policies and objectives are implemented through the Township of Warwick Zoning By-law No. 121 of 2012, which provides exact direction on how land may be used within the municipality. The County of Lambton Official Plan ('County OP'), Township of Warwick Official Plan ('Local OP'), and the Township of Warwick Zoning By-law No. 121 of 2012 are the end products of the planning process under the *Planning Act.*

Off-Site Study Area

The existing land uses within the off-site study area are predominantly agricultural in nature, including but not limited to field crops, greenhouses, and livestock operations, with a small number of single-detached dwellings associated with agricultural operations. The entire settlement area of Watford is located within the southwest portion of the off-site study area, with a mix of low-density residential, indoor and outdoor recreation facilities, open space, commercial, institutional, and commercial industrial uses.

The lands within the off-site study area are predominantly designated as 'Agricultural Area' in the County OP, with the entire 'Urban Centre' of Watford located within the off-site study area to the southwest. 'Urban Centres' contain a wide variety of residential, institutional, commercial, and industrial land uses, with specific land use designations and policies for these areas provided in local official plans. A 'Hwy 402 Service Centre' designation exists south of Highway 402 and west of County Road 79, with the purpose to provide opportunities for strategically located highway service centres and tourist-oriented land uses adjacent to the Highway 402 corridor. There is also a 'Primary Corridor (Group 'C' Feature') within the southern portion of the off-site study area.

Similar to the County OP, the lands to the north, east, and west within the off-site study area are predominantly designated as 'Agriculture' in the Local OP, with a 'Highway Service Centre Commercial' designation to the north, as well as scattered 'Natural Heritage – Woodlot' lands and 'Natural Heritage – Hazard' lands adjacent to creeks and drains. The entire settlement area of Watford is located within the southwest portion of the off-site study area.

Agricultural uses, including the growing of crops, raising of livestock and other animals for food or fur, aquaculture, agro-forestry, and maple syrup production, are the primary permitted uses within the 'Agriculture' designation. New single-detached dwellings accessory to agriculture, existing single-detached non-farm dwellings, and new single-detached non-farm dwellings (subject to certain conditions) are also permitted within the 'Agriculture' designation. Development within 'Natural Heritage' designations is very limited, and generally restricted to agriculture and conservation.

Watford is considered a 'Rural Settlement Area' under the Local OP framework. All new development within Rural Settlement Areas is to be compatible with existing and future surrounding development. The development of non-compatible uses is discouraged, with incompatible uses separated by increased setbacks or buffering measures. Permitted

residential uses within Watford include single-detached dwellings, semi-detached and duplex dwellings, and multiple-unit dwellings.

As per the Township of Warwick Zoning By-law, the lands to the north, east, and west within the off-site study area are predominantly zoned 'Agriculture 1', with a 'Service Centre Commercial' zone to the northwest at the intersection of Highway 402 and County Road 79, as well as scattered 'Natural Heritage – Hazard' and 'Natural Heritage – Significant Woodlot' zoning associated with streams in the area. A property zoned 'Service Commercial 2-1' is located directly to the west of the on-site study area, across County Road 79. A wide range of commercial and industrial uses are permitted in this zone, including but not limited to light and general industrial uses, health clubs, motels, and places of entertainment. A former waste disposal site is located directly to the south of the on-site study area.

The lands north of Confederation Line fronting onto County Road 79 are zoned a mix of 'Industrial' and 'Mixed Commercial/Industrial'. The lands south of Confederation Line within Watford are primarily zoned 'Residential 1', with some properties zoned 'Residential 3' and '5', 'Institutional', 'Open Space 1' and '2', 'Mixed Commercial/ Industrial' with a holding provision, 'Central Commercial' and 'Highway Commercial', and 'Agricultural 2'.

On-Site Study Area

The TCEC is the predominant existing land use within the on-site study area, with 101.8 ha of the site currently licensed for landfilling. A poplar plantation is located to the south of the existing excess soil stockpile, and a mature grove of trees are located directly to the south of the previously-approved landfill expansion area. The southernmost portion of the on-site study area appears to be used for the growing of agricultural crops.

The on-site study area is designated as 'Agricultural Area' in the County OP. The southeastern corner of the on-site study area intersects with a 'Primary Corridor (Group 'C' Feature)' conceptually identified in the off-site study area. The primary permitted land uses in the 'Agricultural Area' designation are agricultural uses of all sizes, types, and intensities. 'Primary Corridor' features represent existing connections between natural heritage areas and tend to follow major watercourses. The County OP also indicates that private commercial waste management facilities (such as the existing landfill) "are to be located on lands designated and zoned for such purposes. An amendment to this Plan and the local official plan is required prior to the establishment of new waste management facilities or the expansion of existing facilities". The County OP policies do not differentiate between vertical and horizontal landfill expansions. Any expansion proposals must be consistent with the County OP and comply with the provisions of the *Environmental Protection Act* and relevant Provincial legislation. Before any *Planning Act* approvals for a proposed expansion are adopted or granted, approval from the Province must be obtained.

The on-site study area is predominantly designated as 'Landfill Site', with smaller areas designated as 'Natural Heritage – Hazard', 'Natural Heritage – Woodlot' and 'Agriculture', in the middle and southern portions of the property on Schedule 'A' of the Local OP. A 'Waste Management Policy Area' designation wraps around the entire TCEC, extending to County Road 39.

A special policy applies to the 'Landfill Site' lands in the on-site study area, which permits the disposal, depositing, and receipt of non-hazardous solid waste within the landfilling

area (also referred to as “the existing landfill” that is approved under the provisions of the *Environmental Protection Act*, including a Certificate of Approval for a Waste Disposal Site). Ancillary and accessory uses are also permitted within the ‘Landfill Site’, including but not limited to an administrative office building, weigh scales, storage buildings, forestry, accessory parking for the adjacent cemetery, an education and interpretative centre, and trails and walkways. Within the most southerly 500 m of the area designated ‘Landfill Site’, the only permitted use is the poplar forest used in conjunction with the approved leachate treatment facility. A limited range of agricultural uses are permitted within the designated ‘Agricultural’ area within the ‘Waste Management Policy Area’, notwithstanding the ‘Agricultural’ policies of the Local OP. Dwellings are not permitted in this area.

The on-site study area is zoned as ‘Industrial Waste Disposal’, with small portions of the property zoned ‘Natural Heritage – Significant Woodlot’ and ‘Natural Heritage – Hazard’, with the southernmost portion zoned ‘Agricultural 2-3’. A former waste disposal site is located within the boundary of the on-site study area.

Although the ‘Landfill Site’ comprises the entire area zoned ‘Industrial Waste Disposal’, the “landfilling area” is limited to the approved area. Waste disposal is only permitted in the “landfilling area”, or existing landfill.

Permitted uses in the ‘Natural Heritage – Significant Woodlot’ zone are limited to agricultural, passive recreation, and conservation uses (all exclusive of buildings and structures), as well as existing single-detached dwellings, new single-detached dwellings on existing lots with an area of 2 ha or less, and buildings, structures, and uses accessory to a single-detached dwelling on the same lot. The ‘Natural Heritage – Hazard’ zone primarily permits agricultural uses and passive recreation; however, no agricultural uses are permitted in a portion of this zone on the property. The ‘Agricultural 2-3’ zone permits the growing of crops, agro-forestry, conservation uses, commercial greenhouses, and accessory buildings and structures.

8 Environmental Assessment Method

The following sections provide an overview of the method that will be used to develop the EA for the proposed undertaking.

The proposed method to be followed in the EA will be a qualitative comparison of the ‘alternative methods’ using criteria, indicators and data sources to identify the preferred alternative.

An effects assessment will be carried out on the preferred alternative using the same criteria, indicators and data sources, and additional studies as required.

8.1 Description of the Existing Environment

The existing environment within the on-site and off-site study areas (**Section 7.1**) will be characterized in the EA Study Report. The characterization of the existing environment will address the five aspects of the environment as defined in the EAA, specifically:

- natural environment;
- built environment;

- cultural environment;
- social environment; and
- economic environment.

For the purposes of the EA, the social and economic environments have been combined into the socio-economic environment.

The characterization of the existing environment will incorporate the results of past studies, field reconnaissance, additional baseline studies, and information from the preliminary data sources outlined in **Appendix B**, as applicable.

The potential environmental effects of the alternative methods will be qualitatively compared against the existing environmental conditions.

8.2 Description and Screening of the Alternative Methods

As described in Section 6.2, potential vertical and horizontal expansion methods may be available within the TCEC site area. Given the financial, technological, and community risks and concerns associated with the horizontal alternative methods, WM has identified a preference for a vertical alternative method. Preliminary concepts for the potential vertical and horizontal expansion methods will be developed. A screening of the vertical and horizontal alternative methods will be carried out in the EA to confirm this conclusion.

Based on the preference for a vertical alternative method, WM has preliminarily identified four vertical expansion alternative methods for the future development of the landfill as described in **Section 6.2**. The alternative methods will be described in further detail in the EA Study Report. The description of the alternative methods will outline future leachate management requirements for the landfill. The long-term leachate management requirements will be described consistent with the approved Leachate Management Plan for the TCEC including a combination of on-site phytoremediation, trucking off-site to approved wastewater treatment plants and consideration of the future construction of an on-site treatment plant. The effects of climate change on the design approach and the effect of the conceptual design on climate change for the alternative methods will be included.

8.3 Prediction of Potential Environmental Effects for Each Alternative Method

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in **Appendix B**. The analysis of potential effects will be based on the maximum allowable waste receipt level for the landfill. Potential effects can be positive or negative, direct or indirect, and short or long-term. Actions necessary, or that may reasonably be expected to be necessary, to prevent or mitigate the potential effects will be identified, as appropriate.

8.4 Identification of the Preferred Alternative

The alternative methods will be assessed in a qualitative comparative process to determine the preferred alternative, using the criteria and indicators provided in **Appendix B**. These evaluation criteria and indicators will be finalized during the EA.

The differences in net effects (the potential effect remaining following implementation of mitigation and/or management measures) will be used to identify and compare the advantages and disadvantages for each alternative. The comparison of alternatives will include a clear rationale for the selection of the preferred alternative.

8.5 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same criteria, indicators and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. A human health assessment review will be completed for the preferred alternative based on the criteria and indicators provided in **Appendix B** and the work plan included in **Appendix C**. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative.

The EA will also include a description of the preferred alternative's contribution to reducing GHG emissions and climate change, and the potential effect of climate change on the preferred alternative.

9 Consultation and Engagement

An overview of the consultation and engagement process conducted during the preparation of the Draft ToR is presented below and detailed in **Supporting Document 4**. The proposed Consultation and Engagement Plan in support of developing the EA is presented in **Section 9.2** and the proposed plan for Indigenous engagement during the EA is presented in **Section 9.3**.

9.1 Summary of Consultation and Engagement Activities on the Draft ToR

WM consulted and engaged with a broad range of stakeholders including the public, agencies, and Indigenous communities during the preparation of this Draft ToR. The following consultation activities took place during preparation of the Draft ToR:

- Distribution of Notice of Commencement and Virtual Consultation and Engagement Event 1;
- Virtual Consultation and Engagement Event 1;
- Distribution of Notice of Review – Draft Terms of Reference and Virtual Consultation and Engagement Event 2;
- Virtual Consultation and Engagement Event 2;

- Draft Terms of Reference review;
- Project website, e-mail, and telephone number;
- Consultation with Agencies and organizations;
- Engagement with Indigenous communities and groups;
- Municipal Council meetings:
    - Township of Warwick Council and staff meetings on November 16, 2020, and March 1, April 6, May 4, June 10, July 6, August 10, and October 5, 2021;
- Warwick Public Liaison Committee (WPLC) meetings:
    - on November 26, 2020 after the publication of the Notice of Commencement; and
    - on February 18, May 6, and August 18, 2021;
- Facility tours and meetings;
- Phone calls; and
- Media publications regarding the Project.

A detailed chronology and description of the various consultation and engagement events and activities during the ToR development is included in **Supporting Document 4**.

Interested persons were identified at the outset of the project for the purpose of developing a contact or mailing list. A list of non-MECP government review agencies (GRT) was provided by the MECP and reviewed by WM to confirm the applicable agencies. The MECP also provided WM with a list of Indigenous communities with a potential interest in the project to be consulted. The Township of Warwick and County of Lambton provided a list of municipal contacts. WM utilized its own contact list developed through previous approval processes, notifications and with the Warwick Public Liaison Committee to identify members of the public, local residents and landowners and the broader community. Additions and changes to the mailing list were made based on requests received during the development of the ToR.

The Notice of Commencement for the ToR was developed, which included an overview of the Project, the EA process, and an invitation to Virtual Consultation and Engagement Event 1. The Notice of Commencement (the Notice, provided in **Supporting Document 4**) was published in three newspapers (one regional and two local): The Sarnia Observer on November 17 and 24, 2020; The Standard Lambton-Middlesex on November 19 and 26, 2020; and The Independent Serving Petrolia and Central Lambton on November 19 and 26, 2020.

The Notice was sent via email to agencies, municipalities, organizations, Indigenous communities, and neighbouring property owners on November 17, 2020. The Notice was also sent via regular mail to neighbouring property owners without available email addresses. A copy of the Notice was uploaded to the project website (www.wm.com/ca/en/twin-creeks-landfill/landfill-optimization-project) on November 17, 2020.

Virtual Consultation and Engagement Event 1 took place over 18 days from Tuesday, November 17 to Friday, December 4, 2020. Due to public gathering restrictions related to

the COVID-19 pandemic, the event was held online and a link to the event was provided on the project website. The virtual event was organized to allow attendees to click through and review the provided content at their own pace. Options to join the mailing list and submit comments were also provided as part of the event. Based on the data gathered during the event, Virtual Consultation and Engagement Event 1 was visited by 51 people in addition to WM and consulting staff. A detailed summary of Virtual Consultation and Engagement Event 1 was posted on the website and is provided in **Supporting Document 4**.

Virtual Consultation and Engagement Event 2 took place Tuesday, June 15 to July 13, 2021. Due to public gathering restrictions related to the COVID-19 pandemic, the event was held online and a link to the event was provided on the project website. The virtual event was organized to allow attendees to click through and review the provided content at their own pace. Options to join the mailing list and submit comments were also provided as part of the event. Based on the data gathered during the event, Virtual Consultation and Engagement Event 2 was visited by 16 people in addition to WM and consulting staff. A detailed summary of Virtual Consultation and Engagement Event 2 is provided in **Supporting Document 4**.

During the development of the Draft ToR, WM responded to comments received by telephone, email, and in writing. All comments received and responses provided by WM are included in **Supporting Document 4**. The company also met with anyone who requested including conducting tours of the TCEC.

A Draft ToR, supporting documents and Record of Consultation and Engagement were prepared and made available to the public, Indigenous communities, Township of Warwick, government review team, and all other stakeholders on the project mailing list for their review and comments. Review comments on the Draft ToR were requested between June 15 and July 13, 2021, which was extended to September 20, 2021. A PDF copy of the Notice of Draft Terms of Reference Review was provided to all project mailing list recipients on June 15, 2021. A copy of the Draft Terms of Reference and all supporting documentation was available to view and download from the project website and a link was provided in the Notice. The Notice, the Draft ToR, supporting documents and Record of Consultation and Engagement were all available from the project website on June 15, 2021. Hard copies of the documents were made available at the Township of Warwick municipal office and the Watford Library for public viewing. Copies of the materials are included in **Supporting Document 4**.

A range of comments were received on the draft ToR. Responses were prepared by WM for each comment, outlining how the comment was addressed in the ToR as appropriate. All comments received and responses provided by WM, including how the comments are addressed in the ToR, are included in Supporting Document 4. Due to the extent and details of the comments received, a summary of the comments received based on topic area or category is as follows:

- Current site operations
- Rationale for the undertaking including additional details on diversion
- Refinement of the “alternatives to” and “alternative methods” descriptions
- Detailed comments on the technical discipline Work Plans

- Off-site study area refinement for specific environmental components
- Inclusion of a human health assessment review for the preferred alternative

9.2 Proposed Consultation and Engagement Program for the EA

WM is committed to carrying out meaningful consultation and engagement on the future development with a broad range of stakeholders. The development of the proposed consultation and engagement program for the EA is based on the following principles:

- transparency, accountability, and accessibility;
- identification of stakeholder and Indigenous community concerns early in the process and addressing these concerns in the EA;
- multiple points of consultation and engagement throughout the EA using a variety of techniques (in-person, digital, print); and
- documentation of issues, concerns, and responses in the EA.

By consulting with interested people, WM will provide opportunities for input before decisions are made and then respond by making changes as appropriate. The input received through the EA consultation and engagement process will be considered in the preparation of the EA and studies, and how this input is incorporated into the EA will be documented.

Consultation and engagement will be undertaken at key points in the process, as well as on an on-going basis, through the following activities as conditions permit:

- **Notice of Commencement for the EA**: by mail, email, newspapers, and on the project website, including details on the project, the EA process and contact information, as a minimum.
- **Notification**: notification will be provided by direct mail, email, newspapers (digital and/or print), and via the project website at key milestones during the EA. Key milestones may include the Notice of Commencement of EA, Existing Conditions/Alternative Methods, Identification of the Preferred Alternative, Draft EA Study Report review, and submission of the Final EA Study Report to the MECP. WM will provide notification by direct mail to all addresses within the local postal code surrounding the TCEC (e.g., through Canada Post neighbourhood mail or similar).
- **Public Open House(s)**: likely in the form of Virtual Consultation and Engagement Event(s) due to the COVID-19 pandemic, to present the ‘alternative methods’, a description of the existing environmental conditions, the comparative evaluation criteria, the results of the assessment and comparative evaluation of the alternative methods, and the identification of the preferred alternative. The format of the Public Open House(s) will be determined based on social gathering restrictions due to the pandemic.
- **Meetings/Tours**: if possible, depending on social gathering restrictions due to the pandemic;

- **Consultation and Engagement Report**: summarizing the results of the open house(s) as well as comments received via fax, email, or post will be prepared, including a record of comments and responses.
- **Website**: established by WM during the development of the Draft ToR, the project website will be maintained during the EA to provide information, inform the public of consultation and engagement events, and provide a means for feedback.
- **Contact Person**: provided for a WM staff member to receive enquiries from interested parties for information and submit comments.
- **Draft EA Study Report**: provided to the public, agencies, and Indigenous communities who have submitted comments on the ToR and/or wish to receive a copy. Written comments on the draft report will be requested within 45 days of its submission to the MECP. Notice of the draft report availability will be provided by newspaper notice, mail, email, and on the project website.
- **Final EA Study Report**: provided to the public, agencies and Indigenous communities who have submitted comments on the Draft EA and/or wish to receive a copy. Notice of the final report availability will be provided by newspaper notice, mail, email, and on the project website.

Consultation and engagement will be conducted in accordance with MECP requirements, and with consideration given to the potential limitations caused by the COVID-19 pandemic. If requested, additional consultation and engagement activities may be undertaken. WM is prepared to discuss individual concerns and comments directly with potentially affected persons. Additional events may be held to address specific issues of concern, as warranted.

A Record of Consultation and Engagement will be prepared as part of the EA which will include information about the EA consultation program, including copies of correspondence from and to the Proponent, information about and received at the public open houses and copies of comments, questions, issues, and concerns from stakeholders and members of the public, and how those questions, issues, and concerns were addressed. Comments received during the preparation of the EA will be recorded and tabulated. A response will be provided to each comment indicating how it has been addressed in the EA, as appropriate.

In accordance with Section 6.1(2)(e) of the EAA, a description of the consultation and engagement program carried out by WM during the EA, along with the results of the consultation and engagement, will be documented in the EA Study Report.

9.3 Indigenous Engagement during the EA

The list of potentially-affected Indigenous communities was developed in consultation with the MECP. The MECP identified the following Indigenous communities for engagement:

- Aamjiwnaang First Nation;
- Walpole Island First Nation – Bkejwanong Territory;
- Caldwell First Nation;
- Chippewas of Kettle and Stony Point First Nation;

- Chippewas of the Thames First Nation;
- Delaware Nation at Moraviantown;
- Munsee Delaware Nation;
- Oneida Nation of the Thames;
- Métis Nation of Ontario – Windsor-Essex Métis Council; and
- Métis Nation of Ontario – Lands, Resources & Consultations Branch.

During the EA, WM will continue to engage with these Indigenous communities and organizations in a manner consistent with any requests that might be received from each community. WM is committed to working with these Indigenous communities and organizations to address any comments or concerns they may have. This includes providing any specific engagement activities, such as meetings, at the request of the community. Consultation and engagement will be conducted in accordance with MECP requirements, and with consideration given to the potential limitations caused by the COVID-19 pandemic. WM will provide written notification to the Indigenous communities and organizations consistent with the consultation and engagement program for the EA.

10 Commitments and Monitoring

The EA will contain a list of commitments made by WM during the ToR process and indicate how such commitments have been addressed in the EA. A list of commitments made by WM during the preparation of the EA will also be included in the EA along with a framework for monitoring when and how all commitments will be fulfilled.

A strategy and schedule for compliance and effects monitoring will be developed and included in the EA. The monitoring plan will consider all relevant project phases: planning, detailed design, tendering, construction, establishment, and post-establishment. Compliance monitoring is an assessment of whether an undertaking has been designed, constructed, implemented and/or operated in accordance with the commitments in the EA document and the conditions of approval. Effects monitoring consists of activities carried out by the proponent after the approval of the EA to determine the environmental effects of the undertaking. Monitoring requirements for effects related to the proposed undertaking are anticipated to be developed as a part of the *Environmental Protection Act* and *Ontario Water Resources Act* approval processes.

11 Flexibility to Accommodate New Circumstances

The proposed project detailed in this ToR is based upon a preliminary or conceptual design, and does not necessarily represent the final design, location, or scope of the project. The description of the project in this ToR should be viewed as a preliminary description, which is subject to change during the preparation of the EA based on the results of on-going studies and advancement of the project design, existing conditions studies and effects assessments, and consultation and engagement including input from

agencies and other regulatory authorities. Consequently, there may be changes to the feasible alternative methods for carrying out the project before the proposed undertaking is confirmed and presented in the EA Study Report.

Subsection 6.1(1) of the EAA states that the EA must be prepared in accordance with the approved ToR. WM is aware that unforeseen circumstances may arise that could prevent the commitments in the ToR from being met; as such, flexibility has been incorporated into this ToR, where appropriate, to accommodate new circumstances that may arise during the progression of the EA and/or project design. It is therefore understood that certain aspects of the ToR may be adjusted without the need to re-start the provincial EA process.

For the purposes of preparing this ToR, flexibility is defined to include a minor variation or modification to the ToR itself, such as a change in consultation and engagement methods, existing conditions study methods, effects assessment methods, and to allow for refinement to things such as study areas, environmental criteria, indicators, and data sources. Therefore, the ToR has not established detailed existing conditions or a full suite of potential effects of the undertaking, for example; these will be determined during the EA and presented in the EA Study Report.

It is noted that proposed minor modifications to the ToR will be discussed with the MECP prior to proceeding with the changes.

12 Other Approvals

In addition to EA approval, certain other approvals may be required, including but not limited to:

- *Environmental Protection Act*;
  - Environmental Compliance Approvals (Waste and Air);
- *Ontario Water Resources Act*;
  - Environmental Compliance Approval (Sewage Works);
- *Drainage Act*;
- *Fisheries Act*;
- *Conservation Authorities Act*; and
- *Planning Act*.

Official Plan and Zoning By-Law amendment approvals may also be required.

The proposed undertaking is not identified as a designated project under the *Impact Assessment Act* (*IAA*) and, based on correspondence received from the Impact Assessment Agency of Canada in November 2020, it has been confirmed that the future development will not be subject to review under *IAA*. A list of the specific approvals required for the proposed undertaking will be provided in the EA.

A

Acronyms and Glossary

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Acronyms

Acronym	Definition
BHR	Built Heritage Resource
C&D	Construction and Demolition
CHL	Cultural Heritage Landscape
COVID-19	Coronavirus Disease
EA	Environmental Assessment
EAA	Environmental Assessment Act
ECA	Environmental Compliance Approval
EGLE	Michigan Department of Environment, Great Lakes and Energy
GHG	Greenhouse Gas
IAA	Impact Assessment Act
IC&I	Industrial Commercial and Institutional
LOS	Level of Service
LFG	Landfill Gas
MECP	Ministry of Environment, Conservation and Parks
MHSTCI	Ministry of Heritage, Sport, Tourism and Culture Industries
MW	Megawatt
NOX	Nitrogen Oxides
OWMA	Ontario Waste Management Association
SAR	Species at Risk
SCC	Species of Conservation Concern
SWH	Significant Wildlife Habitat
TCEC	Twin Creeks Environmental Centre
TSP	Total Suspended Particulate
VOC	Volatile Organic Compounds
WM	Waste Management of Canada Corporation
WPLC	Warwick Public Liaison Committee

Glossary

Term	Definition
Approval	Permission granted by an authorized individual or organization for an undertaking to proceed. This may be in the form of program approval, environmental compliance approval, certificate of approval or provisional certificate of approval
Capacity (Disposal Volume)	The total volume of air space available for disposal of waste at a landfill site for a particular design (typically in m^3); includes both waste and daily cover materials, but excludes the final cover
Composting	The controlled microbial decomposition of organic matter, such as food and yard wastes, in the presence of oxygen, into finished compost (humus), a soil-like material. Humus can be used in vegetable and flower gardens, hedges, etc.

Glossary

Term	Definition
Composting facility	A facility designed to compost organic matter either in the presence of oxygen (aerobic) or absence of oxygen (anaerobic).
Construction and demolition (C&D) waste	Solid waste produced in the course of residential, commercial, industrial, or institutional building construction, demolition, or renovation (e.g., lumber, brick, concrete, plaster, glass, stone, drywall, etc.)
Environment	As defined by the Ontario *Environmental Assessment Act*, environment means: • air, land or water; • plant and animal life, including human life; • the social, economic and cultural conditions that influence the life of humans or a community; • any building, structure, machine or other device or thing made by humans; • any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from human activities; or • any part or combination of the foregoing and the interrelationships between any two or more of them (ecosystem approach).
Environmental Assessment (EA)	A systematic planning process that is conducted in accordance with applicable laws or regulations aimed at assessing the effects of a proposed undertaking on the environment
Environmental Compliance Approval (ECA)	A licence or permit issued by the Ministry of the Environment for the operation of a waste management site/facility
Evaluation criteria	Evaluation criteria are considerations or factors taken into account in assessing the advantages and disadvantages of various alternatives being considered
Greenhouse gas (GHG)	Any of the gases whose absorption of solar radiation is responsible for the greenhouse effect, including carbon dioxide, methane, ozone, and the fluorocarbons.
Indicators	Indicators are specific characteristics of the evaluation criteria that can be measured or determined in some way, as opposed to the actual criteria, which are fairly general
Industrial, commercial and institutional (IC&I) wastes	Wastes originating from the industrial, commercial, and institutional sectors
Landfill gas (LFG)	The gases produced from the wastes disposed in a landfill; the main constituents are typically carbon dioxide and methane, with small amounts of other organic and odour-causing compounds
Landfill site	An approved engineered site/facility used for the final disposal of waste. Landfills are waste disposal sites where waste is spread in layers, compacted to the smallest practical volume, and typically covered by soil.
Leachate	Liquid that drains from solid waste in a landfill and which contains dissolved, suspended and/or microbial contaminants from the breakdown of this waste.
Mitigation	Measures taken to reduce adverse impacts on the environment.
Non-hazardous waste	Non-hazardous wastes include all solid waste that does not meet the definition of hazardous waste and includes designated wastes such as asbestos waste.
Proponent	A person who: • carries out or proposes to carry out an undertaking; or • is the owner or person having charge, management, or control of an undertaking.
Receptor	The person, plant or wildlife species that may be affected due to exposure to a contaminant.
Residual waste	Waste remaining after a technological process has taken place; e.g., unrecyclable/unprocessed materials remaining after being processed at a material recovery facility or non-compostable materials such as plastic from the composting facility.

Glossary

Term	Definition
Source separated organic material	Organics separated by a household or business that include food wastes and may include leaf and yard wastes.
Stakeholder	Any organization, governmental entity, or individual that has a stake in or may be impacted by a given approach to environmental regulation, pollution prevention, energy conservation, etc.
Terms of Reference (ToR)	A terms of reference is a document that sets out detailed requirements for the preparation of an Environmental Assessment.
Undertaking	Is defined in the Ontario *Environmental Assessment Act* as follows: • An enterprise or activity or a proposal, plan, or program in respect of an enterprise or activity by or on behalf of Her Majesty in right of Ontario, by a public body or public bodies or by a municipality or municipalities; • A major commercial or business enterprise or activity or a proposal, plan, or program in respect of a major commercial or business enterprise or activity of a person or persons other than a person or persons referred to in clause (1) that is designated by the regulations; or • An enterprise or activity or a proposal, plan or program in respect of an enterprise or activity of a person or persons, other than a person or persons referred to in clause (a), if an agreement is entered into under section 3.0.1 in respect of the enterprise, activity, proposal, plan or program ("enterprise").
Waste	Refuse from places of human or animal habitation; unwanted materials left over from a manufacturing process.
Waste electrical and electronic equipment	A term encompassing all electronic waste (typically anything with a cord) designated by the MECP for end-of-life management by Ontario Electronic Stewardship.

B

Proposed Evaluation Criteria, Indicators, and Data Sources

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Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
Natural Environment			
Atmospheric Environment			
Air Quality - Dust	Construction and operation activities at a waste disposal site can lead to increased levels of particulates (dust) in the air.	• Off-site point of impingement air concentrations of particulate matter (dust) compounds at identified receptors in the immediate vicinity of the site, and community • Frequency of any exceedance of applicable standards, limits, or guidelines at identified receptors • Number of off-site identified receptors potentially affected (e.g., residential properties, public facilities, businesses/farms, institutions) • Both operational and construction activities occurring in each of the future operational stages of the landfill considered in the assessment will be independently identified	• MECP-provided meteorological data • Applicable MECP guidelines, technical standards and accepted models • Aerial photographic mapping and field reconnaissance • Previously completed reports for the TCEC facility, including the 2016 Environmental Screening report, the 2005 EA, various ECA/ESDM reports, ambient monitoring reports, etc. • Off-site receptors identified in coordination with other disciplines • Available background ambient air data • Site specific ambient particulate monitoring data • Proposed facility characteristics • Landfill design and operation data • Published terrain data • Published air emission factors and predictive models • Published particle size fractionation data • Traffic data • Applicable air quality standards, guidelines, and criteria from the MECP and the CCME
Air Quality – Landfill Gas and Combustion By-Products	Waste disposal site and associated operations can emit gaseous contaminants that can degrade air quality.	• Off-site point of impingement air concentrations of indicator compounds at identified receptors in the immediate vicinity of the site, and community (within 5 km) • Frequency of any exceedance of applicable standards, limits, or guidelines at identified receptors • Number of off-site receptors potentially affected (e.g., residential properties, public facilities, businesses/farms, institutions)	• MECP-provided meteorological data • Applicable MECP guidelines, technical standards and accepted models • Aerial photographic mapping and field reconnaissance • Previously completed reports for the TCEC facility, including the 2016 Environmental Screening report, the 2005 EA, various ECA/ESDM reports, ambient monitoring reports, etc.

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
			• Off-site receptors identified in coordination with other disciplines • Available background ambient air data • Site specific ambient monitoring data • Proposed facility characteristics • Landfill design and operation data • Published terrain data • Published air emission factors and predictive models • Established gas characteristics from the existing operation • Applicable air quality standards, guidelines, and criteria from the MECP and the CCME
Air Quality – Blowing Litter	Waste disposal site and associated operations can release litter, which may be blown to the surround areas.	• Extent of zones potentially impacted by blowing litter • Number of off-site receptors potentially affected (e.g., residential properties, public facilities, businesses/farms odour sensitive area(s), institutions)	• On-site meteorological data • MECP-provided meteorological data • MECP inspection records, WM inspection records, and complaint history • Published literature related to the factors affecting the generation and mitigation of blowing litter • Landfill design and operation data
Odour	Waste disposal site and associated operations can emit contaminants that generate odorous emissions.	• Off-site odour concentrations (odour units) at identified odour sensitive receptors in the immediate vicinity of the site • Frequency of any odour levels above defined odour benchmarks • Number of off-site receptors potentially affected (e.g., residential properties, public facilities, businesses/farms odour sensitive area(s), institutions)	• MECP-provided meteorological data • Applicable MECP guidelines, technical standards, and accepted models • Aerial photographic mapping and field reconnaissance • Previously completed reports for the TCEC facility, including the 2016 Environmental Screening report, the 2005 EA, various ECA/ESDM reports, ambient monitoring reports, etc. • Off-site odour-sensitive receptors defined as per the MECP Odour Technical Bulletin[1], identified in coordination with other disciplines • Proposed facility characteristics • Landfill design and operation data

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
			• Published terrain data • Published air emission factors • Emission measurements from comparable landfills and/or on-site sampling • Applicable air quality standards, guidelines, and criteria from the MECP and the CCME
Noise	Activities related to construction/rehabilitation, operation of the landfill and ancillary sources, and the off-site haul route can result in an increase in off-site noise levels.	• Predicted site-related noise levels (measured in dBA or dBAI) • Change in sound levels (dB)	• Annual on-site noise monitoring data • Off-site noise monitoring • Manufacturer noise specifications • Noise measurement of on-site sources • Applicable MECP guidelines, technical standards and models • Aerial mapping and field reconnaissance to confirm off-site receptors • Topographic and land-use mapping • Land use zoning plans • Proposed facility characteristics • Landfill design and operations data • Traffic counting, characterization and modelling studies
Geology and Hydrogeology			
Groundwater Quality	Contaminants associated with waste disposal at the Site have the potential to enter the groundwater and impact on-Site groundwater. Acceptable groundwater quality, which is 80% of the Guideline B-7 criteria for the PLIL parameters, must be shown at the Site boundaries.	• Predicted effects on groundwater quality on-Site from increased waste quantities disposed within the expansion landfill • Predicted contaminating lifespan	• Applicable regulatory documentation (i.e., Amended Site ECAs, MECP guidelines, technical standards, etc.). • Landfill Environmental Monitoring Plan (Jagger Hims Limited, 2007) (EMP), and as amended per MECP approval. • Historical Hydrogeological studies. • Liquid level monitoring data for on-Site groundwater monitoring wells and leachate monitoring stations. • Liquid level monitoring data for surface water. • Groundwater quality monitoring data at on-Site monitoring wells as outlined in the EMP.

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
			• Quarterly and Annual Site compliance monitoring reports. • Leachate generation and management assessments, as outlined in the Leachate Management Plan, (March 2020) (HDR, 2019). • Proposed facility characteristics, including service life estimates. • Water well survey within the off-Site study area.
Groundwater Quantity	The landfill optimization has the potential to affect the established hydraulic trap design for the expansion landfill and understood groundwater flow patterns on-Site and Off-Site	• Predicted effect of landfill optimization on groundwater flow and quantity both on-Site and off-Site.	• Applicable regulatory documentation (i.e., Amended Site ECAs, MECP guidelines, technical standards, etc.) • Liquid level monitoring data for on-Site groundwater monitoring wells and leachate monitoring stations. • Historical Hydrogeological studies. • Water well records to be reviewed to understand the effect on groundwater quantity on-Site and off-Site as result of off-Site water well use in the area. • Quarterly and Annual Site compliance monitoring reports. • Water taking tracking from the Secondary Drainage Layer. • Proposed facility characteristics. • Water well survey within the off-Site study area.
Surface Water Environment			
Surface Water Quality	The landfill optimization has the potential to affect surface water quality through either possible leachate seepage through the landfill cap, increased erosion of the landfill clayey soil cap, or track-out of Automobile	• Predicted effects on surface water quality on-Site prior to off-Site discharge. • Predicted effects from polyaromatic hydrocarbons (PAHs) on surface water quality within the roadside ditch of the northbound lane of Nauvoo Road from the Site to Hwy 402 in the off-Site study area	• Applicable regulatory documentation (i.e., Amended Site ECAs, MECP guidelines, technical standards, etc.). • Landfill Environmental Monitoring Plan (Jagger Hims Limited, 2007) (EMP), and as amended per MECP approval.

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
	Shredder Residue (ASR) wastes off-Site.		• Surface water quality monitoring data at each on-Site background, internal, and discharge (compliance) monitoring stations. • Provincial Water Quality Monitoring Network (PWQMN). • Topographic maps and aerial photos. • On-Site stormwater management system design for the Site. • Quarterly and Annual Site compliance monitoring reports. • Leachate generation and management assessments, as outlined in the Leachate Management Plan, (March 2020) (HDR, 2019). • Proposed facility characteristics. • Testing for PAHs related to potential effects of ASR on surface water within the roadside ditch of the northbound lane of Nauvoo Road from the Site to Hwy 402 in the off-Site study area
Surface Water Quantity	Construction of physical works may disrupt natural surface drainage patterns and may alter runoff and peak flows. The presence of the expanded landfill may also affect base flow to surface water.	• Change in runoff volumes and peak flows resulting from steeper and longer side slopes. • Changes to drainage areas on-site and off-site. • Predicted occurrence and degree of off-site effects to surface water flows.	• On-site stormwater management system design for expanded landfill. • Landfill design and operations data. • Hydrologic modelling. • Annual monitoring reports. • Published flow information and hydrology design standards from MECP, MNRF, Environment Canada and SCRCA. • Site reconnaissance. • Topographic surveys. • Air photos. • Drainage maps. • Watershed mapping areas including municipal water supply sources within the off-site study area from St. Clair Conservation Area. • Typical stream channel geometry within the off-site study area, to the extent accessible.

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
			• Water well survey within the off-site study area. • PTTW records. • Liaison with MECP, SCRCA, downstream riparian landowners along Gilliland-Geerts Drain between Nauvoo Road and Underpass Road, Township of Warwick.
Ecological Environment			
Terrestrial Ecosystems	Continued or expanded operation of the waste disposal facility may disturb the functioning of natural terrestrial habitats, including rare, threatened or endangered species.	• Predicted effects on vegetation communities and species including rare, threatened or endangered species • Predicted effects on wildlife and wildlife habitat including rare, threatened or endangered species	• Vegetation and wildlife data, including SAR data from previous studies • Terrestrial field studies • Aerial imagery • Local and Indigenous sources of information on the ecological functions of features within the On-site and Off-site study areas. • Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement (Ontario Ministry of Natural Resources 2010) • Significant Wildlife Habitat Technical Guide (Ontario Ministry of Natural Resources 2000) • Significant Wildlife Habitat (Schedule Criteria for Ecoregion 7E (Ontario Ministry of Natural Resources and Forestry 2015) • MECP background data • MNRF background data • SCRCA background data • Natural Heritage Information Centre background data • Ontario Breeding Bird Atlas • Ontario Butterfly Atlas • Ontario Reptile and Amphibian Atlas • Ontario Odonata Atlas • Ontario Mammal Atlas • eBird

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
			• iNaturalist • Proposed facility characteristics • Landfill design and operations data • Annual monitoring report data • Results of other discipline assessments • Survey protocol for Ontario's Species at Risk Snakes (MNRF 2016a) • Survey Protocol for Blanding's Turtle in Ontario (MNRF 2015c) • Blanding's Turtle Nest and Nesting Survey Guidelines (MNRF 2016b) • Ontario Wetland Evaluation System: Southern Manual (MNRF 2014)
Aquatic Ecosystems	Continued or expanded operation of the waste disposal facility may disturb the functioning of natural aquatic habitats and species, including rare, threatened or endangered species.	• Predicted effects on aquatic habitat, including fish habitat • Predicted effects on aquatic biota including rare, threatened or endangered species	• Fish and fish habitat survey data from previous studies • Aquatic field studies • Local and Indigenous sources of information on the ecological functions of features within the On-Site and Off-Site study areas • MNRF review letters of previous existing conditions reports • MNRF aquatic resource data • Fisheries and Oceans Canada (DFO) Aquatic Species at Risk mapping • Annual monitoring report data • Proposed facility characteristics • Landfill design and operations data • Annual monitoring report data • Results of other discipline assessments • Observations obtained as part of interviews with riparian landowners

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
Socio-Economic Environment			
Economic			
Economic effects on local community	The continued operation of the landfill could have economic effects on and/or provide economic benefits to the local community	• Employment at site (number, type, and duration) • Contributions to the host community • Opportunities for the provision and procurement of products and/or services	• Census and municipal data for Village of Watford and Township of Warwick • Municipal tax information / sources of municipal revenues • WM data on host community fee contributions • WM site employment data • WM data on types and values of goods and services procured • WM data on types and values of goods and services provided • Proposed facility characteristics • Results of other discipline assessments
Social			
Effects on local community	Waste disposal facilities can potentially affect local residents and businesses in the vicinity of the site.	• Number of residents and residences (e.g., receptors) • Number and type of local businesses • Nuisance effects (litter, dust, noise, odour, traffic) • Predicted changes to use and enjoyment of property • Level of satisfaction with living/working in the community • Confidence in TCEC operations	• Mapping and field reconnaissance • Census information and municipal data for Village of Watford and Township of Warwick • Number and nature of nuisance complaints received related to the TCEC (e.g., odour, litter, noise) • Community survey(s) • Proposed facility characteristics • Results of other discipline assessments
Visual Impact of Facility	The contours of the waste disposal facility may affect the visual appeal of a landscape.	• Predicted changes in perceptions of landscapes and views.	• Site grading plans • Aerial mapping and field reconnaissance • Proposed facility characteristics • Existing landfill design and operations data • Regional topographic mapping • Results of other discipline assessments

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
Cultural Environment			

Cultural Heritage Resources	Activities related to construction and operation of the landfill may result in direct or indirect effects on identified built heritage resources and cultural heritage landscapes.	• Proximity of known or potential cultural heritage resources to the landfill (known/potential built heritage resources and cultural heritage landscapes will be assessed for potential direct or indirect effects).
		  ○ Direct impacts may include: the destruction of any, or part of any, significant heritage attributes or features; and alteration that is not sympathetic, or is incompatible, with the historic fabric and appearance.
		  ○ Indirect impacts may include: shadows created that alter the appearance of a heritage attribute or change the viability of a natural feature or plantings, such as a garden; and isolation of a heritage attribute from its surrounding environment, context or a significant relationship; direct or indirect obstruction of significant views or vistas within, from, or of built and natural features; a change in land use such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces; and land disturbances such as a change in grade that alters soils, and drainage patterns that adversely affect an archaeological resource.
			• Published data sources
			• Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes (MTCS 2016)
			• Ontario Heritage Tool Kit (MTCS 2006)
			• Commemorative statements
			• Proposed facility characteristics
			• Landfill design and operations data
			• Viewshed analysis
			• Previous EA reports
			• Municipal Heritage Inventories and Staff Reports
			• Provincial and Federal Heritage Registers and Inventories
			• Township of Warwick, MHSTCI, Ontario Heritage Trust, and engagement with Indigenous communities
			• Field survey results
			• Historical mapping, historical topographical maps and aerial photographs

Archaeological Resources	Archaeological resources are non-renewable cultural resources that can be destroyed by the construction and operation of a waste disposal facility.	• Archaeological resources on-site and predicted impacts on them • Cemetery properties within approximately 10 metres of the proposed impacts	• Published data sources • Standards and Guidelines for Consultant Archaeologists • Ontario Archaeological Sites Database (OASD) • MHTSCI register of archaeological reports

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
	Activities related to construction and operation of the landfill may cause negative effects on archaeological sites or areas with archaeological potential.		• Existing Stage 1, 2, 3 Archaeological Assessments for the landfill site • Stage 1 property inspection results • Bereavement Authority of Ontario (BAO) • Cemetery records, plans and plot maps • Historical mapping, topographical maps and aerial photographs and imagery • Proposed facility characteristics • Landfill design and operations data
Built Environment			
Transportation			
Traffic Operations	Truck traffic associated with continued operations of the landfill may adversely affect residents, businesses, institutions and movement of farm vehicles in the site vicinity.	• Change in daily truck traffic volume and AADT along all study area road segments • Intersection performance – capacity, delay, queues (based on HCM 2010 and generated by Synchro 9) – for all study area intersections • Collisions per million vehicles at all study area intersections (severity, involving pedestrians, cyclists, autos, trucks, school buses, and agricultural vehicles) • Collisions per million vehicle-km along all study area road segments (severity, involving pedestrians, cyclists, autos, trucks, school buses, and agricultural vehicles) • Collisions by environmental conditions for segments and intersections • Sight distance at the primary access	• Turning Movement Count • Traffic Model • Collision History • Aerials • Land Survey • Stopping and Turning Sight Distance Review • Field inventory/investigation: Clear Zone, Conflicts, Visual Obstructions, Signage, Pavement Condition, Linework Condition

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
Current and Planned Future Land Use			
Effects on Current and Future Land Uses	The continued operation of the landfill may not be fully compatible with certain current and/or planned future land uses in the Off-Site Study Area. Waste disposal facilities can potentially have a negative impact on sensitive land uses, in the vicinity of the site.	• Current land use • Planned land use • Type(s) and proximity of off-site recreational resources within 1 km of a landfill footprint potentially affected • Type(s) and proximity of off-site sensitive land uses as defined by the Provincial Policy Statement and the MECP D-1 Guidelines (e.g., dwellings, churches, parks) within 1 km of a landfill footprint potentially affected • Type(s) and proximity of agricultural land use/operations (e.g., organic, cash crop, livestock)	• Planning Act • Provincial Policy Statement • D-1 Land Use and Compatibility • D-4 Land Use On or Near Landfills and Dumps • Lambton County Official Plan • Township of Warwick Official Plan • Township of Warwick Zoning By-law 121 of 2012 • Aerial photographic mapping, utilizing the following sources: Lambton County GIS, St. Clair Region Conservation Authority, OMAFRA Agricultural Information Atlas, Google Maps, and Bing Maps • Canadian Lands Inventory mapping • Field reconnaissance • Published data on public recreational facilities/activities • Proposed facility characteristics • Landfill design and operations data
Human Health	Construction and operation activities at a waste disposal site can lead to increase to increased levels of particulates (dust) and related metals in the air.	• Predicted acute and chronic health-based concentration ratios arising from air concentrations of particulate matter (dust) and related metals at identified sensitive receptor locations within the Study Area. Refer to Table 2 for complete list of assessed contaminants. • Frequency of any exceedance of applicable standards, limits, or guidelines at identified receptors.	• Data used in previous 2005 risk assessment. • Available background ambient air data • Ground-level air concentrations modelled by Air Quality team for proposed preferred alternative and associated frequency data • Off-site receptors identified in coordination with other disciplines • Published health-based regulatory benchmarks or toxicity reference values (TRVs) for each contaminant of concern
	Waste disposal site and associated operations can emit gaseous contaminants that can degrade air quality.	• Predicted acute and chronic health-based concentration ratios arising from air concentrations of gaseous contaminants at identified sensitive receptor locations within the Study Area.	

Table B-1. Proposed Evaluation Criteria, Indicators and Data Sources for the Environmental Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
		Refer to Table 2 for complete list of assessed contaminants. • Frequency of any exceedance of applicable standards, limits, or guidelines at identified receptors	

Notes:
[1] MECP, 2016: Technical Bulletin – Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines under O. Reg. 419/05, September 2016.

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Discipline Work Plans

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Air Quality Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

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Acronyms

Acronym	Definition
AAQC	Ambient Air Quality Criteria
BMPP	Best Management Practices Plan
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of Environment
CO2e	Carbon Dioxide Equivalent
EA	Environmental Assessment
ECA	Environmental Compliance Approval
ESDM	Emission Summary and Dispersion Modelling
EST	Eastern Standard Time
GHG	Green House Gas
H_2S	Hydrogen Sulphide
IWA	Interim Waste Authority
LandGEM	Landfill Gas Emission Model
MECP	Ministry of Environment, Conservation and Parks
MOVES	Motor Vehicle Emission Simulator
NAPS	National Air Pollution Surveillance
NO_x	Nitrogen Oxides
NO_2	Nitrogen Dioxide
OLM	Ozone Limiting Method
O.Reg	Ontario Regulation
OU	Odour Unit
PAH	Polycyclic Aromatic Hydrocarbon
PM10	Particulate Matter less than 10 micron in Diameter
PM2.5	Particulate Matter less than 2.5 micron in Diameter
SO_2	Sulphur Dioxide
SOP	Standard Operation Procedure
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
TRS	Total Reduced Sulphur
TSP	Total Suspended Particulate
U.S EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WM	Waste Management of Canada Corporation

1 Introduction

This Air Quality work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

The Air Quality discipline evaluates the releases to air from the Project and assesses their potential impacts on surrounding areas by comparing to standards and guidelines published by government agencies. The Air Quality discipline assesses releases of air quality compounds of interest, particulate matter (dust), odours, blowing litter, and greenhouse gases.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m^3 of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m^3, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $24M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This air quality work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the air quality environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the air quality work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The general study areas proposed for the purposes of the EA are (**Error! Reference source not found.**):

- On-site Study Area: the existing TCEC.
- Off-site Study Area: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area.

For air quality, the general Off-site Study Area has been extended to include lands within approximately 5 kilometres (km) from the TCEC, as shown in **Figure 3**. This 5 km study area is consistent with MECP modelling guidelines and is based on the maximum extent of air quality effects that can be anticipated.

For the purposes of this EA, a number of receptor locations will be identified to assist with the consideration of the effects that may result from the project. Some of these receptor locations will be common with other disciplines. The number and locations of these common receptors will be determined in a collaborative fashion with other disciplines, as appropriate. Of the identified common receptors, only those designated as relevant to air quality will be included in the air quality assessments.

Receptors under consideration for the air quality assessment are shown in **Figure 2**. These receptors represent the initial assessment of receptor locations and are based on previous studies conducted at the TCEC and may be adjusted.

The cemetery located to the west of the landfill will be included in the air quality assessment as an odour-sensitive receptor, subject to reasonable adjustments related to time-of-day when human activities regularly occur. Usage of this area is expected to be short-term and transient in nature. As such, evaluation of this location for air quality (any compound identified with a standard or guideline with an averaging period greater than 10 minutes) is not appropriate.

4 Scope of Work

The scope of work for air quality includes the development of evaluation criteria, indicators, and data sources, characterization of existing air quality conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

The air quality assessment will consist of the following sub-assessments:

- Dust;
- Landfill gas and combustion by-product emissions;
- Odour;
- Blowing Litter; and
- Climate Change.

Each of the primary criteria to be addressed in this study will be assessed during the operational period of the proposed landfill, as this is when the maximum potential air quality effects can occur. The operational period is defined as time during which the waste disposal facility is constructed, filled with waste, and capped. These activities are combined since they occur progressively (i.e., overlap) on a cell-by-cell basis, and they have a similar range of potential effects (e.g., there is heavy equipment active on the site). Within each sub-assessment, the worst-case operational period will be selected, which may vary between sub-assessments.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for the air quality environment are provided in Table 1. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on the air quality environment. These evaluation criteria and indicators will be finalized during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for Air Quality

Evaluation Criteria	Rationale	Indicators	Data Sources
Natural Environment			
Atmospheric Environment			
Air Quality - Dust	Construction and operation activities at a waste disposal site can lead to increased levels of particulates (dust) in the air.	• Off-site point of impingement air concentrations of particulate matter (dust) compounds at identified receptors in the immediate vicinity of the site, and community • Frequency of any exceedance of applicable standards, limits, or guidelines at identified receptors • Number of off-site identified receptors potentially affected (e.g., residential properties, public facilities, businesses/farms, institutions) • Both operational and construction activities occurring in each of the future operational stages of the landfill considered in the assessment will be independently identified, described, and assessed.	• MECP-provided meteorological data • Applicable MECP guidelines, technical standards and accepted models • Aerial photographic mapping and field reconnaissance • Previously completed reports for the TCEC facility, including the 2016 Environmental Screening report, the 2005 EA, various ECA/ESDM reports, ambient monitoring reports, etc. • Off-site receptors identified in coordination with other disciplines • Available background ambient air data • Site specific ambient particulate monitoring data • Proposed facility characteristics • Landfill design and operation data • Published terrain data • Published air emission factors and predictive models • Published particle size fractionation data • Traffic data • Applicable air quality standards, guidelines, and criteria from the MECP and the CCME

Evaluation Criteria	Rationale	Indicators	Data Sources
Air Quality – Landfill Gas and Combustion By-Products	Waste disposal site and associated operations can emit gaseous contaminants that can degrade air quality.	• Off-site point of impingement air concentrations of indicator compounds at identified receptors in the immediate vicinity of the site, and community (within 5 km) • Frequency of any exceedance of applicable standards, limits, or guidelines at identified receptors • Number of off-site receptors potentially affected (e.g., residential properties, public facilities, businesses/farms, institutions)	• MECP-provided meteorological data • Applicable MECP guidelines, technical standards and accepted models • Aerial photographic mapping and field reconnaissance • Previously completed reports for the TCEC facility, including the 2016 Environmental Screening report, the 2005 EA, various ECA/ESDM reports, ambient monitoring reports, etc. • Off-site receptors identified in coordination with other disciplines • Available background ambient air data • Site specific ambient monitoring data • Proposed facility characteristics • Landfill design and operation data • Published terrain data • Published air emission factors and predictive models • Established gas characteristics from the existing operation • Applicable air quality standards, guidelines, and criteria from the MECP and the CCME
Air Quality - Odour	Waste disposal site and associated operations can emit contaminants that generate odorous emissions.	• Off-site odour concentrations (odour units) at identified odour sensitive receptors in the immediate vicinity of the site • Frequency of any odour levels above defined odour benchmarks • Number of off-site receptors potentially affected (e.g., residential properties, public facilities, businesses/farms odour sensitive area(s), institutions)	• MECP-provided meteorological data • Applicable MECP guidelines, technical standards, and accepted models • Aerial photographic mapping and field reconnaissance • Previously completed reports for the TCEC facility, including the 2016 Environmental Screening report, the 2005 EA, various ECA/ESDM reports, ambient monitoring reports, etc. • Off-site odour-sensitive receptors defined as per the MECP Odour Technical Bulletin [1], identified in coordination with other disciplines • Proposed facility characteristics • Landfill design and operation data • Published terrain data • Published air emission factors • Emission measurements from comparable landfills and/or on-site sampling • Applicable air quality standards, guidelines, and criteria from the MECP and the CCME

Evaluation Criteria	Rationale	Indicators	Data Sources
Air Quality - Blowing Litter	Waste disposal site and associated operations can release litter, which may be blown to the surround areas.	• Extent of zones potentially impacted by blowing litter • Number of off-site receptors potentially affected (e.g., residential properties, public facilities, businesses/farms odour sensitive area(s), institutions)	• On-site meteorological data • MECP-provided meteorological data • MECP inspection records, WM inspection records, and complaint history • Published literature related to the factors affecting the generation and mitigation of blowing litter • Landfill design and operation data

[1] MECP, 2016: Technical Bulletin – Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines under O. Reg. 419/05, September 2016.

The potential effects of the proposed landfill optimization will be assessed based on key indicator contaminants. Since the existing TCEC has been well characterized through studies such as the 2005 EA, the 2016 Environmental Screening Report, and various ECA applications, it has been determined which contaminants are of particular interest. The key indicator contaminants were developed based on a review of previous studies completed for the existing TCEC facility, as well as an understanding of the contaminants typically emitted by landfill operations. In general, the contaminants with predicted concentrations greater than 15% of their current criteria in the previously completed 2016 Twin Creeks Environmental Screening report were determined to be the key indicator contaminants.

The key indicator contaminants consist of:

- Total suspended particulate (TSP);
- Particulate matter less than 10 µm in diameter (PM_{10});
- Particulate matter less than 2.5 µm in diameter ($PM_{2.5}$);
- Vinyl Chloride;
- Benzene;
- 1,2-Dichloroethane;
- Ammonia;
- Hydrogen Sulphide (H_2S);
- Total Reduced Sulphur (TRS);
- Odour (as a mixture of compounds);
- Dioxins and Furans;
- Nitrogen Oxides (NO_X) / Nitrogen Dioxide (NO_2)
- Sulphur dioxide (SO_2); and
- Greenhouse Gases (carbon dioxide, methane, and nitrous oxide)

Key sources of these contaminants at the TCEC include the working face, interim cover area, and final cover area of the landfill; flares, generators, and other on-site combustion equipment; on-site traffic, equipment, soil handling, and wind erosion; and leachate treatment operations.

The applicable air quality standards, guidelines and criteria, are included in the following sources:

- MECP Regulation 419/05 standards, guidelines, and screening-level criteria (Reg. 419);
- MECP Ambient Air Quality Criteria (AAQC); and
- Canadian Council of Ministers of Environment (CCME) Canadian Ambient Air Quality Standards (CAAQS).

For any standards, criteria or guidelines with limits to be implemented in the future, these future limits will be presented for comparison to predicted concentrations. As the MECP or CCME update their air quality standards, guidelines, and criteria, the measure of predicted concentrations will be compared to the most stringent limits available at the time of the assessment.

The following table summarizes the applicable Air Quality Criteria to be used to assess potential effects from the TCEC. For contaminants with more than one limit that applies to the same averaging period, only the most stringent criteria will be used in the assessment.

Table 2. Assessment Criteria for Key Indicator Compounds

Contaminant	Applicable Sub-Assessment	Averaging Period	Air Quality Criteria (ug/m^3)	Source
TSP	Dust;	24-hour	120	AAQC and O.Reg 419/05
		Annual	60	AAQC
PM10	Dust;	24-Hour	50	AAQC
PM2.5	Dust;	24-Hour	25	AAQC
		24-Hour	27	CAAQs
		Annual	8.8	CAAQs
Vinyl chloride	Landfill Gas	24-hour	1.0	AAQC & O.Reg 419/05
		Annual	0.2	AAQC
Benzene	Landfill Gas	24-hour	2.3	AAQC
		Annual	0.45	AAQC & O.Reg 419/05
1,2-Dichloroethane	Landfill Gas	24-hour	2	AAQC & O.Reg 419/05
		Annual	0.4	AAQC
Ammonia	Landfill Gas	24-hour	100	AAQC
Hydrogen Sulphide	Landfill Gas	10-minute	13	AAQC & O.Reg 419/05
		24-hour	7	AAQC & O.Reg 419/05
Total Reduced Sulphurs (TRS)	Landfill Gas	10-minute	13	AAQC & O.Reg 419/05
		24-hour	7	AAQC & O.Reg 419/05
Odour	Odour	10-minute	1 OU/m^3	MECP Guidance
Dioxins and Furans	Combustion	24-hour	0.1 pg TEQ/m^3	AAQC

Table 2. Assessment Criteria for Key Indicator Compounds

Contaminant	Applicable Sub-Assessment	Averaging Period	Air Quality Criteria (ug/m^3)	Source
Nitrogen Dioxide	Combustion	1-hour	400	AAQC
		24-hour	200	AAQC
Nitrogen Oxides	Combustion	1-hour	400	O.Reg 419/05
		24-hour	200	O.Reg 419/05
Sulphur Dioxide	Combustion	1-hour	690	AAQC
		1-hour	100	O.Reg 419/05 (future 2023)
		24-hour	275	AAQC
		Annual	10	O.Reg 419/05 (future 2023)
		Annual	55	AAQC

There are no Reg. 419, AAQC, or CAAQS criteria for odour as a mixture of compounds. Historically, the MECP suggests that an upper limit for off-site concentrations of 1 odour unit (OU) per cubic metre, at an averaging time less than or equal to 10 minutes, be applied as a criterion. Odour results will be compared to 1, 3 and 5 OU; these levels are typically associated with odour detection, recognition, and annoyance thresholds, respectively. The MECP's "Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines for Odour under O. Reg. 419/05" outlines the procedure for evaluating compounds with 10-minute odour-based standards and the assessment for frequency of occurrences. Although this document does not explicitly consider it, the MECP typically also accepts this approach for the assessment of odour as a mixture of compounds, therefore; this document will be followed for the evaluation of odour and the frequency of odour events, as well as for assessing the 10-minute standards for H_2S and TRS.

Total releases of greenhouse gases are converted to carbon dioxide equivalents (CO_{2e}) based on Global Warming Potentials (GWP), as published by the MECP and/or ECCC.

4.2 Characterization of Existing Conditions

As part of the environmental assessment process, there is a requirement to evaluate the existing conditions in an area where the Project will occur. This is to develop a general background level so that the cumulative effects from the Project can be assessed and/or to determine what the effects would be with no Project in place. For the air quality assessment, baseline conditions will be defined using a combination of ambient monitoring and dispersion modelling.

4.2.1 Ambient Monitoring

Ambient monitoring has been conducted at the TCEC since 2009. The existing ambient monitoring program will be enhanced in order to fully characterize the existing conditions in the immediate vicinity of the TCEC. The results of the ambient monitoring will be compared to the applicable standards for each key indicator contaminant, as listed in **Table 2**. Ambient monitoring reports will be prepared quarterly.

An assessment of the wind conditions will be completed for each sampling period, in order to determine which of the monitoring locations were upwind and downwind of the landfill on each given day. The upwind samples will be used to develop background concentrations to be added to the dispersion modelling results. The downwind samples will be used for comparison with the dispersion modelling results.

When developing ambient background concentrations, the 90th percentile of the upwind 24-hour monitoring results will be used for assessing contaminants with 24-hour averaging periods and the average concentration of the upwind monitoring data will be used when assessing annual averaging periods. For compounds with averaging periods less than 24 hours (i.e., 1-hour and 10-minute), the 90th percentile 24-hour monitoring result will be converted to the shorter-term averaging period using the method described in MECP Guideline A-10 *Procedure for Preparing an Emission Summary and Dispersion Modelling Report*, version 4.1, March 2018.

Specifics regarding the ambient monitoring for each of the sub-assessments is provided in the following sections.

Dust Assessment

Ambient monitoring of TSP is well established at the existing site. TSP sampling is completed at three fixed locations around the landfill footprint, which were approved by the MECP. Each sample is conducted for a 24-hour period. The sampling commenced in 2009, at the onset of the construction at the site, and has continued to date. As of December 1, 2019, the sampling schedule for particulate was switched to a 6-day schedule from January 1 to May 31 and October 1 to December 31 of each year and a 3-day cycle from June 1 to September 30. Prior to this date, the samples were collected on six- or twelve-day intervals, depending on time of year, in concurrence with the U.S. EPA National Air Pollutant Surveillance monitoring schedule.

In order to develop a robust assessment of the existing conditions at the TCEC, the monitoring campaign will be enhanced to include monitoring of PM_{10}, and $PM_{2.5}$, co-located with the existing TSP samplers. Twenty-four (24) hour PM_{10} and $PM_{2.5}$ samples will be collected on the same schedule as the current TSP samples. All samples will be 24-hours in duration (midnight to midnight, Eastern Standard Time). This enhanced monitoring program will be conducted for a period of one year. The ambient monitoring results for PM_{10} and $PM_{2.5}$ will be used to develop a distribution factor, relative to TSP. This distribution factor will be applied to historical TSP measurements to estimate historical concentrations of PM_{10} and $PM_{2.5}$.

The samples will be collected on glass fibre filters (or other filters specified by the MECP) using General Metal Works standard High-Volume air samplers outfitted with PM_{10} and $PM_{2.5}$ inlet heads. The filters will be supplied, conditioned, and pre- and post-weighed by

an accredited laboratory. The filters will be stored and analyzed in monthly batches during the sampling program. The sampling will be completed according to the Operations Manual (as amended) published by the MECP. Any operational changes made to the MECP Operations Manual (as amended) during the study period will be implemented.

Landfill Gas and Combustion By-Product

Landfill gas is primarily composed of methane and carbon dioxide with trace amounts of VOCs and RS. VOC sampling has been completed through the summer months (July, August, and September) since 2009. A set of concurrent upwind and downwind samples are collected for 30-minutes in duration during TCEC operating hours for each sampling date. No more than two sets of samples are collected in any calendar month. The sample results are compared to the relevant MECP standards or guidelines. There is currently no ambient monitoring of RS compounds at TCEC.

In order to develop a robust assessment of the existing conditions at the TCEC, the monitoring campaign will be enhanced to include ambient monitoring of VOC and RS compounds collected over 24-hour durations (midnight to midnight, EST), co-located and on the same sampling schedule as the particulate monitoring, described in the preceding section. This sampling program will be conducted for four months, from June to September.

The samples will be collected and analyzed using methods defined in U.S. EPA Method TO-14/15 using evacuated canisters. Sampling methodologies will follow the Standard Operating Procedures (SOPs) as noted in the current version of the MECP Operations Manual, as amended.

No ambient monitoring will be conducted for nitrogen dioxide or sulphur dioxide, as these contaminants can be obtained from publicly available ambient monitoring data published by the MECP or from the National Air Pollution Surveillance (NAPS) database. In addition, ambient background ozone concentrations, used for converting NO_X to NO_2, will also be obtained from publicly available MECP or NAPS monitoring data.

Odour

No ambient monitoring is proposed for the odour assessment. Instead, the TCEC complaint log will be reviewed to determine the current level of odour impacts in the vicinity of the landfill. Other odours within the immediate community exist, including agricultural. Although agricultural odours can be related to landfill type odours, the two odour sources are generally distinct and the study will not include farming activities as local background sources.

For on-site odour concentrations, it is proposed to complete a series of on-site odour measurements to confirm the odour levels from the working face, interim cover area, waste soil materials, freshly uncovered waste, leachate collection manholes, and final cover areas. This set of data will be used to update the odour data from other landfills used in the previous TCEC odour assessments as well as confirm current odour conditions at the site. Odour sampling will follow approved Flux Chamber methodology and laboratory based olfactometry as outlined in the Ontario Source Testing Code Method 6. The odour samples would be taken during the summer conditions and would include: 9 samples from

the final cover area, 9 samples from the interim cover area, 3 samples from the working face, and 3 samples from the waste soil piles.

Blowing Litter

No ambient monitoring is proposed for the blowing litter assessment. Instead, the current TCEC complaint log will be reviewed to determine the current level of blowing litter impacts in the vicinity of the landfill.

4.2.2 Dispersion Modelling

Ambient monitoring will provide insight into existing conditions nearest to the property line, however conditions beyond the property line will be established using dispersion modelling. The focus of the modelling will be on predicted effects at identified residential receptors in the immediate vicinity (within ~ 1 kilometer) of the existing site. Modelling will be conducted using the current regulatory version of the US EPA AERMOD dispersion model (version 19191, or whichever version is currently approved by the MECP at the start of the modelling assessment).

The landfill will increase in height over its lifetime and in many cases, the sources of emissions may be located above grade. In past experience, modelling all activity at grade level results in a conservative assessment of predicted off-site effects. Sensitivity modelling will be conducted to confirm whether grade-level sources remain representative of worst-case conditions and, if so, landfill sources will be modelled at grade for a conservative approach.

Site-specific meteorological data will be requested from the MECP for use in the AERMOD dispersion modelling. To ensure that a broad range of dispersion conditions are addressed in the model, the meteorological data set will consist of five years' worth of historical weather data, processed by the MECP for use with AERMOD.

Contaminant concentrations will be predicted for a range of averaging periods for comparison with applicable air quality standards and criteria, as outlined in **Table 2**. Concentrations will be modelled at each of the identified air quality receptors (see **Figure 2**). In addition, concentrations will be modelled over a grid of receptors surrounding the landfill site and extending over the 5 km off-site study area.

The results from the predictive modelling for existing operations will be presented in both tabular form for the identified receptors as well as contour plots for the entire off-site study area for all contaminants. The contours will extend to a maximum distance of 5 km from the site; however, the study area (and associated contours) will be extended further if elevated concentrations occur beyond the 5 km radius. Predicted impacts will be presented both with and without measured upwind background concentrations to show landfill impact relative to the contribution from other sources in the area.

4.2.3 Source Quantification

The methods used for quantifying existing conditions for each of the air quality sub assessments are summarized below.

Dust Assessment

For the characterization of existing conditions, the dust sources will be identified based on previous EA and ECA (ESDM) reports for the facility, current operating conditions, and review of the dust complaint history. Typical dust sources include material handling, on-site equipment, landfill gas flares, wind erosion of exposed surfaces, and tailpipe emissions and re-entrained road dust from traffic on on-site haul routes. Emissions from both landfilling and on-site construction activities will be considered.

Reasonable maximum fugitive dust emission rates will be estimated based on emission factors published by the U.S. EPA for all processes. Roadway parameters such as silt loading, silt content, and moisture content will be based on site specific soil and road surface testing.

Tailpipe emissions for on-road and off-road vehicles will be determined using the U.S. EPA's MOVES 2014b emission program (or equivalent as agreed to by the MECP).

Dust emission rates will be adjusted based on the current mitigation measures in place at TCEC, as described in their Best Management Practices Plan (BMPP) for dust.

When dust particles travel downwind in a plume, larger particles fall out of the air through gravitational settling and other factors and are not replaced. Using the deposition routine within AERMOD provides a simulation of this process. By doing so, a more realistic prediction of dust impacts is produced. In the dispersion model, the dry particle deposition and dry plume depletion will be included as part of the dust assessment. As this is a non-regulatory option within AERMOD, consultation with the MECP will be conducted prior to using this feature. Provided the MECP is in agreement, AERMOD will be run using dry particle deposition and dry plume depletion, with deposition parameters derived from site-specific soil and road surface testing. These parameters will be circulated to the MECP and the Peer Review Team.

Landfill Gas and Combustion By-Product Assessment

For the characterization of existing conditions, the landfill gas compounds (VOC and RS) sources will be identified based on previous EA and ECA (ESDM) reports for the facility and current operating conditions. Typical sources of VOC and RS compounds include fugitive emissions from the landfill mound, the flare(s) or other landfill gas utilization equipment, waste soil stockpiles, and leachate treatment.

Landfill gas generation rates, consisting of emission rates VOCs and sulfur compounds, will be estimated using the U.S. EPA's Landfill Gas Emission Model (LandGEM). For this assessment U.S. EPA default values for landfill gas constituents will be used to determine landfill gas composition. Site specific measurement of landfill gas from TCEC may be used to further refine the emission estimates. The TCEC is equipped with a landfill gas collection system, which operates with a collection efficiency of 70%, as assumed in the 2016 Environmental Screening Report. Therefore, of the total landfill gas predicted by the LandGEM model, 70% will be collected and directed to the flares/other utilization equipment, with the remaining 30% escaping through the surface of the mound as fugitive emissions. The active cell of the landfill, where waste filling would be occurring, would be assumed to have a lower collection efficiency of 50%, since this area would not be under final cover.

The landfill gas emissions from the landfill flare(s) and other on-site utilization equipment will also be assessed. The on-site utilization equipment may include landfill gas-fired generators, a renewable natural gas facility, or other operations. The emissions will be based on the flow rates processed through the flare, the composition of the landfill gas, and typical flare destruction efficiencies for the landfill gas constituents, as published by the US EPA.

Emissions from the waste soil stockpile(s) will be based on testing previously conducted on waste soil at other landfills in Ontario. For the characterization of existing conditions, the combustion by-product emission sources will be identified based on previous EA and ECA (ESDM) reports for the facility and current operating conditions. Typical sources of combustion by-products include the landfill gas flare(s) and other on-site utilization equipment, on-site vehicles, off-road equipment, and other stationary combustion equipment.

Emissions of combustion by-products from the flare(s) and other stationary combustion will be developed based on published emission factors from the US EPA AP-42 documents.

The U.S. EPA's MOVES 2014b emission model (or equivalent as agreed to by the MECP) will be used to determine emission rates for all parameters related to tailpipe emissions from the on-site traffic and mobile equipment. Daily and peak hourly traffic volumes and hourly traffic variations will be obtained from the transportation work plan.

For the assessment of NO_2 impacts, the majority of the emission factors are provided as total nitrogen oxides (NO_X). The predicted NO_X concentration will be converted to NO_2 concentrations using the ozone limiting method (OLM), which limits the conversion of NO_X to NO_2 based on the amount of ozone available.

Odour Assessment

For the characterization of existing conditions, the odour sources will be identified based on previous EA and ECA (ESDM) reports for the facility and current operating conditions as noted above for updated odour measurements. Typical sources of odours include fugitive emissions from the landfill mound (final and interim cover area), the landfill working face, and waste soil stockpiles. Leachate treatment odours will be evaluated based on proposed alternative treatment options or approved systems.

The predicted odour levels from the current waste disposal site will evaluate the potential for odour impacts based on the MECP's 1 OU target levels and frequency of occurrence for odour events above 1 OU, 3 OU and 5 OU at sensitive receptors locations. Odour associated with landfill gas will be based on the MECP emission factor of 10,000 OU/m^3 of gas produced. The site-specific odour measurements, outlined in Section 4.2.1, will be used to characterize odour sources more accurately.

Blowing Litter Assessment

The potential for wind-blown litter to cause a nuisance at nearby residences has been investigated in studies conducted at other landfills in Ontario. The Interim Waste Authority (IWA) conducted a literature review and interviewed landfill operators to get an indication of the potential for nuisance impacts based on distance from the landfill perimeter. In

addition, RWDI has previously conducted wind-tunnel tests to develop threshold wind speeds for wind-blown litter.

Meteorological data, provided by the MECP, and the current operations at the landfill will be used as the primary tools to evaluate the potential for blowing litter events. Wind direction during these events will be used to determine the zones for litter. In addition, changes in windspeed at higher elevations will be considered.

The TCEC complaint record, MECP inspection record, and WM inspection record for blowing litter will be reviewed as part of the blowing litter assessment.

No dispersion modelling will be conducted for the blowing litter assessment.

Climate Change Assessment

The climate change assessment will be conducted for the preferred alternative only; see section 4.3.3.

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- predict the potential environmental effects for each alternative method (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4.3.2); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Section 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1. Potential effects can be positive or negative, direct or indirect, and short or long-term. Alternatives will be assessed with consideration of typical mitigation measures in place.

The proposed facility characteristics of each alternative method will be reviewed to determine potential interactions with Air Quality. The criteria and indicators listed in Table 1 will be applied to each alternative method to determine potential effects. Evaluation of alternative methods will initially be assessed using a qualitative comparison; if this qualitative comparison suggests the alternative methods could result in differing air quality impacts, then a quantitative modelling comparison with be conducted.

If a quantitative comparison of the alternative methods is warranted, for the assessment of dust, landfill gas, combustion by-products, and odour the sources and methodology used for the potential effects assessment are expected to be similar to those considered for the assessment of existing conditions as outlined in Section 4.2. The dispersion modelling methodologies outlined in Section 4.2.2 will also be applied to the qualitative comparison of alternative methods.

One worst-case scenario will be assessed for each alternative method with the potential to have differing air quality impacts. Rationale for selection of the worst-case stages will be outlined in the report. The alternatives will be assessed at the identified receptors only. The alternatives will be assessed for a subset of contaminants, as follows:

- vinyl chloride (as an indicator for VOC contaminants),
- hydrogen sulphide (as an indicator for RS contaminants),
- total particulate matter (as an indicator for dust contaminants),
- nitrogen dioxide (as an indicator for combustion by-products), and,
- odour.

Dispersion modelling will be conducted for the contaminants listed above. The alternative methods will be compared with respect to the following:

- Predicted off-site points of impingement air concentrations of indicator compounds at all identified receptors within 5 kilometers will be presented as concentration isopleths;
- Predicted off-site points of impingement air concentrations for indicator compounds at identified sensitive receptors will be presented as tabular results;
- Change in predicted specific compound concentrations at key receptors from baseline conditions to predicted future operational stages;
- Frequency of any exceedance of applicable standards, limits, or guidelines at identified receptors;
- Number of off-site receptors potentially affected (residential properties, public facilities, businesses/farms, institutions); and
- Contribution from landfill compared to baseline (or existing conditions).

No dispersion modelling will be conducted for the blowing litter assessment. Instead, a comparison of the predicted litter zones between alternatives will be made. Climate change will not be assessed for the alternatives.

4.3.2 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.3 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation

and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative.

Details regarding the operations and design of the preferred alternative will be based on data provided by WM as to planned operations. In general, the sources and methodology used for the effects assessment of the preferred alternative are expected to be similar to those considered for the assessment of existing conditions. Therefore, the dispersion modelling methodologies, outlined in Section 4.2.2 will also be applied to the preferred alternative as well as the "do nothing" alternative (future baseline scenarios).

The preferred alternative will be assessed for all contaminants listed in Section 4.1.

Separate predicted particulate (dust) impacts will be presented for operations activities and construction activities in the assessment of the preferred alternative. Combined impacts of these two activities will also be presented.

As operations will move around the landfill site over the life of the landfill, the effects assessment of the preferred alternative will consider up to three future operational stages. Rationale for selection of the future stages will be outlined in the report.

The TCEC currently has approval to build an on-site leachate treatment plant, however, at the time of this workplan, this plant has not yet been installed. Therefore, the presence of this leachate plant does not form part of the existing conditions. If this leachate plant is part of the preferred alternative, emissions from this leachate plant will be based on emissions presented in the 2016 Environmental Screening Report.

After the assessment is completed, if predicted impacts are outside of acceptable ranges, additional mitigation measures will be proposed and incorporated into the assessment. The resulting net effects will be presented.

Based on the modelling results of the preferred alternative, future monitoring requirements will be developed with the goal of optimizing the monitoring program to cover both operational and construction activities.

A review of existing best management practices (BMPs) will be carried out to develop a framework for improvements to existing BMPs to be carried forward into the Environmental Compliance Approval (ECA) process, where specific details will be developed. This assessment will consider conceptual mitigation options for various on-site activities as well as off-site dust track out as necessary.

For the climate change assessment for the preferred alternative, GHG emission sources will be identified based on previous EA and ECA (ESDM) reports for the facility and current operating conditions. Typical sources of GHG include stationary sources, such as fugitive emissions from the landfill mound, the landfill gas flares, and other stationary combustion equipment, as well as mobile sources, such as on-road vehicles and off-road equipment. Potential credits for beneficial use of landfill gas and/or carbon sequestration will also be considered.

Methane, carbon dioxide, and nitrous oxide releases from the landfill will be quantified using the LANDGEM emission model, Individual GHG emissions will be converted to carbon dioxide equivalents (CO_2e) by applying the appropriate conversion factor (as provided by MECP) to determine the annual CO_2e emissions from the sources. GHG emissions from the on-road vehicles and off-road equipment will be determined through

the use of MOVES emission factors. The total site-wide annual GHG releases will be used to characterize the potential effects.

4.4 Reporting

Two separate reports will be prepared for air quality in support of the EA:

1. A report providing a characterization of Existing Conditions; and
2. A report providing the Effects Assessment.

These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The characterization of existing conditions will include details of completed ambient monitoring and dispersion modelling.

5 References

Canadian Council of Ministers of the Environment
2021 Canadian Ambient Air Quality Standards.

Government of Ontario
1990 Environmental Assessment Act R.S.O. 1990, c. E.18

Technical Assessment and Standards Development Branch Ontario Ministry of the Environment, Conservation and Parks: Human Toxicology and Air Standards Section
2020 Ontario Ambient Air Quality Criteria

International Solid Waste Association (ISWA)
2010 Landfill Operational Guidelines, 2nd Edition.

Ministry of Environment, Conservation, and Parks (MECP)
2016 Technical Bulletin – Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines under O. Reg. 419/05.

Ministry of Environment, Conservation, and Parks (MECP)
2018 Guideline A-10: Procedure for Preparing an Emission Summary and Dispersion Modelling (ESDM) Report.

Ontario Ministry of the Environment Conservation, and Parks (MECP): Air Resources Branch
1992 Interim Guide to Estimate and Assess Landfill Air Impacts.

Ontario Ministry of the Environment and Climate Change
2012 Summary of Standards and Guidelines to support Ontario Regulation 419/05 - Air Pollution – Local Air Quality (including Schedule 6 of O. Reg. 419/05 on UPPER RISK THRESHOLDS).

Ontario Ministry of the Environment Conservation, and Parks (MECP)
2018 Air Contaminants Benchmarks List: standards, guidelines and screening levels for assessing point of impingement concentrations of air contaminants.

United States Environmental Protection Agency (EPA)
2005 Landfill Gas Emissions Model (LandGem) version 3.02.

United States Environmental Protection Agency (EPA)
2019 AERMOD Dispersion Model.

United States Environmental Protection Agency (EPA)
2014 Motor Vehicle Emission Simulator (MOVES), version 2014b.

Waste Management of Canada Corporation
2019 Twin Creeks Landfill Site Air Quality, Odour, and Dust: Evaluation Proposed Increase to Waste Tonnage.

Figures

Figure 1. General On-Site and Off-Site Study Areas

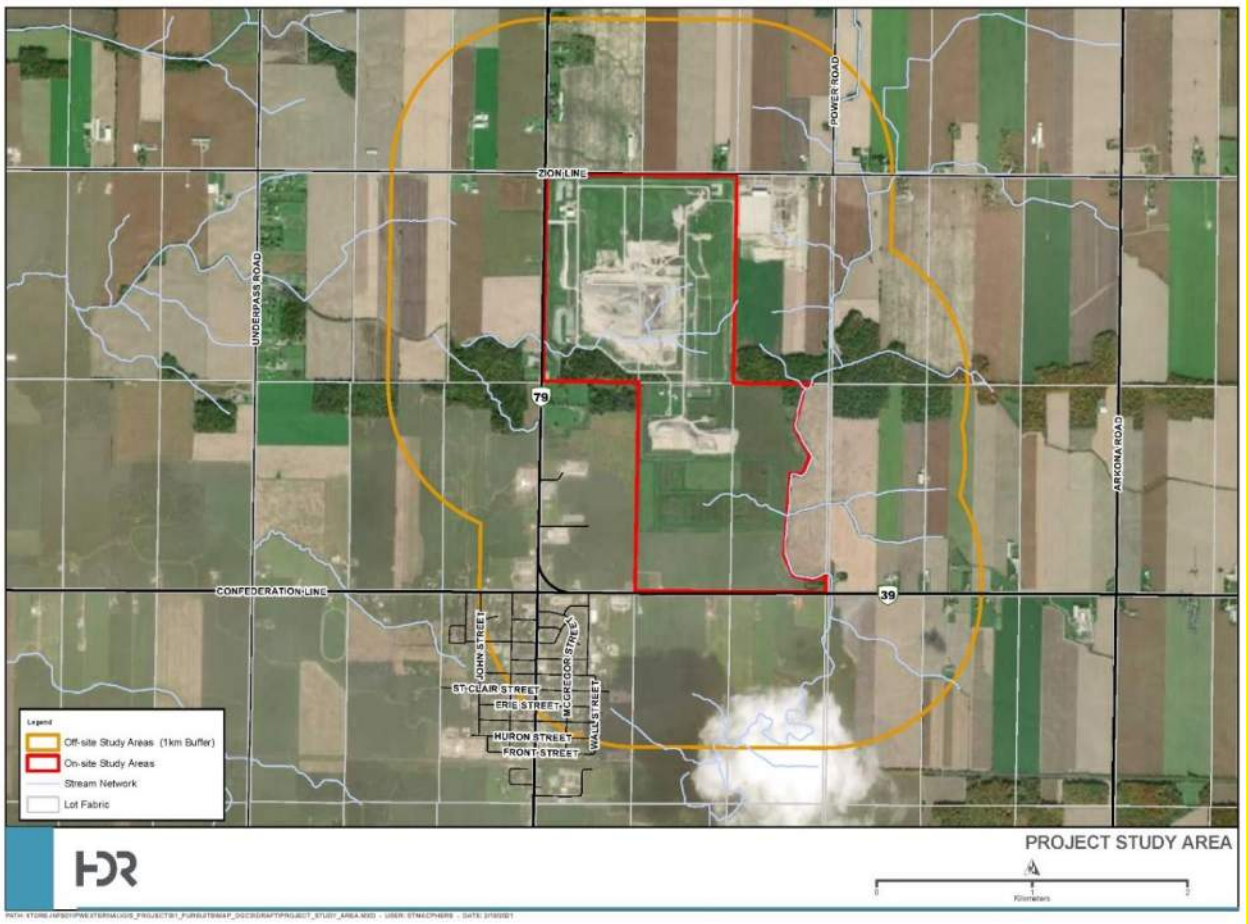
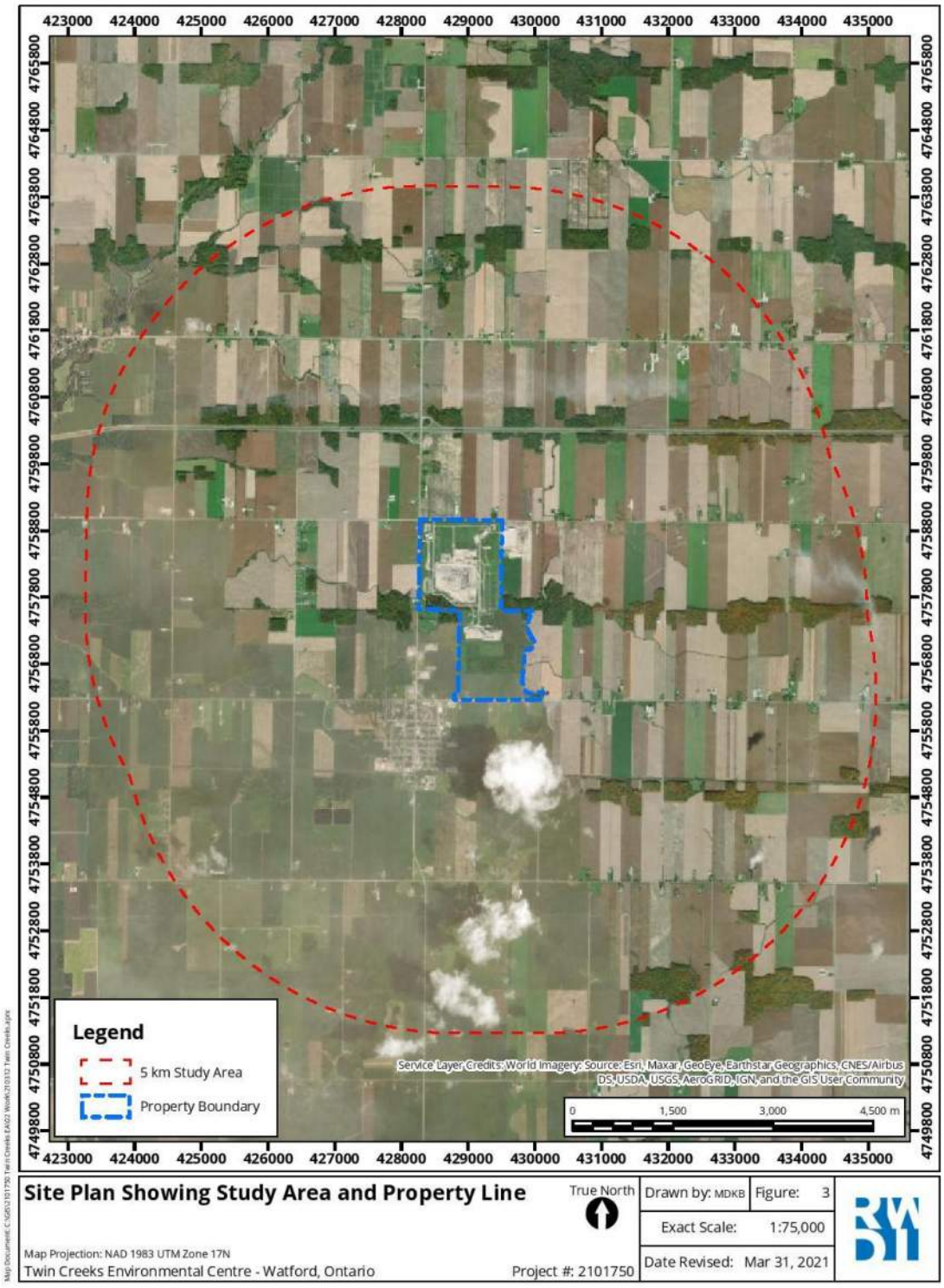


Figure 2. Site Plan Showing Property Boundary, Sensitive Receptors, and TSP Sampling Locations

Figure 3. Site Plan Showing Study Area and Property Line



Archaeology Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

Prepared by:

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Contents

Tables

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Acronyms

Acronym	Definition
ASI	Archaeological Services Inc.
BAO	Bereavement Authority of Ontario
EA	Environmental Assessment
GIS	Geographic Information System
MECP	Ministry of Environment, Conservation and Parks
MHSTCI	Ministry of Heritage, Sport, Tourism, and Culture Industries
TCEC	Twin Creeks Environmental Centre
S&G	Standards and Guidelines for Consultant Archaeologists
ToR	Terms of Reference
WM	Waste Management of Canada Corporation

1 Introduction

This Archaeology work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m³ of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m³, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $23M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act* (Ministry of the Environment, 2016). Part of the EA requires assessment of potential impacts to any archaeological resources within the study area.

The Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) defines archaeology as the study of past human cultures through the investigation of archaeological sites. In Ontario, these sites can include:

- Indigenous hunting camps and villages
- Battlefields
- Pioneer homes
- Burial grounds and cemeteries
- Shipwrecks
- Other evidence of past human activity

Before approving a land development project regulated by legislation, the approval authority for the project requires an archaeological assessment of all lands that are part of the project. Assessments are required when the land is known to have an archaeological site on it or has the potential to have archaeological resources.

The Standards and Guidelines for Consultant Archaeologists (S & G) (MHSTCI, 2011) lists the objectives of a Stage 1 archaeological assessment as follows:

- To provide information about the geography, history, previous archaeological fieldwork of the development property and its current land condition;
- To provide a detailed evaluation of the archaeological potential of the study area which will support recommendations for Stage 2 survey for all or parts of the study area; and
- To recommend appropriate strategies for Stage 2 survey, if necessary.

Indigenous community consultation and engagement activities carried out as part of the EA are separate from the Archaeology work plan.

Cultural heritage assessments are addressed under a separate work plan.

2 Study Purpose and Objectives

This Archaeology work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the archaeological environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the archaeological work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;

2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The general study areas proposed for the purposes of the EA are (Figure 1):

- On-site Study Area: the existing TCEC.
- Off-site Study Area: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area.

During the EA all developments (direct impacts) are proposed within the On-Site Study Area. As archaeology is only concerned with area of direct impact, or within 50 metres of a known archaeological resource, the Off-Site Study Area does not require inclusion in the archaeological assessment. If any impacts are proposed in the Off-Site Study Area, those areas will require Stage 1 archaeological assessment. For the Archaeological Environment, the work will be limited to the On-Site Study Area, historically located in the Township of Warwick, County of Lambton in the following lots and concessions:

- Lots 19-20, Concession 3 South of Egremont Road; and
- Lots 20-21, Concession 4 South of Egremont Road.

4 Scope of Work

The scope of work for Archaeology includes the development of evaluation criteria, indicators, and data sources, characterization of existing archaeological conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for the archaeological environment are provided in Table 1. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on the

archaeological environment. These evaluation criteria and indicators will be finalized during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for Archaeology

Evaluation Criteria	Rationale	Indicators	Data Sources
Archaeological Environment			
Archaeological Resources	Archaeological resources are non-renewable cultural resources that can be destroyed by the construction and operation of a waste disposal facility. Activities related to construction and operation of the landfill may cause negative effects on archaeological sites or areas with archaeological potential.	• Archaeological resources on-site and predicted impacts on them • Cemetery properties within approximately 10 metres of the proposed impacts	• Published data sources • Standards and Guidelines for Consultant Archaeologists • Ontario Archaeological Sites Database (OASD) • MHTSCI register of archaeological reports • Existing Stage 1, 2, 3 Archaeological Assessments for the landfill site • Stage 1 property inspection results • Bereavement Authority of Ontario (BAO) • Cemetery records, plans and plot maps • Historical mapping, topographical maps and aerial photographs and imagery • Proposed facility characteristics • Landfill design and operations data

4.2 Characterization of Existing Conditions

The entire On-Site Study Area has been subject to past Stage 1-2 and Stage 3 archaeological assessments as part of previous landfill expansion projects (ASI, 2001, 2005, 2007, 2008). The Stage 1 report will be conducted to characterize the existing archaeological conditions of the On-Site Study Area; synthesize the findings of the previous assessments; and provide current recommendations in accordance with the 2011 S & Gs and best practices.

The Stage 1 Archaeological assessment report will require the following tasks: provincial inventory and database review; geographic and land use information review; agency and stakeholder consultation; Indigenous community engagement; background historical research; and property inspection to document existing conditions.

Consultation with interested Indigenous groups will be conducted by WM on behalf of ASI to determine if the study area contains any lands known to hold special significance or any features of known Indigenous interest.

The Stage 1 archaeological assessment proposed herein will address the requirements of the Ontario Environmental Assessment Act and the Ontario Heritage Act (R.S.O. 1990,

amended 2005), and will meet the 2011 S&Gs and archaeological license requirements set by MHSTCI. As such, it will also be subject to Ministry of Tourism and Culture review.

The purpose of Stage 1 archaeological assessment is to identify known archaeological sites that may be affected by the undertaking, and to describe the potential for the presence of archaeological resources throughout the EA study area (On-Site and Off-Site). The Stage 1 archaeological assessment will be designed to provide an inventory of known or potentially existing archaeological resources within the study area (Existing Conditions) for the purposes of assessing alternative methods, development of mitigation measures and monitoring programs of the undertaking. The Stage 1 archaeological assessment will involve the following tasks:

Task 1: Project Initiation, Background Research and Review of Existing Archaeological and Historical Data

Update ASI's existing database of known archaeological sites within the study area and identify data gaps that may need to be addressed through subsequent field investigations by:

- Reviewing pertinent provincial government files (OASD)
- Reviewing and compiling the results of a literature search (published and unpublished), including but not limited to archival material held at the Archives of Ontario, and the reports generated by previous archaeological assessment activities within the vicinity of the study area.

Task 2: Determine Archaeological Potential of the Study Area

Determine the archaeological potential of the study area by:

- Reviewing the former geomorphological and hydrological character of the study area, and the reconstructed locations of former settlement and industrial features on the basis of available project mapping, to delimit zones of archaeological potential.
- Should one or more cemeteries be identified, municipal and/or regional cemetery officials and/or heritage planners will be notified to obtain relevant information if necessary.
- Conducting a field review of the study area to confirm the research-based characterization of archaeological potential and to determine the degree to which recent construction disturbances may have affected archaeological potential.

Task 3: Archaeological Inventory and Management Strategy

On the basis of the results of the preceding research, an inventory of known and potential archaeological resources within the study area will be compiled. For each resource that may be impacted by the proposed undertaking, a series of mitigation measures will be recommended for incorporation within the overall development framework plan.

Task 4: Stage 1 Archaeological Assessment Report Preparation

The Stage 1 archaeological assessment report will describe the results of the Stage 1 archaeological assessment and will contain all necessary photographic and cartographic documentation. Available and derived spatial data will be compiled within a geographical information system (GIS) to produce a mapped inventory of known archaeological

resources as well as a zone of archaeological potential for the study area. The report will fulfill the project requirements, while at the same time addressing all of the archaeological and licensing concerns outlined in the Ontario Heritage Act and the Environmental Assessment Act.

The report is sent to MHSTCI as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the S & Gs that are issued by the Minister, and that the archaeological fieldwork and Report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the MHSTCI, a letter will be issued by the Ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development. A copy of this letter will be provided to WM. The report will then be entered into the Ontario Public Registry of Archaeological Reports.

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- predict the potential archaeological effects for each alternative method (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential archaeological effects of each alternative method (Section 4.3.2); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1. Potential effects can be positive or negative, direct or indirect, and short or long-term. Mitigation measures will be identified to minimize or mitigate the potential effects and then the net effects are evaluated taking into consideration the application of mitigation measures.

Potential effects will be identified and evaluated against existing information gathered in the Stage 1 Archaeological Assessment report outlined in Section 4.2, including information provided by the field investigations and the assessment of archaeological potential of any lands that have not adequately been subject to previous archaeological assessment or have additional archaeological conditions/requirements.

4.3.2 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare

the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.3 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative.

If all proposed impacts are within the existing footprint of the landfill, the Stage 1 report will demonstrate that these areas have been cleared of further archaeological concern from previous archaeological assessments.

A site visit will be required to document the existing conditions of the On-Site Study Area and adjacent cemetery property.

4.4 Reporting

One report will be prepared for Archaeology in support of the EA:

1. A report providing a characterization of Existing Conditions and the Effects Assessment (Stage 1 Archaeological Assessment report).

The Stage 1 report will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The characterization of Existing Conditions Stage 1 AA will include a summary of historical developments within the study area, historical mapping review, details of completed field investigations, technical analyses, methods, results, maps of sensitive features within the On-site and Off-site Study Areas, mitigation measures (lands requiring further study by Stage 2, 3 or 4 AA), conclusions, and recommendations, as well as a record of Indigenous consultation.

Stage 3 Cemetery Investigation report may also be required if the preferred alternative is anticipated to impact areas found to retain archaeological potential associated with unmarked burials within the On-Site Study area adjacent to the Watford Cemetery, 5606 Nauvoo Road.

5 References

ASI, (Archaeological Services Inc.). (2001). Stage 1/2 Archaeological Resource Assessment, Warwick Landfill Expansion Project, Township of Warwick, County of Lambton, Ontario [1999-007-054].

ASI, (Archaeological Services Inc.). (2005). Stage 1 and 2 Archaeological Assessment Warwick Landfill Expansion Environmental Assessment, Township of Warwick, County of Lambton, Ontario [1999-007-054, P057-015 (2003), P057-122 (2004) and P057-202 (2005)].

ASI, (Archaeological Services Inc.). (2007). Stage 3 Archaeological Assessment Sites AfHl-8 to -14, -39 to -42, and -45, Warwick Landfill Expansion, Township of Warwick, County of Lambton, Ontario [P057-307-2006 and P057-374-2007].

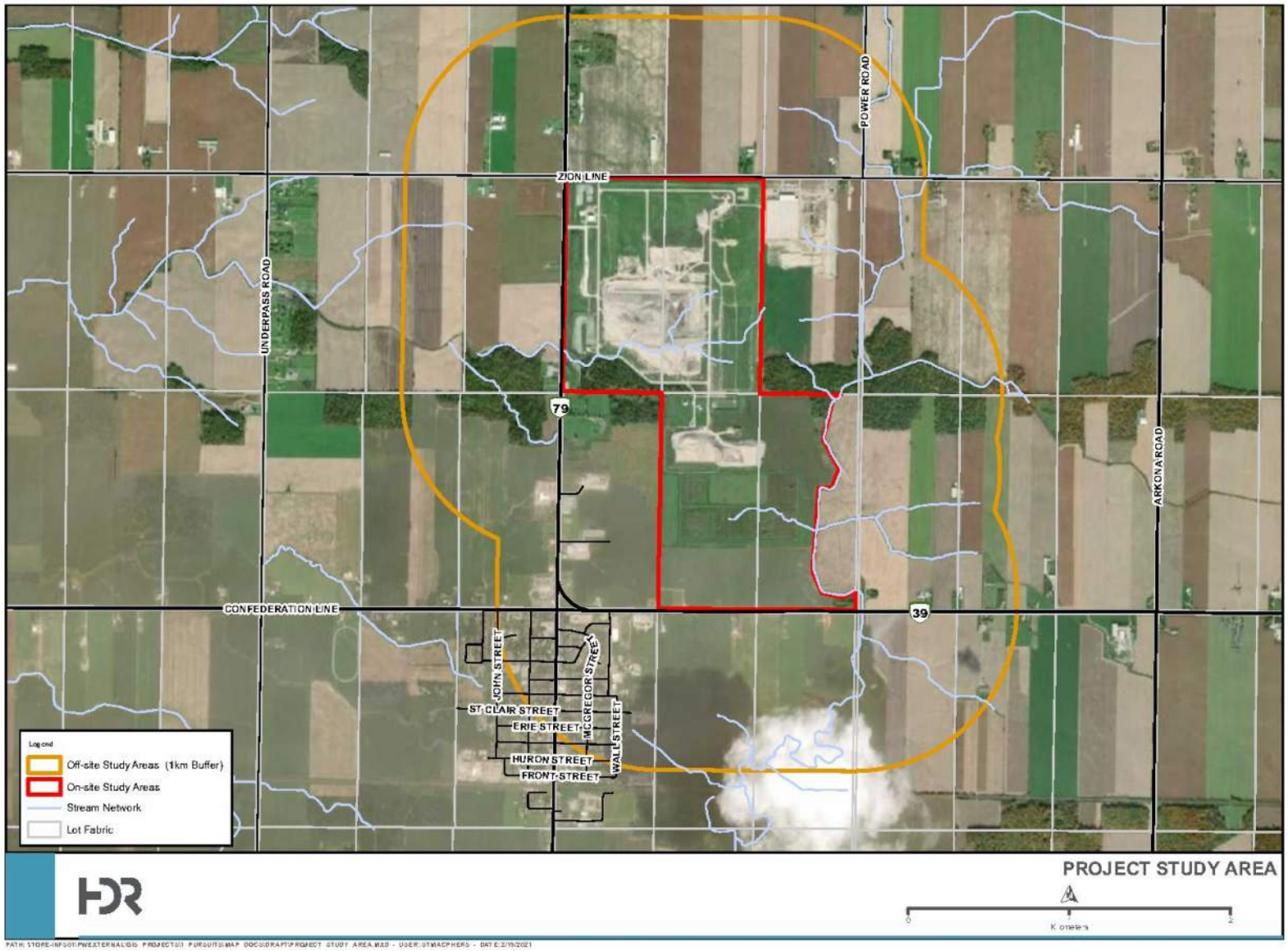
ASI, (Archaeological Services Inc.). (2008). Stage 1 and 2 Archaeological Assessment Highway 402 and County Road 79 Improvements Class Environmental Assessment Warwick Township, Lambton County, Ontario [P057-423-2007].

MHSTCI, (Ministry of Heritage, Sport, Tourism and Culture Industries). (2011). Standards and Guidelines for Consultant Archaeologists. Cultural Programs Branch, Ontario Ministry of Tourism and Culture.

Ministry of the Environment. (2016, February 10). Guide to Environmental Assessment Requirements for Waste Management Projects. Ontario.Ca. https://www.ontario.ca/page/guide-environmental-assessment-requirements-waste-management-projects

Figures

Figure 1. General On-Site and Off-site Study Areas



Cultural Heritage Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

Prepared by:

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Contents

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Acronyms

Acronym	Definition
ASI	Archaeological Services Inc.
BHR	Built Heritage Resource
CHL	Cultural Heritage Landscape
CHER	Cultural Heritage Evaluation Report
EA	Environmental Assessment
HIA	Heritage Impact Assessment
MECP	Ministry of Environment, Conservation and Parks
MHSTCI	Ministry of Heritage, Sport, Tourism, and Culture Industries
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
WM	Waste Management of Canada Corporation

1 Introduction

This Cultural Heritage work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

Cultural heritage assessments in this context consider the above-ground cultural heritage resources that are valued for the important contribution they make to our understanding and appreciation of the history of a place, an event, or people (Ministry of Culture 2006). Cultural heritage resources considered in this assessment include: Built Heritage Resources (BHRs) such as built structures or features with identified design, historical, or contextual value; and Cultural Heritage Landscapes (CHLs) may consist of a geographical area that has been modified by human activity and which has design, historical, or contextual value. Assessment of archaeological site potential for the Project is included in a separate work plan. Similarly, consultation and engagement with Indigenous communities is being carried out during the ToR and the EA and are separate from this work plan.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m^3 of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m^3, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $23M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This Cultural Heritage work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the Cultural Heritage environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the Cultural Heritage work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The general study areas proposed for the purposes of the EA are (**Figure 1**):

- On-site Study Area: the existing TCEC.

- Off-site Study Area: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area.

These study areas have been adopted for Cultural Heritage.

4 Scope of Work

The scope of work for Cultural Heritage includes the development of evaluation criteria, indicators, and data sources, characterization of existing Cultural Heritage conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for Cultural Heritage are provided in **Table 1**. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on Cultural Heritage. These evaluation criteria and indicators will be finalized during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for Cultural Heritage

Evaluation Criteria	Rationale	Indicators	Data Sources
Cultural Environment			
Cultural Heritage Resources (Built Heritage Resources and Cultural Heritage Landscapes)	Activities related to construction and operation of the landfill may result in direct or indirect effects on identified built heritage resources and cultural heritage landscapes.	• Proximity of known or potential cultural heritage resources to the landfill (known/potential built heritage resources and cultural heritage landscapes will be assessed for potential direct or indirect effects). ○ Direct impacts may include: the destruction of any, or part of any, significant heritage attributes or features; and alteration that is not sympathetic, or is incompatible, with the historic fabric and appearance. ○ Indirect impacts may include: shadows created that alter the appearance of a heritage attribute or change the viability of a natural feature or plantings, such as a garden; and isolation of a heritage attribute from its surrounding environment, context or a significant relationship; direct or indirect obstruction of significant views or vistas within, from, or of built and natural features; a change in land use such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces; and land disturbances such as a change in grade that alters soils, and drainage patterns that adversely affect an archaeological resource.	• Published data sources • Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes (MTCS 2016) • Ontario Heritage Tool Kit (MTCS 2006) • Commemorative statements • Proposed facility characteristics • Landfill design and operations data • Viewshed analysis • Previous EA reports • Municipal Heritage Inventories and Staff Reports • Provincial and Federal Heritage Registers and Inventories • Township of Warwick, MHSTCI, Ontario Heritage Trust, and engagement with Indigenous communities • Field survey results • Historical mapping, historical topographical maps and aerial photographs

4.2 Characterization of Existing Conditions

The characterization of the existing cultural heritage conditions of the On-Site and Off-Site Study Areas will require the following tasks:

1. Municipal, provincial and federal heritage inventory and database review. This task will involve review of available municipal, provincial, and federal registers and databases that identify known cultural heritage resources, and previously completed cultural heritage studies completed during the EA (ASI 2005).
2. Agency and stakeholder consultation. Agency and stakeholder consultation and engagement will be carried out as part of the preparation of the Terms of Reference and EA. Municipal and provincial heritage staff will be consulted to determine if any previously identified BHRs and CHLs, including those listed by the municipality, designated under Part IV or Part V of the Ontario Heritage Act, and those subject to any Federal recognition are located within the On-Site or Off-Site Study Areas. Consultation with interested Indigenous groups will be conducted by WM on behalf of ASI to determine if the project area contains any lands known to hold special significance or any features of known Indigenous interest.
3. Background historical research. This task includes conducting historical research for the project area and surrounding historical settlements to establish the Indigenous land use and settlement and the historical Euro-Canadian Township survey and settlement. Historical documents including local historical records, census records, and land ownership records, historical mapping, and aerial photographs will be consulted to establish the historical development and settlement history of the project area. Background historical document review will aid in the determination of approximate construction dates of structures, transportation features, and other landscape features within the project area. As part of the historical map review, project-specific mapping will be produced to illustrate the On-Site and Off-Site Study Area overlaid on historical mapping and aerial photography to demonstrate the development and evolution of the area over time.
4. Field review to document existing conditions. This task will be completed following consultation and background historical research to locate known cultural heritage resources and to identify any potential cultural heritage resources identified during background research. New potential cultural heritage resources will also be identified in field review by following the Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes (Ministry of Tourism, Culture and Sport 2016).
5. Preparation of an inventory of known and potential BHRs and CHLs within the project area. This task includes compiling the results of the heritage inventory and database review, stakeholder consultation, background historical research, and field review to produce an inventory of known and potential BHRs and CHLs within the project area. This inventory will include photographic documentation and description of general features and characteristics, and the rationale for identifying such features.

Outputs of the Characterization of Existing Conditions, including the identification of known and potential BHRs and CHLs within the On-Site and Off-Site Study Area, will allow the

project team to avoid and/or minimize potential effects to identified BHRs and CHLs during the preparation of the preferred alternative through avoidance or by establishing suitable mitigation measures. This cultural heritage assessment will be completed following the guidance presented in, and ensuring compliance with Ontario Heritage Tool Kit (Ministry of Culture 2006), the Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes (Ministry of Tourism, Culture and Sport 2016), and the Guide to Environmental Assessment Requirements for Waste Management Projects (Ministry of the Environment 2016).

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- predict the potential environmental effects for each alternative method (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4.3.2); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1. Potential effects can be positive or negative, direct or indirect, and short or long-term. Mitigation measures will be identified to minimize or mitigate the potential effects and then the net effects are evaluated taking into consideration the application of mitigation measures.

The potential effects of the undertaking on BHRs and CHLs identified in the existing conditions will be considered based on the Ontario Heritage Tool Kit InfoSheet #5: Heritage Impact Assessments and Conservation Plans (Ministry of Tourism and Culture 2006). Potential direct effects that will be considered include: the destruction of any, or part of any, significant heritage attributes or features; and alteration that is not sympathetic, or is incompatible, with the historic fabric and appearance (Ministry of Tourism and Culture 2006). Indirect effects that will be considered include: creation or alteration of shadows; isolation of a heritage attribute from its surroundings; obstruction of significant views to or from the resource; a change in land use; and land disturbance such as grading.

Indirect effects from construction-related vibration have the potential to negatively affect BHRs or CHLs depending on the type of construction methods and machinery selected for the project and proximity and composition of the identified resources. Potential vibration effects are defined as having potential to affect identified BHRs and CHLs where work is taking place within 50 m of features on the property. A 50 m buffer is applied in the absence of a project-specific defined vibration zone of influence based on existing secondary source literature and direction provided from the MHSTCI (Wiss 1981; Rainer 1982; Ellis 1987; Crispino and D'Apuzzo 2001; Carman et al. 2012). This buffer accommodates any additional or potential threat from collisions with heavy machinery or subsidence (Randl

2001). The Off-Site Study Area that extends 1 km from the limits of the TCEC is considered to be an ample buffer to account for any indirect effects to identified cultural heritage resources due to construction or operational vibration effects.

Potential effects on identified BHRs and CHLs will also be considered in terms of their magnitude, severity, duration, frequency, range, and diversity. These are outlined in a document set out by the Ministry of Culture and Communications (now MHSTCI) and the Ministry of the Environment entitled Guideline for Preparing the Cultural Heritage Resource Component of Environmental Assessments (1992).

4.3.2 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.3 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative.

Where potential effects to known and potential BHRs or CHLs are unavoidable, the completion of a resource-specific Cultural Heritage Evaluation Report (CHER) will be required in order to evaluate the specific BHR or CHL for cultural heritage value or interest and confirm its specific heritage attributes that may be subject to effects and require conservation and/or mitigation.

The purpose of the CHER is to examine a property as whole, its relationship to surrounding landscapes, and its individual elements. Conducting archival research and site visits inform such an examination. Background information is gathered from heritage stakeholders where available, local archives, land registry offices, local history collections at public libraries, and the MHSTCI when appropriate. Once background data collection is complete, a site visit (in addition to any site visit completed during the preparation of earlier deliverables) is carried out to conduct photographic documentation and site analysis. These components provide a means to soundly establish the resource's cultural heritage value.

The scope of a CHER is guided by the Ministry of Tourism, Culture and Sport's (now administered by the Ministry of Heritage, Tourism, Sport and Culture Industries) Ontario Heritage Tool Kit (2006). Generally, CHERs include the following components:

A general description of the history of a study area as well as a detailed historical summary of property ownership and building(s) development:

- A description of the cultural heritage landscape and built heritage resources;

- Representative photographs of the structure, and character-defining details;
- A cultural heritage resource evaluation guided by the Ontario Heritage Act criteria;
- A summary of heritage attributes;
- Historical mapping and photographs; and
- A location plan.

Using background information and data collected during the site visit, the property is evaluated using criteria contained within Ontario Regulation 9/06 of the Ontario Heritage Act. The criteria are grouped into the following categories which determine the cultural heritage value or interest of a potential heritage resource in a municipality:

- Design/Physical Value;
- Historical/Associative Value; and
- Contextual Value.

Should a CHER determine that a known or potential BHR or CHL that retains cultural heritage value or interest will be impacted by the preferred alternative, a Heritage Impact Assessment (HIA) should be completed to determine the extent of impacts and to propose suitable mitigation measures.

To assess the potential effects of the preferred alternative for the proposed undertaking on the specific heritage attributes of a BHR or CHL with cultural heritage value or interest confirmed in a CHER, a detailed review of the preliminary design for the preferred alternative is required. Potential effects to identified BHRs and CHLs are considered against a range of possible negative impacts, based on the Ontario Heritage Tool Kit InfoSheet #5: Heritage Impact Assessments and Conservation Plans (Ministry of Tourism and Culture 2006). The preferred alternative will be examined in detail, and the specific effects to individual properties will be assessed for:

Direct impacts:

- Destruction of any, or part of any, significant heritage attributes or features; and
- Alteration that is not sympathetic, or is incompatible, with the historic fabric and appearance.

Indirect impacts

- Shadows created that alter the appearance of a heritage attribute or change the viability of a natural feature or plantings, such as a garden;
- Isolation of a heritage attribute from its surrounding environment, context or a significant relationship;
- Direct or indirect obstruction of significant views or vistas within, from, or of built and natural features;
- A change in land use such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces; and
- Land disturbances such as a change in grade that alters soils, and drainage patterns that adversely affect an archaeological resource.

Several additional factors are also considered when evaluating potential effects on identified BHRs and CHLs. These are outlined in a document set out by the Ministry of Culture and Communications (now MHSTCI) and the Ministry of the Environment entitled Guideline for Preparing the Cultural Heritage Resource Component of Environmental Assessments (1992) and include:

- Magnitude: the amount of physical alteration or destruction which can be expected;
- Severity: the irreversibility or reversibility of an impact;
- Duration: the length of time an adverse impact persists;
- Frequency: the number of times an impact can be expected;
- Range: the spatial distribution, widespread or site specific, of an adverse impact; and
- Diversity: the number of different kinds of activities to affect a heritage resource.

The proposed undertaking should endeavor to avoid adversely affecting known and potential BHRs and CHLs and interventions should be managed in such a way that identified significant cultural heritage resources are conserved. When the nature of the undertaking is such that adverse effects are unavoidable, it may be necessary to implement alternative approaches or mitigation strategies that alleviate the negative effects on identified BHRs and CHLs. Mitigation is the process of lessening or negating anticipated adverse effects to cultural heritage resources and may include, but are not limited to, such actions as avoidance, monitoring, protection, relocation, remedial landscaping, and documentation of the BHR or CHL if to be demolished or relocated.

4.4 Reporting

Two separate reports will be prepared for Cultural Heritage in support of the EA:

1. A report providing a characterization of Existing Conditions (Cultural Heritage Report: Existing Conditions); and
2. A report providing the Effects Assessment (Cultural Heritage Report: Preliminary Impact Assessment with resource-specific CHERs and HIAs included as appendices as required where potential effects are predicted).

These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The characterization of existing conditions will include a methodology, summary of historical developments within the study area, historical mapping review, field review, inventory of known and potential BHRs and CHLs, record of municipal and Provincial and stakeholder or Indigenous consultation, technical analysis, maps of sensitive features within the On-site and Off-site Study Areas, mitigation measures, conclusions, and recommendations.

5 References

ASI, (Archaeological Services Inc.)
2005 *Warwick Landfill Expansion Environmental Assessment: Cultural Heritage Resources*. CHRA. Report on File at ASI, Toronto, ON.

Carman, Richard A., David Buehler, Stephen Mikesell, and Carolyn L. Searls
2012 *Current Practices to Address Construction Vibration and Potential Effects to Historic Buildings Adjacent to Transportation Projects*. Wilson, Ihrig and Associates, ICF International, and Simpson, Gumpertz and Heger, Incorporated for the American Association of State Highway and Transportation Officials (AASHTO), Washington, D.C.

Crispino, M., and M. D'Apuzzo
2001 Measurement and Prediction of Traffic-Induced Vibrations in a Heritage Building. *Journal of Sound and Vibration* 246(2):319–335.

Ellis, Patricia
1987 Effects of Traffic Vibration on Historic Buildings. *The Science of the Total Environment* 59:37–45.

Ministry of Culture
2006 Ontario Heritage Tool Kit.

Ministry of Culture and Communications, and Ministry of the Environment
1992 Guideline for Preparing the Cultural Heritage Resource Component of Environmental Assessments.

Ministry of the Environment
2016 Guide to Environmental Assessment Requirements for Waste Management Projects. *Ontario.ca*. February 10. https://www.ontario.ca/page/guide-environmental-assessment-requirements-waste-management-projects.

Ministry of Tourism and Culture
2006 InfoSheet #5: Heritage Impact Assessments and Conservation Plans.

Ministry of Tourism, Culture and Sport
2016 Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes.

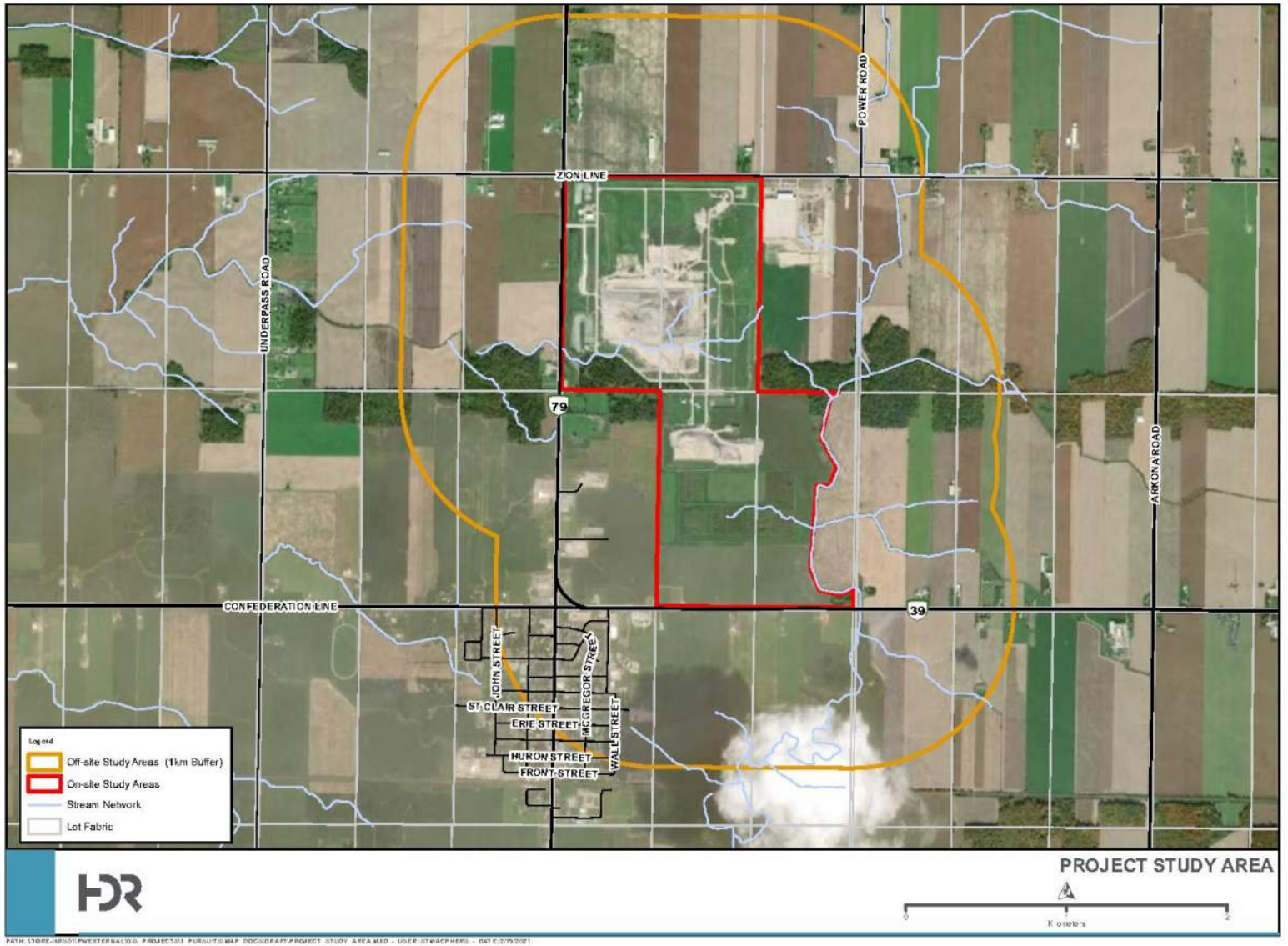
Rainer, J. H.
1982 Effect of Vibrations on Historic Buildings. *The Association for Preservation Technology Bulletin* XIV(1):2–10.

Randl, Chad
2001 Preservation Tech Notes: Protecting a Historic Structure during Adjacent Construction. U.S. Department of the Interior National Park Service, July. https://www.nps.gov/tps/how-to-preserve/tech-notes/Tech-Notes-Protection03.pdf.

Wiss, J. F.
1981 Construction Vibrations; State-of-the-Art. *Journal of Geotechnical Engineering* 107:167–181.

Figures

Figure 1. General On-Site and Off-site Study Areas



Ecological Environment Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

Prepared by:

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Appendices

Acronyms

Acronym	Definition
EA	Environmental Assessment
ELC	Ecological Land Classification
MECP	Ministry of Environment, Conservation and Parks
MNRF	Ministry of Natural Resources and Forestry
NRSI	Natural Resource Solutions Inc.
SAR	Species at Risk
SCC	Species of Conservation Concern
SCRCA	St. Clair River Conservation Authority
SWH	Significant Wildlife Habitat
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
WM	Waste Management of Canada Corporation

1 Introduction

This Ecological Environment (Terrestrial and Aquatic) work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

The Ecological Environment considers both the terrestrial and aquatic ecosystems and includes vegetation communities and species, wildlife and wildlife habitat, aquatic organisms such as fish and aquatic habitat. Studying the Ecological Environment affords an opportunity to assess the species and communities present, as well as the abundance of these organisms.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m³ of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m³, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $24M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This Ecological (Terrestrial and Aquatic) work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the Terrestrial and Aquatic environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the Ecological (Terrestrial and Aquatic) work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The general study areas proposed for the purposes of the EA are (**Figure 1**):

- On-site Study Area: the existing TCEC.
- Off-site Study Area: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area.
    - The Off-site Study Area will include the Gilliland-Geerts Drain downstream and westward of the TCEC to Underpass Road.

These study areas have been adopted for the Ecological Environment. The Off-site Study Area encompasses a 'primary zone of influence' extending 120m from the existing TCEC in keeping with the definition of 'adjacent lands' as set forth in the Natural Heritage Reference Manual (MNRF 2010).

4 Scope of Work

The scope of work for the Ecological (Terrestrial and Aquatic) work includes the development of evaluation criteria, indicators, and data sources, characterization of existing terrestrial and aquatic ecological conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for the terrestrial and aquatic ecological environment are provided in **Table 1**. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on the Terrestrial and Aquatic environment. These evaluation criteria and indicators will be finalized during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for the Ecological Environment

Evaluation Criteria	Rationale	Indicators	Data Sources
Ecological Environment			
Terrestrial Ecosystems	Continued or expanded operation of the waste disposal facility may disturb the functioning of natural terrestrial habitats, including rare, threatened or endangered species.	• Predicted effects on vegetation communities and species including rare, threatened or endangered species • Predicted effects on wildlife and wildlife habitat including rare, threatened or endangered species	• Vegetation and wildlife data, including SAR data from previous studies • Terrestrial field studies • Aerial imagery • Local and Indigenous sources of information on the ecological functions of features within the On-site and Off-site Study Areas. • Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement (Ontario Ministry of Natural Resources 2010) • Significant Wildlife Habitat Technical Guide (Ontario Ministry of Natural Resources 2000) • Significant Wildlife Habitat (Schedule Criteria for Ecoregion 7E (Ontario Ministry of Natural Resources and Forestry 2015) • MECP background data • MNRF background data • SCRCA background data

Table 1. Evaluation Criteria, Indicators, and Data Sources for the Ecological Environment

Evaluation Criteria	Rationale	Indicators	Data Sources
			• Natural Heritage Information Centre background data • Ontario Breeding Bird Atlas • Ontario Butterfly Atlas • Ontario Reptile and Amphibian Atlas • Ontario Odonata Atlas • Ontario Mammal Atlas • eBird • iNaturalist • Proposed facility characteristics • Landfill design and operations data • Annual monitoring report data • Results of other discipline assessments • Survey protocol for Ontario's Species at Risk Snakes (MNRF 2016a) • Survey Protocol for Blanding's Turtle in Ontario (MNRF 2015c) • Blanding's Turtle Nest and Nesting Survey Guidelines (MNRF 2016b) • Ontario Wetland Evaluation System: Southern Manual (MNRF 2014)
Aquatic Ecosystems	Continued or expanded operation of the waste disposal facility may disturb the functioning of natural aquatic habitats and species, including rare, threatened or endangered species.	• Predicted effects on aquatic habitat, including fish habitat • Predicted effects on aquatic biota including rare, threatened or endangered species	• Fish and fish habitat survey data from previous studies • Aquatic field studies • Local and Indigenous sources of information on the ecological functions of features within the On-site and Off-site Study Areas. • MNRF review letters of previous existing conditions reports • MNRF aquatic resource data • Fisheries and Oceans Canada (DFO) Aquatic Species at Risk mapping • Annual monitoring report data • Proposed facility characteristics • Landfill design and operations data • Annual monitoring report data • Results of other discipline assessments • Observations obtained as part of interviews with riparian landowners

4.2 Characterization of Existing Conditions

In order to determine a study approach for the Ecological (Terrestrial and Aquatic) Environment component of the EA, existing natural heritage information was first gathered and reviewed to identify key natural heritage features and species that are reported from, or have potential to occur within the On-site and Off-site Study Areas.

4.2.1 Background Data Collection

Available background information pertaining to the biological resources within the On-site and Off-site Study Areas was collected and reviewed to inform this work plan. During the EA, additional information from various sources will be considered and incorporated into an updated Characterization of Existing Conditions as it becomes available. This information has included (or will include) file material from the St. Clair River Conservation Authority (SCRCA), MECP, Ministry of Northern Development, Mines, Natural Resources and Forestry (MNRF), Ontario Breeding Bird Atlas (BSC et al. 2006), Ontario Butterfly Atlas (Macnaughton et al. 2020), Ontario Reptile and Amphibian Atlas (Ontario Nature 2019), Ontario Mammal Atlas (Dobbyn 1994), and online databases, such as the Natural Heritage Information Centre (NHIC), SAR listings at the federal and provincial levels, and species of regional significance.

Previous reporting from the EA prepared in 2004 will be utilized, specifically the natural heritage reporting completed by Gartner Lee Ltd. (2004).

4.2.2 Species at Risk / Species of Conservation Concern Screening

A preliminary screening has been completed to determine the potential for SAR, SCC and their habitats to be present within the On-site and Off-site Study Areas. The habitats on the site, as derived from air photo interpretation and data from existing data sources (e.g., Gartner Lee Ltd. 2004), have been compared to the habitat requirements of SAR and SCC reported from the local area. See Appendix A for the preliminary SAR/SCC screening. Based on the results of the preliminary screening, 17 SAR and SCC were identified as having potentially suitable habitat within the study areas. Surveys for these species will be undertaken and the species will be addressed in the EA.

4.2.3 Significant Wildlife Habitat Screening

Potential Significant Wildlife Habitat (SWH) types were screened based on NRSI's knowledge of the natural heritage features within the study area and using discrete significance established by the MNRF (2015a). The results of the preliminary SWH screenings have informed the surveys required to determine if such habitats are present within the On-site and Off-site Study Areas.

Based on the preliminary screening, 14 Candidate SWH types were identified as potentially occurring within the On-site and Off-site Study Areas, pending further assessment during site investigations. Appendix B provides a summary of the SWH screening exercise, including rationale as to why SWH types are considered "Candidate SWH" or "Not SWH".

4.2.4 Field Surveys and Characterization

As outlined in Section 3 of this work plan, the Off-site Study Area extends to 1km from the perimeter of the On-site Study Area (Figure 1). Field surveys will be completed in the On-site Study area and will also be completed in the Off-Site Study Area to the extent possible, subject to property access. Where property access is not available, surveys in the Off-site Study Area will focus on the lands that can be reviewed from the boundary of the On-site Study Area, as well as from road right of ways (ROWs).

The following field surveys will be completed to characterize the existing natural features and wildlife habitats according to standardized survey protocols:

Vegetation Surveys

- Mapping of vegetation communities using the Ecological Land Classification (ELC) methods for southern Ontario (Lee et al. 1998). Details on the vegetation communities will be recorded, including species composition, dominance, uncommon species or features;
- Three-season vascular flora inventory, consisting 3 visits: 1 each in the spring (early to mid-May), summer (late June to July), and late summer (late August to September) seasons. Any rare species or vegetation communities identified and their location(s) will be recorded with a handheld GPS;
    - Vascular flora inventories will also function to determine the presence of the SAR Butternut (*Juglans cinerea*) and SCC Green Dragon (*Arisaema dracontium*), Puttyroot (*Aplectrum hyemale*), and Black Ash (*Fraxinus nigra*) as identified in Appendix A;
- Wetland boundary and woodland dripline delineation and agency review to confirm boundaries of these features (this will be undertaken within the On-site Study Area only). Wetland boundary delineation will be completed in accordance with the Ontario Wetland Evaluation System (OWES; MNRF 2014). Woodlands will be delineated based on the dripline.

Avifaunal Surveys

- Breeding bird surveys, consisting of 3 visits in the early morning, spaced at least 1 week apart between May 25 and July 10. Point counts (10 min each), walking transects, and area searches will be utilized. Standard breeding evidence will be recorded according to the Ontario Breeding Bird Atlas methodology (OBBA 2020). These surveys, along with habitat characterizations, will allow for the identification of any significant species and SWH that may be present;
    - Within appropriate open grassland habitats that have been identified in Appendix A as potential habitat for the SAR Eastern Meadowlark (*Sturnella magna*) and Bobolink (*Dolichonyx oryzivorus*), breeding bird surveys will follow the methodologies outlined in the Bobolink and Eastern Meadowlark Survey Methodology (MNRF 2015b).
    - In addition to Eastern Meadowlark and Bobolink, several other bird SAR and SCC have been identified in Appendix A; breeding bird surveys will also function to determine the presence of these species;

- During all site visits, including breeding bird surveys, general observations of the abundance and activity of gulls (*Laridae* family) will be documented specifically within the On-site Study Area.
    - Information on any site-specific bird management programs that are currently in place at the existing TCEC facility will be researched and documented as part of the EA.

Herpetofaunal Surveys

- Evening anuran call surveys during the amphibian breeding season, consisting of 3 visits: 1 each in April, May, and June when air temperatures are a minimum of 5°C, 10°C, and 17°C, respectively. Surveys will be completed during the first half of each month, and will follow the methodology outlined in the Marsh Monitoring Program protocol (BSC 2009);
- Daytime anuran call surveys during the breeding season for the SCC Western Chorus Frog (*Pseudacris triseriata* pop. 2), consisting of at least 2 visits at least 24h apart between mid-March and April when air temperature is at least 10°C. Surveys will follow the methodologies outlined in the Survey Protocol for 2020 Western Chorus Frog Long-Term Monitoring Program (Blazing Star Environmental 2020), and be conducted between 1000h and 1800h. Should Western Chorus Frog be detected at any survey location by the end of the 2nd survey, a 3rd survey will not be completed. Should Western Chorus Frog not be detected by the end of the 2nd survey, a 3rd survey will be completed.
- Reptile surveys following a phased approach:
    - Phase 1 will involve a reptile habitat assessment, consisting of 1 visit in late March (prior to the spring reptile emergence period) to determine if suitable habitat for significant snake and turtle species is present. Assessments will be completed by reviewing natural features and comparing available habitats with those preferred by the target species. As summarized in Appendix A of this work plan, target species include the SCC Snapping Turtle (*Chelydra serpentina*) and the SAR Eastern Hog-nosed Snake (*Heterodon platirhinos*);
    - Phase 2 will be initiated should the reptile habitat assessment indicate that suitable habitat is present. Should it be determined that habitat for Eastern Hog-nosed Snake is present, it will be assumed that the species is present in keeping with the methods outlined in the Survey Protocol for Ontario's Species at Risk Snakes (MNRF 2016a) due to the cryptic nature of the species, and no further targeted surveys will be undertaken for this species. Should it be determined that habitat for Snapping Turtle is present, the following surveys will be completed in accordance with the methodologies outlined in the Survey Protocol for Blanding's Turtle in Ontario (MNRF 2015c) and the Blanding's Turtle Nest and Nesting Survey Guidelines (MNRF 2016b), which are also appropriate for assessing the presence of Snapping Turtle:
        - Spring turtle emergence and basking visual encounter surveys, consisting of 5 visits spread over at least 3 weeks and beginning once ice cover has melted. Surveys will occur no later than June 15, and will be conducted during the daytime when weather conditions are suitable for turtle basking;

        - Turtle nest and nesting surveys, consisting of 6 visits on suitable nights during a 3-week period following the first reports of Snapping Turtle nesting in the area. Surveys will consist of area searches for actively-nesting turtles, signs of turtle activity (e.g., tracks, test pits), and any identifiable nests;
    - Reptile area searches will also be carried out in tandem with all other surveys listed in this work plan that are conducted during suitable weather conditions within the reptile active season (April to October). During peak reptile activity periods (e.g., spring emergence, nesting), searches will expand to include driving surveys that will document any reptiles on roadways in the Off-site Study Area. These area searches and driving surveys will inform the general abundance and diversity of reptile species in the On- and Off-site Study Areas;

Insect Surveys

- Insect area searches will be carried out as part of each of the visits listed above in order to determine if Monarch (*Danaus plexippus*) and its larval food plants (Milkweed, *Asclepias* spp.) are present. Surveys will be focused in summer (June, July and August);

Mammal Surveys

- Bat habitat assessments, consisting of 2 site visits: 1 each in leaf-off and leaf-on conditions according to the Survey Protocol for Species at Risk Bats within Treed Habitats (MNRF 2017). Surveys will assess the presence of suitable roosting habitat (e.g., cavity trees, leaf clusters) that may be used by SAR bats;
    - Acoustic surveys aimed at determining the bat species that are present are not included in this work plan. WM's preference is to develop additional disposal capacity through a vertical expansion of the approved landfill. Consequently, no woodland habitat will be removed. Determining the presence or absence of SAR bat species through acoustic surveys is not typically required if habitat removal is not proposed. An assessment of potential effects on any identified habitat is appropriate. It will be assumed that SAR bat species are present if suitable habitat is present. Should a different preferred alternative be identified during the EA that will result in the removal of treed habitats, survey requirements will be confirmed with the MECP at that time;
- During all site visits, general observations of the abundance and activity of all mammal species will be documented specifically within the On-site Study Area. A particular focus will be placed on identifying the presence and type of predatory mammals. Direct observations, as well as signs such as dens, tracks, scats, etc.

Aquatic Surveys

- Aquatic habitat assessments of watercourse features to characterize the current aquatic habitat conditions. This will include an assessment of the general morphology of the features (e.g., bankfull and wetted widths, bank height, riffle/pool characteristics), general flow conditions and water depths, substrate composition, available aquatic habitat and instream cover, riparian vegetation community conditions and adjacent land uses, and in situ water quality measurements (e.g., water temperature, conductivity, pH and turbidity). Surveys will be completed in the spring

and summer. Primary focus will be on the Kersey Drain / Brown Creek, and the Gilliland-Geerts Drains and their headwater tributaries;

  - Flow conditions and water temperature in the watercourses of primary focus will be documented during the completion of other surveys throughout the field season, to provide information on the flow and thermal regimes of the features.

- Fish community surveys will be completed to assess the presence of direct fish habitat in the watercourses of primary focus. Surveys will be undertaken with a backpack electrofishing unit and will be conducted in accordance with the Ontario Stream Assessment Protocol (OSAP) single-pass electrofishing methodology (Stanfield 2017). Once collected, fish will be identified to species and released outside of the sampling area. The number of individual fish, and minimum and maximum lengths for each species, will be recorded along with representative photographs of each species. Water quality conditions, electrofisher settings, and number of shocking seconds for each pass will be documented. Due to the intermittent/ephemeral nature of the features, surveys will be conducted when flows are seasonally elevated in either the spring or fall;

  - While fish community assessments will provide information on the composition and diversity of resident fish populations, they will also function to determine the presence of the SCC Northern Sunfish (*Lepomis peltastes*) as identified in Appendix A;

Other Surveys

- In addition to targeted surveys noted above, all wildlife species will be recorded during field surveys. Any features that may be indicative of SWH or habitat for SAR will be documented in detail, photographed, and georeferenced. General assessments of habitat connectivity and ecological linkage areas will be also be completed during surveys.

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- predict the potential environmental effects for each alternative method (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4.3.2); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1. Potential effects can be positive or negative, direct or indirect, and short or long-term. Mitigation measures will be identified to minimize or mitigate the potential effects and then

the net effects are evaluated taking into consideration the application of mitigation measures.

The analysis and evaluation of impacts will be divided into direct, indirect, induced, and cumulative impacts, which will be assessed in the short- and long-terms.

- Direct impacts associated with the disruption or displacement caused by the actual proposed footprint of the undertaking, such as direct impacts to wildlife and/or their habitats;
- Indirect impacts associated with changes in site conditions, such as indirect impacts to wildlife and modifications to drainage and water quantity and quality; and
- Induced impacts associated with impacts after the landfill expansion is in operation, such as the subsequent increase in landfill capacity and the increased demand on the resources by use of the area.

Recommendations with regard to mitigation of construction and residual effects will also be made and opportunities for enhancements will be highlighted. As part of the recommendations outlined, timing windows to avoid impacts will be included, such as tree removal (if required).

4.3.2 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.3 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the ‘do nothing’ alternative and will examine cumulative impacts associated with surrounding activities over time and space.

4.4 Reporting

Two separate reports will be prepared for the Ecological (Terrestrial and Aquatic) work in support of the EA:

1. A report providing a characterization of Existing Conditions; and
2. A report providing the Effects Assessment.

These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The characterization of existing conditions will include details of completed field investigations, technical analyses, methods, results, maps of sensitive features within the On-site and Off-site Study Areas, conclusions, and recommendations.

5 References

Bird Studies Canada. 2009. Marsh Monitoring Program Participant's Handbook for Surveying Amphibians. 2009 Edition. Published by Bird Studies Canada in Cooperation with Environment Canada and the U.S. Environmental Protection Agency. February 2009.

Bird Studies Canada, Environment Canada's Canadian Wildlife Service, Ontario Nature, Ontario Field Ornithologists and Ontario Ministry of Natural Resources. 2006. Ontario Breeding Bird Atlas Database, 31 January 2008. http://www.birdsontario.org/atlas/aboutdata.jsp?lang=en (Accessed February 2021).

County of Lambton. 2020. County of Lambton Official Plan: October 1, 2020 Office Consolidation. Accessed from: (https://www.lambtononline.ca/en/business-and-development/official-plan.aspx).

Dobbyn, J.S. 1994. Atlas of the Mammals of Ontario. Don Mills, Federation of Ontario Naturalists.

Gartner Lee Ltd. 2004. Natural Environment and Resource Baseline – Warwick Landfill Expansion Environmental Assessment. Prepared for Waste Management of Canada Corporation.

Lee, H.T., W.D. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and its Application. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

Macnaughton, A, R. A Layberry, C Jones, and B Edwards. 2020. "Ontario Butterfly Atlas Online." Toronto Entomologists' Association. Updated February 2020. Available: http://www.ontarioinsects.org/atlas_online.htm.

Ontario Breeding Bird Atlas (OBBA). 2020. Instructions for General Atlassing. Birds Canada, Ontario Field Ornithologists, Ontario Nature, Ontario Ministry of Natural Resources and Forestry, and Environment and Climate Change Canada. December 2020. 17pp.

Ontario Nature. 2019. Ontario Reptile and Amphibian Atlas Program: Interactive Range Maps. Accessed October 2019.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2010. Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005. Second Edition, March 18, 2010. Available: https://docs.ontario.ca/documents/3270/natural-heritage-reference-manual-for-natural.pdf

Ontario Ministry of Natural Resources and Forestry (MNRF). 2014. Wetland Evaluation System: Southern Manual. 3rd Edition, Version 3.3.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2015a. Significant Wildlife Habitat Ecoregion 7E Criterion Schedule: Addendum to Significant Wildlife Habitat Technical Guide. MNRF, January 2015.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2015b. Bobolink/Eastern Meadowlark Survey Methodology. Ministry of Natural Resources and Forestry- Aurora District. June 2015. 2pp.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2015c. Survey Protocol for Blanding's Turtle (*Emydoidea blandingii*) in Ontario. Species Conservation Policy Branch. Peterborough, Ontario. ii + 16 pp.

Ministry of Natural Resources and Forestry (MNRF). 2016a. Survey Protocol for Ontario's Species at Risk Snakes. Ontario Ministry of Natural Resources and Forestry, Species Conservation Policy Branch. Peterborough, Ontario. ii + 17 pp.

Ministry of Natural Resources and Forestry (MNRF). 2016b. Blanding's Turtle Nest and Nesting Survey Guidelines. Ministry of Natural Resources and Forestry Guelph District. May 2016 – version 1. 2pp.

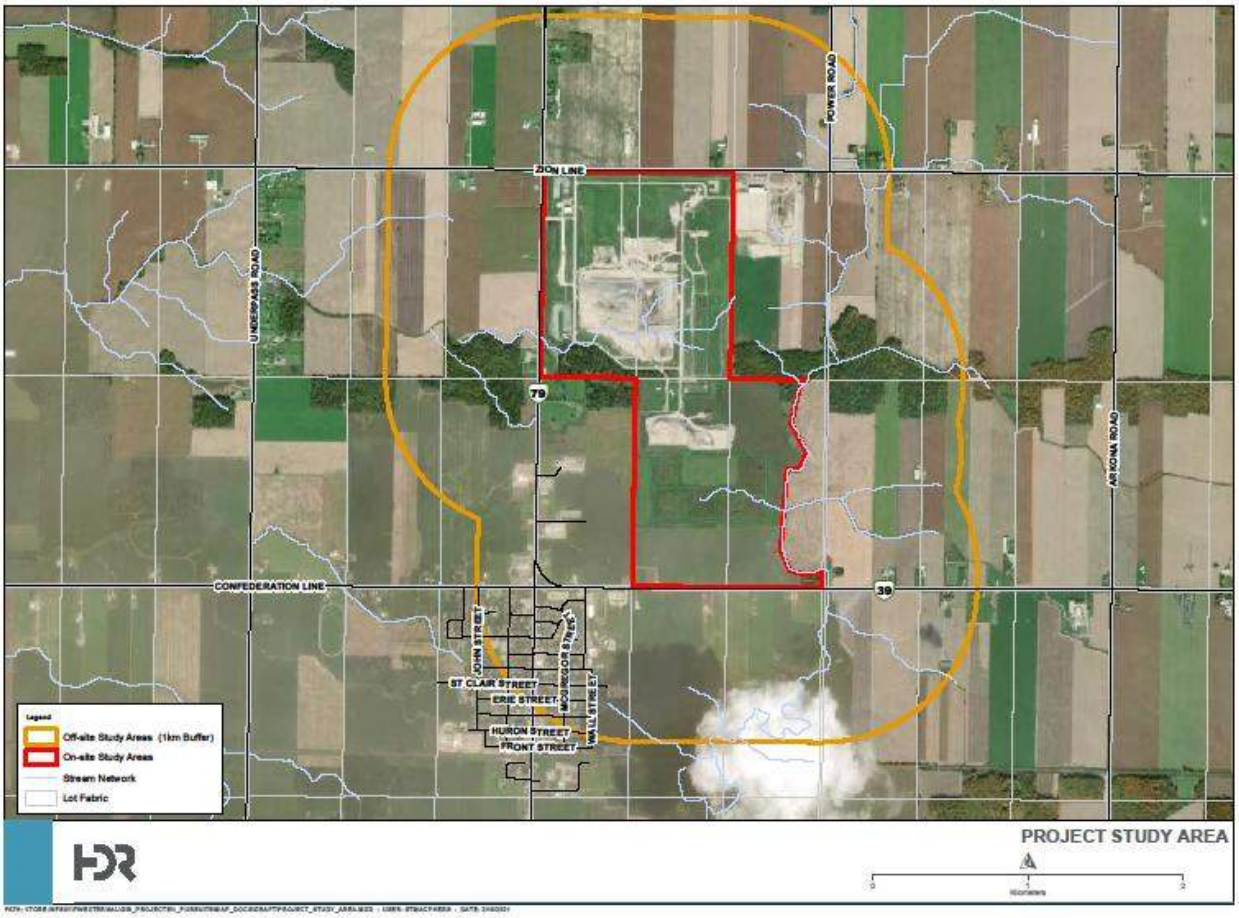
Ontario Ministry of Natural Resources and Forestry (MNRF). 2017. Survey Protocol for Species at Risk Bats within Treed Habitats. April 2017.

Stanfield, L. 2017. Ontario Stream Assessment Protocol. Version 10. Last updated April 2017. (https://s3-ca-central-1.amazonaws.com/trcaca/app/uploads/2019/06/05112225/osap-master-version-10-july1-accessibility-compliant_editfootnoteS1M4.pdf)

Township of Warwick. 2010. Township of Warwick Official Plan. Accessed from: (https://www.warwicktownship.ca/en/business-and-development/official-plan.aspx).

Figures

Figure 1. General On-site and Off-site Study Areas



A

Species at Risk / Species of Conservation Concern Screening Assessment

Preliminary Species at Risk and Species of Conservation Concern Screening - Twin Creeks Environmental Centre Landfill Optimization Project (Project #2538)

Scientific Name	Common Name	S-RANK[1]	SARO[1]	COSEWIC[2]	SARA[2]	SARA Schedule[2]	Background Source	Habitat Requirements	Suitable Habitat Within Study Areas?
Birds									
Chaetura pelagica	Chimney Swift	S3B	THR	T	T	Schedule 1	BSC et al. 2006	Commonly found in urban areas near buildings; nests in chimneys, hollow trees,and crevices of rock cliffs. Feeds over open water.[3,4]	Unlikely. Cultural woodlands and deciduous forests present within On- and Off-site Study Areas and may contain suitable cavity trees with diameter (dbh) > 50cm, however this species prefers to nest in uncapped chimneys which are rare within the On- and Off-Site Study Areas. Breeding bird surveys will be completed to confirm presence / absence.
Contopus virens	Eastern Wood-pewee	S4B	SC	SC	SC	Schedule 1	Gartner Lee Ltd. 2004; BSC et al. 2006	Mid-canopy layer of forest clearings and edges of deciduous and mixed forest. Abundant in intermediate-age mature forest stands with little understory vegetation.[3,4]	Yes. Deciduous forest and cultural woodland habitats are present within the On- and Off-Site Study Areas. Breeding bird surveys will be completed to confirm presence / absence.
Dolichonyx oryzivorus	Bobolink	S4B	THR	T	T	Schedule 1	Gartner Lee Ltd. 2004; BSC et al. 2006; MNRF 2021b	Large (>10 ha), open expansive grasslands, pastures, hayfields, meadows or fallow fields with dense ground cover. Occassionally nest in large (>50 ha) fields of winter wheat and rye in southwestern Ontario. [3,4]	Yes. Suitable habitat consisting of cultural meadows is present within the On-site Study Area. Active agricultural lands, particularly row crops, found within the Off-site Study Area are not suitable for Bobolink. Breeding bird surveys will be completed to confirm presence / absence.
Hirundo rustica	Barn Swallow	S4B	THR	SC	T	Schedule 1	BSC et al. 2006	Farmlands, rural areas and other open or semi-open areas near body of water. Nests almost exclusively on human-made structures such as open barns, buildings, bridges and culverts.[3,4]	Yes. Suitable foraging and nesting habitat is likely present within the On- and Off-Site Study Areas. Breeding bird surveys will be completed to confirm presence / absence.
Hylocichla mustelina	Wood Thrush	S4B	SC	T	T	Schedule 1	Gartner Lee Ltd. 2004; BSC et al. 2006	Carolinian and Great Lakes-St. Lawrence forest zones. Undisturbed moist mature deciduous or mixed forest with deciduous sapling growth. Near pond or swamp. Must have some trees higher than 12 m.[3,4]	Yes. Deciduous forest and cultural woodland habitats are present within the On- and Off-Site Study Areas. Breeding bird surveys will be completed to confirm presence / absence.
Riparia riparia	Bank Swallow	S4B	THR	T	T	Schedule 1	BSC et al. 2006	Nests in burrows in natural and human-made settings with vertical faces in silt and sand deposits. Ususally on banks of river and lakes, but also found in sand and gravel pits.[3,4]	Possible. Suitable foraging habitat is present within the On- and Off-Site Study Areas. Suitable nesting habitat may be present within the On-site Study Area. Breeding bird surveys will be completed to confirm presence / absence.
Sturnella magna	Eastern Meadowlark	S4B, S3N	THR	T	T	Schedule 1	Gartner Lee Ltd. 2004; BSC et al. 2006; MNRF 2021b	Open pastures, hayfields, grasslands or grassy meadows with elevated singing perches (small trees, shrubs or fence posts). Also weedy borders of croplands, roadsides, orchards, airports, shrubby overgrown fields or other open areas. Generally prefers larger tracts of habitat >10 ha, but will sometimes use smaller tracts.[3,4]	Yes. Suitable habitat consisting of cultural meadows is present within the On-site Study Area. Active agricultural lands, particularly row crops, found within the Off-site Study Area are not suitable for Eastern Meadowlark. Breeding bird surveys will be completed to confirm presence / absence.
Herpetofauna									
Turtles									
Chelydra serpentina	Snapping Turtle	S4	SC	SC	SC	Schedule 1	Ontario Nature 2019	Slow-flowing rivers and streams, lakes, and permanent or semi-permanent wetlands with soft substrates and vegetation. Key habitat requirements: open areas with structures for basking, open sand or gravel areas for nesting, shallow areas with soft substrates to bury in, soft banks or substrates for hibernation.[3]	Yes. A reptile habitat assessment will be completed to confirm the presence of suitable habitat for the species. If suitable habitat is present, targeted surveys for turtles will be completed to confirm presence / absence.

Preliminary Species at Risk and Species of Conservation Concern Screening - Twin Creeks Environmental Centre Landfill Optimization Project (Project #2538)

Scientific Name	Common Name	S-RANK[1]	SARO[1]	COSEWIC[2]	SARA[2]	SARA Schedule[2]	Background Source	Habitat Requirements	Suitable Habitat Within Study Areas?
Snakes									
Heterodon platirhinos	Eastern Hog-nosed Snake	S3	THR	T	T	Schedule 1	MECP 2021	Open habitats, such as open woods, brushland or forest edges, with well-drained loose or sandy soils, well-drained substrates. Specializes in hunting and eating toads; occurs in habitats near or adjacent to wetland habitats where toads are present. Rocks, logs, stumps, etc. are used for shelter. Uses snout to dig nests as well as to dig burrows for overwintering.[5]	Yes. Suitable habitat is likely to be present within the On- and Off-Site Study Areas. A reptile habitat assessment will be completed to confirm the presence of suitable habitat for the species. Should it be determined that habitat for Eastern Hog-nosed Snake is present, it will be assumed that the species is present, and no further targeted surveys will be undertaken.
Anurans									
Pseudacris triseriata pop.2	Western Chorus Frog (Great Lakes - St. Lawrence - Canadian Shield population)	S4	NAR	T	T	Schedule 1	iNaturalist 2021	Moist forest, prairie, meadows, cultural meadows, or marshes. Breeds in shallow, temporary, fishless wetlands, including flooded ditches, marshes, flooded fields, pastures, temporary ponds, pools, and swamps. Hibernates in terrestrial habitats under rocks, logs, leaf litter, loose soil, or in animal burrows.[6]	Yes. Daytime anuran call surveys for breeding frogs and toads will be completed to confirm presence / absence.
Mammals									
Myotis lucifungus	Little Brown Myotis	S3	END	E	E	Schedule 1	Dobbyn 1994	Uses caves, quarries, tunnels, hollow trees or buildings for roosting. Winters in humid caves. Maternity sites in dark warm areas such as attics and barns. Feeds primarily in wetlands and forest edges.[3,4]	Yes. Bat habitat assessments will be conducted to confirm if suitable habitat is present. Should it be determined that habitat for Little Brown Myotis is present, it will be assumed that the species is present.
Myotis septentrionalis	Northern Myotis	S3	END	E	E	Schedule 1	Dobbyn 1994	Roosts in houses and man-made structures but prefers hollow trees or under loose bark. Hibernates in mines or caves. Hunts within forest, below the canopy.[3,4]	Yes. Bat habitat assessments will be conducted to confirm if suitable habitat is present. Should it be determined that habitat for Northern Myotis is present, it will be assumed that the species is present.
Perimyotis subflavus	Tri-colored Bat	S3?	END	E	E	Schedule 1	Dobbyn 1994	Roosts and maternity colonies in older forests and occassionally in barns or other sturctures. Forage over water and along streams in the forest. Hibernate in caves.[3,4]	Yes. Bat habitat assessments will be conducted to confirm if suitable habitat is present. Should it be determined that habitat for Tri-colored Bat is present, it will be assumed that the species is present.
Insects									
Butterflies									
Danaus plexippus	Monarch	S2N, S4B	SC	END	SC	Schedule 1	Macnaughton et al. 2020	Adults found in a diversity of habitats with a variety of wildflowers. Caterpillars are confined to meadows and open areas where milkweeds grow (larval food plants).[3]	Yes. Suitable habitat consisting of cultural meadows and cultural woodlands are present within the On-and Off-Site Study Areas. Insect surveys will be conducted within the study area to determine presence / absence.
Polystoechotes punctata	Speckled Giant Lacewing	SH	-	-	-	-	MNRF 2021b	Cultural and natural landscapes. Extirpated from Ontario by mid-1950s. Only present in western North America (M. Burrell, NHIC pers.comm).	No. Species extirpated from Ontario.
Fish									
Lepomis peltastes pop. 2	Northern Sunfish (Great Lakes - Upper St. Lawrence populations)	S3	SC	SC	SC	Schedule 1	DFO 2019	Shallow vegetated areas of quiet, slow-flowing rivers and streams, as well as warm lakes and ponds, with sandy banks or rocky bottoms.[7]	Yes. Based on past surveys, Kersey Drain / Brown Creek and the Gilliland-Geerts Drain are likely to provide suitable aquatic habitat that could support Northern Sunfish. Fish community assessments will be completed to confirm presence / absence.

Preliminary Species at Risk and Species of Conservation Concern Screening - Twin Creeks Environmental Centre Landfill Optimization Project (Project #2538)

Scientific Name	Common Name	S-RANK[1]	SARO[1]	COSEWIC[2]	SARA[2]	SARA Schedule[2]	Background Source	Habitat Requirements	Suitable Habitat Within Study Areas?
Plants									
Aplectrum hyemale	Puttyroot	S2	-	-	-	-	MNRF 2021b	Rich forests, both upland beech-maple and swamps in moist ground.[8]	Possible. Deciduous forests found within the On- and Off-Site Study Areas may provide suitable growing conditions. Vascular flora inventories will be conducted to determine presence / absence.
Arisaema dracontium	Green Dragon	S3	-	SC	SC	Schedule 3	MNRF 2021b	Moist forests, especially along river banks and floodplains.[8]	Possible. Deciduous forests found within the On- and Off-Site Study Areas may provide suitable growing conditions. Vascular flora inventories will be conducted to determine presence / absence.
Fraxinus nigra	Black Ash	S4	-	T	NS	No Schedule	Gartner Lee Ltd. 2004	Usually on mucky or peaty soils in swamps, such as river floodplains.[8]	Yes. Deciduous forests found within the On- and Off-Site Study Areas provide suitable growing conditions. Vascular flora inventories will be conducted to determine presence / absence.
Juglans cinerea	Butternut	S2?	END	E	E	Schedule 1	Gartner Lee Ltd. 2004	Stream banks and swamps, as well as upland beech-maple, oak-hickory, and mixed hardwood stands.[8]	Yes. Deciduous forests found within the On- and Off-Site Study Areas provide suitable growing conditions. Vascular flora inventories will be conducted to determine presence / absence.

References:

[1]MNRF 2021a Ministry of Natural Resources and Forestry (MNRF). 2021a. Natural Heritage Information Centre (NHIC): Species List for Ontario. Published: 2014-07-17. All Species List Updated: 2021-03-18. Available: https://www.ontario.ca/page/get-natural-heritage-information

[2]Government of Canada 2021 Government of Canada. 2021. Species at Risk Public Registry: Species Search. Updated: 2021-02-02. Available: https://species-registry.canada.ca/index-en.html#/species?sortBy=commonNameSort&sortDirection=asc&pageSize=10

[3]MECP 2020 Ministry of the Environment, Conservation, and Parks (MECP). 2020. Species at Risk in Ontario. Published: 12-07-2018. Updated: 09-11-2020. Available: https://www.ontario.ca/page/species-risk-ontario

[4]OMNR 2000 Ontario Ministry of Natural Resources (OMNR). 2000. Significant Wildlife Habitat Technical Guide. Appendix G: Wildlife Habitat Matrices and Habitat Descriptions for Rare Vascular Plants. October 2000.

[5]Kraus 2011 Kraus, T. 2011. Recovery Strategy for the Eastern Hog–nosed Snake (Heterodon platirhinos) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. i + 6 pp + Appendix vi + 24 pp. Adoption of the Recovery Strategy for the Eastern Hog–nosed Snake (Heterodon platirhinos) in Canada (Seburn, 2009). https://www.ontario.ca/page/eastern-hog-nosed-snake-recovery-strategy#section-1

[6]COSEWIC 2008 COSEWIC. 2008. COSEWIC Assessment and Update Status Report on the Western Chorus Frog *Pseudacris triseriata* Carolinian population and Great Lakes/St. Lawrence - Canadian Shield Population in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 47 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

[7]Holm et al. 2011 Holm, E, NE Mandrak, M Burridge. 2010. The ROM Field Guide to Freshwater Fishes of Ontario. Published by the Royal Ontario Museum, toronto Ontario. 462 pp.

[8]Reznicek et al. 2011 A. A. Reznicek, E. G. Voss, & B. S. Walters. Michigan Flora Online. University of Michigan. Published: February 2011. Available: https://michiganflora.net/genus.aspx?id=Sium.

BSC et al. 2006 Bird Studies Canada (BSC), Environment Canada's Canadian Wildlife Service, Ontario Nature, Ontario Field Ornithologists and Ontario Ministry of Natural Resources. 2006. Ontario Breeding Bird Atlas Database, 31 January 2008. https://www.birdsontario.org/jsp/datasummaries.jsp

Dobbyn 1994 Dobbyn, J.S. 1994. Atlas of the Mammals of Ontario. Don Mills, Federation of Ontario Naturalists. 120p.

Gartner Lee Ltd. 2004 Gartner Lee Ltd. 2004. Natural Environment and Resource Baseline – Warwick Landfill Expansion Environmental Assessment. Prepared for Waste Management of Canada Corporation.

iNaturalist 2021 iNaturalist. 2021. Research-Grade Plant and Wildlife Observations for Southern Ontario. Accessed: November 11, 2021. Available: https://www.inaturalist.org.

Macnaughton et al. 2020 Macnaughton A., Layberry R., Cavasin R., Edwards B., and C. Jones. Ontario Butterfly Atlas. Updated February 2020. Available: https://www.ontarioinsects.org/atlas/index.html

MECP 2021 Ministry of the Environment, Conservation, and Parks (MECP). 2021. Species at Risk Branch Response to Information Request. Email correspondence between A. Reinert (Natural Resource Solutions Inc.) and A. Zarkovich (MECP SAR Branch) dated March 15, 2021.

MNRF 2021b Ministry of Natural Resources and Forestry (MNRF). 2021b. Natural Heritage Information Centre (NHIC): Make a Natural Heritage Area Map Application. Published: 2014-07-17. Updated 2021-05-27. Available: https://www.ontario.ca/page/make-natural-heritage-area-map

Ontario Nature 2019 Ontario Nature. 2019. Ontario Reptile and Amphibian Atlas Program: Interactive Range Maps. Accessed October 2019.

B

Significant Wildlife Habitat Screening Assessment

Significant Wildlife Habitat Assessment Tables

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Waterfowl Stopover and Staging Areas (Terrestrial)					
Rationale: Habitat important to migrating waterfowl	American Black Duck Northern Pintail Gadwall Blue-winged Teal Green-winged Teal American Wigeon Northern Shoveler Tundra Swan	CUM1 CUT1 - Plus evidence of annual spring flooding from melt water or run-off within these Ecosites. - Fields with seasonal flooding and waste grain in the Long Point, Rondeau, Lake. St. Clair, Grand Bend and Pt. Pelee areas may be important to Tundra Swans.	Fields with sheet water during Spring (mid March to May). • Fields flooding during spring melt and run-off provide important invertebrate foraging habitat for migrating waterfowl. • Agricultural fields with waste grains are commonly used by waterfowl, these are not considered SWH unless they have spring sheet water available[cxlviii] Information Sources • Anecdotal information from the landowner, adjacent landowners or local naturalist clubs may be good information in determining occurrence. • Reports and other information available from Conservation Authorities (CAs) • Sites documented through waterfowl planning processes (eg. EHJV implementation plan) • Field Naturalist Clubs • Ducks Unlimited Canada • Natural Heritage Information Centre (NHIC) Waterfowl Concentration Area	Studies carried out and verified presence of an annual concentration of any listed species, evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • Any mixed species aggregations of 100[f] or more individuals required. • The area of the flooded field ecosite habitat plus a 100-300m radius buffer dependant on local site conditions and adjacent land use is the significant wildlife habitat[cxlviii]. • Annual use of habitat is documented from information sources or field studies (annual use can be based on studies or determined by past surveys with species numbers and dates). • SWHMIST[cxlix] Index #7 provides development effects and mitigation measures.	Study area highly disturbed, specifically the TCEC. Species are not tolerant to human disturbance. **Not SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Waterfowl Stopover and Staging Areas (Aquatic)					
Rationale: Important for local and migrant waterfowl populations during the spring or fall migration or both periods combined. Sites identified are usually only one of a few in the eco-district	Canada Goose Cackling Goose Snow Goose Green-winged Teal American Black Duck Northern Pintail Northern Shoveler American Wigeon Gadwall Blue-winged Teal Hooded Merganser Common Merganser Red-breasted Merganser Lesser Scaup Greater Scaup Common Goldeneye Bufflehead Long-tailed Duck Surf Scoter White-winged Scoter Black Scoter Canvasback Redhead Ruddy Duck Brant White-winged Scoter Black Scoter	MAS1 MAS2 MAS3 SAS1 SAM1 SAF1 SWD1 SWD2 SWD3 SWD4 SWD5 SWD6 SWD7	• Ponds, marshes, lakes, bays, coastal inlets, and watercourses used during migration. Sewage treatment ponds and storm water ponds do not qualify as a SWH, however a reservoir managed as a large wetland or pond/lake does qualify. • These habitats have an abundant food supply (mostly aquatic invertebrates and vegetation in shallow water). Information Sources • Environment Canada • Naturalist clubs often are aware of staging/stopover areas • OMNRF Wetland Evaluations indicate presence of locally and regionally significant waterfowl staging. • Sites documented through waterfowl planning processes (eg. EHJV implementation plan) • Ducks Unlimited projects • Element occurrence specification by Nature Serve: http://www.natureserve.org • Natural Heritage Information Centre (NHIC) Waterfowl Concentration Area	Studies carried out and verified presence of: • Aggregations of 100[i] or more of listed species for 7 days[i], results in >700 waterfowl use days. • Areas with annual staging of ruddy ducks, canvasbacks, and redheads are SWH[cxlix] • The combined area of the ELC ecosites and a 100m radius area is the SWH[cxlviii] • Wetland area and shorelines associated with sites identified within the SWHTG[cxlviii] Appendix K[cxlix] are significant wildlife habitat. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • Annual Use of Habitat is Documented from Information Sources or Field Studies (Annual can be based on completed studies or determined from past surveys with species numbers and dates recorded). • SWHMIST[cxlix] Index #7 provides development effects and mitigation measures.	Suitable habitat is not present within study area. **Not SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Shorebird Migratory Stopover Area					
Rationale: High quality shorebird stopover habitat is extremely rare and typically has a long history of use	Greater Yellowlegs Lesser Yellowlegs Marbled Godwit Hudsonian Godwit Black-bellied Plover American Golden-Plover Semipalmated Plover Solitary Sandpiper Spotted Sandpiper Semipalmated Sandpiper Pectoral Sandpiper White-rumped Sandpiper Baird's Sandpiper Least Sandpiper Purple Sandpiper Stilt Sandpiper Short-billed Dowitcher Red-necked Phalarope Whimbrel Ruddy Turnstone Sanderling Dunlin	BBO1 BBO2 BBS1 BBS2 BBT1 BBT2 SDO1 SDS2 SDT1 MAM1 MAM2 MAM3 MAM4 MAM5	Shorelines of lakes, rivers and wetlands, including beach areas, bars and seasonally flooded, muddy and un-vegetated shoreline habitats. Great Lakes coastal shorelines, including groynes and other forms of armour rock lakeshores, are extremely important for migratory shorebirds in May to mid-June and early July to October. Sewage treatment ponds and storm water ponds do not qualify as a SWH. Information Sources • Western hemisphere shorebird reserve network • Canadian Wildlife Service (CWS) Ontario Shorebird Survey • Bird Studies Canada • Ontario Nature • Local birders and naturalist clubs • Natural Heritage Information Center (NHIC) Shorebird Migratory Concentration Area	Studies confirming: • Presence of 3 or more of listed species and > 1000[i] shorebird use days during spring or fall migration period (shorebird use days are the accumulated number of shorebirds counted per day over the course of the fall or spring migration period). • Whimbrel stop briefly (<24hrs) during spring migration, any site with >100[i] Whimbrel used for 3 years or more is significant. • The area of significant shorebird habitat includes the mapped ELC shoreline ecosites plus a 100m radius area[cxlviii] • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHMIST[cxlix] Index #8 provides development effects and mitigation measures.	Suitable habitat is not present within study area. **Not SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Raptor Wintering Area					
Rationale: Sites used by multiple species, a high number of individuals and used annually are most significant	Rough-legged Hawk Red-tailed Hawk Northern Harrier American Kestrel Snowy Owl Special Concern: Short-eared Owl Bald Eagle	Hawks/Owls: Combination of ELC Community Series; need to have present one Community Series from each land class. Forest: FOD, FOM, FOC Upland: CUM, CUT, CUS, CUW Bald Eagle: Forest Community Series: FOD, FOM, FOC, SWD, SWM, or SWC, on shoreline areas adjacent to large rivers or adjacent to lakes with open water (hunting area).	The habitat provides a combination of fields and woodlands that provide roosting, foraging and resting habitats for wintering raptors. Raptor wintering (hawk/owl) sites need to be > 20ha[cxlviii, cxlix] with a combination of forest and upland[xvi, xvii, xviii, xix, xx, xxi]. Least disturbed sites, idle/fallow or lightly grazed field/meadow (>15ha) with adjacent woodlands[cxlix] Field area of the habitat is to be wind swept with limited snow depth or accumulation. Eagle sites have open water and large trees and snags aviable for roosting[cxlix] Information Sources • OMNRF Districts • Natural clubs • Natural Heritage Information Centre (NHIC) Raptor Winter Concentration Area • Data from Bird Studies Canada • Reports and other information available from CAs • Results of Christmas Bird Counts	Studies confirm the use of these habitats by: • One or more Short-eared Owls, or, One of more Bald Eagles or; at least 10 individuals and two listed hawk/owl species • To be significant a site must be used regularly (3 in 5 years)[cxlix] for a minimum of 20 days by the above number of birds[i]. • The habitat area for an Eagle winter site is the shoreline forest ecosites directly adjacent to the prime hunting area. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHMIST[cxlix] Index #10 and #11 provides development effects and mitigation measures.	Study area highly disturbed, specifically the TCEC. Species are not tolerant to human disturbance. **Not SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Bat Hibernacula					
Rationale: Bat hibernacula, are rare habitats in all Ontario landscapes.	Big Brown Bat Eastern Pipistrelle/Tri-colored Bat	Bat Hibernacula may be found in these ecosites: CCR1 CCR2 CCA1 CCA2 (Note: buildings are not considered to be SWH)	Hibernacula may be found in caves, mine shafts, underground foundations and Karsts. Active mine sites should not be considered The locations of bat hibernacula are relatively poorly known. Information Sources • OMNRF for possible locations and contact for local experts • Natural Heritage Information Centre (NHIC) Bat Hibernaculum • Ministry of Northern Development and Mines for location of mine shafts • Clubs that explore caves (eg. Sierra Club) • University Biology Departments with bat experts	• All sites with confirmed hibernating bats are SWH[i]. • The area includes 200m radius around the entrance of the hibernaculum[cxlviii, ccvii, í]. for the development types and 1000m for wind farms [ccv.] • Studies are to be conducted during the peak swarming period (Aug. – Sept.). Surveys should be conducted following methods outlined in the[ccv]."Bats and Bat Habitats: Guidelines for Wind Power Projects" [ccv] • SWHMIST[cxlix] Index #1 provides development effects and mitigation measures.	Suitable habitat not present within study area. **Not SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Bat Maternity Colonies					
Rationale: Known locations of forested bat maternity colonies are extremely rare in all Ontario landscapes.	Big Brown Bat Silver-haired Bat	Maternity colonies considered SWH are found in forested Ecosites. All ELC Ecosites in ELC Community Series: FOD FOM SWD SWM	Maternity colonies can be found in tree cavities, vegetation and often in building [sxxii, xxv, xxvi, xxvii, xxxi] (buildings are not considered to be SWH). • Maternity roosts are not found in caves and mines in Ontario[xxii]. • Maternity colonies located in Mature deciduous or mixed forest stands[ccix, ccx] with >10/ha large diameter (>25cm dbh) wildlife trees[ccvii]. • Female Bats prefer wildlife tree (snags) in early stages of decay, class 1-3[ccxiv] or class 1 or 2[ccxii]. • Silver-haired Bats prefer older mixed or deciduous forest and form maternity colonies in tree cavities and small hollows. Older forest areas with at least 21 snags/ha are preferred[ccx]. Information Sources • OMNRF for possible locations and contact for local experts • University Biology Departments with bat experts	Maternity Colonies with confirmed use by: • >10 Big Brown Bats[i] • >5 Adult Female Silver-haired Bats[i] • The area of the habitat includes the entire woodland or the forest stand ELC Ecosite containing the maternity colonies[i]. • Evaluation methods for maternity colonies should be conducted following methods outlined in the "Bats and Bat Habitats: Guidelines for Wind Power Projects"[ccv]. • SWHMIST[cxlix] Index #12 provides development effects and mitigation measures.	Suitable habitat is present within the study area. Bat habitat surveys will be completed in 2021 to determine presence / absence of this feature. **Candidate SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Turtle Wintering Area					
Rationale: Generally sites are the only known sites in the area. Sites with the highest number of individuals are most significant.	Midland Painted Turtle Special Concern: Northern Map Turtle Snapping Turtle	Snapping and Midland Painted Turtles: ELC Community Classes: SW, MA, OA and SA ELC Community Series: FEO and BOO Northern Map Turtle: Open Water areas such as deeper rivers or streams and lakes with current can also be used as over-wintering habitat.	• For most turtles, wintering areas are in the same general area as their core habitat. Water has to be deep enough not to freeze and have soft mud substrates. • Over-wintering sites are permanent water bodies, large wetlands, and bogs or fens with adequate Dissolved Oxygen[cix, cx, cxi, cxviii]. • Man-made ponds such as sewage lagoons or storm water ponds should not be considered SWH Information Sources • EIS studies carried out by Conservation Authorities • Field naturalists clubs • OMNRF Ecologist or Biologist • Natural Heritage Information Centre (NHIC)	• Presence of 5 over-wintering Midland Painted Turtles is significant[i]. • One or more Northern Map Turtle or Snapping Turtle over-wintering within a wetland is significant[í]. • The mapped ELC ecosite area with the over wintering turtles is the SWH. If the hibernation site is within a stream or river, the deep-water pool where the turtles are over wintering is the SWH. • Over wintering areas may be identified by searching for congregations (Basking Areas) of turtles on warm, sunny days during the fall (Sept. – Oct.) or spring (Mar. – Apr)[cvii]. Congregation of turtles is more common where wintering areas are limited and therefore significant[cix, cx, cxi, cxii]. • SWHMIST[cxiix] Index #28 provides development effects and mitigation measures for turtle wintering habitat.	Suitable habitat is present within the study area. Reptile surveys will be conducted in 2021 to determine presence, although absence cannot be ruled out without more extensive surveys. **Candidate SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Reptile Hibernaculum					
Rationale: Generally sites are the only known sites in the area. Sites with the highest number of individuals are most significant	Snakes: Eastern Gartersnake Northern Watersnake Northern Red-bellied Snake Northern Brownsnake Smooth Green Snake Northern Ring-necked Snake Special Concern: Milksnake Eastern Ribbonsnake	For all snakes, habitat may be found in any ecosite in southern Ontario other than very wet ones. Talus, Rock Barren, Crevice and Cave, and Alvar sites may be directly related to these habitats. Observations of congregations of snakes on sunny warm days in the spring or fall is a good indicator. The existence of rock piles or slopes, stone fences, and crumbling foundations assist in identifying candidate SWH.	For snakes, hibernation takes place in sites located below frost lines in burrows, rock crevices and other natural locations. Areas of broken and fissured rock are particularly valuable since they provide access to subterranean sites below the frost line[xliv, l, li, lii, cxii]. Wetlands can also be important over-wintering habitat in conifer or shrub swamps and swales, poor fens, or depressions in bedrock terrain with sparse trees or shrubs with sphagnum moss or sedge hummock ground cover. Information Sources • In spring, local residents or landowners may have observed the emergence of snakes on their property (e.g. old dug wells). • Reports and other information available from CAs • Local naturalists and experts, as well as university herpetologists may also know where to find some of these sites. • Natural Heritage Information Centre (NHIC)	Studies confirming: • Presence of snake hibernacula used by a minimum of five individuals of a snake sp., or, individuals of two or more snake spp. • Congregations of a minimum of five individuals of a snake sp., or, individuals of two or more snake spp. near potential hibernacula (eg. foundation or rocky slope) on sunny warm days in Spring (Apr/May) and Fall (Sept/Oct)[í]. • Note: If there are Special Concern Species present, then site is SWH • Note: Sites for hibernation possess specific habitat parameters (e.g. temperature, humidity, etc.) and consequently are used annually, often by many of the same individuals of a local population (i.e. strong hibernation site fidelity). Other critical life processes (e.g. mating) often take place in close proximity to hibernacula. The feature in which the hibernacula is located plus a 30m buffer is the SWH[í]. • SWHMIST[cxlix] Index #13 provides development effects and mitigation measures for snake hibernacula.	Suitable habitat may be present within the study area. Reptile surveys will be completed in 2021 to determine presence, although absence cannot be ruled out without more extensive surveys. **Candidate SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Colonially - Nesting Bird Breeding Habitat (Bank and Cliff)					
Rationale: Historical use and number of nests in a colony make this habitat significant. An identified colony can be very important to local populations. All swallow population are declining in Ontario.	Cliff Swallow Northern Rough-winged Swallow (this species is not colonial but can be found in Cliff Swallow colonies)	Eroding banks, sandy hills, borrow pits, steep slopes, and sand piles Cliff faces, bridge abutments, silos, barns Habitat found in the following ecosites: CUM1 CUT1 CUS1 BLO1 BLS1 BLT1 CLO1 CLS1 CLT1	• Any site or areas with exposed soil banks, undisturbed or naturally eroding that is not a licensed/permitted aggregate area. • Does not include man-made structures (bridges or buildings) or recently (2 years) disturbed soil areas, such as berms, embankments, soil or aggregate stockpiles. • Does not include a licensed/permitted Mineral Aggregate Operation. Information Sources • Reports and other information available from CAs • Ontario Breeding Bird Atlas[ccv]. • Bird Studies Canada: Nature Counts http://www.birdscanada.org/birdmon/ • Field Naturalist clubs	Studies confirming: • Presence of 1 or more nesting sites with 8[cxlvix] or more cliff swallow pairs and/or rough-winged swallow pairs during the breeding season. • A colony identified as SWH will include a 50m radius habitat area from the peripheral nests[ccvii]. • Field surveys to observe and count swallow nests are to be completed during the breeding season. Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi]. • SWHMIST[cxlix] Index #4 provides development effects and mitigation measures.	Suitable habitat may be present within the study area. Breeding bird surveys will be completed in 2021 to determine presence/absence. **Candidate SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Colonially - Nesting Bird Breeding Habitat (Tree/Shrubs)					
Rationale: Large colonies are important to local bird population, typically sites are only known colony in area and are used annually.	Great Blue Heron Black-crowned Night-Heron Great Egret Green Heron	SWM2 SWM3 SWM5 SWM6 SWD1 SWD2 SWD3 SWD4 SWD5 SWD6 SWD7 FET1	• Nests in live or dead standing trees in wetlands, lakes, islands, and peninsulas. Shrubs and occasionally emergent vegetation may also be used. • Most nests in trees are 11 to 15 m from ground, near the top of the tree. Information Sources • Ontario Breeding Bird Atlas[ccv], colonial nest records. • Ontario Heronry Inventory 1991 available from Bird Studies Canada or NHIC (OMNRF). • Natural Heritage Information Centre (NHIC) Mixed Wader Nesting Colony • Aerial photographs can help identify large heronries. • Reports and other information available from CAs • MNRF District Offices • Field naturalist clubs	Studies confirming: • Presence of 2 or more active nests of Great Blue Heron or other list species. • The habitat extends from the the edge of the colony and a minimum 300m radius or extent of the Forest Ecosite containing the colony or any island <15.0ha with a colony is the SWH[cc, ccvii]. • Confirmation of active colonies must be achieved through site visits conducted during the nesting season (April to August) or by evidence such as the presence of fresh guano, dead young and/or eggshells • SWHMIST[cxlix] Index #5 provides development effects and mitigation measures.	Marginal suitable habitat is present within the study area, however, criterion species are not tolerant of heavily industrial environment of the immediate study area. **Not SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Colonially - Nesting Bird Breeding Habitat (Ground)					
Rationale: Colonies are important to local bird population, typically sites are only known colony in area and are used annually.	Herring Gull Great Black-backed Gull Little Gull Ring-billed Gull Common Tern Caspian Tern Brewer's Blackbird	Any rocky island or peninsula (natural or artificial) within a lake or large river (two-lined on a 1:50,000 NTS map). Close proximity to watercourses in open fields or pastures with scattered trees or shrubs (Brewer's Blackbird) MAM1 – 6 MAS1 – 3 CUM CUT CUS	• Nesting colonies of gulls and terns are on islands or peninsulas associated with open water or in marshy areas. • Brewers Blackbird colonies are found loosely on the ground in or in low bushes in close proximity to streams and irrigation ditches within farmlands. Information Sources • Ontario Breeding Bird Atlas[ccv], rare/colonial species records. • Canadian Wildlife Service • Reports and other information available from CAs • Natural Heritage Information Centre (NHIC) Colonial Waterbird Nesting Area • MNRF District Offices • Field naturalist clubs	Studies confirming: • Presence of >25 active nests for Herring Gulls, >5 active nests for Common Tern or >2 active nests for Caspian Tern[í]. • Any active nesting colony of one or more Little Gull, and Great Black-backed Gull is significant[í]. • Presence of 5 or more pairs for Brewer's Blackbird[í]. • The edge of the colony and a minimum 150m radius area of the habitat, or the extent of the ELC ecosites containing the colony or any island <3.0ha with a colony is the SWH[cc, ccvii]. • Studies would be done during May/June when actively nesting. Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi]. • SWHMIST[cxlix] Index #6 provides development effects and mitigation measures.	Suitable habitat is not present within the study area. **Not SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Migratory Butterfly Stopover Areas					
Rationale: Butterfly stopover areas are extremely rare habitats and are biologically important for butterfly species that migrate south for the winter	Painted Lady Red Admiral Special Concern: Monarch	Combination of ELC Community Series; need to have present one Community Series from each landclass: Field: CUM CUT CUS Forest: FOC FOD FOM CUP Anecdotally, a candidate sight for butterfly stopover will have a history of butterflies being observed.	A butterfly stopover area will be a minimum of 10ha in size with a combination of field and forest habitat present, and will be located within 5km of Lake Ontario and Erie[cxlix]. • The habitat is typically a combination of field and forest, and provides the butterflies with a location to rest prior to their long migration south[xxxii, xxxiii, xxxiv, xxxv, xxxvi]. • The habitat should not be disturbed, fields/meadows with an abundance of preferred nectar plants and woodland edge providing shelter are requirements for this habitat[cxlviii, cxlix]. • Staging areas usually provide protection from the elements and are often spits of land or areas with the shortest distance to cross the Great Lakes[xxxvii, xxxviii, xxxix, xl, xli]. Information Sources • MNRF District Offices • Natural Heritage Information Centre (NHIC) • Agriculture Canada in Ottawa may have list of butterfly experts. • Field Naturalist Clubs • Toronto Entomologists Association • Conservation Authorities	Studies confirm: • The presence of Monarch Use Days (MUD) during fall migration (Aug/Oct)[xliii]. MUD is based on the number of days a site is used by Monarchs, multiplied by the number of individuals using the site. Numbers of butterflies can range from 100-500/day[xxxvii], significant variation can occur between years and multiple years of sampling should occur[xl, xlii]. • Observational studies are to be completed and need to be done frequently during the migration period to estimate MUD • MUD of >5000 or >3000 with the presence of Painted Ladies or White Admiral's is to be considered significant[l]. • SWHMIST[cxlix] Index #16 provides development effects and mitigation measures.	Study area is located >5km from the Lake Ontario and Erie shoreline. **Not SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Landbird Migratory Stopover Areas					
Rationale: Sites with a high diversity of species as well as high numbers are most significant	All migratory songbirds Canadian Wildlife Service Ontario website: http://www.on.ec.gc.ca/wildlife_e.html All migrant raptors species Ontario Ministry of Natural Resources: Fish and Wildlife Conservation Act, 1997. Schedule 7: Specially Protected Birds (Raptors)	All Ecosites associated with these ELC Community Series: FOC FOM FOD SWC SWM SWD	Woodlots need to be >5 ha[i] in size and within 5km [iv, v, vi, vii, viii, ix, x, xi, xii, xiii, xiv, xv] of Lake Ontario and Erie. If woodlands are rare in an area of shoreline, woodland fragments 2-5ha can be considered for this habitat • If multiple woodlands are located along the shoreline those Woodlands <2km from Lake Erie or Ontario are more significant[cxlix]. • Sites have a variety of habitats: forest, grassland and wetland complexes[cxlix]. • The largest sites are more significant[cxlix] • Woodlots and forest fragments are important habitats to migrating birds[ccxviii], these features located along the shore and located within 5km of Lake Ontario and Lake Erie are Candidate SWH[cxlviii]. Information Sources • Bird Studies Canada • Ontario Nature • Local birders and naturalist clubs • Ontario Important Bird Areas (IBA) Program	Studies confirm: • Use of the habitat by >200 birds/day and with >35 spp. with at least 10 bird spp. recorded on at least 5 different survey dates[i]. This abundance and diversity of migrant bird species is considered above average and significant. • Studies should be completed during spring (March/May) and fall (Aug/Oct) migration using standardized assessment techniques. Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi]. • SWHMIST[cxlix] Index #9 provides development effects and mitigation measures.	Study area is located >5km from the Lake Ontario and Erie shoreline. **Not SWH**

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Deer Winter Congregation Areas					
Rationale: Deer movement during winter in the southern areas of Ecoregion 7E are not constrained by snow depth, however deer will annually congregate in large numbers in suitable woodlands to reduce or avoid the impacts of winter conditions [cxlviii]	White-tailed Deer	All Forested Ecosites with these ELC Community Series: FOC FOM FOD SWC SWM SWD Conifer plantations (CUP) smaller than 50 ha may also be used.	• Woodlots >100 ha in size or if large woodlots are rare in a planning area woodlots>50ha[i]. • Deer movement during winter in Ecoregion 7E are not constrained by snow depth, however deer will annually congregate in large numbers in suitable woodlands[cxlviii]. • Large woodlots > 100ha and up to 1500 ha are known to be used annually by densities of deer that range from 0.1-1.5 deer/ha[ccxxiv]. • Woodlots with high densities of deer due to artificial feeding are not significant[i]. Information Sources • MNRF District Offices • LIO/NRVIS	Studies confirm: • Deer management is an MNRF responsibility, deer winter congregation areas considered significant will be mapped by MNRF[cxlviii]. • Use of the woodlot by white-tailed deer will be determined by MNRF, all woodlots exceeding the area criteria are significant, unless determined not to be significant by MNRF[i]. • Studies should be completed during winter (Jan/Feb) when >20cm of snow is on the ground using aerial survey techniques[ccxxiv], ground or road surveys, or a pellet count deer density survey[ccxxv]. • SWHMIST[cxlix] Index #2 provides development effects and mitigation measures.	The MNRF has not identified this SWH within the study area. **Not SWH**

Significant Wildlife Habitat Assessment Tables

Table 2. Characteristics of Rare Vegetation Communities for Ecoregion 7E.

Rare Vegetation Community[1]	Candidate SWH			Confirmed SWH	Study Area
	ELC Ecosite Codes[1]	Habitat Description[1]	Detailed Information and Sources[1]	Defining Criteria[1]	Assessment Details
Cliff and Talus Slopes					
Rationale: Cliffs and Talus Slopes are extremely rare habitats in Ontario.	Any ELC Ecosite within Community Series: TAO CLO TAS CLS TAT CLT	A Cliff is vertical to near vertical bedrock >3m in height. A Talus Slope is rock rubble at the base of a cliff made up of coarse rocky debris.	Most cliff and talus slopes occur along the Niagara Escarpment. Information Sources • The Niagara Escarpment Commission has detailed information on location of these habitats. • OMNRF Districts • Natural Heritage Information Centre (NHIC) has location information available on their website • Field naturalist clubs • Conservation Authorities	• Confirm any ELC Vegetation Type for Cliffs or Talus Slopes[lxxviii] • SWHMIST[cxlix] Index #21 provides development effects and mitigation measures.	Vegetation community is not present within study area. **Not SWH**

Table 2. Characteristics of Rare Vegetation Communities for Ecoregion 7E.

Rare Vegetation Community[1]	Candidate SWH			Confirmed SWH	Study Area
	ELC Ecosite Codes[1]	Habitat Description[1]	Detailed Information and Sources[1]	Defining Criteria[1]	Assessment Details
Sand Barrens					
Rationale: Sand barrens are rare in Ontario and support rare species. Most Sand Barrens have been lost due to cottage development and forestry.	ELC Ecosites: SBO1 SBS1 SBT1 Vegetation cover varies from patchy and barren to continuous meadow (SBO1), thicket-like (SBS1), or more closed and treed (SBT1). Tree cover always ≤ 60%.	Sand Barrens typically are exposed sand, generally sparsely vegetated and caused by lack of moisture, periodic fires and erosion. They have little or no soil and the underlying rock protrudes through the surface. Usually located within other types of natural habitat such as forest or savannah. Vegetation can vary from patchy and barren to tree covered but less than 60%.	A sand barren area >0.5ha in size Information Sources • OMNRF Districts • Natural Heritage Information Centre (NHIC) has location information available on their website • Field naturalist clubs • Conservation Authorities	• Confirm any ELC Vegetation Type for Sand Barrens[lxxviii] • Site must not be dominated by exotic or introduced species (<50% vegetative cover are exotics sp)[i]. • SWHMIST[cxlix] Index #20 provides development effects and mitigation measures.	Vegetation community is not present within study area. **Not SWH**

Table 2. Characteristics of Rare Vegetation Communities for Ecoregion 7E.

Rare Vegetation Community[1]	Candidate SWH			Confirmed SWH	Study Area
	ELC Ecosite Codes[1]	Habitat Description[1]	Detailed Information and Sources[1]	Defining Criteria[1]	Assessment Details
Alvar					
Rationale: Alvars are extremely rare habitats in Ecoregion 7E	ALO1 ALS1 ALT1 FOC1 FOC2 CUM2 CUS2 CUT2-1 CUW2 **Five Alvar Indicator Species:** 1) Carex crawei 2) Panicum philadelphicum 3) Eleocharis compressa 4) Scutellaria parvula 5) Trichostema brachiatum These indicator species are very specific to Alvars within Ecoregion 7E[cxlix]	An alvar is typically a level, mostly unfractured calcareous bedrock feature with a mosaic of rock pavements and bedrock overlain by a thin veneer of soil. The hydrology of alvars is complex, with alternating periods of inundation and drought. Vegetation cover varies from sparse lichen-moss associations to grasslands and shrublands and comprising a number of characteristic or indicator plant. Undisturbed alvars can be phyto- and zoogeographically diverse, supporting many uncommon or are relict plant and animals species. Vegetation cover varies from patchy to barren with a less than 60% tree cover[lxxviii].	An Alvar site > 0.5ha in size[lxxv]. Alvar is particularly rare in Ecoregion 7E where the only known sites are found in the western islands of Lake Erie[cxcix]. Information Sources • Alvars of Ontario (2000), Federation of Ontario Naturalists[lxxvi]. • Ontario Nature – Conserving Great Lakes Alvars[ccviii]. • Natural Heritage Information Centre (NHIC) has location information available on their website • OMNRF Staff • Field Naturalist clubs • Conservation Authorities	Field studies identify four of the five **Alvar indicator species**[lxxv] at a candidate Alvar site is Significant • Site must not be dominated by exotic or introduced species (<50% vegetative cover exotics). • The alvar must be in excellent condition and fit in with surrounding landscape with few conflicting land uses[lxxv]. • SWHMIST[cxlix] Index #17 provides development effects and mitigation measures.	Vegetation community is not present within study area. **Not SWH**

Table 2. Characteristics of Rare Vegetation Communities for Ecoregion 7E.

Rare Vegetation Community[1]	Candidate SWH			Confirmed SWH	Study Area
	ELC Ecosite Codes[1]	Habitat Description[1]	Detailed Information and Sources[1]	Defining Criteria[1]	Assessment Details
Old Growth Forest					
Rationale: Due to historic logging practices and land clearance for agriculture, old growth forest is rare in Ecoregion 7E.	Forest Community Series: FOD FOC FOM SWD SWC SWM	Old growth forests are characterized by heavy mortality or turnover of overstorey trees resulting in a mosaic of gaps that encourage development of a multi-layered canopy and an abundance of snags and downed woody debris.	Woodland area is >0.5ha Information Sources • OMNRF Forest Resource Inventory mapping • OMNRF Districts • Field naturalist clubs • Conservation Authorities • Sustainable Forestry Licence (SFL) companies will possibly know locations through field operations. • Municipal forestry departments	Field Studies will determine: • If dominant trees species of the ecosite are >140 years old, then stand is Significant Wildlife Habitat[cxlviii]. • The forested area containing the old growth characteristics will have experienced no recognizable forestry activities [cxlviii] (cut stumps will not be present) • Determine ELC Vegetation Type for forest area containing the old growth characteristics[lxxviii]. • SWHMIST[cxlix] Index #23 provides development effects and mitigation measures.	Vegetation community is not present within study area. **Not SWH**

Table 2. Characteristics of Rare Vegetation Communities for Ecoregion 7E.

Rare Vegetation Community[1]	Candidate SWH			Confirmed SWH	Study Area
	ELC Ecosite Codes[1]	Habitat Description[1]	Detailed Information and Sources[1]	Defining Criteria[1]	Assessment Details
Savannah					
Rationale: Savannahs are extremely rare habitats in Ontario.	TPS1 TPS2 TPW1 TPW2 CUS2	A Savannah is a tallgrass prairie habitat that has tree cover between 25 – 60%. In Ecoregion 7E, known Tallgrass Prairie and savannah remnants are scattered between Lake Huron and Lake Erie, near Lake St. Clair, north of and along the Lake Erie shoreline, in Brantford and in the Toronto area (north of Lake Ontario)[cc].	No minimum size to site[l] Site must be restored or a natural site. Remnant sites such as railway right of ways are not considered to be SWH. Information Sources • OMNRF Districts • Natural Heritage Information Centre (NHIC) has location data available on their website • Field naturalists clubs • Conservation Authorities	Field studies confirm one or more of the Savannah indicator species listed in[lxxv] Appendix N should be present[l]. Note: Savannah plant spp. list from Ecoregion 7E should be used. • Area of the ELC Vegetation type is the SWH[lxxviii]. • Site must not be dominated by exotic or introduced species (<50% vegetative cover exotics). • SWHMIST[cxlix] Index #18 provides development effects and mitigation measures.	Suitable habitat not present within study area. **Not SWH**

Table 2. Characteristics of Rare Vegetation Communities for Ecoregion 7E.

Rare Vegetation Community[1]	Candidate SWH			Confirmed SWH	Study Area
	ELC Ecosite Codes[1]	Habitat Description[1]	Detailed Information and Sources[1]	Defining Criteria[1]	Assessment Details
Tallgrass Prairie					
Rationale: Tallgrass Prairies are extremely rare habitats in Ontario.	TPO1 TPO2	A Tallgrass Prairie has ground cover dominated by prairie grasses. An open Tallgrass Prairie habitat has < 25% tree cover. In Ecoregion 7E, known Tallgrass Prairie and savannah remnants are scattered between Lake Huron and Lake Erie, near Lake St. Clair, north of and along the Lake Erie shoreline, in Brantford and in the Toronto area (north of Lake Ontario)[cc].	No minimum size to site[l]. Site must be restored or a natural site. Remnant sites such as railway right of ways are not considered to be SWH. Information Sources • Natural Heritage Information Centre (NHIC has location information available on their website • OMNRF Districts • Field naturalists clubs • Conservation Authorities	Field studies confirm one or more of the Prairie indicator species listed in[lxxv] Appendix N should be present[l]. Note: Prairie plant spp. list from Ecoregion 7E should be used. • Area of the ELC Vegetation Type is the SWH[lxxviii]. • Site must not be dominated by exotic or introduced species (<50% vegetative cover exotics). • SWHMIST[cxlix] Index #19 provides development effects and mitigation measures.	Suitable habitat not present within study area. **Not SWH**

Table 2. Characteristics of Rare Vegetation Communities for Ecoregion 7E.

Rare Vegetation Community[1]	Candidate SWH			Confirmed SWH	Study Area
	ELC Ecosite Codes[1]	Habitat Description[1]	Detailed Information and Sources[1]	Defining Criteria[1]	Assessment Details
Other Rare Vegetation Communities					
Rationale: Plant communities that often contain rare species which depend on the habitat for survival.	Provincially Rare S1, S2 and S3 vegetation communities are listed in Appendix M of the SWHTG[cxlviii]. Any ELC Ecosite Code that has a possible ELC Vegetation Type that is Provincially Rare is Candidate SWH.	Rare Vegetation Communities may include beaches, fens, forest, marsh, barrens, dunes and swamps.	ELC Ecosite codes that have the potential to be a rare ELC Vegetation Type as outlined in appendix M[cxlviii]. The OMNRF/NHIC will have up to date listing for rare vegetation communities. Information Sources • Natural Heritage Information Centre (NHIC) has location information available on their website • OMNRF Districts • Field naturalists clubs • Conservation Authorities	Field studies should confirm if an ELC Vegetation Type is a rare vegetation community based on listing within Appendix M of SWHTG[cxlviii]. • Area of the ELC Vegetation Type polygon is the SWH. • SWHMIST[cxlix] Index #37 provides development effects and mitigation measures.	Based on preliminary ELC work, rare vegetation communities are not present within the study area. Ecological Land Classification surveys in 2021 will confirm presence/absence. **Unlikely SWH**

Significant Wildlife Habitat Assessment Tables

Table 3. Characteristics of Specialized Wildlife Habitat for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Waterfowl Nesting Area					
Rationale: Important to local waterfowl populations, sites with greatest number of species and highest number of individuals are significant	American Black Duck Northern Pintail Northern Shoveler Gadwall Blue-winged Teal Green-winged Teal Wood Duck Hooded Merganser Mallard	All upland habitats located adjacent to these wetland ELC Ecosites are Candidate SWH: MAS1 MAS2 MAS3 SAS1 SAM1 SAF1 MAM1 MAM2 MAM3 MAM4 MAM5 MAM6 SWT1 SWT2 SWD1 SWD2 SWD3 SWD4 **Note: includes adjacency to Provincially Significant Wetlands**	A waterfowl nesting area extends: 120m[cxlix] from a wetland (>0.5ha) or a wetland (>0.5ha) with small wetlands (0.5ha) within 120m or a cluster of 3 or more small (<0.5 ha) wetlands within 120m of each individual wetland where waterfowl nesting is known to occur[cxlix]. • Upland areas should be at least 120m wide so that predators such as racoons, skunks, and foxes have difficulty finding nests. • Wood Ducks and Hooded Mergansers utilize large diameter trees (>40cm dbh) in woodlands for cavity nest sites. Information Sources • Ducks Unlimited staff may know the locations of particularly productive nesting sites. • OMNRF Wetland Evaluations for indication of significant waterfowl nesting habitat. • Reports and other information available from CAs	Studies confirmed: • Presence of 3 or more nesting pairs for listed species excluding Mallards[i], or, • Presence of 10 or more nesting pairs for listed species including Mallards[i]. • Any active nesting site of an American Black Duck is considered significant. • Nesting studies should be completed during the spring breeding season (April - June). Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • A field study confirming waterfowl nesting habitat will determine the boundary of the waterfowl nesting habitat for the SWH, this may be greater or less than 120m[cxlviii] from the wetland and will provide enough habitat for waterfowl to successfully nest. • SWHMIST[cxlix] Index #25 provides development effects and mitigation measures.	Suitable habitat may be present within study area. Breeding bird surveys will be completed in 2021 to confirm presence/absence. **Candidate SWH**

Table 3. Characteristics of Specialized Wildlife Habitat for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Bald Eagle and Osprey Nesting, Foraging and Perching Habitat					
Rationale: Nest sites are fairly uncommon in Ecoregion 7E and are used annually by these species. Many suitable nesting locations may be lost due to increasing shoreline development pressures and scarcity of habitat.	Osprey Special Concern: Bald Eagle	ELC Forest Community Series: FOD, FOM, FOC, SWD, SWM and SWC directly adjacent to riparian areas – rivers, lakes, ponds and wetlands.	Nests are associated with lakes, ponds, rivers or wetlands along forested shorelines, islands, or on structures over water. Osprey nests are usually at the top a tree whereas Bald Eagle nests are typically in super canopy trees in a notch within the tree's canopy. Nests located on man-made objects are not to be included as SWH (e.g. telephone poles and constructed nesting platforms). Information Sources • Natural Heritage Information Center (NHIC) compiles all known nesting sites for Bald Eagles in Ontario • MNRF values information (LIO/NRVIS) will list known nesting locations, Note: data from NRVIS is provided as a point format and does not include all the habitat. • Nature Counts, Ontario Nest Records Scheme data • OMNRF Districts • Check the Ontario Breeding Bird Atlas[ccv] or Rare Breeding Birds in Ontario for species documented • Reports and other information available from CAs • Field naturalists clubs	Studies confirm the use of these nests by: • One or more active Osprey or Bald Eagle nests in an area[cxlviii]. • Some species have more than one nest in a given area and priority is given to the primary nest with alternate nests included within the area of the SWH. • For an Osprey, the active nest and a 300m radius around the nest or the contiguous woodland stand is the SWH[ccvii], maintaining undisturbed shorelines with large trees within this area is important[cxlviii]. • For a Bald Eagle the active nest and a 400-800m radius around the nest is the SWH[cvi, ccvii]. Area of the habitat from 400-800m is dependant on site lines from the nest to the development and inclusion of perching and foraging habitat[cvi]. • To be significant a site must be used annually. When found inactive, the site must be known to be inactive for ≥3 years or suspected of not being used for >5 years before being considered not significant[ccvii]. • Observational studies to determine nest site use, perching sites and foraging areas need to be done from mid March to mid August. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHMIST[cxlix] Index #26 provides development effects and mitigation measures.	Suitable habitat not present within study area. **Not SWH**

Table 3. Characteristics of Specialized Wildlife Habitat for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Woodland Raptor Nesting Habitat					
Rationale: Nests sites for these species are rarely identified; these area sensitive habitats are often used annually by these species.	Northern Goshawk Cooper's Hawk Sharp-shinned Hawk Red-shouldered Hawk Barred Owl Broad-winged Hawk	May be found in all forested ELC Ecosites. May also be found in SWC, SWM, SWD and CUP3	All natural or conifer plantation woodland/forest stands combined >30ha or with >4ha of interior habitat[lxxxviiii, lxxxix, xc, xci, xciii, xciv, xcv,xcvi, cxxxiii]. Interior habitat determined with a 200m buffer[cxlviii]. • Stick nests found in a variety of intermediate-aged to mature conifer, deciduous or mixed forests within tops or crotches of trees. Species such as Coopers hawk nest along forest edges sometimes on peninsulas or small off-shore islands. • In disturbed sites, nests may be used again, or a new nest will be in close proximity to old nest. Information Sources • OMNRF Districts • Check the Ontario Breeding Bird Atlas[ccv] or Rare Breeding Birds in Ontario for species documented. • Check data from Bird Studies Canada • Reports and other information available from CAs	Studies confirm: • Presence of 1 or more active nests from species list is considered significant[cxlviii]. • Red-shouldered Hawk and Northern Goshawk – A 400m radius around the nest or 28 ha of habitat is the SWH[ccvii].(the 28ha habitat area would be applied where optimal habitat is irregularly shaped around the nest) • Barred Owl – A 200m radius around the nest is the SWH[ccvii]. • Broad-winged Hawk and Coopers Hawk – A 100m radius around the nest is the SWH[ccvii]. • Sharp-Shinned Hawk – A 50m radius around the nest is the SWH[ccvii]. • Conduct field investigations from early March to end of May. The use of call broadcasts can help in locating territorial (courting/nesting) raptors and facilitate the discovery of nests by narrowing down the search area. • SWHMIST[cxlix] Index #27 provides development effects and mitigation measures.	Suitable habitat not present within study area. **Not SWH**

Table 3. Characteristics of Specialized Wildlife Habitat for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Turtle Nesting Area					
Rationale: These habitats are rare and when identified will often be the only breeding site for local populations of turtles.	Midland Painted Turtle Special Concern: Northern Map Turtle Snapping Turtle	Exposed mineral soil (sand or gravel) areas adjacent (<100m)[cxlviii] or within the following ELC Ecosites: MAS1 MAS2 MAS3 SAS1 SAM1 SAF1 BOO1 FEO1	• Best nesting habitat for turtles are close to water and away from roads and sites less prone to loss of eggs by predation from skunks, raccoons or other animals. • For an area to function as a turtle-nesting area, it must provide sand and gravel that turtles are able to dig in and are located in open, sunny areas. Nesting areas on the sides of municipal or provincial road embankments and shoulders are not SWH. • Sand and gravel beaches adjacent to undisturbed shallow weedy areas of marshes, lakes, and rivers are most frequently used. Information Sources • Use Ontario Soil Survey reports and maps to help find suitable substrate for nesting turtles (well-drained sands and fine gravels). • Check the Ontario Herpetofaunal Summary Atlas records or other similar atlases for uncommon turtles; location information may help to find potential nesting habitat for them. • Natural Heritage Information Center (NHIC) Field naturalist clubs	Studies confirm: • Presence of 5 or more nesting Midland Painted Turtles[l] • One or more Northern Map Turtle or Snapping Turtle nesting is a SWH[i] • The area or collection of sites within an area of exposed mineral soils where the turtles nest, plus a radius of 30-100m around the nesting area dependant on slope, riparian vegetation and adjacent land use is the SWH[cxlviii]. • Travel routes from wetland to nesting area are to be considered within the SWH as part of the 30-100m area of habitat[cxlix]. • Field investigations should be conducted in prime nesting season typically late spring to early summer. Observation studies observing the turtles nesting is a recommended method. • SWHMIST[cxlix] Index #28 provides development effects and mitigation measures for turtle nesting habitat.	Suitable habitat is present within the study area. Reptile surveys will be conducted in 2021 to determine presence, although absence cannot be ruled out without more extensive surveys. **Candidate SWH**

Table 3. Characteristics of Specialized Wildlife Habitat for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Seeps and Springs					
Rationale: Seeps/Springs are typical of headwater areas and are often at the source of coldwater streams	Wild Turkey Ruffed Grouse Spruce Grouse White-tailed Deer Salamander spp.	Seeps/Springs are areas where ground water comes to the surface. Often they are found within headwater areas within forested habitats. Any forested Ecosite within the headwater areas of a stream could have seeps/springs.	Any forested area (with <25% meadow/field/pasture) within the headwaters of a stream or river system[cxvii, cxlix]. • Seeps and springs are important feeding and drinking areas especially in the winter will typically support a variety of plant and animal species[cxix, cxx, cxxi, cxxii, cxiii, cxiv]. <u>Information Sources</u> • Topographical Map • Thermography • Hydrological surveys conducted by CAs and MOE • Field naturalists and landowners • Municipalities and Conservation Authorities may have drainage maps and headwater areas mapped	Field Studies confirm: • Presence of a site with 2 or more[í] seeps/springs should be considered SWH. • The area of a ELC forest ecosite containing the seeps/springs is the SWH. The protection of the recharge area considering the slope, vegetation, height of trees and groundwater condition need to be considered in delineation of the habitat[cxlviii]. • SWHMIST[cxlix] Index #30 provides development effects and mitigation measures.	Seeps or springs may be present within the study area. Field surveys will be conducted to confirm presence/absence. **Candidate SWH**

Table 3. Characteristics of Specialized Wildlife Habitat for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Amphibian Breeding Habitat (Woodland)					
Rationale: These habitats are extremely important to amphibian biodiversity within a landscape and often represent the only breeding habitat for local amphibian populations	Eastern Newt Blue-spotted Salamander Spotted Salamander Gray Treefrog Spring Peeper Western Chorus Frog Wood Frog	All Ecosites associated with these ELC Community Series: FOC FOM FOD SWC SWM SWD Breeding pools within the woodland or the shortest distance from forest habitat are more significant because they are more likely to be used due to reduced risk to migrating amphibians.	• Presence of a wetland, pond or woodland pool (including vernal pools) >500m^2 (about 25m diameter) [ccvii] within or adjacent (within 120m) to a woodland (no minimum size)[clxxxii, lxiii, lxv, lxvi, lxvii, lxviii, lxix, lxx]. Some small wetlands may not be mapped and may be important breeding pools for amphibians. • Woodlands with permanent ponds or those containing water in most years until mid-July are more likely to be used as breeding habitat[cxlviii]. Information Sources • Ontario Herpetofaunal Summary Atlas (or other similar atlases) for records • Local landowners may also provide assistance as they may hear spring-time choruses of amphibians on their property. • OMNRF Districts and wetland evaluations • Field naturalist clubs • Canadian Wildlife Service Amphibian Road Call Survey • Ontario Vernal Pool Association: http://www.ontariovernalpools.org	Studies confirm: • Presence of breeding population of 1 or more of the listed newt/salamander species or 2 or more of the listed frog/toad species with at least 20 individuals (adults or eggs masses) or 2 or more of the listed frog/toad species with Call Level Codes of 3. • A combination of observational study and call count surveys [cviii] will be required during the spring (March-June) when amphibians are concentrated around suitable breeding habitat within or near the woodland/wetlands. • The habitat is the wetland area plus a 230m radius of woodland area[lxiii, lxv, lxvi, lxvii, lxviii, lxix, lxx, lxxi]. If a wetland area is adjacent to a woodland, a travel corridor connecting the wetland to the woodland is to be included in the habitat. • SWHMIST[cxlix] Index #14 provides development effects and mitigation measures.	Suitable habitat is present within the study area. Field surveys will be completed in 2021 to confirm presence/absence. **Candidate SWH**

Table 3. Characteristics of Specialized Wildlife Habitat for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Amphibian Breeding Habitat (Wetland)					
Rationale: Wetlands supporting breeding for these amphibian species are extremely important and fairly rare within Central Ontario Landscapes	Eastern Newt American Toad Spotted Salamander Four-toed Salamander Blue-spotted Salamander Gray Treefrog Western Chorus Frog Northern Leopard Frog Pickerel Frog Green Frog Mink Frog Bullfrog	ELC Community Classes SW, MA, FE, BO, OA and SA. Typically these wetland ecosites will be isolated (>120m) from woodland ecosites, however larger wetlands containing predominantly aquatic species (e.g. Bull Frog) may be adjacent to woodlands.	• Wetlands >500m^2 (about 25m diameter)[ccvii] supporting high species diversity are significant: some small or ephemeral habitats may not be identified on MNR mapping and could be important amphibian breeding habitats[clxxxiv]. • Presence of shrubs and logs increase significance of pond for some amphibian species because of available structure for calling, foraging, escape and concealment from predators. • Bullfrogs require permanent water bodies with abundant emergent vegetation. Information Sources • Ontario Herpetofaunal Summary Atlas (or other similar atlases) • Canadian Wildlife Service Amphibian Road Surveys and Backyard Amphibian Call Count. • OMNRF Districts and wetland evaluations • Reports and other information available from CAs	Studies confirm: • Presence of breeding population of 1or more of the listed newt/salamander species or 2 or more of the listed frog or toad species and with at least 20 breeding individuals (adults and eggs masses)[lxxi, lxxiii] or 2 or more of the listed frog/toad species with Call Level of 3. or; Wetland with confirmed breeding Bullfrogs are significant[i]. • The ELC ecosite wetland area and the shoreline are the SWH. • A combination of observational study and call count surveys cviii to determine breeding/larval stages will be required during the spring (May March-June) when amphibians are concentrated around suitable breeding habitat within or near the woodland/wetlands. • If a SWH is determined for Amphibian Breeding Habitat (Wetlands) then Movement Corridors are to be considered as outlined in Table 1.4.1 of this Schedule. • SWHMIST[cxlix] Index #15 provides development effects and mitigation measures.	Suitable habitat may be present within the study area. Field surveys will be completed in 2021 to confirm presence/absence. **Candidate SWH**

Table 3. Characteristics of Specialized Wildlife Habitat for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Woodland Area-Sensitive Bird Breeding Habitat					
Rationale: Large, natural blocks of mature woodland habitat within the settled areas of Southern Ontario are important habitats for area sensitive interior forest song birds.	Yellow-bellied Sapsucker Red-breasted Nuthatch Veery Blue-headed Vireo Northern Parula Black-throated Green Warbler Blackburnian Warbler Black-throated Blue Warbler Ovenbird Scarlet Tanager Winter Wren Pileated Woodpecker Special Concern: Cerulean Warbler Canada Warbler	All Ecosites associated with these ELC Community Series: FOC FOM FOD SWC SWM SWD	• Habitats where interior forest breeding birds are breeding, typically large mature (>60 yrs. old) forest stands or woodlots >30ha[cv, cxxxi, cxxxii, cxxxiii, cxxxiv, cxxxv, cxxxvi, cxxxvii, cxxxviii, cxxxix, cxl, cxli, cxlii, cxliii, cxliv, cxlv, cxlvi, cl, cli, clii, cliii, cliv, clv, clvi, clvii, clviii, clix]. • Interior forest habitat is at least 200m from forest edge habitat[clxiv]. Information Sources • Local birder clubs • Canadian Wildlife Service (CWS) for the location of forest bird monitoring • Bird Studies Canada conducted a 3-year study of 287 woodlands to determine the effects of forest fragmentation on forest birds and to determine what forests were of greatest value to interior species. • Reports and other information available from CAs	Studies confirm: • Presence of nesting or breeding pairs of 3 or more of the listed wildlife species[l]. • Note: any site with breeding Cerulean Warblers or Canada Warbler is to be considered SWH[l]. • Conduct field investigations in early summer when birds are singing and defending their territories. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHMIST[cxlix] Index #34 provides development effects and mitigation measures.	Suitable habitat not present within study area. **Not SWH**

Significant Wildlife Habitat Assessment Tables

Table 4. Characteristics of Habitat for Species of Conservation Concern for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Marsh Bird Breeding Habitat					
Rationale: Wetlands for these bird species are typically productive and fairly rare in Southern Ontario landscapes.	American Bittern Virginia Rail Sora Common Gallinule American Coot Pied-billed Grebe Marsh Wren Sedge Wren Common Loon Green Heron Trumpeter Swan Special Concern: Black Tern Yellow Rail	MAM1 MAM2 MAM3 MAM4 MAM5 MAM6 SAS1 SAM1 SAF1 FEO1 BOO1 For Green Heron: All SW, MA and CUM1 sites	• Nesting occurs in wetlands • All wetland habitat is to be considered as long as there is shallow water with emergent aquatic vegetation present[cxxiv]. • For Green Heron, habitat is at the edge of water such as sluggish streams, ponds and marshes sheltered by shrubs and trees. Less frequently, it may be found in upland shrubs or forest a considerable distance from water. Information Sources • OMNRF Districts and wetland evaluations • Field naturalist clubs • Natural Heritage Information Centre (NHIC) • Reports and other information available from CAs • Ontario Breeding Bird Atlas[ccv]	Studies confirm: • Presence of 5 or more nesting pairs of Sedge Wren or Marsh Wren or breeding by any combination of 4 or more of the listed species[i]. • Note: any wetland with breeding of 1 or more Trumpeter Swans, Black Terns, Green Heron or Yellow Rail is SWH[i]. • Area of the ELC ecosite is the SWH • Breeding surveys should be done in May/June when these species are actively nesting in wetland habitats. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHMIST[cxlix] Index #35 provides development effects and mitigation measures	Suitable habitat may be present. Breeding bird surveys will be completed in 2021 to determine presence/absence. **Candidate SWH**

Table 4. Characteristics of Habitat for Species of Conservation Concern for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Open Country Bird Breeding Habitat					
Rationale: This wildlife habitat is declining throughout Ontario and North America. Species such as the Upland Sandpiper have declined significantly the past 40 years based on CWS (2004) trend records.	Upland Sandpiper Grasshopper Sparrow Vesper Sparrow Northern Harrier Savannah Sparrow Special Concern: Short-eared Owl	CUM1 CUM2	Large grassland areas (includes natural and cultural fields and meadows) >30ha[clx, clxi, clxii, clxiii, clxiv, clxv, clxvi, clxvii, clxviii, clxix]. Grasslands not Class 1 or 2 agricultural lands, and not being actively used for farming (i.e. no row cropping or intensive hay or livestock pasturing in the last 5 years)[i]. Grassland sites considered significant should have a history of longevity, either abandoned fields, mature hayfields and pasturelands that are at least 5 years or older. The Indicator bird species are area sensitive requiring larger grassland areas than the common grassland species. Information Sources • Agricultural land classification maps Ministry of Agriculture • Local birder clubs • Ontario Breeding Bird Atlas[ccv] • EIS Reports and other information available from CAs	Field Studies confirm: • Presence of nesting or breeding of 2 or more of the listed species[l]. • A field with 1 or more breeding Short-eared Owls is to be considered SWH. • The area of SWH is the contiguous ELC ecosite field areas. • Conduct field investigations of the most likely areas in spring and early summer when birds are singing and defending their territories. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHMIST[cxlix] Index #32 provides development effects and mitigation measures	Suitable habitat may be present. Breeding bird surveys will be completed in 2021 to determine presence/absence. **Candidate SWH**

Table 4. Characteristics of Habitat for Species of Conservation Concern for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Shrub/Early Successional Bird Breeding Habitat					
Rationale: This wildlife habitat is declining throughout Ontario and North America. The Brown Thrasher has declined significantly over the past 40 years based on CWS (2004) trend records.	Indicator Spp: Brown Thrasher Clay-coloured Sparrow Common Spp. Field Sparrow Black-billed Cuckoo Eastern Towhee Willow Flycatcher Special Concern: Yellow-breasted Chat Golden-winged Warbler	CUT1 CUT2 CUS1 CUS2 CUW1 CUW2 Patches of shrub ecosites can be complexed into a larger habitat such as woodland area for some bird species.	Large natural field areas succeeding to shrub and thicket habitats >10ha[clxiv] in size. Shrub land or early successional fields, not class 1 or 2 agricultural lands, not being actively used for farming (i.e. no row-cropping, haying or live-stock pasturing in the last 5 years)[i]. Shrub thicket habitats (>10 ha) are most likely to support and sustain a diversity of these species[clxxiii]. Shrub and thicket habitat sites considered significant should have a history of longevity, either abandoned fields or pasturelands. Information Sources • Agricultural land classification maps, Ministry of Agriculture. • Local bird clubs • Ontario Breeding Bird Atlas[ccv] • Reports and other information available from CAs	Field Studies confirm: • Presence of nesting or breeding of 1 of the indicator species and at least 2 of the common species[i]. • A field with breeding Yellow-breasted Chat or Golden-winged Warbler is to be considered as Significant Wildlife Habitat[i]. • The area of the SWH is the contiguous ELC ecosite field/thicket area. • Conduct field investigations of the most likely areas in spring and early summer when birds are singing and defending their territories • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHMIST[cxlix] Index #33 provides development effects and mitigation measures.	Suitable habitat may be present. Breeding bird surveys will be completed in 2021 to determine presence/absence. **Candidate SWH**

Table 4. Characteristics of Habitat for Species of Conservation Concern for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Terrestrial Crayfish					
Rationale: Terrestrial Crayfish are only found within SW Ontario in Canada and their habitats are very rare. [Ccii]	Chimney or Digger Crayfish (*Fallicambarus fodiens*) Devil Crawfish or Meadow Crayfish (*Cambarus Diogenes*)	MAM1 MAM2 MAM3 MAM4 MAM5 MAM6 MAS1 MAS2 MAS3 SWD SWT SWM CUM1 with inclusions of above meadow marsh ecosites can be used by terrestrial crayfish	Wet meadow and edges of shallow marshes (no minimum size) identified should be surveyed for terrestrial crayfish. • Constructs burrows in marshes, mudflats, meadows, the ground can't be too moist. Can often be found far from water. • Both species are a semi-terrestrial burrower which spends most of its life within burrows consisting of a network of tunnels. Usually the soil is not too moist so that the tunnel is well formed. Information Sources • Information sources from "Conservation Status of Freshwater Crayfishes" by Dr. Premek Hamr for the WWF and CNF March 1998.	Studies Confirm: • Presence of 1 or more individuals of species listed or their chimneys (burrows) in suitable marsh meadow or terrestrial sites[cci]. • Area of ELC Ecosite or an ecoelement area of meadow marsh or swamp within the large ecosite area is the SWH • Surveys should be done April to August in temporary or permanent water. Note the presence of burrows or chimneys are often the only indicator of presence, observance or collection of individuals is very difficult [cci] • SWHMIST[cxlix] Index #36 provides development effects and mitigation measures.	Suitable habitat may be present within mineral meadow marsh lands found within the study area. Area searches will be conducted to confirm presence/absence. **Candidate SWH**

Table 4. Characteristics of Habitat for Species of Conservation Concern for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Special Concern and Rare Wildlife Species					
Rationale: These species are quite rare or have experienced significant population declines in Ontario	All Special Concern and Provincially Rare (S1-S3, SH) plant and animal species. Lists of these species are tracked by the Natural Heritage Information Centre (NHIC).	All plant and animal element occurrences (EO) within a 1 or 10km grid. Older element occurrences were recorded prior to GPS being available, therefore location information may lack accuracy.	When an element occurrence is identified within a 1 or 10 km grid for a Special Concern or provincially Rare species; linking candidate habitat on the site needs to be completed to ELC Ecosites[lxxviii]. Information Sources • Natural Heritage Information Centre (NHIC) will have the Special Concern and Provincially Rare (S1-S3, SH) species lists and element occurrences for these species. • NHIC Website: "Get Information" http://nhic.mnr.gov.on.ca • Ontario Breeding Bird Atlas[ccv] • Expert advice should be sought as many of the rare spp. have little information available about their requirements.	Studies Confirm: • Assessment/inventory of the site for the identified special concern or rare species needs to be completed during the time of year when the species is present or easily identifiable. • The area of the habitat to the finest ELC scale that protects the habitat form and function is the SWH, this must be delineated through detailed field studies. The habitat neess to be easily mapped and cover an important life stage component for a species e.g. specific nesting habitat for foraging habitat. • SWHMIST[cxlix] Index #37 provides development effects and mitigation measures.	Special Concern and Provincially Rare plant and animal species are possible within the study area. Wildlife and vegetation surveys will be conducted within the study area to confirm presence/absence. **Candidate SWH**

Significant Wildlife Habitat Assessment Tables

Table 5. Characteristics of Animal Movement Corridors for Ecoregion 7E.

	Wildlife Species[1]	Candidate SWH		Confirmed SWH	Study Area
		ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Amphibian Movement Corridors					
Rationale: Movement corridors for amphibians moving from their terrestrial habitat to breeding habitat can be extremely important for local populations.	Eastern Newt American Toad Blue-spotted Salamander Spotted Salamander Four-toed Salamander Gray Treefrog Northern Leopard Frog Pickerel Frog Western Chorus Frog	Corridors may be found in all ecosites associated with water. • Corridors will be determined based on identifying the significant breeding habitat for these species in Table 1.1.	Movement corridors between breeding habitat and summer habitat[clxxiv, clxxv, clxxvi, clxxvii, clxxviii, clxxix, clxxx, clxxxi] Movement corridors must be considered when Amphibian breeding habitat is confirmed as SWH from Table 1.2.2 (Amphibian Breeding Habitat – Wetland) of this Schedule[i]. Information Sources • MNRF District Office • Natural Heritage Information Centre NHIC • Reports and other information available from CAs • Field naturalist Clubs	• Field Studies must be conducted at the time of year when species are expected to be migrating or entering breeding sites. • Corridors should consist of native vegetation, with several layers of vegetation. Corridors unbroken by roads, waterways or bodies, and undeveloped areas are most significant[cxlix]. • Corridors should have at least 15m of vegetation on both sides of waterway[cxlix] or be up to 200m wide[cxlix] of woodland habitat and with gaps <20m[cxlix] • Shorter corridors are more significant than longer corridors, however amphibians must be able to get to and from their summer and breeding habitat[cxlix]. • SWHMIST[cxlix] Index #40 provides development effects and mitigation measures.	Amphibian Breeding Habitat may be present within the study area. If Amphibian Breeding Habitat - Wetland is confirmed, an Amphibian Movement Corridor will be identified. Anuran surveys are to be completed in 2021. **Candidate SWH**

Significant Wildlife Habitat Assessment Tables

Table 6. Exceptions for Ecodistricts within Ecoregion 7E.

	Wildlife Habitat and Species	Candidate SWH			Confirmed SWH	Study Area
		Ecosites	Habitat Description	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
EcoDistrict						
7E-2	Bat Migratory Stopover Area Rationale: Stopover areas for long distance migrant bats are important during fall migration. Hoary Bat Eastern Red Bat Silver-haired Bat	No specific ELC types		• Long distance migratory bats typically migrate during late summer and early fall migrating summer breeding habitats throughout Ontario to southern wintering areas. Their annual fall migration may concentrate these species of bats at stopover areas. • This is the only known bat migratory stopover habitats based on current information. <u>Information Sources</u> • OMNRF for possible locations and contact for local experts • University of Waterloo, Biology Department	• Long Point (42°35'N, 80°30'E, to 42°33'N, 80°03'E) has been identified as a significant stop-over habitat for fall migrating Silver-haired bats, due to significant increases in abundance, activity and feeding that was documented during fall migration[ccxv]. • The confirmation criteria and habitat areas for this SWH are still being determined. • SWHMIST[cxlix] Index #38 provides development effects and mitigation measures	This study area does not fall within the Long Point area. **Not SWH**

Human Health Assessment Review Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

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Acronyms

Acronym	Definition
CEI	Cantox Environmental Inc.
CR	Concentration Ratio
EA	Environmental Assessment
HCl	Hydrogen chloride
HHRA	Human Health Risk Assessment
ILCR	Incremental Lifetime Cancer Risk
MECP	Ministry of Environment, Conservation and Parks
NOx	Oxides of Nitrogen
PAHs	Polycyclic Aromatic Hydrocarbons
SO_2	Sulphur Dioxide
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
VOC	Volatile Organic Compound
WHO	World Health Organization
WMCC	Waste Management of Canada Corporation

1 Introduction

This Human Health Assessment Review work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m³ of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m³, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $24M in host community fees and municipal property taxes to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This Human Health Assessment Review work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on human health, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the Human Health Assessment Review, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency, and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The general study areas proposed for the purposes of the EA are (**Figure 1.** General On-Site and Off-site Study Areas

):

- On-site Study Area: the existing TCEC.
- Off-site Study Area: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area.

The 2005 HHRA extended the off-site study area to 3.5 km from the landfill site consistent with the air quality study completed at the time. The current air quality assessment has extended their study area to 5 km from the TCEC. While data from the current air quality study will be used as comparison to those completed in the original 2005 HHRA, the highest ground-level air concentrations would be expected to occur in close proximity to the landfill. As such, the additional 1.5 km extended area within the

current Off-site Study Area is unlikely to affect the comparison to the original 2005 HHRA, despite the difference in size of the Off-site Study Areas.

For the Human Health Assessment Review, the general Off-site Study Area has been extended to include lands within approximately 1 km from the TCEC.

4 Scope of Work

The scope of work for Human Health Assessment Review includes the development of evaluation criteria, indicators, and data sources, characterization of existing human health conditions, assessment of the potential environmental effects of the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for the Human Health Assessment Review are provided in **Table 1**. The assessment criteria, indicators, and data sources will be used to assess the effects of the preferred alternative on human health. These evaluation criteria and indicators focus on air exposure pathways based on the conclusions of the 2005 Warwick Landfill Expansion EA, and may be updated during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for the Human Health Assessment Review

Evaluation Criteria	Rationale	Indicators	Data Sources
Human Health	Construction and operation activities at a waste disposal site can lead to increase to increased levels of particulates (dust) and related metals in the air.	• Predicted acute and chronic health-based concentration ratios arising from air concentrations of particulate matter (dust) and related metals at identified sensitive receptor locations within the Study Area. Refer to **Table 2** for complete list of assessed contaminants. • Frequency of any exceedance of applicable standards, limits, or guidelines at identified receptors	• Data used in previous 2005 risk assessment. • Available background ambient air data • Ground-level air concentrations modelled by Air Quality team for proposed preferred alternative and associated frequency data • Off-site receptors identified in coordination with other disciplines • Published health-based regulatory benchmarks or toxicity reference values (TRVs) for each contaminant of concern
	Waste disposal site and associated operations can emit gaseous contaminants that can degrade air quality.	• Predicted acute and chronic health-based concentration ratios arising from air concentrations of gaseous contaminants at identified sensitive receptor locations within the Study Area. Refer to **Table 2** for complete list of assessed contaminants. • Frequency of any exceedance of applicable standards, limits, or guidelines at identified receptors	

4.2 Characterization of Existing Conditions

An evaluation of potential health effects from expected operations at the proposed expansion of the then Warwick Landfill in the form of a detailed human health risk assessment (HHRA) conducted by Cantox Environmental Inc. (now Intrinsik Corp.) was included in the Warwick Landfill Expansion EA conducted in 2005.

In general, a HHRA is a scientific study that evaluates the potential for the occurrence of adverse health effects from exposures of people (receptors) to contaminants of concern (COCs) present in surrounding environmental media (e.g., air, soil, sediment, surface water, groundwater, food, etc.), under existing or predicted exposure conditions. HHRA procedures are based on the fundamental dose-response principle of toxicology. The response of an individual to a contaminant exposure increases in proportion to the contaminant concentration in critical target tissues where adverse effects may occur. The concentrations of contaminants in the target tissues (the dose) are determined by the degree of exposure, which is proportional to the contaminant concentrations in the environment where the receptor resides, works, or visits. All contaminants (both natural and man-made) have the potential to cause effects in people and the ecosystem. It is the contaminant concentration, the route and amount of exposure, and the inherent toxicity of the contaminant that determines the level of risk for adverse health effects to occur. As such, an HHRA allows stakeholders to evaluate the potential health implications of a proposed project and address potential mitigation options should potential health risks be identified.

4.2.1 Summary of 2005 Landfill Expansion HHRA

As a requirement of the then Ontario Ministry of the Environment (MOE), through the EA process and ToR review, WM was required to conduct an HHRA to evaluate landfill air emissions. The HHRA was established to evaluate the potential human health impacts, on nearby residential communities that could arise from expected airborne emissions associated with the proposed landfill expansion. The HHRA was carried out in compliance with the risk assessment procedures endorsed by relevant regulatory agencies such as the MOE, Environment Canada, Health Canada, and the United States Environmental Protection Agency.

The HHRA evaluated the potential human health impacts on nearby residential communities, that could arise from expected airborne emissions associated with the proposed landfill expansion. Future air emissions associated with the expansion were predicted by air dispersion modellers using a series of Ministry-approved computer models. The estimated future ground-level air concentrations of contaminants resulting from the proposed landfill expansion were then used in the HHRA study.

The objective of the HHRA was to determine whether expected emissions from the proposed Landfill expansion would pose unacceptable health risks to residents living in the study area. The original study area encompassed receptors within 3.5 km of the existing landfill site, extending past Highway 402 to the north and including the nearby village of Watford to the south. The HHRA evaluated the potential health impacts associated with predicted landfill emissions to people residing (or potentially residing) at specific locations which were predicted to have the highest ground-level air concentrations. Both long-term (chronic) and short-term (i.e., 24-hour exposure durations) related health

risks were evaluated at individual receptor locations. Acute health risks associated with very short durations of exposure (i.e., ½-hour and 1-hour) to combustion gases were also evaluated at the maximum fence-line location since it was considered plausible that an individual could spend small amounts of time at this location (CEI, 2005).

Different time frames which were representative of different landfill operating phases were also evaluated. A baseline/background scenario which reflected the pre-expansion conditions at the landfill site were first considered. Six (6) future operating time frames within the projected lifespan of the facility were also considered including Year 2005, Year 2010, Year 2015, Year 2020, Year 2025 and Year 2030 and represent predicted emissions following expansion through to closure of the facility.

In the original 2005 HHRA, health risks were estimated using both deterministic and stochastic analyses. A deterministic approach involves using conservative (i.e., protective), discrete values for each parameter (e.g., a child is assumed to play outside 5 hours per day) to generate a single point estimate health risk value. A stochastic approach involved using probability distributions of exposure parameters rather than single point estimate values (e.g., a child is assumed to play outside between 3 and 7 hours per day) to generate a possible range or distribution of health risk estimates.

In addition to evaluating the health impacts associated with emissions of non-methane organic compounds produced by the landfill itself, dusts generated from within the landfill and along two different potential access routes (i.e., Zion Line to the north and County Road 79 to the west) were considered. Based on the results of the air quality assessment, County Road 79 (the west entrance) was considered to be the preferred access route, due to the smaller amount of dust generated. As a result, the HHRA focussed on the west entrance (i.e., County Road 79) during the quantitative evaluation of particulate from crustal sources. Products of incomplete combustion (e.g., polycyclic aromatic hydrocarbons (PAHs) and dioxins/furans) as a result of the landfill flare and leachate treatment options (i.e., evaporation/incineration) were also considered and assessed.

The 2005 HHRA employed the standard HHRA framework and assessed the following COCs. At the time, the MOE required that WM include an initial list of 17 non-methane organic compounds which have been previously identified as posing the greatest concern to human health at landfill sites in Ontario. As a result of the peer review process and consideration of leachate treatment options, additional compounds (including products of incomplete combustion, particulate matter and metals) were selected for inclusion in the HHRA.

Table 2. Proposed Contaminants of Concern for the Human Health Assessment Review

COC Group	COC Source	COC		
Landfill Gases	Landfill gases produced by decomposition of landfill wastes	1,1-Dichloroethane 1,2-Dichloroethane Butan-2-ol 1,1,2-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1-Dichloroethylene	Methylene chloride Methyl mercaptan Trichloroethylene Bromodichloromethane Vinyl Chloride Octane	Dimethylsulphide Chloroethane Hydrogen sulphide Benzene Ethyl mercaptan
Combustion Gases and Products of Incomplete Combustion	Landfill flare and leachate treatment options (evaporation/incineration)	Sulphur dioxide Hydrogen chloride	Nitrogen dioxide Benzo(a)pyrene-TEQ (representing carcinogenic PAH group)	Carbon monoxide Dioxin/Furans (TEQ)
Particulate	Crustal sources (*i.e.*, soil) due to on- and off-site activities; contaminated soils; and various combustion sources including motor vehicle exhaust	Total Suspended Particulate (TSP)	PM_{10}	$PM_{2.5}$
Metals	Leachate treatment option (evaporation/incineration)	Arsenic Mercury	Cadmium Nickel	Lead

Polycyclic aromatic hydrocarbons (PAHs) are a group of ubiquitous environmental pollutants that typically arise from incomplete combustion or related chemical processes. Similar to the dioxin/furan group, they are known to be a family of chemicals which act through similar toxicological modes of action based on the primary carcinogen in the group, benzo(a)pyrene. Toxic equivalency factors/quotients (TEF/TEQs) are commonly used in risk assessment to express the toxicity of complex mixtures. For PAHs, TEF values are available for assessing their carcinogenic potential and are expressed as benzo[a]pyrene equivalents (*i.e.*, benzo[a]pyrene-TEQ or BAP-TEQ). As part of a risk assessment process, rather than assessing each of the carcinogenic PAHs individually, the environmental concentrations can be combined based on their individual TEQ values to express the environmental concentration of the overall carcinogenic PAH group as a BAP-TEQ concentration. In the 2005 HHRA, air concentrations of the PAHs were provided as BAP-TEQ concentrations. For the current review, the Air Quality group will provide BAP-TEQ air concentrations to permit an apples-to-apples comparison.

As an initial step in the Human Health Assessment Review, the list of assessed contaminants may be reduced based upon screening conducted by the Air Quality group. As noted in the Air Quality workplan:

> "The potential effects of the proposed landfill optimization will be assessed based on key indicator contaminants. Since the existing TCEC has been well characterized through studies such as the 2005 EA, the 2016 Environmental Screening Report, and various ECA applications, it has been determined which contaminants are of particular interest. The key indicator contaminants were developed based on a review of previous studies completed for the existing TCEC facility, as well as an understanding of the contaminants typically emitted by landfill operations. In general, the contaminants with predicted concentrations greater than 15% of their current criteria

in the previously completed 2016 Twin Creeks Environmental Screening report were determined to be the key indicator contaminants."

As noted previously, a series of long-term residential exposure scenarios were used to evaluate potential health risks resulting from exposures to non-carcinogenic COCs at the maximum discrete receptor location. Annual average air concentrations under pre-expansion (i.e., background/baseline) conditions and six future operating conditions (2005, 2010, 2015, 2020, 2025 and 2030) were evaluated in the HHRA. For carcinogenic COCs, a lifetime residential exposure scenario evaluating incremental lifetime cancer risks (ILCRs) at the maximum discrete receptor location was assessed. For this scenario, predicted ground-level air concentration data over a 70-year lifespan (modelled data from 2005 through 2075) were used to approximate average lifetime daily exposures to the carcinogenic COCs, for a residential receptor conservatively assumed to live at the maximum discrete receptor location for their entire lifetime (CEI, 2005).

For the 2005 HHRA, the following exposure pathways were considered:

- Inhalation of Air;
- Inhalation of Soils and Dusts;
- Ingestion of Soils and Dusts;
- Ingestion of Locally Grown Produce;
- Ingestion of Locally Derived Beef and Dairy Products;
- Ingestion of Breast Milk; and
- Dermal Exposure to Soils and Dusts.

The HHRA applied standard regulatory-approved assumptions and methodologies to estimate potential health risks from both acute and chronic exposures to the modelled COC concentrations for the baseline conditions and over the six discrete time-slice scenarios (*i.e.*, 2005, 2010, 2020, 2025, and 2030). The results of the HHRA were as follows:

Short-Term Acute Human Health Impacts

- All 24-hour exposure durations were evaluated at the maximum discrete receptor location and at the maximum fenceline location.
- No short-term adverse health effects were predicted to occur as a result of exposure to combustion gases at the maximum receptor location under the *landfill flare only* or *landfill flare plus evaporation/incineration* options.
- With the exception of SO_2 in Year 26, all ½-hour and 1-hour concentrations modelled at the maximum fence-line location were less than the corresponding benchmark under both the *landfill flare only* and *landfill flare plus evaporation/incineration* options.
- Given the conservatism of the WHO SO_2 air quality criterion and the exposure assumptions employed, the HHRA concluded that the CR value of 1.1 (*i.e.*, 10% above the criteria) predicted for operational year 2030 at the maximum fence-line location under the *landfill flare plus evaporation/incineration* option was considered to be of minimal significance.

Chronic Long-Term Human Health Impacts

- Long-term non-cancer health risks as a result of predicted exposures to landfill gases from the proposed expansion were considered minimal (i.e., CR values less than 1.0) at the maximum discrete receptor location.
- ILCR estimates for all COCs including metals, products of incomplete combustion and VOCs from all sources) were below the regulatory benchmark of one-in-one million risk level.
- Chronic human health risks associated with exposure to emissions resulting from both the *landfill flare only* scenario (i.e., PAHs, dioxin/furans), and the *landfill flare plus evaporation/incineration* scenario (i.e., dioxins/furans, benzo(a)pyrene, lead, cadmium, arsenic, nickel and mercury) were all below the corresponding regulatory benchmarks, and in many cases significantly so.
- Annual concentration ratio values for chronic exposures to all combustion gases (i.e., CO, SO_2, NOx and HCl) at the maximum discrete receptor location for both the *landfill flare only* and the *landfill flare plus leachate incineration* were below the corresponding regulatory benchmarks.
- Given the small magnitude and low frequency of exceedances predicted for PM_{10} and $PM_{2.5}$ under assumed worst-case conditions at the maximum residential receptor location, and the level of conservatism used in the HHRA, the HHRA concluded that likelihood of adverse health effects occurring as a result of exposure to particulate matter was extremely low.

4.2.2 Confirmation of Current Conditions based on 2005 HHRA (pre-proposed expansion)

Given the current proposed landfill optimization involves no change in the landfill footprint, approved service area, or annual fill rate, one would not expect significant changes in the assumptions used in the original HHRA. As such, to confirm that the conclusions of the original 2005 HHRA still hold for the current landfill (post proposed expansion), it is proposed that the following steps be taken as part of the current EA process:

- A comparison of the results of the contaminant analyses from the recent annual monitoring program against assumptions made in the original 2005 HHRA. This will include all available empirical data from the annual monitoring program. Preference will be given to the most recent available air monitoring data (*i.e.*, 2018 and 2019, where available);
- An assessment of new contaminants identified for potential health risks, and the reassessment of contaminants detected in recent annual compliance monitoring at concentrations higher, or lower than those considered in the original 2005 HHRA; and
- A review of recent regulatory risk assessment guidance (including toxicological reference values, exposure parameters, etc.) compared to those used in the original 2005 HHRA to identify if there have been any significant changes in standard assessment procedures that may impact HHRA conclusions.

Should these reviews identify additional contaminants that should be evaluated that were not on the original COC list in the 2005 HHRA, these will be highlighted for further assessment as part of this process. Should a dramatic increase in concentration be identified that could pose a risk through secondary pathways (*i.e.*, farmed produce, country foods), these will be highlighted for further assessment as part of this process.

4.3 Assessment of Potential Environmental Effects of the Preferred Alternative

As part of the EA, the alternative methods will be comparatively assessed and evaluated for the other environmental components (i.e., those components forming the natural, socio-economic, cultural, and built environments), using their proposed evaluation criteria, indicators, and data sources to determine the Preferred Alternative.

Based on an examination of the proposed alternative methods, it is unlikely that any of the alternative methods would alter the conclusions of the human health assessment review. As such, the review will focus on a comparison of the Preferred Alternative to the risk assessment work previously completed in 2005.

As previously noted, given the current proposed expansion involves no change in the landfill footprint, approved service area, or annual fill rate, one would not expect significant changes in the assumptions used in the original HHRA. As such, the conclusions of the original 2005 HHRA will be confirmed for the current landfill (post proposed expansion).

It is acknowledged that a fill rate change was permitted for the Twin Creeks Environmental Centre in 2017. The implications of this change will be evaluated as per its potential impacts on the assumptions and conclusions of the original 2005 HHRA.

To assess the effects of the preferred alternative, an evaluation of the data produced from the various components in the current landfill optimization EA (e.g., air quality, surface water, groundwater, etc.) will be conducted to determine whether they differ significantly from those used in the original 2005 HHRA. This assessment will include an evaluation of whether new receptor locations may be relevant (i.e., have any residential homes been built closer to the facility since the 2005 HHRA) and whether localized surface water impacts may have broader impacts that were not assessed in the 2005 HHRA. While it is noted that the Off-site Study area has been extended from 3.5 km in the original 2005 HHRA to 5 km in the current EA, this is unlikely to impact the comparison between the current landfill and the preferred alternative as the highest potential risks related to air emissions are typically in the closest proximity to the landfill (*i.e.*, not in the area from 3.5 to 5 km away from the landfill).

An effects assessment will be carried out considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the ‘do nothing’ alternative.

4.4 Reporting

Two separate reports will be prepared for Human Health Assessment Review in support of the EA:

1. A report providing a characterization of Existing Conditions; and
2. A report providing the Effects Assessment.

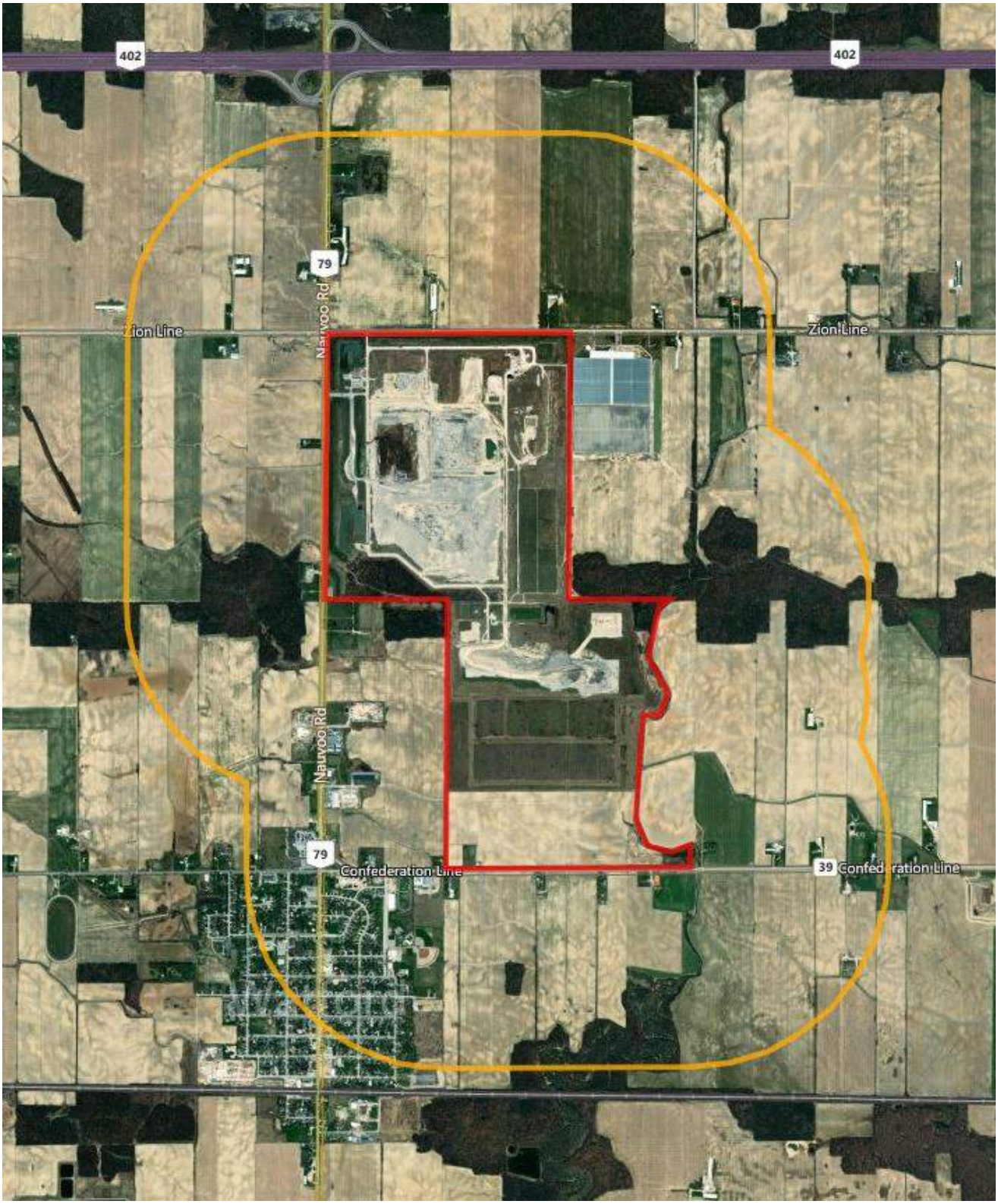
These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

5 References

CEI. 2005. Human Health Risk Assessment of the Proposed Warwick Landfill Expansion. Cantox Environmental Inc. September 2005.

Figures

Figure 1. General On-Site and Off-site Study Areas



LEGEND

On-Site Study Area

General Off-Site Study Area (1 km)

Hydrogeology Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

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Contents

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Acronyms

Acronym	Definition
EA	Environmental Assessment
ECA	Environmental Compliance Approval
EMP	*Environmental Monitoring Plan* (Jagger Hims Limited, 2007)
MECP	Ministry of Environment, Conservation and Parks
PDL	Primary Drainage Layer
PLIL	Primary Leachate Indicator List
SDL	Secondary Drainage Layer
SLIL	Secondary Leachate Indicator List
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
WM	Waste Management of Canada Corporation
Waste ECA	Amended Environmental Compliance Approval (ECA) No. A032203, dated December 19, 2020

1 Introduction

This Hydrogeology work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

The Hydrogeology discipline evaluates the flow and quality of groundwater with its movement through the Site. The evaluation compares assessed groundwater quality results against established provincial standards, as well as current established site-specific criteria per MECP approval. The hydrogeology evaluation considers specific chemical concentrations, as well as flow direction of groundwater.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m³ of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m³, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-Site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed through an under-drain system toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-Site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $24M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This Hydrogeology work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the geologic and hydrogeologic environment and groundwater quality, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the hydrogeology work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-Site and off-Site. The general study areas proposed for the purposes of the EA are presented below and shown in **Figure 1**.

- On-Site Study Area: the existing TCEC.
- Off-Site Study Area (vicinity): the lands within the vicinity of the TCEC extending approximately 1 kilometre off WM's property boundaries. It is noted that the regional geologic area (5 to 10 kilometres from Site) will be documented, but the effects of the landfill optimization project would not be expected beyond the Off-Site Study Area.

Both the on-Site and off-Site Study Areas are located within till plains, with the remnants of a shoreline scarp located to the west near County Road 79. The Regional Setting is between 5 to 10 kilometres of the Site and is based on watershed boundaries, and is located within the southeastern portion of the Horseshoe Moraines physiographic region and within the St. Clair Clay Plain physiographic region. The Horseshoe Moraines consist of a large horseshoe-shaped landform that includes a series of moraines aligned roughly parallel to the Lake Huron shoreline. The Site, in context to the Regional Setting is presented in **Figure 2**.

4 Scope of Work

The scope of work for hydrogeology includes the development of evaluation criteria, indicators, and data sources, characterization of the existing geologic and hydrogeologic environmental conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

The hydrogeologic assessment will evaluate:

- Existing groundwater quality trends around the Site in context to current and proposed Site operations;
- Groundwater flow within each hydrostratigraphic unit as a result of increasing volume of waste being disposed in the Expansion Landfill from the landfill optimization project; and
- Evaluation of the contaminating lifespan (CLS) of the Expansion Landfill.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for the hydrogeologic environment are provided in **Table 1**. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on the hydrogeologic environment. These evaluation criteria and indicators may be modified during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for the Hydrogeologic Environment

Evaluation Criteria	Rationale	Indicators	Data Sources
Natural Environment			
Geology and Hydrogeology			
Groundwater Quality	Contaminants associated with waste disposal at the Site have the potential to enter the groundwater and impact on-Site groundwater. Acceptable groundwater quality, which is 80% of the Guideline B-7 criteria for the PLIL parameters, must be shown at the Site boundaries.	• Predicted effects on groundwater quality on-Site from increased waste quantities disposed within the Expansion Landfill • Predicted contaminating lifespan	• Applicable regulatory documentation (i.e. Amended Site ECAs, MECP guidelines, technical standards, etc.). • Landfill Environmental Monitoring Plan (Jagger Hims Limited, 2007) (EMP), and as amended per MECP approval. • Historical Hydrogeological studies. • Liquid level monitoring data for on-Site groundwater monitoring wells and leachate monitoring stations. • Liquid level monitoring data for surface water. • Groundwater quality monitoring data at on-Site monitoring wells as outlined in the EMP. • Quarterly and Annual Site compliance monitoring reports. • Leachate generation and management assessments, as outlined in the Leachate Management Plan, (March 2020) (HDR, 2019). • Proposed facility characteristics, including service life estimates. • Water well survey within the off-Site study area.

Table 1. Evaluation Criteria, Indicators, and Data Sources for the Hydrogeologic Environment

Evaluation Criteria	Rationale	Indicators	Data Sources
Groundwater Quantity	The landfill optimization has the potential to affect the established hydraulic trap design for the Expansion Landfill and understood groundwater flow patterns on-Site and Off-Site	• Predicted effect of landfill optimization on groundwater flow and quantity both on-Site and off-Site.	• Applicable regulatory documentation (i.e. Amended Site ECAs, MECP guidelines, technical standards, etc.) • Liquid level monitoring data for on-Site groundwater monitoring wells and leachate monitoring stations. • Historical Hydrogeological studies. • Water well records to be reviewed to understand the effect on groundwater quantity on-Site and off-Site as result of off-Site water well use in the area. • Quarterly and Annual Site compliance monitoring reports. • Water taking tracking from the Secondary Drainage Layer. • Proposed facility characteristics. • Water well survey within the off-Site study area.

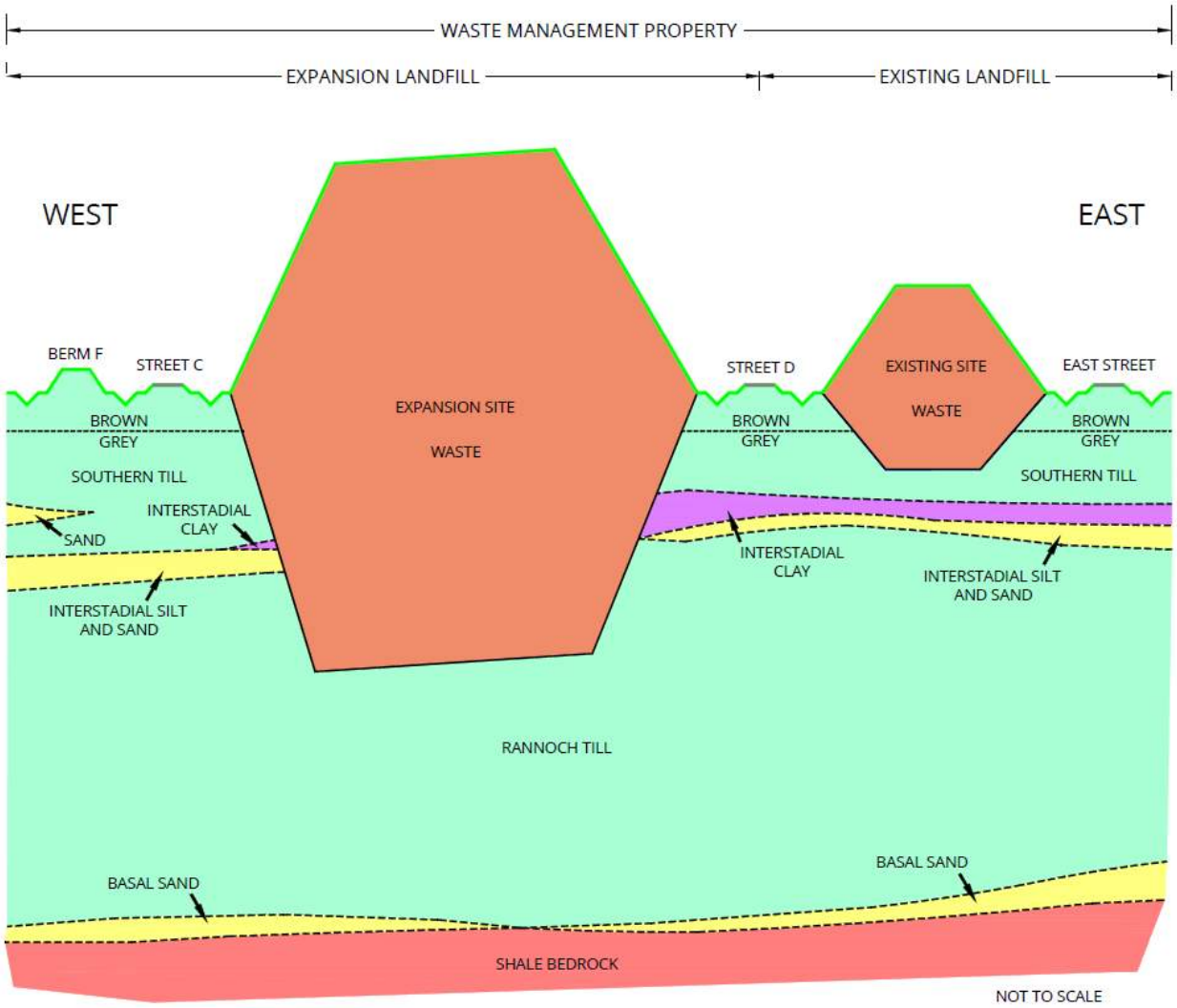
4.2 Characterization of Existing Conditions

As part of the environmental assessment process, there is a requirement to document the existing conditions that occur at the Site. This is to develop a general baseline condition understanding so that the effects from the project can be assessed. For the hydrogeologic assessment, baseline conditions will be defined using the established hydrogeologic monitoring program completed at the Site.

The hydrogeologic monitoring program for the Site is developed to assess that groundwater at the Site is not unacceptably degraded in comparison to the background quality, and that flow at the Site is in accordance with the hydraulic trap design of the Expansion Landfill.

4.2.1 On-Site Study Area Geologic Setting

The understood on-Site study area geologic stratigraphy is subdivided into the following main units: 1) the Southern Till; 2) interstadial deposits; 3) the Rannoch Till; and 4) bedrock and the overlying basal sand. Each unit is shown in the following cross-section.



The characteristics of each of the aforementioned geologic units will be documented to outline existing conditions at the Site.

4.2.2 On-Site Study Area Hydrogeologic Setting

Site Hydrogeology

There is an established groundwater setting below the Site. The stratigraphic sequence described above can be associated with hydrostratigraphic units, as summarized below. It is noted that although each stratigraphic unit is identified as part of a hydrostratigraphic unit, each unit has a hydraulic influence on the others.

Stratigraphic Unit	Hydrostratigraphic Unit	Approximate Depth to top of Hydrostratigraphic Unit (m)
Southern Till: Brown Zone	Active Aquitard	0.0
Southern Till: Grey Zone	Upper Aquitard	1.6 to 7.9
Interstadial Deposits: Clay and Silt	Upper Aquitard	1.6 to 7.9
Interstadial Deposits: Silt and Sand	Interstadial Silt & Sand	4.0 to 10.7
Rannoch Till	Lower Aquitard	4.5 to 12.5
Fractured Bedrock and Basal Sand	Interface Aquifer	22.8 to 29.3

The characteristics of each of the aforementioned hydrogeologic units will be documented to outline existing conditions at the Site. Additionally, the Site hydrogeology with respect to the broader regional hydrogeology will be documented with respect to source water protection.

4.2.3 Off-Site Study Area Geologic and Hydrogeologic Setting

Off-Site Geology

The understood off-Site study area geologic stratigraphy is similar to that of the on-Site study area where it is subdivided into the following main units: 1) the Southern Till; 2) interstadial deposits; 3) the Rannoch Till; and 4) bedrock and the overlying basal sand.

Off-Site Hydrogeology

The established groundwater setting below the Site is also similar to that of the on-Site study area which is comprised of the stratigraphic sequence as shown above in section 4.2.2.

4.2.4 Site Leachate Collection Infrastructure

The leachate collection infrastructure is critical to the protection of groundwater resources at the Site. The fundamental design of the Expansion Landfill is hydraulic containment, which is the inducement of groundwater flow towards the landfill footprint thereby preventing the outward movement of leachate. As a best practice, the leachate levels at the Existing Landfill are similarly managed, but levels are also managed in consideration of leachate storage for volume availability to operate the on-Site Poplar System phytoremediation system as an environmental stewardship proactive alternative to off-Site

disposal at a wastewater treatment plant. The extraction of leachate within the Existing Landfill is prioritized based on the leachate elevations for each individual waste cell to promote inward hydraulic gradients, except where leachate is stored in the waste during late winter and early spring for irrigation application to the Poplar System in the subsequent growing season. It is noted that from a compliance perspective, the Existing Landfill is evaluated for groundwater and surface water quality, and not from a hydraulic containment perspective.

Documentation of the details of the interaction of the leachate collection systems for both the Existing and Expansion Landfills on the groundwater within each hydrostratigraphic unit will be completed to outline how these systems protect the groundwater resources at the Site.

Existing Landfill Leachate Collection Infrastructure

Within the Existing Landfill, Cells 3S, 4, 5, 6, 7, 8, 9, 10, 11, Cell 12 and the Sump are completed with leachate collection and pumping systems, while Cell 3 relies on the leachate collection systems of the adjacent cells. These manholes, along with 9 inter-waste leachate level monitoring wells are assessed semi-annually per the EMP for input to leachate management. The assessed maintenance holes and leachate level monitoring wells are presented on **Figure 3**.

The leachate collection principles for each of the aforementioned cells, and the findings from the established monitoring program for the aforementioned leachate assessment locations will be documented to outline existing conditions.

Expansion Landfill Infrastructure

Hydraulic containment of the Expansion Landfill occurs immediately upon excavation of a given waste disposal cell. The upward and inward movement of groundwater is slowly saturating the secondary drainage layer (SDL). Pumping stations PS2, PS4, and PS6, as well as future PS8 are operated in a ‘normally off’ position to allow for groundwater accumulation within the SDL.

The leachate collection system in the primary drainage layer (PDL) is designed to maintain a hydraulic trap design of the Expansion Landfill whereby leachate is maintained below the level of the water in the SDL, as well as adjacent groundwater levels and pressures.

Monitoring of the PDL and SLD pumping stations are assessed in accordance with the EMP. Additionally, to supplement the PDL pumping station leachate level monitoring, inter-waste leachate levels are assessed from select early vertical gas collection wells. The assessed PDL and SDL pumping stations, as well as the early vertical gas collection wells used for level monitoring are presented on **Figure 3**.

The existing conditions of these two drainage layers will be documented to outline the principals of the hydraulic trap design for the Expansion Site. Chemical findings for the Expansion Site leachate will be documented to outline the relationship of leachate quality to groundwater quality at the Site.

4.2.5 On-Site Groundwater Monitoring

Groundwater monitoring wells are developed within each of the hydrostratigraphic units that have the greatest potential to readily show potential landfill leachate effects, as well as are sources of drinking water supply in the vicinity of the Site.

The hydrostratigraphic units including the **Active Aquitard**; **Interstadial Silt and Sand**; and **Interface Aquifer** are monitored semiannually in accordance with the EMP to assess for potential landfill leachate effects on groundwater quality.

The location of each of the following monitoring wells, as presented as monitoring well nests (i.e., OW16 represents OW16-6 and OW16-7), is provided in **Figure 3**.

Hydrostratigraphic Unit	Monitoring Wells
Active Aquitard	OW16-6, OW17-4, OW40D-4, OW54A-4, OW56-4, OW57-4, OW58-6, OW59-6, OW60-4, OW61-4, OW62-5, OW67-4, OW68-5, OW69-5, OW70B-5, OW71A-5, OW72-6, OW73-6, OW75-3, OW76-5, OW77-4, OW78-4, OW79-5, OW80-3, OW81-5, OW82(new), OW83(new), OW84(new), OWOW85-5
Interstadial Silt and Sand	OW16-7, OW40A-7, OW46-7, OW47-6, OW54-10, OW57-15, OW58-17, OW60-8, OW61-6, OW62-7, OW67-11, OW72-10, OW73-9, OW75-7, OW78-6, OW79-7, OW80-6, OW81-7, OW82(new), OW83(new), OW84(new), OW85-8
Interface Aquifer	OW17-30, OW19-29, OW39A-26, OW40A-28, OW49-29, OW60-25, OW61-26, OW62-30, OW79-26, OW80-27, OW81-27, OW82(new), OW83(new), OW84(new), Cemetery Well

Note: 1) Italicized denotes monitoring well is inactive as it is to be used to evaluate the Poplar Plantation two (2) months prior to activation of the system.
2) (new) denotes that monitoring well to be installed per the installation frequency outlined in the Environmental Monitoring Plan (EMP) dated December 20, 2007.

There are three groundwater Primary Leachate Indicator List (PLIL) parameters (chloride, nitrate (as N), and boron) that would most readily show as a landfill leachate effect on groundwater if shown together in elevated concentrations compared to background concentrations. It is the PLIL parameters that are assessed for compliance with the site-specific groundwater trigger concentrations per the EMP. It is noted that the established comprehensive groundwater monitoring program at the Site has shown acceptable quality and predicted groundwater flow for each hydrostratigraphic unit at the Site since monitoring began.

Groundwater data collected from the Site for the established comprehensive environmental monitoring program serve as a strong baseline database in order to document existing conditions, as well as to be assessed to evaluate potential effects from the landfill optimization project on groundwater flow and quality for each of the aforementioned hydrostratigraphic units. Documentation of the mechanics of the monitoring program will be completed. This documentation will outline the rationale for the development of the monitoring program to evaluate for possible landfill leachate effects on groundwater, which will include what parameters are assessed, where sampling locations are located, when is sampling initiated, and how the quality results are assessed to evaluate existing conditions.

Presented below are the assessments that will be completed to document existing conditions and to evaluate potential effects from the landfill optimization project on groundwater quality and flow at the Site.

Evaluation of Groundwater Quality

The landfill optimization project has the potential to affect groundwater quality by the increased volume of waste being disposed and the make-up of waste to be disposed. The data from the established comprehensive monitoring program will serve as a strong baseline comprehensive database in order to document existing conditions, as well as to be assessed to evaluate potential effects from the landfill optimization project on groundwater quality.

An assessment of the PLIL Parameters will be completed of existing groundwater quality data compared to the leachate quality collected from the Expansion Site. This assessment will evaluate actual imperial chemical data from the leachate collected from the newer waste (< 12 years old) compared to predicted data used in the EMP. The intent of the assessment of the three PLIL Parameters (chloride, nitrate, and boron) will be to determine that the PLIL Parameters are still the most suitable parameters for evaluating possible landfill leachate effects on groundwater quality.

Evaluation of Groundwater Quantity (Flow)

The landfill optimization project has the potential to affect groundwater quantity, or more specifically the flow direction of the groundwater. This is important as the Expansion Site is designed based on hydraulic containment (the inducement of inward groundwater gradients towards the waste mound).

Similar to the evaluation for groundwater quality, documentation of the mechanics of the monitoring program will be completed to evaluate groundwater flow. This will document the rationale for the development of the monitoring program to evaluate for possible landfill effects on groundwater flow, what assessment considerations are evaluated, where monitoring wells are located, when levels and pressures are assessed, and how the monitoring results are assessed to evaluate existing conditions.

The available groundwater and leachate liquid elevation data will be assessed since disposal activities occurred in the Expansion Site to evaluate if there is a correlation to groundwater levels and pressures as a result of increased volume of waste disposed over the years.

4.2.6 Contaminating Lifespan

Leachate at the Site is generated by the percolation of infiltrating precipitation through the column of waste at Site. Consequently, the waste at the Site is degraded by the percolation of infiltrating precipitation over time. At a point in time in the future, the waste will be so degraded that the percolating precipitation will no longer generate leachate of sufficient strength that it would unacceptably affect groundwater quality.

There is a requirement for the Site to calculate the point in time in the future when the leachate would no longer negatively affect groundwater quality at the Site boundary. This duration of time in the future when the leachate would no longer negatively affect groundwater quality is termed the contaminating lifespan (CLS). As the Expansion Landfill has a significantly larger and newer volume of waste than the Existing Landfill, it is the waste in the Expansion Landfill that defines the duration of the CLS.

The existing conditions for the CLS for the Site will be documented, which will be presented in two manners: 1) the CLS for the current waste placed in the Expansion Landfill; and 2) the CLS for the fully constructed Expansion Landfill per its current approval volume. The documentation will outline the input considerations that are used to calculate the CLS for the Expansion Landfill.

Evaluation of the Contaminating Lifespan

The contaminating lifespan (CLS) for Expansion Landfill has the potential to be affected by the landfill optimization project. An evaluation of the CLS will be completed to present how the different volumes of waste for each alternative will affect the duration of the CLS for the Site.

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- predict the potential environmental effects for each alternative method (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4.3.2); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1. Potential effects can be positive or negative, direct or indirect, and short or long-term. Mitigation measures will be identified to minimize or mitigate the potential effects and then the net effects are evaluated taking into consideration the application of mitigation measures.

The proposed facility characteristics of each alternative method will be reviewed to determine potential interactions with groundwater quality and flow. The criteria and indicators listed in **Table 1** will be applied to each alternative method to determine potential effects.

For the evaluation of the hydrogeologic environment, the characterization of the existing conditions outlined in Section 4.2 for groundwater quality and flow, as well as the CLS for the Expansion Site will be used to assess potential effects that each of the alternative methods of the landfill optimization project may have on the Site.

4.3.2 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare

the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.3 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative.

Climate change has affected the frequency and intensity (less frequent and more intense) of precipitation events that are occurring globally, as well as at the Site. On-Site monitoring of precipitation began during 2003, with the first full year in 2004. The available on-Site precipitation data will be evaluated and compared to the two most relevant (closest with sufficient data) Environment Canada climatic stations in consideration of year to year patterns since 2004, as well as in consideration of relevant historical 30-year normal amounts (as measured at the Environment Canada climatic stations). The assessment will enable an evaluation of precipitation infiltration into the waste cells (in other words: leachate generation) which may be affected by landfill optimization and therefore the chemical strength of the leachate within the waste mound could change up or down as a result of the landfill optimization program. The assessment will also enable an evaluation of the potential for increased leachate seeps/springs and mounding of leachate within the waste mound. Weaker or stronger strength leachate will impact the contaminating lifespan of the landfill, down or up, respectively. This assessment will be completed for the Preferred Alternative.

4.4 Reporting

Two separate reports will be prepared for the Hydrogeological Environment in support of the EA:

1. A report providing a characterization of Existing Conditions; and
2. A report providing the Effects Assessment.

These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The characterization of existing conditions will include details of completed field investigations to date, technical analyses of available data, assessment methods, interpretation of results for compliance with the Waste and Sewage ECAs, as well as provide a summary of conclusions and recommendations.

5 References

Chapman, L.J. and Putnam, D.

2013 The Physiography of Southern Ontario, Third Edition. Ontario Geological Survey, Special Volume 2, 270pp.

HDR

2019 Leachate Management Plan (March 2020), Twin Creeks Environmental Centre.

Henderson, Paddon Environmental Inc.

1997 Development & Operations Report, Canadian Waste Services Inc., Warwick Landfill, Warwick Township. Prepared for Canadian Waste Services Inc.

Henderson, Paddon & Associates Limited

2008 Development and Operations Plans, Warwick Landfill Expansion Volumes 1 to 3, Prepared for Waste Management of Canada Corporation

Jagger Hims Limited

2005 Warwick Landfill Expansion, Environmental Assessment, Hydrogeological Assessment Volumes 1 to 3, Prepared for Waste Management of Canada Corporation

Jagger Hims Limited

2007 Environmental Monitoring Plan, Warwick Landfill Expansion, Township of Warwick, Ontario, Prepared for Waste Management of Canada Corporation

Ministry of the Environment

2003 Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines. Revised April 1994.

Ministry of the Environment and Energy

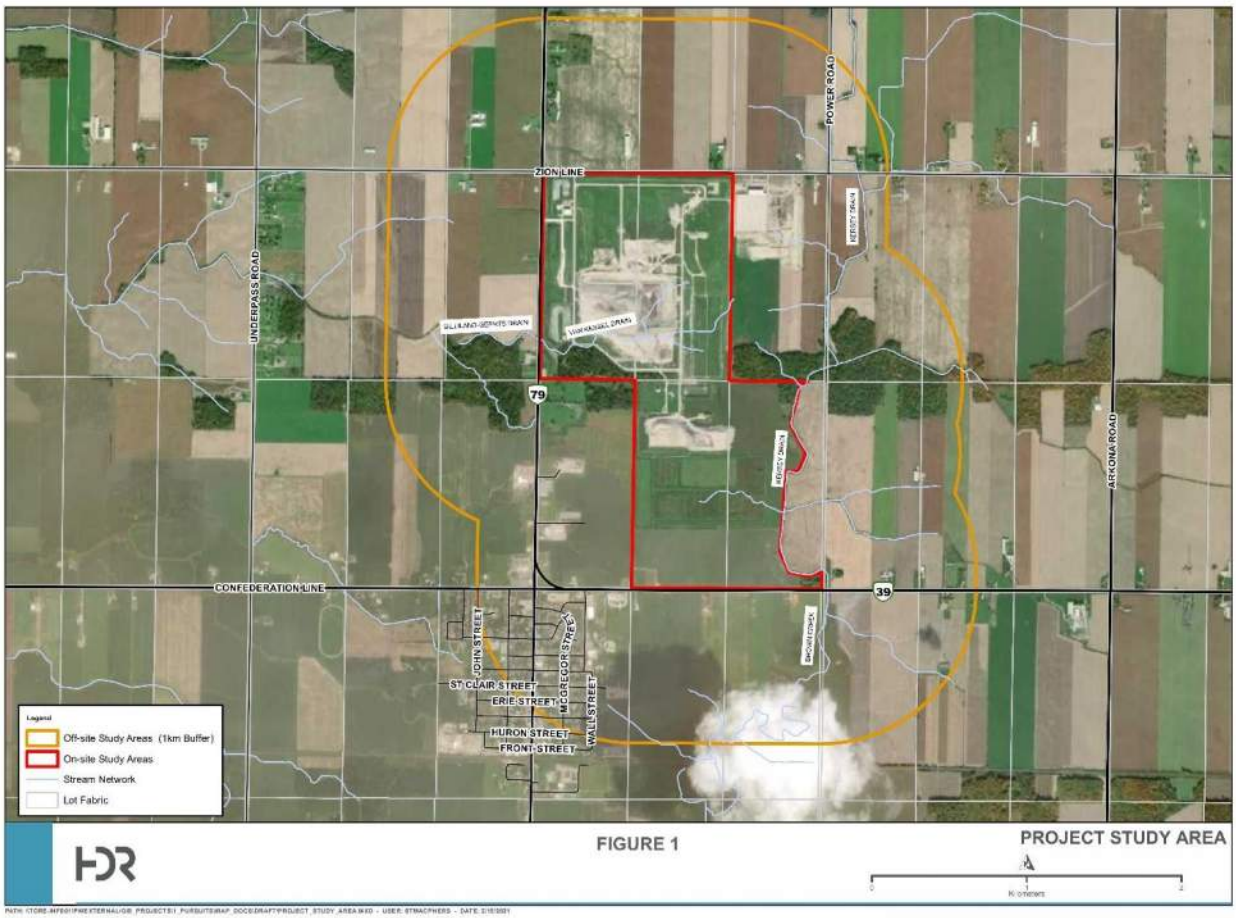
2003 Guideline B-7 (formerly 15-08), Incorporation of the Reasonable Use Concept in MOEE Groundwater Management Activities, Revised June 2006.

RWDI AIR Inc.

2021 2020 Fourth Quarter and Annual Monitoring Report, Twin Creeks Environmental Centre, Township of Warwick, Ontario, Prepared for Waste Management of Canada Corporation

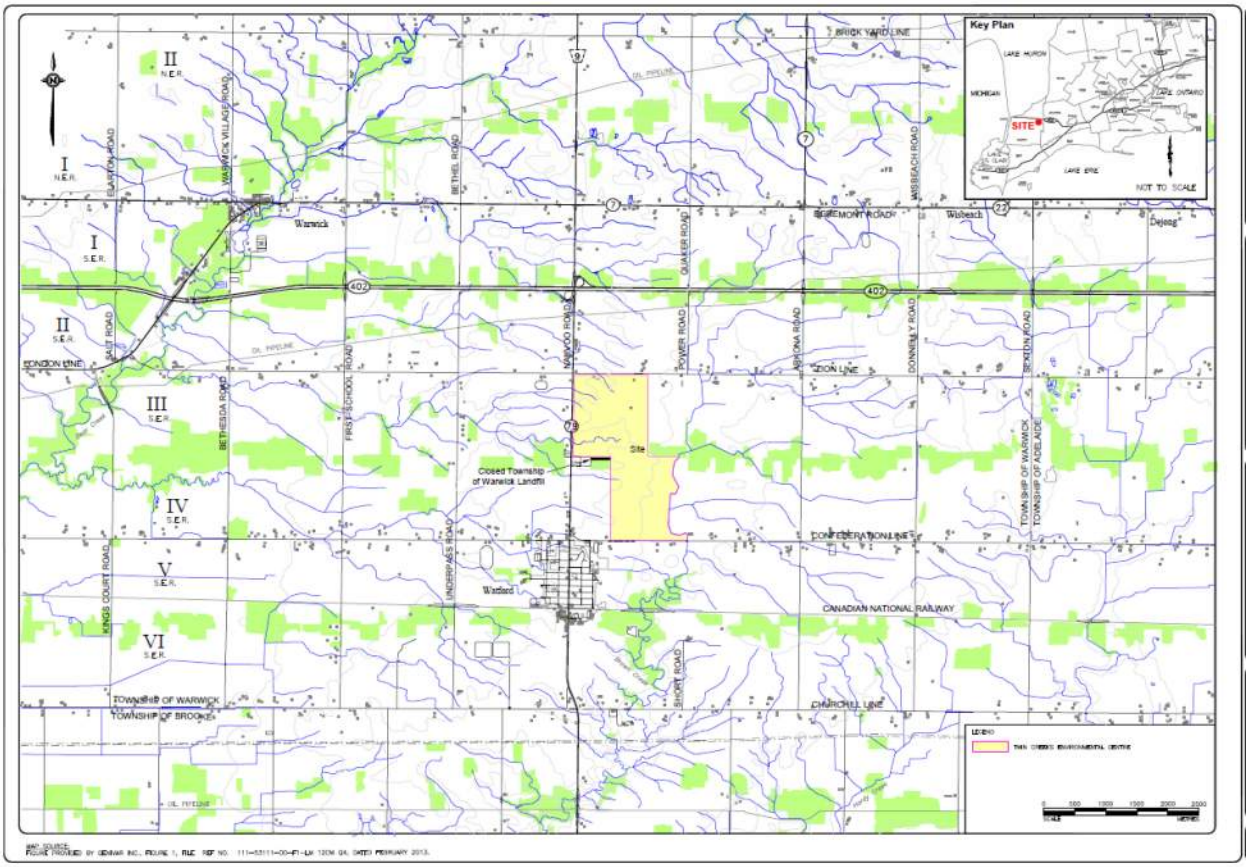
Figures

Figure 1. General On-Site and Off-Site Study Areas



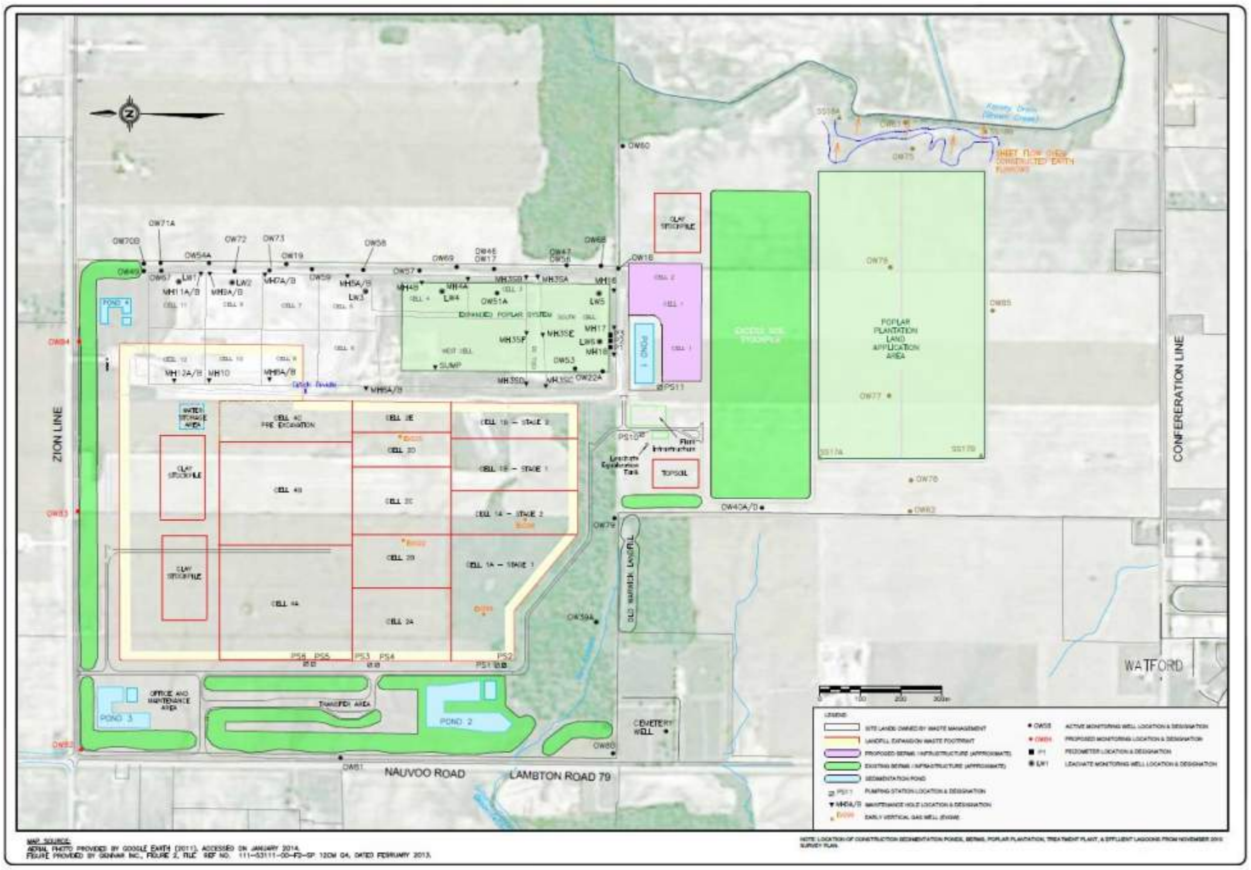
Source: HDR, 2021

Figure 2. Site Location in Regional Setting



Source: RWDI, April 2021

Figure 3. Hydrogeologic Monitoring Network



Source: RWDI, April 2021

Land Use Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

Prepared by:

Monteith Brown Planning Consultants
610 Princess Avenue, London ON, N6B 2B9

Contents

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Acronyms

Acronym	Definition
EA	Environmental Assessment
MBPC	Monteith Brown Planning Consultants
MECP	Ministry of Environment, Conservation and Parks
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
OP	Official Plan
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
WM	Waste Management of Canada Corporation
ZBL	Zoning By-law

1 Introduction

This Land Use work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

The Province of Ontario sets out the legislative framework for land use planning in Ontario through the *Planning Act*, which describes how land uses may be controlled, and who may control them. The effects of the proposed landfill expansion on current and future land uses within the On-Site and Off-Site Study Areas will be evaluated through the EA process, with a particular focus on existing and planned "sensitive land uses," as defined by the PPS and the MECP D-1 Guidelines on Land Use and Compatibility.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to optimize the landfill design and operation, maximizing the use of the constructed infrastructure and the significant investment made at the TCEC. The optimization could involve a vertical expansion of the landfill within the approved 101.8 ha Expansion Landfill footprint by modifying the side slopes and increasing the elevation of the landfill. This optimization could provide additional airspace of up to approximately 14M m^3, which could extend the site life by approximately 12 years (from 2032 to 2044). There would be no change to the current 101.8 ha landfill footprint area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $23M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of

the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This Land Use work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the Land Use environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the Land Use work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The general study areas proposed for the purposes of the EA are shown on **Figure 1**, with the Land-Use-specific Off-Site Study Area shown on **Figure 2**.

- On-Site Study Area: the existing TCEC.
- Off-Site Study Area: The Land Use Planning assessment Off-Site Study area corresponds to the Off-Site Study Area identified for the Socio-Economic Assessment,

including lands within 1 km of the On-Site Study Area, as well as the entire Settlement Area of Watford.

When evaluating effects across the study areas, all applicable Provincial D-series guidelines will be considered in the scope of this EA, including guidelines D-1, D-1-1, D-1-2, and D-1-3, as well as D-4, D-4-1, D-4-2, and D-4-3. The Provincial 'D-4' Guidelines for Land Uses on or Near Landfills and Dumps identifies that "*the Ministry considers the most significant contaminant discharges and visual problems to be normally within 500 metres of the perimeter of a fill area",* and recommends that this distance be used as a study area for land use proposals, although the actual influence areas may vary by individual landfills (s.s. 5.3).

4 Scope of Work

The scope of work for Land Use includes the development of evaluation criteria, indicators, and data sources, characterization of existing Land Use conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources which will be used to assess the effects of the alternatives and the preferred alternative on the Land Use environment are provided in **Table 1**. These evaluation criteria and indicators will be finalized through the EA process.

Table 1. Evaluation Criteria, Indicators, and Data Sources for Land Use

Evaluation Criteria	Rationale	Indicators	Data Sources
Current and Planned Future Land Use			
Effects on Current and Future Land Uses	The continued operation of the landfill may not be fully compatible with certain current and/or planned future land uses in the Off-Site Study Area. Waste disposal facilities can potentially have a negative impact on sensitive land uses, in the vicinity of the site.	• Current land use • Planned land use • Type(s) and proximity of off-site recreational resources within 1 km of a landfill footprint potentially affected • Type(s) and proximity of off-site sensitive land uses as defined by the Provincial Policy Statement and the MECP D-1 Guidelines (e.g., dwellings, churches, parks) within 1 km of a landfill footprint potentially affected • Type(s) and proximity of agricultural land use/operations (e.g., organic, cash crop, livestock)	• Planning Act • Provincial Policy Statement • All applicable Provincial D-series guidelines, including guidelines D-1, D-1-1, D-1-2 and D-1-3 (Land Use and Compatibility), as well as D-4, D-4-1, D4-2, and D-4-2 (Land Use On or Near Landfills and Dumps) • Lambton County Official Plan • Township of Warwick Official Plan • Township of Warwick Zoning By-law 121 of 2012 • Aerial photographic mapping, utilizing the following sources: Lambton County GIS, St. Clair Region Conservation Authority, OMAFRA Agricultural Information Atlas, Google Maps, and Bing Maps • Canadian Lands Inventory mapping • Field reconnaissance • Published data on public recreational facilities/activities • Proposed facility characteristics • Landfill design and operations data • The results of other discipline assessments for this EA, where applicable

Source: HDR & MBPC

4.2 Characterization of Existing Conditions

The EA will evaluate the effects of the proposed landfill expansion on current and future land uses within the On-Site and Off-Site Study Areas. In particular, waste disposal facilities may have a significant effect on sensitive land uses (as defined in the PPS, the 'D-1' Guidelines, and the 'D-4' Guidelines, see **Table 2**) within the vicinity of the site. The EA process will also identify the extend of the amendments required to be consistent with current Provincial policies, legislation, and guidelines.

The characterization of existing conditions will be informed by the Land Use planning framework in Ontario, which is set out in Provincial legislation through the *Planning Act*, The *Act* describes how land uses may be controlled, and who may control them. The Provincial Policy Statement ('PPS') (2020) is issued by the Province under the *Planning Act* and provides policy direction on matters of provincial interest related to land-use planning and development, which are implemented at the County and Municipal levels of government through Official Plans and Zoning By-laws (i.e., the County of Lambton Official Plan, Township of Warwick Official Plan, and Township of Warwick Zoning By-law No. 121 of 2012). All land-use planning decisions in Ontario must be consistent with the PPS.

The analysis will also be informed by a review of the Provincial 'D-1 Land Use and Compatibility' and 'D-4 Land Use On or Near Landfills and Dumps' guidelines, issued under the legislative authority of the *Environmental Protection Act, Environmental Assessment Act, Planning Act,* and other related legislation. The objective of the 'D-1' guidelines is *"to minimize or prevent, through the use of buffers, the exposure of any person, property, plant or animal life to adverse effects associated with the operation of specified facilities"*, including landfills (s.s. 1.2). The 'D-4' guidelines were written specifically to assist planning authorities in determining how to decide what types of land uses are appropriate near landfilled waste.

Table 2. Provincial Definition of 'Sensitive Land Use'

Source	Definition
Provincial Policy Statement (2020)	*Sensitive land uses: means buildings, amenity areas, or outdoor spaces where routine or normal activities occurring at reasonably expected times would experience one or more adverse effects from contaminant discharges generated by a nearby major facility. Sensitive land uses may be a part of the natural or built environment. Examples may include, but are not limited to: residences, day care centres, and educational and health facilities.*
D-1-3 Land Use Compatibility Definitions	*Sensitive Land Use* *A building, 'amenity area' or outdoor space where routine or normal activities occurring at reasonably expected times would experience 1 or more 'adverse effect(s)' from contaminant discharges generated by a nearby 'facility'. The 'sensitive land use' may be a part of the natural or built environment. Depending upon the particular 'facility' involved, a sensitive land use and associated activities may include one or a combination of:* *i. residences or facilities where people sleep (e.g., single and multi-unit dwellings, nursing homes, hospitals, trailer parks, camping grounds, etc.). These uses are considered to be sensitive 24 hours/day.* *ii. a permanent structure for non-facility related use, particularly of an institutional nature (e.g., schools, churches, community centres, day care centres).* *iii. certain outdoor recreational uses deemed by a municipality or other level of government to be sensitive (e.g., trailer park, picnic area, etc.).* *iv. certain agricultural operations (e.g., cattle raising, mink farming, cash crops and orchards).* *v. bird/wildlife habitats or sanctuaries*.

Table 2. Provincial Definition of 'Sensitive Land Use'

Source	Definition
D-4 Land Use On or Near Landfills and Dumps	*Sensitive land uses for landfills currently in operation* *Any existing or committed land use which includes:* *a. a permanent structure used in animal husbandry; or* *b. agricultural land used for pasturing livestock; or* *c. a permanent structure where:* *i. a person sleeps, or* *ii. a person is present on a full time basis; but not including food or motor vehicle service facilities adjacent to a highway, utility operations, scrap yards, heavy industrial uses, gravel pits, quarries, mining or forestry activities; or* *d. cemeteries*

Source: PPS (2020), D-1-3 Land Use Compatibility Definitions, D-4 Land Use On or Near Landfills and Dumps

The following tasks will be undertaken to fully characterize existing conditions within the On-Site and Off-Site Study Areas:

1. Collect Background Information on the Land-Use Planning Context
    a. A review of relevant background documents will be undertaken to inform the understanding of the land-use planning context, including the County of Lambton Official Plan, the Township of Warwick Official Plan, and the Township of Warwick Zoning By-law 121 of 2012, and their respective schedules.
2. Undertake a Desktop Review of Aerial Photographic Mapping
    a. A range of data sources, including but not limited to Lambton County GIS online mapping, St. Clair Region Conservation Authority online mapping, the OMAFRA Agricultural Information Atlas, Google Maps, and Bing Maps, will be utilized to identify existing sensitive land uses, recreational resources, and agricultural operations within the Off-Site Study Area, and note where 'planned' land uses differ from existing land uses.
3. Request Data on Recreational Facilities
    a. Data will be requested from the Township and the County (if applicable) on the usage of public recreational facilities within the Off-Site Study Area.
4. Site Visit
    a. A field visit to the On-Site and Off-Site Study Areas will be arranged to ensure a thorough understanding of existing land-use conditions. A 'windshield tour' of the Off-Site Study Area will be conducted to take photographs of sensitive land uses.
5. Produce a Detailed Characterization of Land-Use Conditions
    a. The findings from the background document review, desktop mapping review, data requests, and field investigations will be synthesized into a detailed characterization of conditions within the On-Site and Off-Site Study Areas, identifying specific receptors that are considered to be "sensitive land uses" under the established PPS and 'D-1' Guidelines. Locations within the Off-Site Study Area that may accommodate sensitive land uses in the future (based on the existing planning framework) will also be identified to recognize where the proposed landfill expansion may have a negative impact on future development.

For the purposes of the EA, the Land Use and Socio-Economic Studies will be conducted separately. Information will be shared between the two assessments as appropriate.

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- predict the potential environmental effects for each alternative method (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4.3.2); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Section 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1. Potential effects can be positive or negative, direct or indirect, and short or long-term. Indirect impacts are those impacts on Land Use that result from an effect of the project on another discipline. Mitigation measures will be identified to minimize or mitigate the potential effects and then the net effects are evaluated taking into consideration the application of mitigation measures.

An effects assessment for the ‘Current and Future Land Uses’ criterion will be conducted by evaluating how each of the Alternative Methods will affect the sensitive land uses within the Off-Site Study Area that were identified through the ‘Characterization of Existing Conditions’. As noted above, “sensitive land uses” will be identified by using the definitions found in the Provincial Policy Statement, the ‘D-1-3’ Guidelines, and the ‘D-4’ Guidelines, as those definitions were written by the Province to include land uses that may be negatively impacted by landfills. Any required land use approvals for the Alternative Methods will be identified as part of this evaluation, as appropriate.

Mitigation and monitoring programs for the ‘Land Use’ discipline will be based on the land-use planning tools available to the County of Lambton and the Township of Warwick through the *Planning Act*, as well as the ‘D-4’ Guidelines provided by the Province to guide land use approvals within and near landfills and dumps.

4.3.2 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.3 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative.

4.4 Reporting

Two separate reports will be prepared for Land Use in support of the EA:

1. A report providing a characterization of Existing Conditions; and
2. A report providing the Effects Assessment.

These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The Land Use assessment will be informed by the land-use planning framework established in Ontario through the *Planning Act*. The characterization of existing conditions will include details of completed field investigations, technical analyses, methods, results, maps of sensitive features within the On-Site and Off-Site Study Areas, conclusions, and recommendations.

5 References

County of Lambton
2020 County of Lambton Official Plan

Province of Ontario
1990 *Planning Act*, R.S.O. 1990, c. P. 13

Province of Ontario
1994 D-4 Land Use On or Near Landfills and Dumps

Province of Ontario
1995 D-1 Land Use and Compatibility

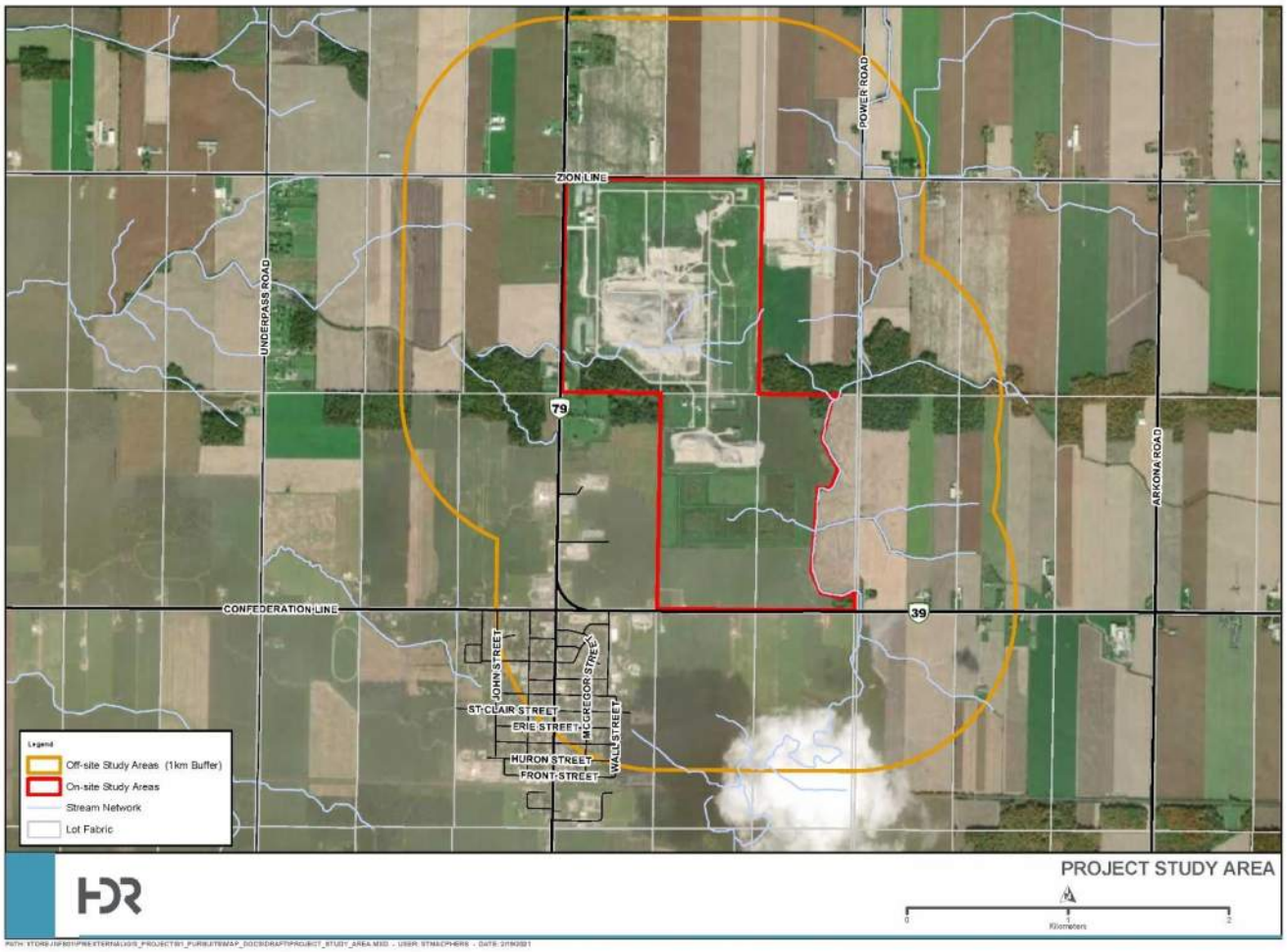
Province of Ontario
2020 Provincial Policy Statement (2020) Under the *Planning Act*.

Township of Warwick
2011 Township of Warwick Official Plan

Township of Warwick
2012 Township of Warwick Zoning By-law 121 of 2012

Figures

Figure 1. General On-Site and Off-Site Study Areas



Source: HDR Inc. (2021)

Figure 2. Land Use On-Site and Off-Site Study Areas

Source: MBPC (2021)

Noise Assessment Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

Prepared by:

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Guelph, Ontario N1G 4P6

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Acronyms

Acronym	Definition
EA	Environmental Assessment
MECP	Ministry of the Environment, Conservation and Parks
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
WM	Waste Management of Canada Corporation

1 Introduction

This Noise Assessment Work Plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of the Environment, Conservation and Parks (MECP) for approval.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m³ of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m³, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, haul route, or the annual fill rate.

Activities with associated noise sources that are included in this assessment are landfilling (i.e., bulldozers, haul trucks, excavators, compactors, portable generators used in landfilling), ancillary facilities (i.e., landfill gas management system and public drop-off), and construction (i.e., bulldozers, haul trucks, and excavators related to capping).

There are no existing or proposed sources of vibration associated with the site.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $23M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of

the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This noise assessment work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the noise assessment environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the noise and vibration assessment work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of three study areas: on-site, along the haul routes, and off-site. The general study areas proposed for the purposes of the EA are (**Figure 1**):

- On-site study area: the existing TCEC.
- Off-site study area: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area.
- Off-site haul route area, within 1 km from the primary haul route from Highway 402 to the site entrance.

These initial study areas will be reviewed and refined following the analysis of the existing conditions. If necessary, and depending on study findings, the Off-site study area may be expanded or contracted. For the purposes of noise assessment, receptor locations in the Off-site study area may include those locations that represent the following:

1. Residences;
2. Schools, day nurseries, community centres, hospitals, hotels, motels;
3. Places of worship that are not on commercially or industrially zoned land; and
4. Accessible properties that are vacant and zoned to allow future sensitive use.

If it is deemed necessary per study findings or required to support other disciplines, additional receptors may be added to the analysis.

4 Scope of Work

The scope of work for the noise assessment includes the development of evaluation criteria, indicators, and data sources, characterization of existing noise and vibration assessment conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for the noise and vibration assessment environment are provided in **Table 1**. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on the noise and vibration assessment environment. These evaluation criteria and indicators will be finalized during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for Noise Assessment

Evaluation Criteria	Rationale	Indicators	Data Sources
Noise	Activities related to construction/rehabilitation, operation of the landfill and ancillary sources, and the off-site haul route can result in an increase in off-site noise levels	• Predicted site-related noise levels (measured in dBA or dBAI) • Change in sound levels (dB)	• Annual on-site noise monitoring data • Off-site noise monitoring • Manufacturer noise specifications • Noise measurement of on-site sources • Applicable MECP guidelines, technical standards and models • Aerial mapping and field reconnaissance to confirm off-site receptors • Topographic and land-use mapping • Land use zoning plans • Proposed facility characteristics • Landfill design and operations data • Traffic counting, characterization and modelling studies

4.1.1 Sound Level Criteria

Landfill Operations

The applicable sound level limit for existing landfilling activities is provided by the MECP *Noise Guidelines for Landfill Sites (Landfill Guidelines)* (MOE 1998), as presented in **Table** 2. *Landfill Guidelines* defines landfilling operations as construction and rehabilitation as well as conveyance activity. The guideline specifies that the sound level limits do not apply to ancillary facilities and off-site haul road; therefore, these sources are not to be included in the assessment of existing conditions of the landfill operations.

When elevated background, or ambient, sound levels are assessed, *Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites* (MOE 2012) states that if "the environment [is] dominated by noise sources of man-made activities, such as industry, commerce of road transportation, which produce sound in excess of the above limits, the higher sound levels may be used as the limit, provided that the noise sources are not under consideration for noise abatement by the Municipality or the MECP" (MOE 2012, p. 60). This definition indicates that noise from nearby roadways can be considered as part of the existing background sound level. An investigation of background sound levels and their implications on the sound level limits in **Table 2** can be considered as part of the EA.

Stationary Sources

The sound level limits that will be applicable for ancillary activities are provided by the MECP's *Publication NPC-300: Environmental Noise Guideline – Stationary and Transportation Sources – Approval and Planning (NPC-300)* (MOE 2013). The default or exclusion limits are based on a description of the acoustic environment at the receptor. The term "Class" is used to describe similar acoustic environments, where Class 3 is a very rural acoustic environment, while Class 2 has the sounds of nature and limited anthropogenic noise. The exclusion, or default, limits that would apply to the receptors are those that correspond to Class 2 or Class 3 limits. These are presented in **Table 2**. Where background sound levels are above the exclusion limits, the background sound levels become the limits.

Table 2. Receptor Sound Level Limits (dBA)

Receptor Class	Landfill Limit[b]		Ancillary Equipment Exclusion Limit (Outdoor Living Area/Façade)[a][b]		
	Day (7 AM – 7 PM)	*Night (7 PM – 7 AM)*	*Day (7 AM – 7 PM)*	*Evening (7 PM – 11 PM)*	*Night (11 PM – 7 AM)*
2	55	45	50/50	50/45	-/45
3	55	45	45/45	40/40	-/40

Source: *Landfill Guidelines* and *NPC-300*

[a] Limits presented for outdoor living area and façade of Point of Reception per *NPC-300*.

[b] Higher limits may apply when existing background sound levels are above the limits shown.

As in the case of landfill operations, for stationary sources, NPC-300 stipulates that the sound level limit at a point of reception is the higher of the default limit or the minimum background sound level. The most common driver of elevated background sound levels is traffic noise. Consequently, to accurately model background sound levels, an accounting for noise from nearby roadways will be included in the EA.

Pest Control Devices

Pest control devices can include impulsive sources (e.g., propane cannons), and quasi-steady impulsive sources (e.g., whistles). Sound level limits for pest control devices at off-site receptors are defined in *Landfill Guidelines*:

- For impulsive noise, the applicable limit is 70 dBAI for logarithmic mean impulse levels; and
- For quasi-steady impulsive noise, the applicable limit is 60 dBA for one-hour equivalent sound levels.

For quasi-steady impulsive sources, the requirements of *Publication NPC-103: Procedures* (MOE 1977b) and *Publication NPC-104: Sound Level Adjustment* (MOE 1977c) will apply. A 10 dB penalty would be applied to a source whose quasi-steady sound is audible off-site. Thus, the sound from the source would be modelled and assessed as if it is 10 dB louder than determined via measurement sound level meters.

4.2 Characterization of Existing Conditions

The characterization of existing conditions for Noise will involve data collection, as described in Section 4.1, within the study areas identified in **Figure 1**. Receptors will be chosen as described in Section 4.2 and data representing predictable worst-case existing and future conditions will be generated from modelling. Noise levels will be modeled using a computerized implementation of the internationally recognized ISO-9613 noise propagation algorithms, like the Cadna/A noise model which is produced by DataKustik GmbH. The ISO-9613 algorithms account for various noise propagation factors including:

- Distance attenuation (geometric spreading of noise);
- Reflections from structures;
- Atmospheric absorption;
- Ground attenuation; and
- Terrain effects such as shielding from perimeter berms.

The model will predict noise levels at the representative points of reception, as well as provide figures showing isopleths of equal 1-hour averaged sound levels (“noise contours”).

Modelled levels will be assessed against the applicable limits, as described in Sections 4.1.1 and 4.2.2. Changes to landfilling and ancillary facilities are being considered; therefore, the focus is placed on these activities.

4.2.1 Field Data Collection

The noise study will rely on data collected through field studies, to serve as key inputs into noise modeling of future conditions, assessments of compliance, and determination of required noise mitigation measures. Noise field evaluation will be conducted to:

- Identify noise sensitive receptors of interest within the study areas;
- Characterize background noise levels at representative receptors surrounding the site;
- Characterize adjacent industrial, commercial and non-field agricultural operations;
- Measure receptor-based noise levels from TCEC operations at representative receptors and at the property boundary; and
- Measure at-source noise emission levels at the TCEC site.

4.2.2 Background Sound Level

As described in Section 4.1.1, an understanding of background sound levels is necessary for establishment of appropriate limits at each point of reception. To determine the background sound level, road traffic noise modelling will occur per *Publication NPC-206: Sound Levels Due to Road Traffic* (MOE 1995b).

To model background noise levels, road traffic data will be needed. The traffic discipline will develop the required traffic data during their studies, through background traffic data collection, and projections of future service. The following data will be required:

- Road traffic volumes present if proposed landfill were no longer operating along the identified haul route provided by the traffic consultant, in the form of hourly traffic counts, including a breakdown into light vehicles (cars and light trucks), medium trucks (trucks with <6 wheels and vehicle weights of <12,000 kg) and heavy trucks (trucks with >6 wheels and weights >12,000 kg), as well as posted speed limits;
- Existing road traffic volumes along the identified haul route provided by the traffic consultant, in the form of hourly traffic counts, including a breakdown into light vehicles (cars and light trucks), medium trucks (trucks with <6 wheels and vehicle weights of <12,000 kg) and heavy trucks (trucks with >6 wheels and weights >12,000 kg), as well as posted speed limits. Traffic data should be split in order to obtain data regarding the current flow of traffic related to the TCEC and the other unrelated traffic; and
- Future proposed landfill related-traffic (including landfill operations, construction materials, and traffic related to ancillary sources and separately the traffic data should also split the traffic related to the TCEC and all other related traffic) volumes along the proposed off-site haul routes, in the form of hourly traffic counts, broken down into light vehicles, medium trucks and heavy trucks (recognizing that most landfill related traffic will be heavy trucks).

4.2.3 Landfilling Noise

The existing operations of the landfill will be characterized by modelling using the data sources described above and supported by on-site monitoring data. Sound levels will be modelled. The predicted sound levels will be presented over the entire study area in figures showing isopleths of equal 1-hour averaged sound levels (“noise contours”). The representative or worst-case points of reception (i.e., closest or most exposed) with respect to sound level in each cardinal direction will be considered.

4.2.4 Ancillary Facilities Noise

Sound from existing ancillary facilities will be characterized by modelling using the data sources described above. Sound levels will be modelled, with the predicted sound levels presented over the entire study area in figures showing isopleths of equal 1-hour averaged sound levels (“noise contours”). The points of reception that have representative or worst-case sound levels in each cardinal direction will be considered.

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- describe the potential environmental effects for each alternative method using qualitative methods (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4.3.2); and
- conduct a quantitative effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of qualitative aspects of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1. The alternative methods will be comparatively assessed and evaluated qualitatively.

Data from Modelling for Off-site Study Area

Noise impacts for three future operational periods of the preferred alternative will be modelled to ensure that predictable worst-case impacts are captured. Key model inputs will include:

- Noise emission levels for landfill equipment, in the form of sound power levels (PWL values), based on measurements of equipment at other landfill sites in the Province of Ontario, where applicable, and/or noise emission levels for similar items equipment from equipment manufacturers, regulated limits, and from previous measurement of similar or identical equipment;
- Landfill phasing data, including mapping and the conceptual design report, showing the location of activities at different times during the proposed optimization of the landfill. This will provide information on proposed landfill activities including:
    - Hours of operation;
    - Types and number of landfill heavy vehicles (e.g., bulldozers), on-site road vehicles, and on-site haul vehicle hourly distributions during construction and normal operations;
    - Types of pest (vermin) control measures to be used. If impulsive noise measures are to be used (e.g., propane cannons, “bird banger”, fireworks, etc.), the location, time and frequency of use; and
    - Plot plans and topographical mapping data, preferably in a digital format, showing the location of the existing/future landfill, and representative receptors of concern within 1000 m.

The predicted sound levels will be presented over the entire study area in figures showing isopleths of equal 1-hour averaged sound levels (“noise contours”). The worst-case sound level assessment in each cardinal direction will be further addressed in tabular form showing the change assessment and detailed quantitative analysis.

4.3.2 Identification of Preferred Alternative

As described in Section 6 of the Terms of Reference (WM 2021) document, selection of the preferred alternative to the undertaking has been completed. Alternative methods will be assessed against an ambient sound environment that does not include landfilling operations, and the change assessment will be made using ratings limited to insignificant, noticeable, significant, and very significant.

Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative.

Landfilling Noise

The future operations of the landfill will be characterized by modelling of up to three operational periods using the data sources described above. Sound levels will be modelled, with the predicted sound levels presented over the entire study area in figures showing isopleths of equal 1-hour averaged sound levels ("noise contours"). The worst-case sound level assessment in each cardinal direction will be further addressed in tabular form showing the change assessment and detailed quantitative analysis. Sound levels at the representative points of reception will be compared with the *Landfill Guidelines* described above.

Ancillary Facilities Noise

The sound levels from future activity of the ancillary facilities will be characterized by modelling using the data sources described above. Sound levels will be modelled, with the predicted sound levels presented over the entire study area in figures showing isopleths of equal 1-hour averaged sound levels ("noise contours"). Assessment will be made at points of reception (i.e., closest or most exposed) in each cardinal direction that have representative or worst-case sound levels. Sound levels at the representative points of reception will be compared with the *NPC-300* limits described above.

Change in Sound Levels

Landfilling noise and ancillary facilities noise are first assessed separately, as above, and then cumulatively. The goal of the cumulative approach is to evaluate the magnitude of change in noise levels at receptors. Changes in noise levels are calculated by comparing the environmental noise levels that would exist if the landfill were no longer operating with the expected future noise levels due to the proposed landfill, ancillary sources, and construction activities. The change is then assessed based on the increase in sound level at the point of reception from the existing condition to the proposed condition:

- A sound level increase of 1 – 3 dB is qualitatively rated as insignificant;
- A sound level increase of 3 – 5 dB is qualitatively rated as noticeable;
- A sound level increase of 5 – 10 dB is qualitatively rated as significant; and
- A sound level increase of greater than 10 dB is qualitatively rated as very significant.

Using the above qualitative scale, an effect will occur only if the sound level increase is rated as noticeable or greater.

4.4 Reporting

Two separate reports will be prepared for the noise assessment in support of the EA:

1. A report providing a characterization of Existing Conditions; and
2. A report providing the Effects Assessment.

These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The characterization of existing conditions will include details of field measurements and observations, technical analyses, methods, results, maps of sensitive features within the Off-site Study Area, conclusions, and recommendations.

5 References

Aercoustics Engineering Limited (AEL)
2005 Proposed Expansion of WM Warwick Landfill: Predicted Noise Impact

Ministry of the Environment (MOE)
1977a Publication NPC-102: Instrumentation, originally published as part of the Model Municipal Noise Control By-Law

Ministry of the Environment (MOE)
1977b Publication NPC-103: Procedures, originally published as part of the Model Municipal Noise Control By-Law

Ministry of the Environment (MOE)
1977c Publication NPC-104: Sound Level Adjustments, originally published as part of the Model Municipal Noise Control By-Law

Ministry of the Environment (MOE)
1983 Publication NPC-207: Impulse Vibration in Residential Buildings

Ministry of the Environment (MOE)
1995a Publication NPC-205: Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban)

Ministry of the Environment (MOE)
1995b Publication NPC-206: Sound Levels Due to Road Traffic

Ministry of the Environment (MOE)
1995c Publication NPC-232: Sound Level Limits for Stationary Sources in Class 3 Areas (Rural)

Ministry of the Environment (MOE)
1995d Publication NPC-233: Information to be Submitted for Approval of Stationary Sources of Sound

Ministry of the Environment (MOE)

1998 Noise Guidelines for Landfill Sites (October 1998 Draft)

Ministry of the Environment (MOE)

2012 Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites

Ministry of the Environment (MOE)

2013 Publication NPC-300: Environmental Noise Guideline - Stationary and Transportation Sources - Approval and Planning

RWDI

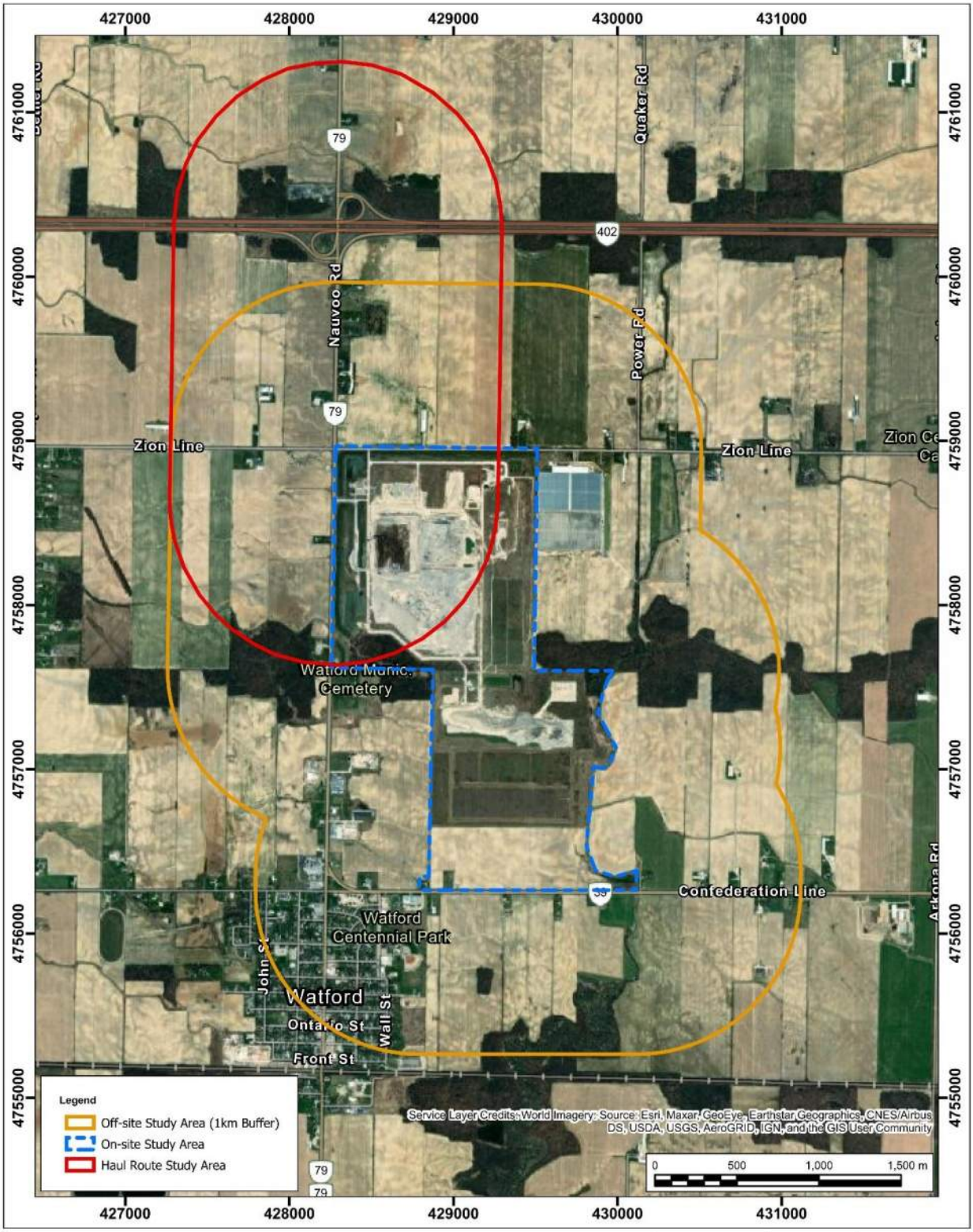
2021 Twin Creeks Environmental Centre: Acoustic Audit – Resubmission in Response to TRT Comments

Waste Management of Canada Corporation (WM)

2021 Draft Terms of Reference: Twin Creeks Environmental Centre Landfill Optimization Project Environmental Assessment

Figures

Figure 1. On-Site and Off-Site Noise Study Areas



On-Site and Off-Site Noise Study Areas

True North

Drawn by: LRC | Figure: 1

Aprox. Scale: 1:32,000

Date Revised: Nov 12, 2021

Map Projection: NAD 1983 UTM Zone 17N

Twin Creeks Environmental Centre - Watford, Ontario

Project #: 2101750

Socio-Economic Environment Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

Prepared by:

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Contents

Tables

Figures

Acronyms

Acronym	Definition
EA	Environmental Assessment
MECP	Ministry of Environment, Conservation and Parks
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
WM	Waste Management of Canada Corporation

1 Introduction

This Socio-Economic Environment work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

The Socio-Economic Environment comprises both the social and economic environments and considers the potential effects of the Project on the local community and economy. The Visual Landscape component of the Socio-Economic Environment and associated effects on the local community will be addressed under separate cover and is therefore not included in this work plan. Similarly, consultation and engagement activities to be carried out during the Terms of Reference and EA are separate from this work plan.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m^3 of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m^3, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

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WM pays host community fees annually to the Township of Warwick (the Township). Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $24M in host community fees and municipal property taxes to the Township.

There is a need for the continued operation and development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future

development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This Socio-Economic Environment work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the socio-economic environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the socio-economic environment work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The general study areas proposed for the purposes of the EA are (**Figure 1**):

- On-site Study Area: the existing TCEC.
- Off-site Study Area: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area.

For the Socio-Economic Environment, the general Off-site Study Area has been extended for the social component to include Watford, and for the economic component to include the Township of Warwick (**Figure 2**). These study areas may be further refined during the EA if necessary.

4 Scope of Work

The scope of work for the Socio-Economic Environment includes the development of evaluation criteria, indicators, and data sources, characterization of existing Socio-Economic Environment conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for the Socio-Economic Environment are provided in **Table 1**. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on the Socio-Economic Environment and are focused on those aspects of the environment where potential effects are anticipated. These evaluation criteria and indicators may be updated during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for the Socio-Economic Environment

Evaluation Criteria	Rationale	Indicators	Data Sources
Socio-Economic Environment			
Economic			
Economic effects on local community	The continued operation of the landfill could have economic effects on and/or provide economic benefits to the local community	• Employment at site (number, type, and duration) • Contributions to the host community • Opportunities for the provision and procurement of products and/or services	• Census and municipal data for Village of Watford and Township of Warwick • Municipal tax information / sources of municipal revenues • WM data on host community fee contributions • WM site employment data • WM data on types and values of goods and services procured • WM data on types and values of goods and services provided • Proposed facility characteristics • Results of other discipline assessments

Table 1. Evaluation Criteria, Indicators, and Data Sources for the Socio-Economic Environment

Evaluation Criteria	Rationale	Indicators	Data Sources
Social			
Effects on local community	Waste disposal facilities can potentially affect local residents and businesses in the vicinity of the site.	• Number of residents and residences (e.g., receptors) • Number and type of local businesses • Nuisance effects (litter, dust, noise, odour, traffic) • Predicted changes to use and enjoyment of property • Level of satisfaction with living/working in the community • Confidence in TCEC operations	• Mapping and field reconnaissance • Census information and municipal data for Village of Watford and Township of Warwick • Number and nature of nuisance complaints received related to the TCEC (e.g., odour, litter, noise) • Community survey(s) • Proposed facility characteristics • Results of other discipline assessments
Visual Impact of Facility	See Visual Landscape Work Plan		

4.2 Characterization of Existing Conditions

The characterization of existing conditions for the Socio-Economic Environment will involve the collection and analysis of data for both the economic and social components identified in **Table 1**. For the economic component, existing conditions will be characterized within the Township of Warwick and community of Watford with a focus on those businesses that have, or may have, a direct interaction with the TCEC. For the social component, the focus of the existing conditions will be the community of Watford and residents located within 1 km of the TCEC, where it is anticipated that most potential nuisance effects would be experienced.

The proposed tasks associated with the characterization of existing conditions for the Socio-Economic Environment are outlined in **Table 2**. These tasks may be further refined throughout the EA if necessary.

Table 2. Proposed Tasks for the Characterization of Existing Conditions for the Socio-Economic Environment

Evaluation Criteria	Indicators	Tasks to Characterize Existing Conditions
Economic		
Economic effects on local community	• Employment at site (number, type, and duration)	• Review latest publicly available census and municipal data for Village of Watford and Township of Warwick to determine employment characteristics within the study areas • Review employment characteristics for the TCEC to determine employment at the site (number, type, and duration)
	• Contributions to the host community	• Examine WM's host community fee contributions to the Township of Warwick (2009[1]-2020) to determine the level of contribution to the municipality • Review municipal tax information and sources of municipal revenue for the Township of Warwick as available to characterize municipal finance and determine portion attributable to the TCEC • Examine municipal expenditures (if available) to characterize existing municipal spending within the local community
	• Opportunities for the provision and procurement of products and/or services	• Review the values and types of goods and services procured by WM for the TCEC (2018-2020) to determine procurement from local businesses • Conduct survey(s) (mail out and/or online) of local businesses that provide goods and services to the TCEC to determine the importance of the TCEC to the success of their operations[2] • Review values and types of goods and services provided by the TCEC (2018-2020) to determine provision of services to the local community and businesses
Social		
Effects on local community	• Number of residences and residents	• Review latest publicly available census and municipal data for Village of Watford and Township of Warwick to determine population within the study areas
	• Number and type of local businesses	• Review latest publicly available census and municipal data for Village of Watford and Township of Warwick to determine industry characteristics within the study areas • Review mapping, municipal data such as business directories (as available), and carry out field reconnaissance (site visit if necessary) to determine the number and type of local businesses within Watford and 1 km of the TCEC
	• Nuisance effects (litter, dust, noise, odour, traffic)	• Review mapping and carry out field reconnaissance (site visit if necessary) to determine the location of residential and non-residential receptors within the off-site study area – this task will likely be conducted in conjunction with the air/noise/odour and visual assessments • Review the number and nature of nuisance complaints received related to the TCEC (e.g., odour, litter, dust, noise, traffic) (2017-2020) to determine the past and current level of complaints related to site operation • Incorporate existing conditions from Air Quality, Noise, and Transportation disciplines
	• Predicted changes to use of property	• Consider nuisance effects association with property use, level of satisfaction, and confidence in TCEC operations

Table 2. Proposed Tasks for the Characterization of Existing Conditions for the Socio-Economic Environment

Evaluation Criteria	Indicators	Tasks to Characterize Existing Conditions
	• Level of satisfaction with living/working in the community • Confidence in TCEC operations	• Consider visual landscape existing conditions association with property use, level of satisfaction, and confidence in TCEC operations • Conduct community survey(s) (mail out and/or online) to determine the following[2,3]: ○ current use of property/local area for outdoor recreation activities ○ current level of satisfaction with living/working in the community including identification of issues that may affect level of satisfaction ○ confidence in current operations at the TCEC

Note:

1. 2009 is the year that the TCEC expansion landfill began receiving waste.
2. This is the portion of the survey(s) that addresses existing conditions. Consideration of potential effects is addressed in **Table 3**. Input on the surveys will be sought from social impact assessment and economic specialists as appropriate.
3. Residents will not be asked to provide information about their medical status or conditions, nor to speculate on medical matters in relation to existing TCEC operations.

The characterization of existing conditions may also include the review of additional relevant information not listed above as and when it becomes available (e.g., other background reports or documents, municipal information, etc.).

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- predict the potential environmental effects for each alternative method (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4.3.2); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1. Potential effects can be positive or negative, direct or indirect, and short or long-term. Mitigation measures will be identified to minimize or mitigate the potential effects and then the net effects are evaluated taking into consideration the application of mitigation measures.

The proposed facility characteristics of each alternative method will be reviewed to determine potential interactions with the Socio-Economic Environment for both the social

and economic components. The criteria and indicators listed in **Table 1** will be applied to each alternative method to determine potential effects.

The proposed tasks associated with the evaluation of alternative methods for the Socio-Economic Environment are outlined in **Table 3**. These tasks may be further refined throughout the EA if necessary.

Table 3. Proposed Tasks for the Evaluation of Alternative Methods for the Socio-Economic Environment

Evaluation Criteria	Indicators	Tasks to Evaluate Alternative Methods
Economic		
Economic effects on local community	• Employment at site (number, type, and duration)	• Review proposed facility characteristics for each alternative method, such as proposed landfill capacity and resulting length of operation • Determine potential effects on employment at the site (number, type, and duration) for each alternative method based on continued TCEC operation
	• Contributions to the host community	• Review proposed facility characteristics for each alternative method, such as proposed landfill capacity and resulting length of operation • Develop an estimate of WM's future host community fee contributions to the Township of Warwick for each alternative method based on continued TCEC operation. • Characterize WM's continued host community fee contributions in the framework of continued municipal revenues for each alternative method based on continued TCEC operation • Characterize continued municipal spending within the local community resulting from each alternative method, if possible, based on available information (see Table 2) and continued TCEC operation
	• Opportunities for the provision and procurement of products and/or services	• Review proposed facility characteristics for each alternative method, such as proposed landfill capacity and resulting length of operation • Estimate WM's continued procurement from local businesses for each alternative method based on continued TCEC operation • Conduct survey(s) (mail out and/or online) of local businesses that provide goods and services to the TCEC to determine the importance of the continued operation of the TCEC to the success of their operations[1] • Characterize WM's continued provision of services to the local community and businesses for each alternative method based on continued TCEC operation
Social		
Effects on local community	• Number of residents and residences	• Review proposed facility characteristics for each alternative method, such as proposed landfill capacity and resulting length of operation • Review latest publicly available municipal data for Village of Watford and Township of Warwick (e.g., Official Plans) to determine projected population and potential future residential expansion within the study areas for each alternative method within the timeline of continued TCEC operation

Table 3. Proposed Tasks for the Evaluation of Alternative Methods for the Socio-Economic Environment

Evaluation Criteria	Indicators	Tasks to Evaluate Alternative Methods
	• Number and type of local businesses	• Review proposed facility characteristics for each alternative method, such as proposed landfill capacity and resulting length of operation • Review latest publicly available census and municipal data for Village of Watford and Township of Warwick (e.g., Official Plans) to determine any future commercial/industrial expansion within the study areas for each alternative method within the timeline of continued TCEC operation
	• Nuisance effects (litter, dust, noise, odour, traffic)	• Review proposed facility characteristics for each alternative method, such as proposed landfill capacity and resulting length of operation • Coordinate residential and non-residential receptor locations with the Air Quality, Noise, and Transportation disciplines • Review the results of the Air Quality, Noise, and Transportation effects assessments for each alternative method including mitigation measures • Predict extent of nuisance effects on residential and non-residential receptors in the off-site study area for each alternative method • Propose mitigation measures as appropriate
	• Predicted changes to use of property • Level of satisfaction with living/working in the community • Confidence in TCEC operations	• Coordinate residential and non-residential receptor locations with the Visual Landscape discipline • Incorporate results of Visual Landscape effects assessment and association with property use, level of satisfaction, and confidence in TCEC operations for each alternative method including mitigation measures • Incorporate results of nuisance effects assessment and association with property use, level of satisfaction, and confidence in TCEC operations for each alternative method • Conduct community survey(s) (mail out and/or online) to determine the following[1,2]: ○ likelihood of changes in use of property/local area for outdoor recreation activities as a result of the Project ○ likelihood of changes in level of satisfaction with living/working in the community including identification of issues that may affect level of satisfaction as a result of the Project ○ likelihood of changes in confidence in TCEC operations as a result of the Project ○ concerns regarding the Project and future TCEC operations • Predict effects on use of property, level of satisfaction with living/working in the community, and confidence in TCEC operations for each alternative method • Propose mitigation measures as appropriate

Note:

1. This is the portion of the survey(s) that addresses potential effects. Consideration of existing conditions is addressed in **Table 2**. Input on the surveys will be sought from social impact assessment and economic specialists as appropriate.
2. Residents will not be asked to provide information about their medical status or conditions, nor to speculate on medical matters in relation to the Project.

4.3.2 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.3 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative.

4.4 Reporting

Two separate reports will be prepared for the Socio-Economic Environment in support of the EA:

1. A report providing a characterization of Existing Conditions; and
2. A report providing the Effects Assessment.

These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The characterization of existing conditions will include details of completed field reconnaissance, analyses, methods, results, maps of receptors within the On-site and Off-site Study Areas, conclusions, and recommendations, as applicable.

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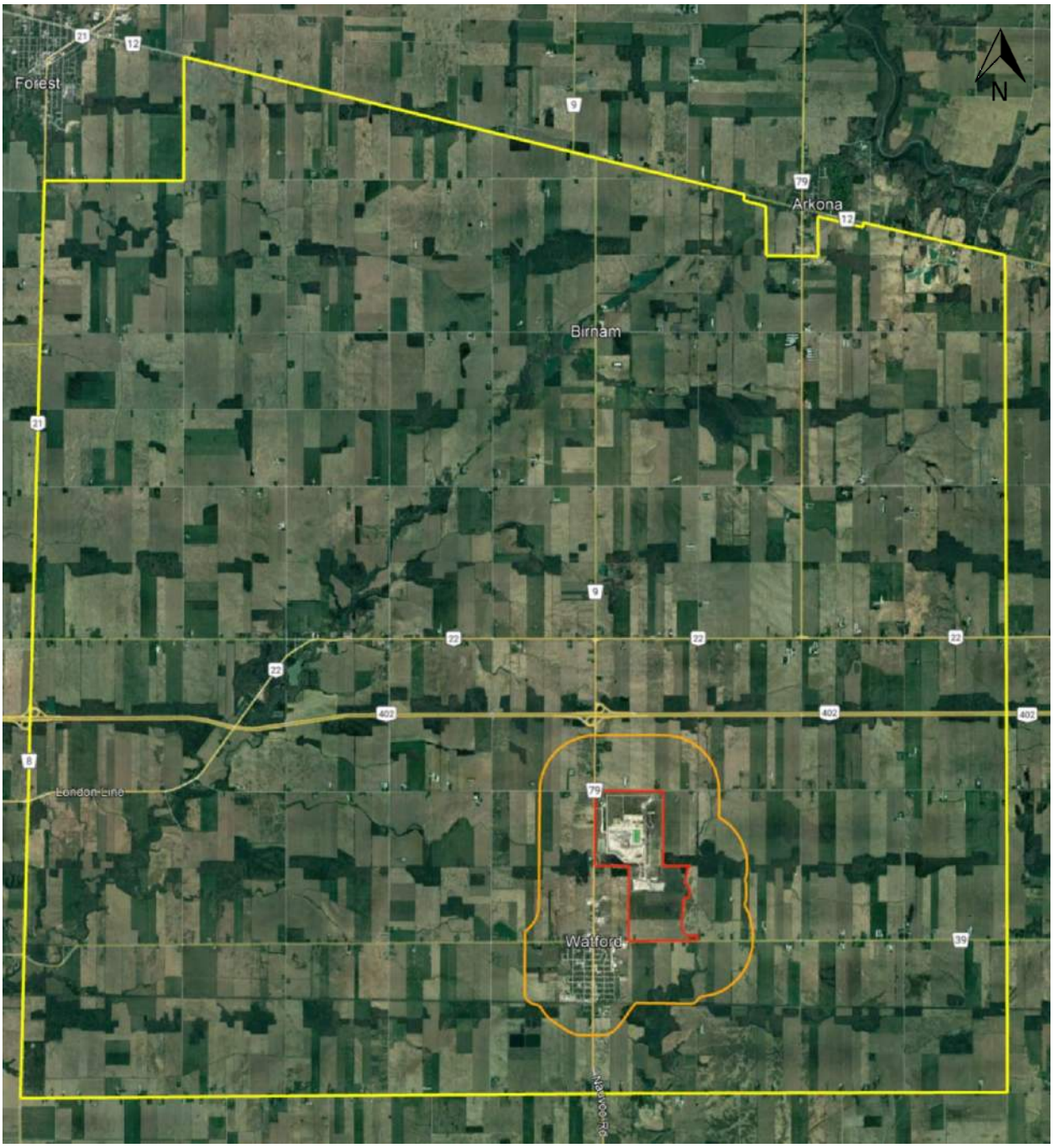
Figures

Figure 1. General On-Site and Off-site Study Areas

Figure 2. Socio-Economic Environment Study Areas



LEGEND

On-Site Study Area

Social Off-Site Study Area

Economic Off-Site Study Area

Surface Water Quality Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

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Contents

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Acronyms

Acronym	Definition
EA	Environmental Assessment
ECA	Environmental Compliance Approval
EMP	*Environmental Monitoring Plan* (Jagger Hims Limited, 2007)
MECP	Ministry of Environment, Conservation and Parks
PLIL	Primary Leachate Indicator List
SLIL	Secondary Leachate Indicator List
Sewage ECA	Amended ECA for an Industrial Sewage Works No. 2403-BE6LZ4, dated August 21, 2019
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
TSS	Total Suspended Solids
WM	Waste Management of Canada Corporation
Waste ECA	Amended Environmental Compliance Approval (ECA) No. A032203, dated December 19, 2020

1 Introduction

This surface water quality work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

The Surface Water Quality discipline evaluates the quality of stormwater prior to its off-Site discharge. The evaluation compares assessed surface water quality results against established provincial objectives, as well as current established site-specific criteria per MECP approval.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m³ of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m³, which could extend the Site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-Site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-Site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $24M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This Surface Water Quality work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the surface water quality environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the surface water quality work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-Site and off-Site. The general study areas proposed for the purposes of the EA are **(Figure 1)**:

- On-Site Study Area: the existing TCEC. Surface water quality at the TCEC is evaluated for compliance with established MECP-approved site-specific criteria before it is discharged to a receiver and ultimately off-Site.
- Off-Site Study Area (vicinity): the lands within the vicinity of the TCEC extending approximately 1 kilometre off WM's property boundaries. A monitoring program will be implemented off-Site for a 12-month period in concert with the current surface water quality monitoring program to establish existing conditions off-Site.

Figure 2 shows the established surface water quality system including monitoring locations, which outlines the flow path onto the Site, as well as on-Site prior to off-Site discharge.

Figure 3 shows an exploded view of the northern portion of the Site that denotes the flow path for water that discharges from each of the four sedimentation ponds up to WM's property boundary. Each sedimentation pond's discharge flow path has a unique colour for differentiation purposes.

Figure 4 shows the proposed surface water monitoring locations as part of the 12-month monitoring program, which outlines the flow paths onto the Site, on-Site prior to discharge, as well as off-Site heading away from the Site.

4 Scope of Work

The scope of work for surface water quality includes the development of evaluation criteria, indicators, and data sources, characterization of existing surface water conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

The surface water quality assessment will evaluate:

- Existing surface water quality trends with flow around the Site in context to current and proposed Site operations;
- Existing surface water quality trends in consideration of clayey soil erosional effects; and
- Surface water quality in consideration of possible effects from Automobile Shredder Residue (ASR) within the roadside ditch of the northbound lane of Nauvoo Road from the Site to Hwy 402 in the off-Site Study Area.

The aforementioned assessments will consider the current potential influences of clayey soil erosion and potential effects of landfilling operations on surface water quality on-Site, as well as possible effects from ASR on surface water quality off-Site. The findings from these assessments will enable an evaluation to be completed if the landfill optimization project will have an effect on the understood surface water quality.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for the surface water quality environment are provided in **Table 1**. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on the surface water quality environment. These evaluation criteria and indicators may be modified during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for Surface Water Quality

Evaluation Criteria	Rationale	Indicators	Data Sources
Natural Environment			
Surface Water Quality	The landfill optimization has the potential to affect surface water quality through either possible leachate seepage through the landfill cap increased erosion of the landfill clayey soil cap or track-out of Automobile Shredder Residue (ASR) wastes off-Site.	• Predicted effects on surface water quality on-Site prior to off-Site discharge. • Predicted effects from polyaromatic hydrocarbons (PAHs) on surface water quality within the roadside ditch of the northbound lane of Nauvoo Road from the Site to Hwy 402 in the off-Site study area	• Applicable regulatory documentation (i.e. Amended Site ECAs, MECP guidelines, technical standards, etc.). • Landfill Environmental Monitoring Plan (Jagger Hims Limited, 2007) (EMP), and as amended per MECP approval. • Surface water quality monitoring data at each on-Site background, internal, and discharge (compliance) monitoring stations. • Provincial Water Quality Monitoring Network (PWQMN). • Topographic maps and aerial photos. • On-Site stormwater management system design for the Site. • Quarterly and Annual Site compliance monitoring reports. • Leachate generation and management assessments, as outlined in the Leachate Management Plan, (March 2020) (HDR, 2019). • Proposed facility characteristics. • Testing for PAHs related to potential effects of ASR on surface water within the roadside ditch of the northbound lane of Nauvoo Road from the Site to Hwy 402 in the off-Site study area.

4.2 Characterization of Existing Conditions

As part of the environmental assessment process, there is a requirement to document the existing conditions that occur at the Site. This is to develop a general baseline condition understanding so that the effects from the project can be assessed. For the surface water quality assessment, baseline conditions on-Site will be defined using the established surface water quality compliance monitoring completed at the Site.

The surface water quality monitoring program for the Site is developed to assess that surface water quality that discharges from the Site is not unacceptably degraded in

comparison to the background surface water quality that naturally/normally flows onto the Site.

Baseline conditions will be established off-Site through the implementation of a monitoring program that will be completed for a 12-month period in concert with the current surface water quality monitoring program completed for the Site.

4.2.1 On-Site Study Area Surface Water Flow Path

It is important to note that surface water flow at the Site is ephemeral in nature, where the presence of flow is precipitation or snowmelt dependent.

Since the development of the Expansion Landfill, beginning in 2008, overall Site improvements to protect the downstream watercourses have been implemented. These improvements include an extensive watercourse drainage network consisting of vegetated drainage ditches with rock-check dams, straw bale check dams, stormwater control berms, as wells as four (4) stormwater management ponds.

Stormwater from the Site flows toward either: 1) Kersey Drain (Brown Creek) to the east; or 2) drains and ditches associated with Bear Creek to the west. The locations and descriptions of the monitoring stations are detailed in the following summary table and are presented on **Figure 2**.

Task	Monitoring Station Designations	Monitoring Station Description
Surface Water Environmental Monitoring Program	SS1	Downstream of landfill on WM property, 60 m east of Lambton Road 79 (Nauvoo Road) – Compliance Point
	SS10	Off-Site flow into East Ditch of the Existing Landfill – Background Surface Water Quality
	SS16	Flow onto Site from lands located to the south – Background Surface Water Quality
	SP1	Outlet Weir of Sedimentation Pond 1 – Internal assessment location
	SP2	Outlet Weir of Sedimentation Pond 2 – Compliance Point
	SP3	Outlet Weir of Sedimentation Pond 3 – Compliance Point
	SP4	Outlet Weir of Sedimentation Pond 4 – Compliance Point
Surface Water Poplar System Monitoring Program	SS14A	On-Site flow within East Ditch of the Existing Landfill, upstream of Poplar System – Internal assessment location
	SS14B	On-Site flow within West Ditch of the Existing Landfill, downstream of Poplar System as of June 2011 – Internal assessment location
	SS15A	South Ditch of the Existing Landfill and inlet point to Sedimentation Pond 1. Downstream of Poplar System – Internal assessment location
Surface Water Poplar Plantation Monitoring Program	SS17A	On-Site flow from western portion of Poplar Plantation, northwest corner - Compliance Point when plantation is active
	SS17B	On-Site flow from western portion of Poplar Plantation, southwest corner - Compliance Point when plantation is active
	SS18A	On-Site flow from eastern portion of Poplar Plantation, north end of stormwater control berm plantation - Compliance Point when plantation is active
	SS18B	On-Site flow from eastern portion of Poplar Plantation, south end of stormwater control berm plantation - Compliance Point when plantation is active

Sedimentation Ponds 1 through 4 were fully constructed in 2009. Sampling of these ponds occurred during construction in the latter half of 2008 and beginning three-quarters of 2009, with results that showed expected incomplete treatment.

Sedimentation Pond 1 receives stormwater flow from most of the east half and the southern approximate one-quarter of the western half of the Existing Landfill. Sedimentation Pond 1 discharges water through twin culverts to an open drainage ditch on-Site, which flows westward until it enters a municipal drain (surface water monitoring station SS1) near the western Site boundary. This municipal drainage tile discharges into one of the headwater branches of the Gilliland-Geerts Drain on the east side of Lambton County Road 79 (Nauvoo Road).

Sedimentation Pond 2 receives flow from the central western portion of the Existing Site, as well as the southern two-thirds of the current footprint of the Expansion Landfill. Discharge from Sedimentation Pond 2 is through twin culverts to an open drainage ditch that flows to the western Site boundary and into one of the headwater branches of the Gilliland-Geerts Drain on the east side of Lambton County Road 79 (Nauvoo Road).

Sedimentation Pond 3 receives stormwater flow from the northern approximate one-third of the Expansion Site, as well as a large area of the undeveloped northwestern portion of the Site, and discharges through three culverts that flow to the eastern roadside ditch of Nauvoo Road, which in-turn directs the stormwater flow to two additional headwater branches of the Gilliland-Geerts Drain all to the west of Nauvoo Road.

Sedimentation Pond 4 receives stormwater flow from approximately one-quarter of the northeastern portion of the Existing Landfill, as well as a portion of land to not be developed to the east of the pond. Stormwater discharges from Sedimentation Pond 4 flows through a culvert then into an open drainage ditch that flows westward until it enters a series of culverts that direct water under a screening berm and then under Zion Line to flow into one of the headwater branches of the Gilliland-Geerts Drain.

The surface water flow paths along with outlining where the sampling locations are located and the rationale for those locations will be documented as part of the existing conditions.

4.2.2 Off-Site Study Area Surface Water Flow Path

It is important to note that surface water flow off-Site is also ephemeral in nature, where the presence of flow is precipitation or snowmelt dependent.

Stormwater from a component of the northern portion of the Site flows from the Site along the northbound roadside ditch of Nauvoo Road to Auld-Redmond Drain Branch where the water crossed under Nauvoo Road to flow west until it turns into the McKay Drain prior to entering into Bear Creek. Along the northbound ditch of Nauvoo Road, within the off-Site Study Area, are: 1) two flow paths that form part of the Auld-Redmond Drain Branch to the west; and 2) one flow path that form part of the Morris Drain to the west. The locations and descriptions of the monitoring stations are detailed in the following summary table and are presented on **Figure 3**.

Task	Monitoring Station Designations	Monitoring Station Description
Proposed 12-month Surface Water Environmental Monitoring Program	SW1	Downstream of landfill at the intersection of Zion Line and Nauvoo Road, at the culvert heading northbound under Zion Line.
	SW2	North and downstream of landfill, within the roadside ditch upstream of the flow at the first culvert facing westward under Nauvoo Road that forms part of the Auld-Redmond Drain Branch.
	SW3	North of landfill, within the roadside ditch upstream of the flow at the first culvert facing westward under Nauvoo Road that forms part of the Morris Drain (close to Hwy 402).

4.2.3 Existing Site Surface Water Quality

Surface water quality data collected from the Site since late 2003 for the established existing environmental monitoring program serve as a strong baseline comprehensive database in order to document existing conditions, as well as to be assessed to evaluate potential effects from the landfill optimization project on surface water quality prior to its discharge from the Site. Documentation of the mechanics of the monitoring program will be completed. This will document the rational for the development of the monitoring program to evaluate for possible landfill leachate effects on surface water quality, which will include what parameters are assessed, where sampling locations are located, when is sampling initiated, and how the quality results are assessed to evaluate existing conditions.

Presented below are the assessments that will completed to document existing conditions and to evaluate potential effects from the landfill optimization project on surface water quality prior to its discharge from the Site.

Evaluation of Existing Surface Water Quality Trends

Existing water quality trends with flow around the Site will be evaluated to understand existing conditions. The available surface water quality for the primary leachate indicator list (PLIL) parameters obtained from the established monitoring locations will be evaluated for potential chemical trends such as seasonal patterns. The PLIL parameters (chloride, boron, unionized ammonia, phenols, chromium, nickel, and zinc) are the parameters that would most readily show a landfill leachate effect on surface water. Of these PLIL parameters, not all parameters together, but more than one parameter is usually needed to be observed in elevated concentrations compared to background concentrations to be indicative of a possible landfill leachate effect on surface water quality. This work will be competed for the background surface water that flows on the Site, internal assessment locations, as well as discharge locations. Assessments of trends for the PLIL parameters will be completed to understand the quality of water that flows onto the Site, the quality of water onSite, as well as the quality of water prior to its discharge from the Site.

Existing Surface Water Quality and Clayey Soil Erosional Effects

The surface water quality for the PLIL parameters will be evaluated for chemical concentration trends in consideration of clayey soil erosional effects. Clayey soils naturally have metals within their mineralogical make-up. Upon erosion the clayey soils can remain in suspension in the surface water column for an extended period of time and are consequently tested as part of collected surface water samples. An evaluation will be completed to see if there is a trend of surface water chemical quality for the PLIL

parameters assessed to total suspended solids (TSS) concentrations. This assessment will be used to evaluate if the TSS concentrations have a relationship between natural/normal clayey soil erosional effects to potential Site operations effects.

In addition, a review of the stormwater management system, including the four existing facilities/ponds, will be completed for each alternative to confirm that the ponds are properly sized to manage sediment.

4.2.4 Off-Site Surface Water Quality

Baseline conditions for polyaromatice hydrocarbons (PAHs) will be established off-Site through the implementation of a monitoring program for a 12-month period, which will be completed in concert with the current quarterly surface water quality monitoring program for the Site.

This monitoring program will be implemented to determine the predicted possible effects from ASR on surface water quality within the roadside ditch of the northbound lane of Nauvoo Road from the Site to Hwy 402 in the off-Site study area.

At the three proposed surface water monitoring locations, for evaluating existing conditions for ASR, the locations will be evaluated for PAHs per method EPA 8270M.

If PAHs are detected above their respective PWQO, then confirmation monitoring will be completed consistent with the EMP for the current surface water quality monitoring program.

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- predict the potential environmental effects for each alternative method (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 0); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators, and data sources as outlined in Section 4.1. Potential effects can be positive or negative, direct or indirect, and short or long-term. Mitigation measures will be identified to minimize or mitigate the potential effects and then the net effects are evaluated taking into consideration the application of mitigation measures.

The proposed facility characteristics of each alternative method will be reviewed to determine potential interactions with surface water quality. The criteria and indicators listed in **Table 1** will be applied to each alternative method to determine potential effects.

For the evaluation of surface water quality for the PLIL parameters as outlined above, the characterization of the existing conditions outlined in Section 4.2 will be used to assess potential effects that each of the alternative methods of the landfill optimization project may have on stormwater prior to its discharge from the Site.

4.3.2 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.3 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative.

Details regarding the operations and design of the preferred alternative will be based on data provided by WM as to planned operations.

Climate change has affected the frequency and intensity (less frequent and more intense) of precipitation events that are occurring globally, as well as at the Site. On-Site monitoring of precipitation began during 2003, with the first full year in 2004. The available on-Site precipitation data will be evaluated and compared to the two most relevant (closest with sufficient data) Environment Canada climatic stations in consideration of year to year patterns since 2004, as well as in consideration of relevant historical 30-year normal amounts (as measured at the Environment Canada climatic stations). A review of the current surface water monitoring program will be completed. The evaluation will enable an establishment of precipitation patterns to consider the appropriateness of the sampling trigger mechanism ($\geq$ 10 mm/24 hrs) as these smaller intensity precipitation events may not reliably generate stormwater flow. Also, these smaller intensity precipitation events may not represent the average intensity precipitation event, and as such would represent stormwater flow that has better than average potential to erode less soils. The landfill optimization project has the potential to cause increased erosional effects within the stormwater runoff from the steeper and/or larger clayey soil cap; and as Climate Change has intensified the magnitude of precipitation events, the culmination of these two potential effects to add to the possibility of increased soil erosion affecting stormwater at the Site. This assessment will be complete for the Preferred Alternative.

In addition, a review of the stormwater management system, including the four existing facilities/ponds, will be completed for the preferred alternative to confirm that the ponds are properly sized for use.

4.4 Reporting

Two separate reports will be prepared for surface water quality in support of the EA:

1. A report providing a characterization of Existing Conditions; and
2. A report providing the Effects Assessment.

These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The characterization of existing conditions will include details of completed field investigations to date, technical analyses of available data, assessment methods, interpretation of results for compliance with the Waste and Sewage ECAs, as well as provide a summary of conclusions and recommendations.

5 References

Chapman, L.J. and Putnam, D.

2013 The Physiography of Southern Ontario, Third Edition. Ontario Geological Survey, Special Volume 2, 270pp.

HDR

2019 Leachate Management Plan (March 2020), Twin Creeks Environmental Centre.

Henderson, Paddon Environmental Inc.

1997 Development & Operations Report, Canadian Waste Services Inc., Warwick Landfill, Warwick Township. Prepared for Canadian Waste Services Inc.

Henderson, Paddon & Associates Limited

2008 Development and Operations Plans, Warwick Landfill Expansion Volumes 1 to 3, Prepared for Waste Management of Canada Corporation

Jagger Hims Limited

2005 Warwick Landfill Expansion, Environmental Assessment, Hydrogeological Assessment Volumes 1 to 3, Prepared for Waste Management of Canada Corporation

Jagger Hims Limited

2007 Environmental Monitoring Plan, Warwick Landfill Expansion, Township of Warwick, Ontario, Prepared for Waste Management of Canada Corporation

Ministry of the Environment and Energy

1994 Water management: Polices, Guidelines, Provincial Water Quality Objectives. Reprinted 1995.

RWDI AIR Inc.

2021 2020 Fourth Quarter and Annual Monitoring Report, Twin Creeks Environmental Centre, Township of Warwick, Ontario, Prepared for Waste Management of Canada Corporation

Figures

Figure 1. General On-Site and Off-Site Study Areas

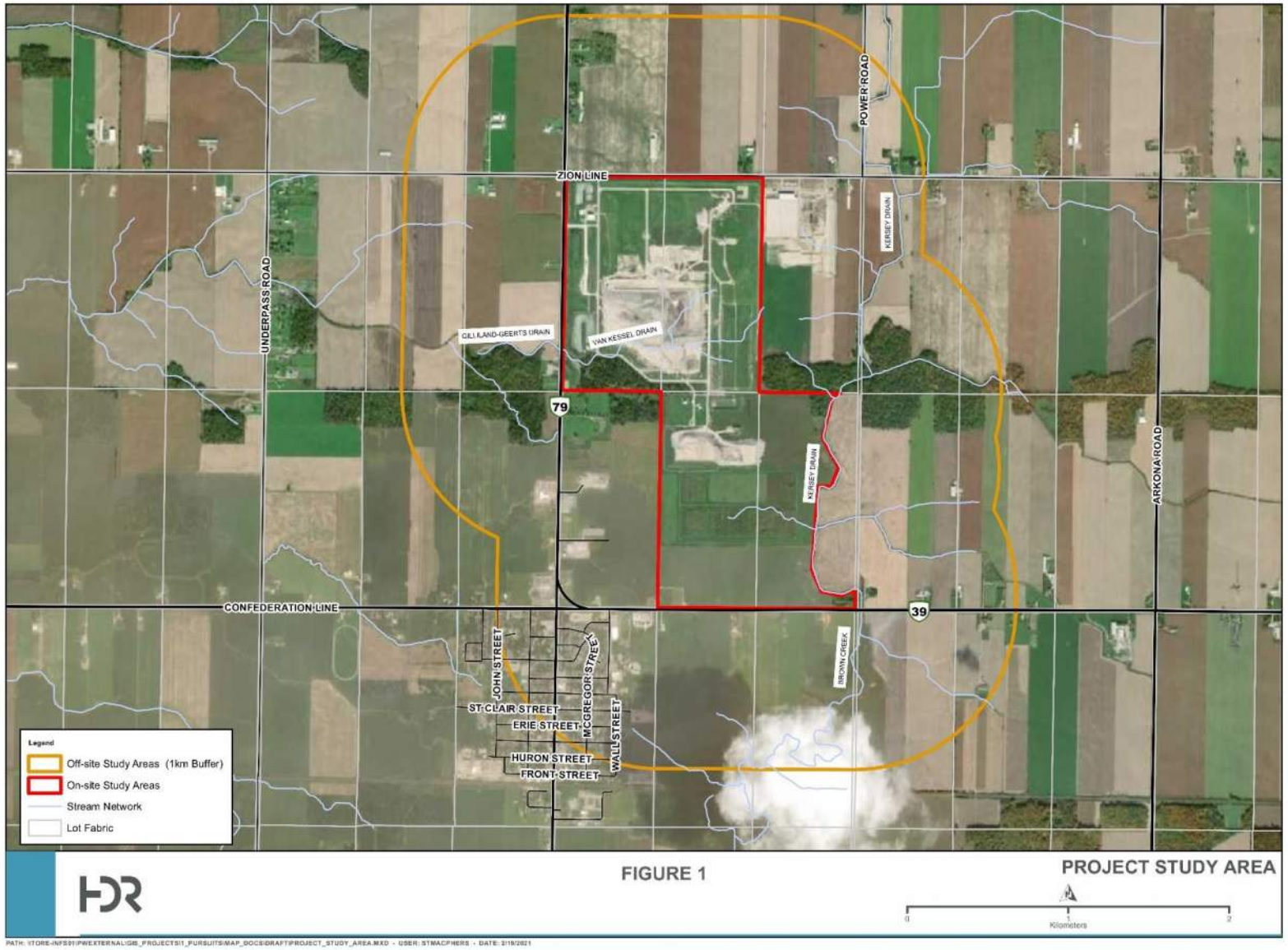


Figure 2. Surface Water Quality System

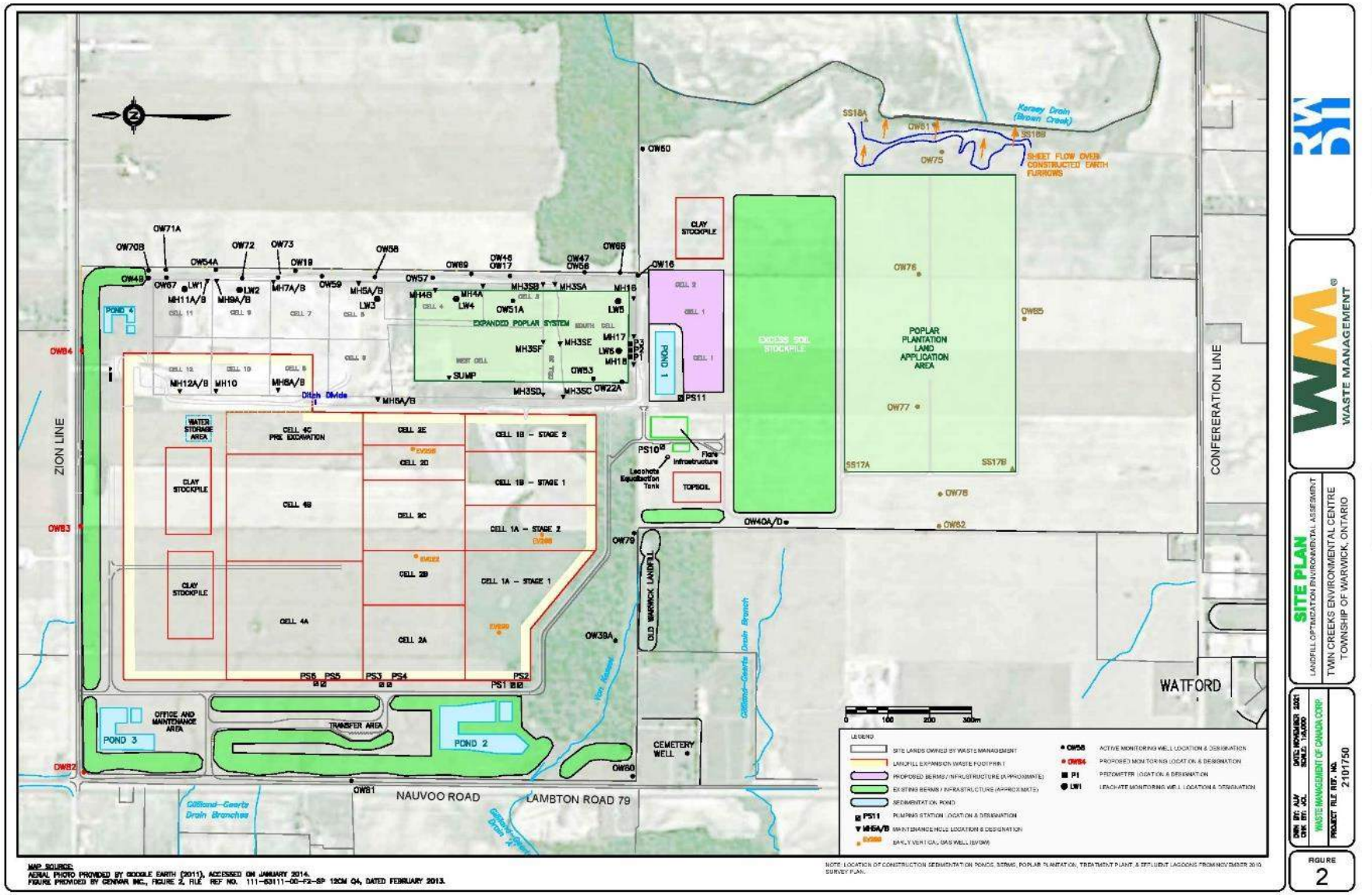


Figure 3. Expanded View of Surface Water Quality System

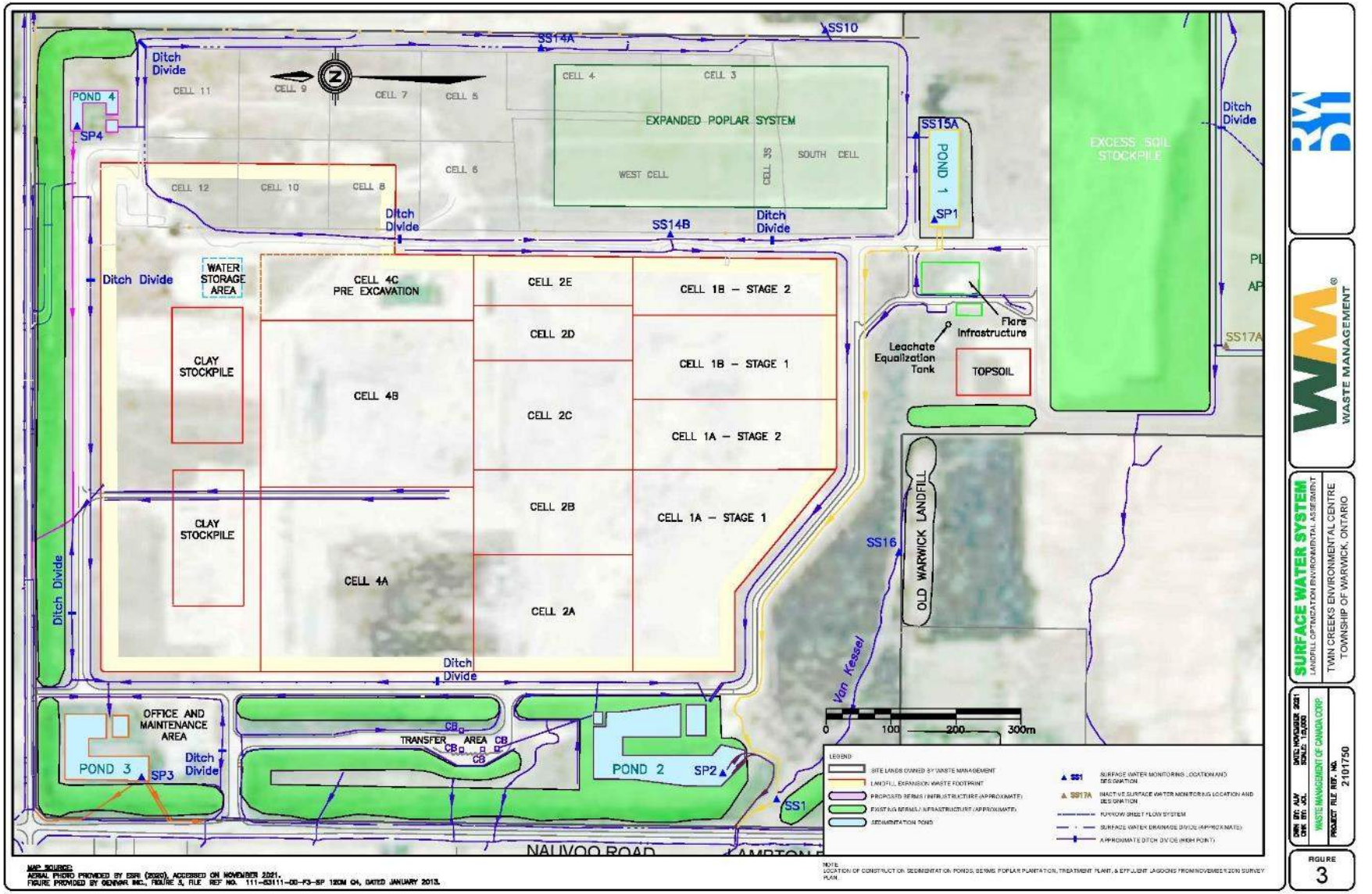
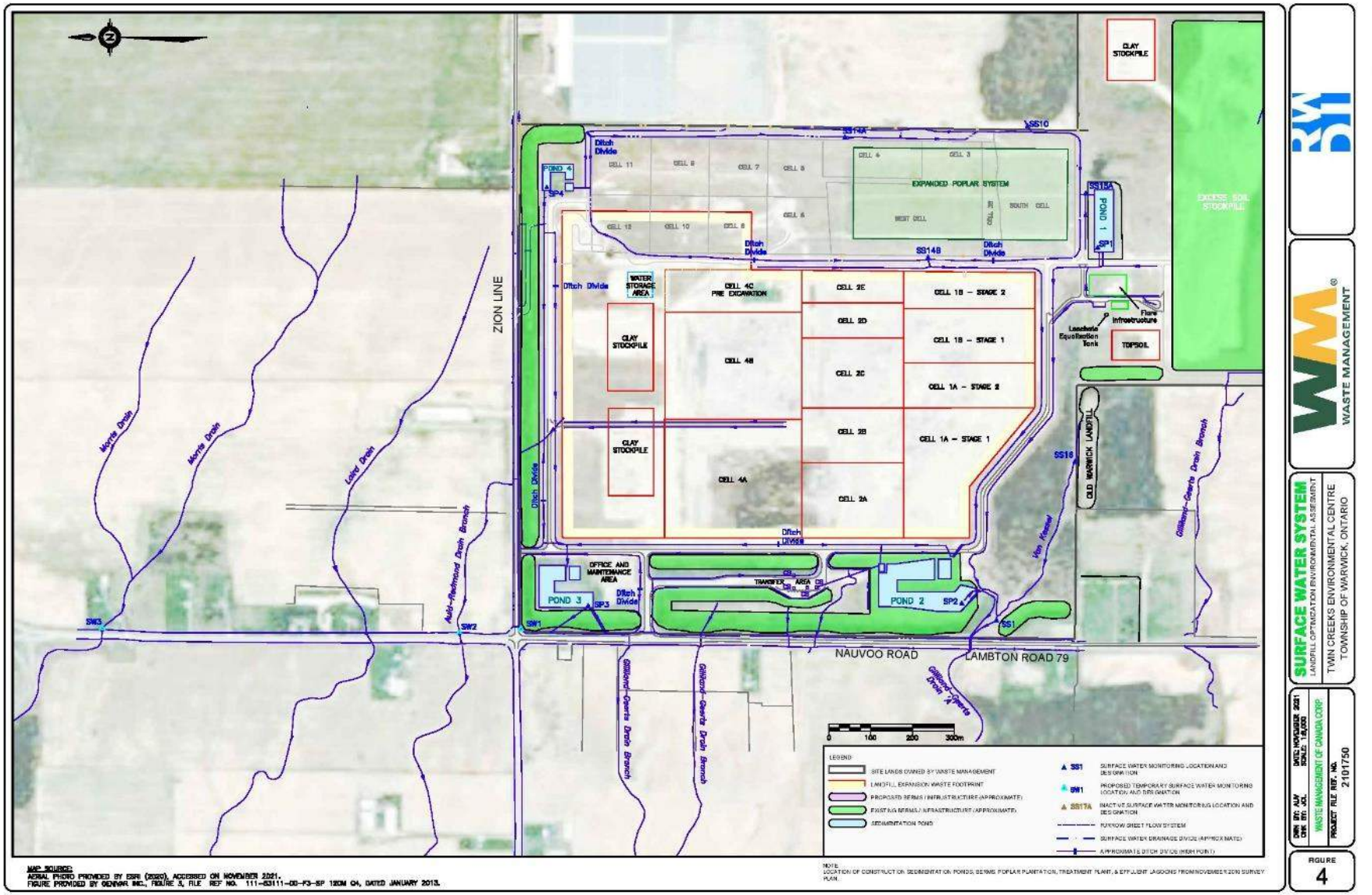


Figure 4. Proposed Surface Water Monitoring Locations



Surface Water Quantity (Hydrology) Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

Prepared by:

55 King Street, Suite 700
St. Catharines, ON L2R 3H5

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Acronyms

Acronym	Definition
EA	Environmental Assessment
MECP	Ministry of Environment, Conservation and Parks
MNRF	Ministry of Natural Resources and Forestry
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
WM	Waste Management of Canada Corporation
SCRCA	St. Clair Region Conservation Authority

1 Introduction

This Surface Water Quality (Hydrology) work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

The Surface Water Quality (Hydrology) assessment will predict change in runoff volumes and peak flows resulting from steeper slopes and longer side slopes and predicted degree of on-site and off-site drainage systems effects. Based on the findings, determine the mitigation measures required. Although the landfill footprint will remain the same, surface water quantity is expected to change slightly as the area of steeper slopes of the waste footprint will increase. Surface water quality is addressed under a separate work plan.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m^3 of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m^3, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $24M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of

the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This Surface Water (Hydrology) work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the Surface Water (Hydrology) environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the Surface Water (Hydrology) work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The general study areas proposed for the purposes of the EA are (refer to Figure 1):

- On-site Study Area: the existing TCEC.
- Off-site Study Area: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area and along the Gilliland-Geerts Drain between Nauvoo Road and Underpass Road.

Drawing SP1 shows the watershed divide within the On-Site Study Area between Bear Creek and Brown Creek. For Surface Water (Hydrology) the Off-site Study Area includes those portions of the Bear Creek and Brown Creek watersheds within 1 km of the On-site Study Area.

4 Scope of Work

The scope of work for Surface Water (Hydrology) includes the development of evaluation criteria, indicators, and data sources, characterization of existing hydrologic conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for Surface Water (Hydrology) are provided in Table 1. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on Surface Water (Hydrology). These evaluation criteria and indicators will be finalized during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for Surface Water (Hydrology)

Evaluation Criteria	Rationale	Indicators	Data Sources
Surface Water Quantity and Flow	Construction of physical works may disrupt natural surface drainage patterns and may alter runoff and peak flows. The presence of the expanded landfill may also affect base flow to surface water.	• Change in runoff volumes and peak flows resulting from steeper and longer side slopes. • Changes to drainage areas on-site and off-site. • Predicted occurrence and degree of off-site effects to surface water flows.	• On-site stormwater management system design for expanded landfill. • Landfill design and operations data. • Hydrologic modelling. • Annual monitoring reports. • Published flow information and hydrology design standards from MECP, MNRF, Environment Canada and SCRCA. • Site reconnaissance. • Topographic surveys. • Air photos. • Drainage maps. • Watershed mapping areas including municipal water supply sources within the off-site study area from St. Clair Conservation Area. • Typical stream channel geometry within the off-site study area, to the extent accessible. • Water well survey within the off-site study area. • PTTW records. • Liaison with MECP, SCRCA, downstream riparian landowners along Gilliland-Geerts Drain between Nauvoo Road and Underpass Road, Township of Warwick.

4.2 Characterization of Existing Conditions

The study area for the Surface Water (Hydrology) will focus on the on-site ditches and Stormwater Ponds 1, 2, 3 and 4 and will extend to the Off-Site Study Area within the vicinity of the TCEC extending 1 km out from the On-site Study Area. The off-site study area involves the Kersey Drain to the east, Van Kessel Drain to the west and municipal drainage tile at catch basin (SS1). The municipal drainage tile ultimately flows to the Gilliland-Geerts Drain, beneath Nauvoo Road (County Road 79), as shown on Drawing SP1.

This will enable a more comprehensive characterization of baseline conditions at a watershed scale to assist in the assessment of potential surface water effects. A desktop review of background data will be completed to enable an understanding and synthesis of recently completed studies and relevant supporting information.

The on-site stormwater management ponds are an unnatural feature design to hold water for the purpose of water quality treatment, water flow control and for on site usage as per rates indicated in the Permit To Take Water.

The investigations will include the following tasks:

- A desktop review of background data to understand the baseline conditions;
- A site reconnaissance to corroborate existing conditions;
- Confirmation of overland flow routes, drainage boundaries and outlet locations;
- Inventory of existing hydraulic structures (i.e., location, size, material);
- Measurements of typical stream channel geometry within WM property (i.e., bottom width, side slopes, depth);
- Climate and stream flow monitoring (initiated in the fall of 2015) to collect:
    - Rainfall data and ambient temperature data;
    - Water temperature and water levels data; and
    - Stream flow gauging measurements.

Although the landfill footprint is not proposed to change, surface water quantity is expected to change slightly as the area of steeper slopes of the waste footprint will increase. The drainage catchment areas will likely be modified, thereby slightly changing the drainage area to each of the on-site stormwater ponds. Mitigation measures associated with sediment control to maintain flows and having hydraulic structures design with enough capacity to manage major storm events and prevent flooding will likely be required.

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- predict the potential environmental effects for each alternative method (i.e., leachate seeps) (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4.3.2); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1.

Potential effects can be positive or negative, direct or indirect, and short or long-term. Mitigation measures will be identified to minimize or mitigate the potential effects and then the net effects are evaluated taking into consideration the application of mitigation measures.

The potential for each site development alternative to have an impact on surface water quantity and flow will be assessed based on the established baseline water quantity and flow conditions.

The assessment of surface water flow conditions will involve a combination of technical analyses to determine baseline conditions and potential impacts for each of the indicators (e.g., upstream/downstream flood levels, hydrograph timing/duration, changes in baseflow, and stream-bank erosion potential). Tasks that will be completed as part of the flow condition assessment include:

- Predict effect of each alternative on hydrologic modelling results;
- Water Balance Assessment; and
- Hydraulic Analyses and Flood Hazard Delineation.

4.3.2 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.3 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the ‘do nothing’ alternative.

Consideration for the potential of climate change on the operation of the proposed TCEC expansion will be made. The Surface Water Assessment will identify mitigation measures as well as potential contingency plans to address future extreme weather events.

4.4 Reporting

Two separate reports will be prepared for Surface Water (Hydrology) in support of the EA:

1. A report providing a characterization of Existing Conditions; and
2. A report providing the Effects Assessment.

These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

Surface water quantity assessment will be undertaken to corroborate the post-development runoff quantity considerations in accordance with the criteria outlined in the Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Site (January 2012) document.

The characterization of existing and proposed conditions (considering the most critical expansion alternative) will include a recent site plan of existing and proposed conditions, historical discharge of water quantity data, hydrologic assessment, potential impacts to surface water quantity and flow conditions due to steep side slopes and peak flows due to shorter time of concentrations resulting from steeper side slopes within the site surface water system and municipal drains, conclusions, and recommendations.

5 References

Henderson Paddon & Associates Limited

2008. Development & Operations Report, Warwick Landfill Expansion. Prepared for: Waste Management of Canada Corporation, March 2008.

Ministry of the Environment

2012. Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites. Last Revision Date: January 2012.

Ministry of the Environment, Conservation and Parks

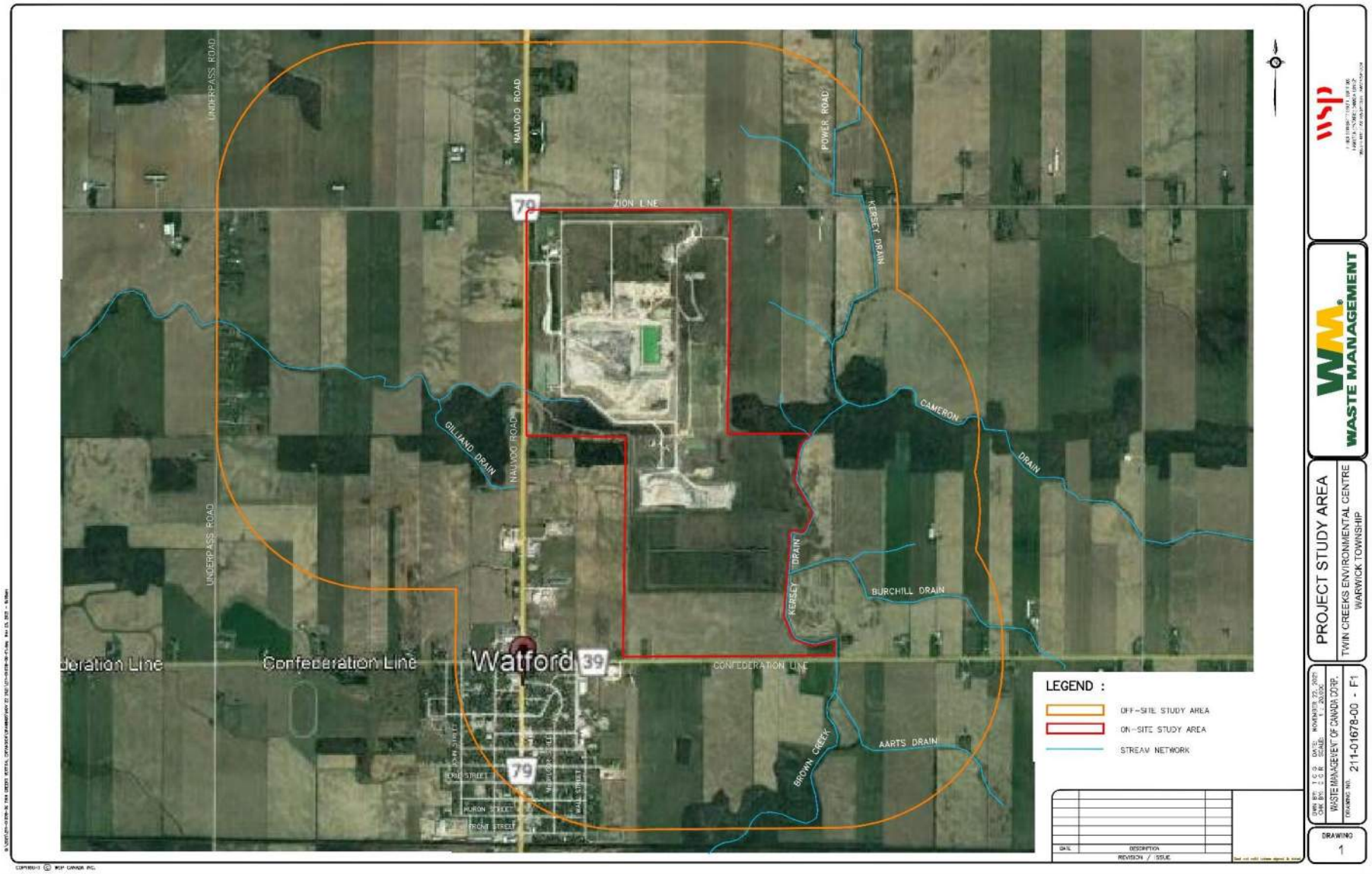
2020. Amended Environmental Compliance Approval Number A032203. Issue Date: December 19, 2020.

RWDI Air Inc.

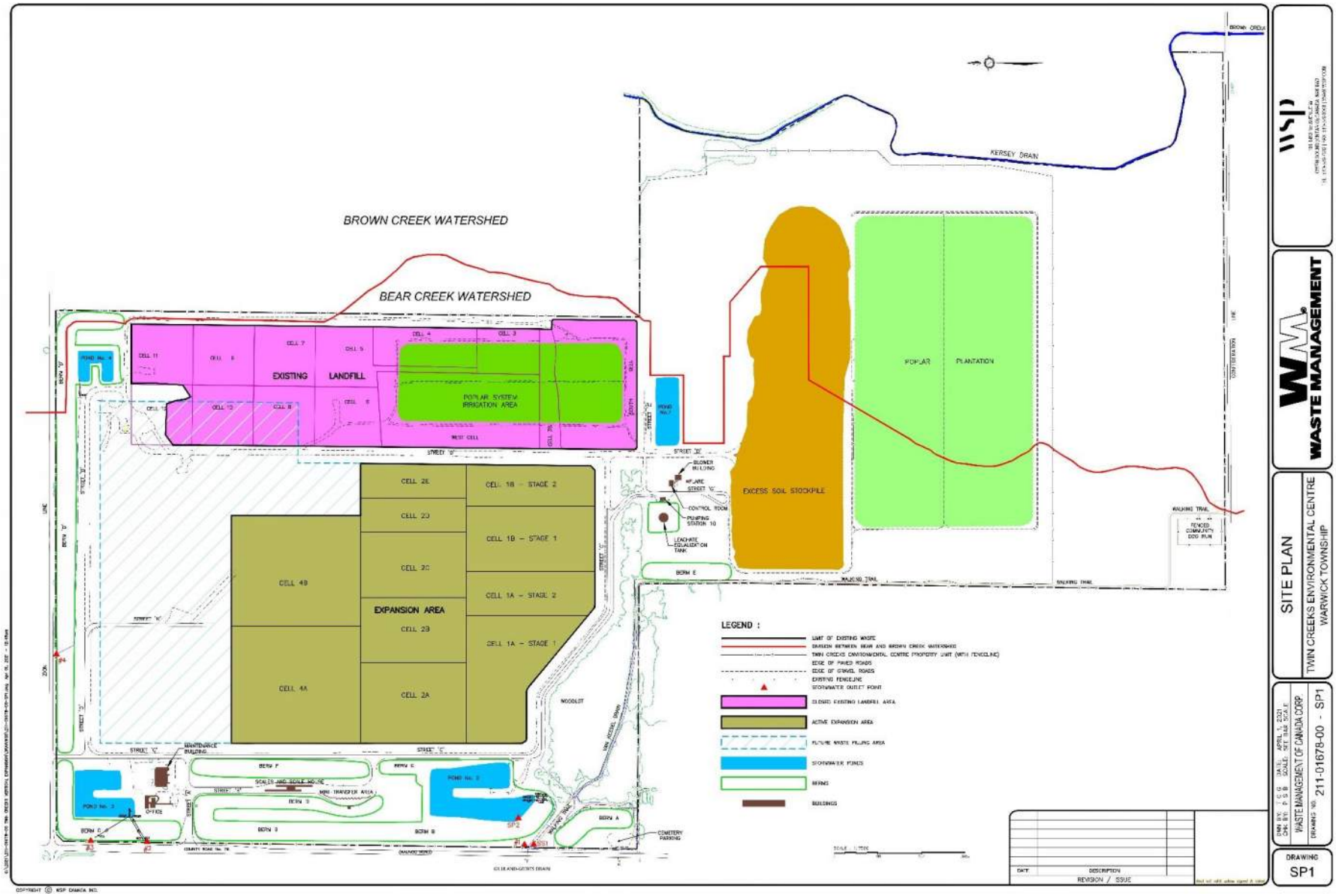
2020. Twin Creeks Environmental Centre: 2019 Fourth Quarter & Annual Monitoring Report Volume 1 of 5 – Compliance Monitoring. Prepared for: Waste Management of Canada Corporation, February 27, 2020.

Figures

Figure 1. Project Study Area



Drawing SP1. Site Plan



Transportation Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

Prepared by:

HDR Corporation

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Acronyms

Acronym	Definition
EA	Environmental Assessment
MECP	Ministry of Environment, Conservation and Parks
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
WM	Waste Management of Canada Corporation
TMC	Turning Movement Count
ATR	Automatic Traffic Recorder Count
AADT	Average Annual Daily Traffic
SADT	Summer Average Daily Traffic
DHV	Design Hourly Volume

1 Introduction

This Transportation work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

The transportation scope of work will include an operational assessment of study intersections under future conditions. The operational analysis will be based on forecast traffic volumes which include the landfill generated traffic volumes, general background traffic growth, as well as traffic generated by any future planned developments within the study area. The operational analysis will use the standard measures of effectiveness including demand and capacity calculations (volume-to-capacity ratios), level of service (delays), and queuing. Safety for all vehicle types including vulnerable road uses (i.e. cyclists) will also be reviewed by analyzing collision history along study area roadways to identify repeating collision causes, or collision 'hotspots' which will lead to a more focused review and development of mitigative measures. The external study roadways and access point along Nauvoo Road will be reviewed for safety and functional requirements relating to truck movements and impacts from truck activities.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m^3 of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m^3, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $24M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This Transportation work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the Transportation environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the Transportation work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The general study areas proposed for the purposes of the EA are (**Figure 1**):

- On-site Study Area: the existing TCEC.
- Off-site Study Area: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area.

For Transportation, the general Off-site Study Area has been extended to include external study area intersections that will be used by facility vehicles to serve the local and broader areas based on known haul routes and typical origin-destinations for site traffic. Background information informing this decision was extracted from the report entitled *Twin Creeks Landfill Annual Fill Rate Increase Traffic Impact Study* (February 2017, HDR). Based on knowledge of the site operations, the primary haul routes are to and from Highway 402, with approximately 80% of site traffic going to the north to Highway 402 and the remainder of site traffic heading to the south towards Watford. The same traffic patterns are expected to continue in the future.

Critical intersections will be reviewed in detail, including data collection and analysis of traffic operations, as determined based on the magnitude of traffic and critical traffic movements. Study area intersections included in the Transportation scope of work include the following 5 locations which are consistent with the February 2017 Traffic Impact Study, and will be analyzed to assess traffic operations:

1. Highway 402 and Nauvoo Road Eastbound Off-ramp Terminal;
2. Highway 402 and Nauvoo Road Westbound Off-ramp Terminal;
3. Nauvoo Road and Confederation Line;
4. Nauvoo Road and Zion Line; and,
5. Primary facility access along Nauvoo Road.

The Highway 402 interchange includes two stop-control intersections, as well as free-flow ramps which would not be analyzed since there are no critical (controlled) movements. However, the free-flow on-ramps will be included within the analysis of collision history if there are documented collisions at these locations. The employee-only secondary access along Zion Line is generally closed to facility traffic and would not be included in the analysis, although it is acknowledged that it may be used under some conditions when the primary access on Nauvoo Road is inaccessible. Study area intersections are shown in **Figure 2**.

There are no changes or alternatives to the current haul route being proposed as part of the undertaking. Intersections at the interchanges with Kerwood Road or Forest Road will not be included since facility related traffic traveling through these interchanges will be free-flow and will not exit or enter Highway 402 via the interchanges.

Only local traffic arrives at the site from the south. The study area will also capture the southerly limits of Watford, approximately 280 metres south of Bond Street and collision

history will be requested and reviewed up to these southerly limits of the Town to confirm if facility truck traffic contributes to collisions within the Town.

4 Scope of Work

The scope of work for Transportation includes the development of evaluation criteria, indicators, and data sources, characterization of existing Transportation conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for the Transportation environment are provided in **Table 1**. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on the Transportation environment. These evaluation criteria and indicators will be finalized during the EA. The study will adhere to the MTO requirements for the preparation of Traffic Impact Studies. The site is located within the Township of Warwick, within Lambton County. Neither the Township nor the County have traffic impact study guidelines. However, the MTO requirements should result in an adequate scope of work for this study.

Table 1. Evaluation Criteria, Indicators, and Data Sources for Transportation

Criteria	Indicators	Data Sources
Traffic Operations	• Change in daily truck traffic volume and AADT along all study area road segments • Intersection performance – capacity, delay, queues (based on HCM 2010 and generated by Synchro 9) – for all study area intersections	• Turning Movement Count • Traffic Model
Road Safety Assessment	• Collisions per million vehicles at all study area intersections (severity, involving pedestrians, cyclists, autos, trucks, school buses, and agricultural vehicles) • Collisions per million vehicle-km along all study area road segments (severity, involving pedestrians, cyclists, autos, trucks, school buses, and agricultural vehicles) • Collisions by environmental conditions for segments and intersections • Sight distance at the primary access	• Collision History • Aerials • Land Survey • Stopping and Turning Sight Distance Review • Field inventory/investigation: Clear Zone, Conflicts, Visual Obstructions, Signage, Pavement Condition, Linework Condition

The following guidelines and standards will be referenced:

- General Guidelines for the Preparation of Traffic Impact Studies, Ministry of Transportation;
- Geometric Design Guide for Canadian Roads, Transportation Association of Canada;

- Geometric Design Standards for Ontario Highways, Ministry of Transportation of Ontario;
- Ontario Traffic Manuals, Ministry of Transportation of Ontario;
- Manual of Uniform Traffic Control Devices for Canada, Transportation Association of Canada;
- Roadside Safety Manual, Ministry of Transportation of Ontario;
- Highway Safety Manual, American Association of State Highway and Transportation Officials;
- Trip Generation, Institute of Transportation Engineers;
- Highway Capacity Manual, Transportation Research Board, National Research Council;
- Road design criteria for the Warwick Township and Lambton County; and
- Official Plans of the Warwick Township and Lambton County.

Secondary source data that will be referenced and will be supplemental to the primary data collected for the study, is as follows:

- Traffic data from MTO, Warwick Township, and Lambton County, and adjacent municipalities:
    - Existing and historical traffic counts (intersection turning movement counts and 24-hour automatic traffic recorder counts);
    - AADT, SADT, DHV data;
    - Vehicle classification data;
    - Traffic growth rates;
    - Traffic control signal timings; and
    - Trail crossings and use.
- To the extent that data and planning studies for the Township's Industrial Park area is available, it will be included in the background traffic forecasts.

Collision data from MTO, the Warwick Township, Lambton County and adjacent municipalities:

- Collision statistics / history along the haul route over the past five years;
- Detailed collision reports for collisions along the haul route over the past five years; and
- Typical collision rates within Warwick Township, Lambton County and adjacent municipalities.

Trip generation data from Waste Management:

- Existing land uses;
- Typical site-generated trip distribution and traffic patterns by season and day of week; and
- Weight scale Data (multiple years).

Studies and reports from MTO, the Warwick Township, Lambton County, and local municipalities:

- Traffic impact studies;
- Traffic planning studies;
- Pavement conditions studies;
- Official plans;
- Transportation and traffic master plans (provincial and municipal);
- Road needs studies;
- Environmental assessment studies for municipal roads and provincial highways;
- Development applications; and
- Safety reviews and corridor studies.

Base mapping and drawings from MTO, Lambton County and the Warwick Township:

- Topographic base mapping;
- Aerial photography; and
- Roadway design drawings.

Information from other agencies and organizations:

- School bus routes from the Lambton Kent District School Board;
- Data from local organizations such as trail, cycling or horse-riding clubs;
- Comments received via the consultation process.
- From MTO, information will be obtained on Emergency Detour Routes including the frequency of closures of Highway 402 as background information to the study.

Listed below is a description of the field data that will be collected. Following a review of air photography, site visits will be conducted to characterize the preferred haul routes and catalogue its characteristics and conditions, including:

- Horizontal and vertical alignment;
- Road cross-section travel way width;
- Roadside clear zone width;
- Road cross-section shoulder width and shoulder condition (paved, gravel, or partially paved);
- Intersection configurations and storage lane lengths;
- Rail crossings, including type (at-grade, overpass, underpass), crossing treatment, and number of tracks;
- Potential conflict points with trucks, pedestrians, cyclists, trail users and farm vehicles;
- Pavement structure conditions;
- Existing signs, signals, pavement markings and illumination;
- Residential and commercial driveways;

- Sensitive land uses along the route, including facilities where groups of people can gather, such as churches, schools, day care facilities, parks, hospitals, cemeteries, senior citizen centres, community centres, etc.;
- Turning and minimum sight distance / visibility deficiencies; and
- Length of route (km).

The existing traffic conditions will be established through the collection of current traffic data in the form of traffic data at study intersections as well most recent available weight scale data. Standard Turning Movement Counts (TMCs) will be commissioned at all external study intersections and will capture the volume of regular vehicles, medium size trucks, and large trucks, as well as pedestrian and cyclists volumes. The external study intersection TMCs will capture the following time periods:

- Weekday AM (7:00am to 9:00am);
- Weekday midday time period (11:00am to 2:00pm); and
- Weekday PM (4:00pm to 6:00pm).

Daily weight scale data will be requested for one full year of operation. The weight scale data is anticipated to include:

- Vehicle Arrival Time;
- Load Weight (kg); and,
- Vehicle Type.

The weight scale data will be used to identify monthly and daily variations by vehicle types.

Available bi-directional ATR (Automatic Traffic Recorder) count data will be used to identify external magnitude and classification of traffic volumes, and variations throughout the day, week, and year on the adjacent study roadways of Zion Line and Nauvoo Road. If necessary, the ATR data will be used to modify available TMC data according to the daily, weekly, and monthly trends.

The locations for the counts cannot be determined until all background information is gathered, because existing counts may be available. To the best extent possible, any traffic counts will be carried out such that the presence of the personnel and equipment does not itself influence the data or traffic behaviour. The dates and times for counts will be chosen to ensure a normal, representative traffic pattern during non-summer months. Seasonal variations based on average annual daily traffic (AADT) from adjacent roadways will be applied to the traffic data to ensure the data is representative of typical conditions and generally of higher volume months. The above peak time periods may be adjusted as necessary once the background data has been analyzed. Covid-19 impacts will be considered in the review of historical traffic data. Collection of current data may not be appropriate due to the changes to magnitude of traffic and traffic patterns resulting from Covid-19 and historical data may be relied upon and adjusted (using growth rates or other modifications to traffic volumes or count details) to develop representative traffic conditions without Covid-19 impacts, as appropriate.

4.2 Characterization of Existing Conditions

Both the weight scale data as well as the TMCs will be used in traffic operations software (Synchro and SimTraffic) to estimate queue lengths, delays, and volume-to-capacity ratios at study intersections, the primary site access, and at the weight scales. The analysis will be performed following the requirements of the MTO as well as using Highway Capacity Manual (2000) outputs. The established baseline conditions will be used as the basis of further forecasting and comparisons of alternatives. Weight scale operations will be emulated using Synchro and SimTraffic traffic operations analysis software and calibrated to reflect actual field observations and weight scale processing times. The traffic models will be used as the basis for the assessment of future conditions.

As previously mentioned, the traffic data may be adjusted using historical traffic data to develop a dataset of representative current year conditions without Covid-19 impacts. This representative traffic data will be developed through a review of historical traffic data, historical growth rates, and historical shifts in traffic patterns, to identify predominant trends independent of the Covid-19 pandemic.

A Road Safety Assessment will be performed. Collision history will be requested for Nauvoo Road and Zion Line in the vicinity of the site at intersections and midblock locations, inclusive of the study area intersections at Confederation Line and Highway 402, and extending southerly to the southern limits of the Town of Watford, approximately 280 metres south of Bond Street. The collision history will be reviewed to determine trends or patterns in collision severity and causes which may be used to identify locations of existing safety concerns of deficiencies in the network. The collision history review will include vulnerable user (truck-cyclists and truck-pedestrian) safety impacts. Pedestrian and vulnerable road user impacts will be assessed by correlating collision history rates with truck rates, and extrapolated to future conditions. The frequency and location of collisions involving vulnerable road users (pedestrians and cyclists) will be reviewed for potential causes and mitigation. If problem areas are identified based on collision rates being greater than the Provincial average or 'hotspots' within the study area, the data will undergo a more focused review to identify causes and mitigation.

A field inventory will be performed to determine the condition of existing pavement, painted lines, signage, and generally confirm the transportation environment and infrastructure within the study area (mode of control, lane configurations, posted speeds). Sightlines will be assessed for the site access in-field and substantiated with desktop reviews using available aerial imagery, surveys, and topographic surveys. The field investigation will identify obstructions within the clearway along Nauvoo Road and along Zion Line along the site frontage which is where truck traffic is anticipated based on existing and future haul routes.

Storage and turn lane requirements for traffic movements impacted by truck activity will be reviewed to confirm adherence to MTO Design Supplement for TAC Geometric Design Guide (GDG) for Canadian Roads – April 2020.

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- predict the potential environmental effects for each alternative method (Section 4.3.1);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4.3.2); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4.3.3).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1. Potential effects can be positive or negative, direct or indirect, and short or long-term. Mitigation measures will be identified to minimize or mitigate the potential effects and then the net effects are evaluated taking into consideration the application of mitigation measures.

For each potential alternative, the following indicators will be developed and compared to the existing conditions. Traffic operations will produce the following outputs for direct comparison of each option:

- Volume-to-Capacity (v/c) Ratios;
- Estimated 50^{th} and 95^{th} percentile queues at study intersections, the primary site driveway, and at the weight scales.

Other criteria and indicators established for existing conditions such as the safety related items including the collision history review and the sightline assessment will be used to guide the development of alternative options.

For internal site operations, the same measures of effectiveness will be used to evaluate alternatives to reduce queuing times and queue lengths. On-site observations will supplement the Synchro/SimTraffic model. Queuing will also be assessed using first principle approaches (spreadsheet methods) which will estimate queues based on dwell times, weigh-scale times, vehicle types and vehicle lengths.

Turn lane requirements, acceleration lane requirements (including the northbound acceleration lane at the site driveway on Nauvoo Road), and deceleration lane requirements at study intersections will be assessed based on Synchro operation as well as the MTO Design Supplement for TAC Geometric Design Guide (GDG) for Canadian Roads – April 2020.

Signal warrant analysis will be undertaken based on the OTM Book 12 Signal Warrants. Assessment of intersections under roundabout control will be tested using Arcady. Warrant criteria will be confirmed with review agencies.

The following horizon years are proposed for the transportation impact assessment:

- Existing (2022)

- Future Background/Total 2032 (10-year horizon)
- Future Background/Total 2043 (20-year horizon + 1 year to meet projected operating life)

4.3.2 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.3 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative. The Do Nothing alternative only applies to analysis horizon years beyond 2032 since the existing facility is expected to operate until 2032. Beyond 2032, the Do Nothing will reflect removal of all site traffic and operations.

4.4 Reporting

A Traffic Impact Study report will be prepared for Transportation in support of the EA, including:

1. A characterization of Existing Conditions; and
2. The Effects Assessment.

This report will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The characterization of existing conditions will include details of completed field investigations, technical analyses, methods, results, maps of sensitive features within the On-site and Off-site Study Areas, conclusions, and recommendations.

Figures

Figure 1. General On-Site and Off-site Study Areas

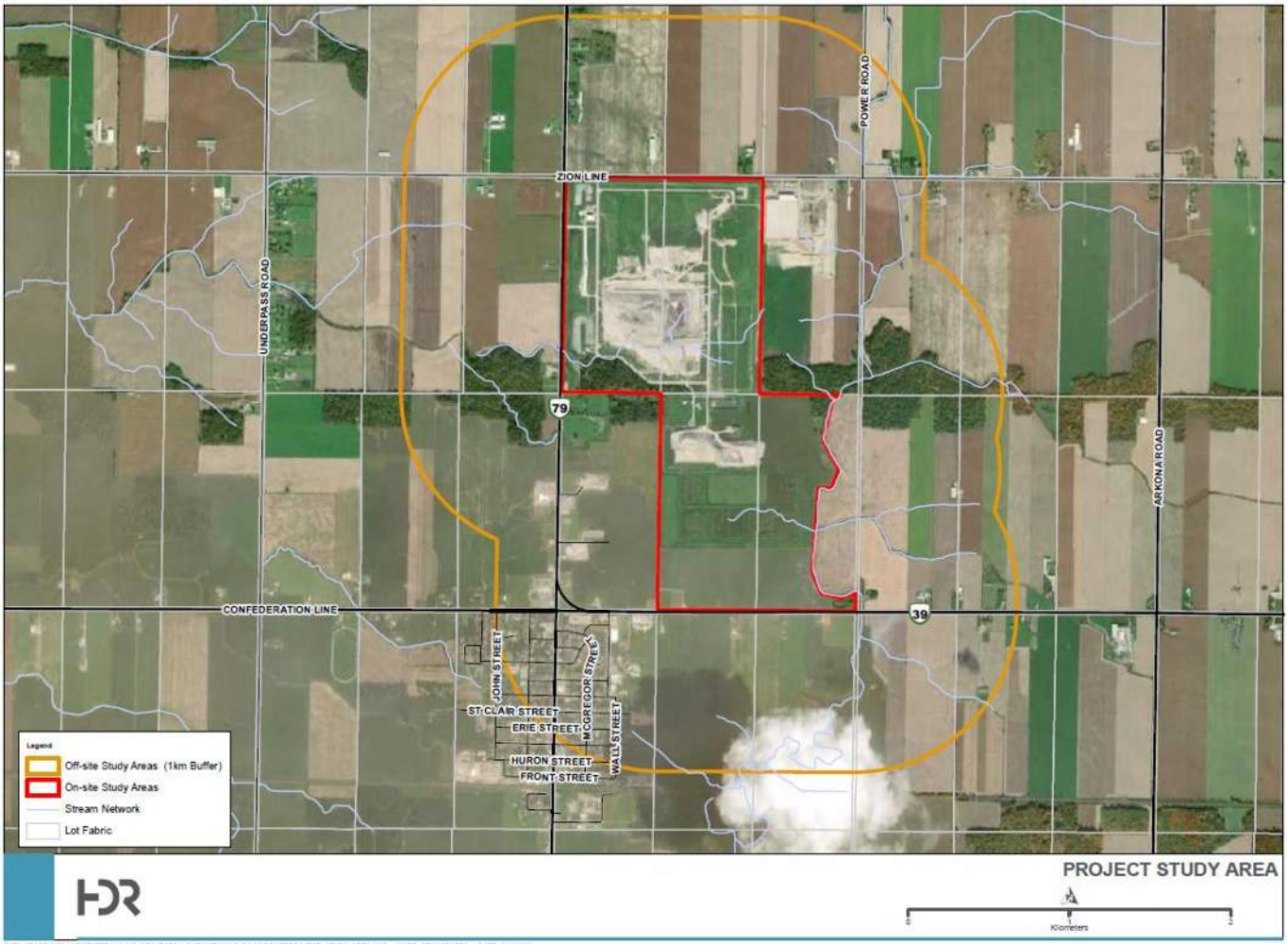

Figure 2. Transportation Study Area Intersections

Visual Landscape Work Plan

Twin Creeks Environmental Centre Landfill Optimization Project

Waste Management of Canada Corporation

Watford, Ontario

March 30, 2022

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Acronyms

Acronym	Definition
CEV	Combined Effect Value
EA	Environmental Assessment
MECP	Ministry of Environment, Conservation and Parks
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
VACF	Visual Absorption Capacity Factor
WM	Waste Management of Canada Corporation

1 Introduction

This Visual Landscape work plan has been prepared to support the environmental assessment (EA) for the Twin Creeks Environmental Centre Landfill Optimization Project (the Project) and will be appended to the Terms of Reference (ToR) for the EA to be submitted to the Ministry of Environment, Conservation and Parks (MECP) for approval.

The objective of the Visual Landscape assessment is to describe the potential changes in views from viewpoints (receptors) in the vicinity of the TCEC and assess the potential visual impact of the landfill optimization proposal. The process for conducting the Visual Landscape Assessment will include the characterization of the existing visual landscape conditions, the identification of receptors from which the proposed modifications to the TCEC might be visible, a description and assessment of the anticipated changes in views and a determination of the degree of potential change in the visual landscape. The assessment will enable a comparison between the existing condition and the anticipated visual landscape condition over the duration of the TCEC landfill optimization project.

Waste Management of Canada Corporation (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated an EA seeking approval to increase the landfill airspace capacity at the TCEC. The TCEC has approximately 13.2M m^3 of remaining approved landfill airspace, which corresponds to about 10 years of operating life (2021 to 2031). This optimization project could provide additional airspace capacity of up to approximately 14M m^3, which could extend the site life by about 12 years (from 2031 to 2043). There would be no change to the current 301 ha site area, the approved service area, or the annual fill rate.

The TCEC is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving the Province of Ontario. The landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes generated, including non-hazardous contaminated soil.

The TCEC is engineered with environmental protection systems that meet or exceed regulatory requirements and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, landfill gas collection and control, and on-site leachate disposal through phytoremediation. The TCEC provides landfill gas, for heating, to the 40-acre greenhouse facility adjacent to the landfill property. Prior to this, all landfill gas was flared. The intent is for the landfill to supply gas for heating to the greenhouses for 25 years.

Leachate that is generated in the waste is conveyed toward a perimeter leachate collection system. WM received approval to treat leachate through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

WM pays host community fees annually to the Township of Warwick. Since 2009, when the TCEC Expansion Landfill began receiving waste, WM has contributed over $24M in host community fees to the Township.

There is a need for the continued development of the TCEC as it is a significant component of the provincial waste management network and infrastructure, which is lacking in

sufficient and secure long-term disposal capacity. Optimizing the future development of the TCEC allows for on-going sustainable business operations and continued provision of essential financial support for community services and programs.

The purpose of the EA is to assess the potential effects of the proposed landfill optimization on the environment. The EA will be carried out in accordance with the requirements of the *Ontario Environmental Assessment Act*.

2 Study Purpose and Objectives

This Visual Landscape work plan outlines the tasks required to support the EA through the characterization of existing conditions and assessment of potential environmental effects of the project on the visual environment, including the evaluation of the various alternative methods and the identification and assessment of a preferred alternative. This work plan outlines the scope of the Visual Landscape work, including protocols and/or standards to be adhered to while the work is undertaken. The specific evaluation criteria, indicators, and data sources to be used and the study areas to be considered are provided below. These items may be adjusted during the EA process.

In accordance with the *Ontario Environmental Assessment Act*, the objectives of the EA are as follows:

1. Describe the environment potentially affected by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking;
2. Carry out an evaluation of the environmental effects of the proposed undertaking, using the environmental assessment criteria and studies that have been established through the development of the ToR;
3. Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate environmental effects;
4. Provide a description and evaluation of the environmental advantages and disadvantages of the proposed undertaking, based on the net environmental effects that will result following mitigation; and
5. Prepare monitoring, contingency and impact management plans to mitigate the environmental effects of the proposed undertaking.

3 Study Areas

During the EA, existing conditions and potential effects will be considered in the context of two study areas: on-site and off-site. The general study areas proposed for the purposes of the EA are (**Figure 1**):

- On-site Study Area: the existing TCEC.
- Off-site Study Area: the lands within the vicinity of the TCEC extending approximately 1 km out from the On-site Study Area.

For the Visual Landscape discipline, the general Off-site Study Area will be extended beyond this defined 1.0 km distance based upon the sensitivity of the land use and the visual relationship between the land use and the TCEC.

4 Scope of Work

The scope of work for the Visual Landscape assessment includes the development of evaluation criteria, indicators, and data sources, characterization of existing Visual Landscape conditions, assessment of the potential environmental effects of the alternative methods and the preferred alternative, development of mitigation measures and monitoring programs, and reporting as outlined below.

4.1 Evaluation Criteria, Indicators, and Data Sources

The environmental assessment criteria, indicators, and data sources for the visual environment are provided in **Table 1**. The assessment criteria, indicators, and data sources will be used to assess the effects of the alternatives and the preferred alternative on the visual environment. These evaluation criteria and indicators will be finalized during the EA.

Table 1. Evaluation Criteria, Indicators, and Data Sources for Visual Landscape

Evaluation Criteria	Rationale	Indicators	Data Sources
Socio-Economic Environment			
Social			
Visual Impact of Facility	The contours of the waste disposal facility may affect the visual appeal of a landscape.	• Predicted changes in perceptions of landscapes and views.	• Site grading plans • Aerial mapping and field reconnaissance • Proposed facility characteristics • Existing landfill design and operations data • Regional topographic mapping • Results of other discipline assessments

4.2 Characterization of Existing Conditions

The following tasks will be completed to characterize the existing Visual Landscape conditions.

4.2.1 Background Data Collection

Relevant background information will be compiled including, but not limited to the following:

- Topographic base maps that illustrate the existing conditions;
- Aerial photography of the site and the vicinity;
- Natural heritage features inventory data and maps;

- Cultural heritage features inventory and mapping;
- Local and regional official plans and land use maps; and
- Data and background information from the original EA.

This data will be reviewed and summarized. A composite base plan will be prepared.

4.2.2 Field Data Collection

An initial visit to the site and the vicinity will be conducted during a period when the trees are in a defoliated condition to assess the visual landscape. The purpose of this initial site visit is to identify key visual receptors and to document the existing visual landscape condition utilizing photographs. Potential photographic inventory locations are illustrated in **Figure 2**. Actual photograph locations will be confirmed as a component at the field data collection exercise. Existing visual screening measures will be assessed including the types of vegetation, rate of survival and rate of growth in comparison with the original landscape plans. Receptors are locations where viewpoints to the TCEC are available and where there is a potential for a change in the visual landscape as a result of the implementation and/or operation of the landscape optimization project. Candidate receptors may include residences businesses, public amenities (such as parks and recreational facilities), cemeteries and other land uses that may be sensitive to changes in the visual environment.

Throughout the course of the study, additional field visits will be conducted to assess views throughout the various seasons. Views from receptors will be documented using photographs that are cross-referenced to a key plan.

The limits of the study area for the visual landscape will be confirmed in response to the findings of the field reconnaissance. This refined study area may extend beyond the defined 1.0 km Off-site Study Area based upon the sensitivity of the land use and its respective visual relationship with the facility.

4.2.3 Data Analysis

Potential receptors will be assessed and confirmed based on the following criteria.

A. Visible landfill area
B. Distance from the landfill optimization site within the TCEC
C. Horizontal angle of view
D. Visual Absorption Capacity Factor (VACF)

Based upon the values related to each of the above recorded for each potential receptor utilizing a scale ranging from 1 to 5, a combined effect evaluation will be calculated that will determine the Combined Effect Value (CEV) for each receptor. The CEV will determine the magnitude of the visual effect related to each receptor. The following **Table 2** sets out scale of the relative magnitude of visual effect based on the range of CEV values.

Table 2. Combined Effect Value Scale

Combined Effect Value Scale	Visual Effect
13 – 20	High Effect
9 – 12	Moderate Effect
4 - 8	Low Effect

The combined effect values will be applied to address the 'Visual Impact of Facility' evaluation criterion related to each receptor based upon the following:

- For receptors that are determined to experience a 'High Effect', the proposed landfill optimization project would demand the viewer's attention.
- For receptors that are determined to experience a 'Moderate Effect', the view of the landfill optimization project would be reduced in scale as a result of the following existing conditions:
    - Distance from the site.
    - Extent and location of existing screening elements, including woodlands, topography and/or existing buildings/structures. Although the landfill optimization area would be visible, it would not dominate views. Overall shapes, patterns and details would be discernable when viewed from the receptor.
- For receptors that are determined to experience a 'Low Effect', the proposed landfill optimization project would be expected to blend into the existing landscape and would not be identifiable when viewed from the receptor.

Existing available topographic maps, aerial photographs and ground-level photographs will be used to measure the visible landfill area, horizontal angle of view and distance from the landfill. AutoCAD Civil 3D software will be utilized to calculate the VACF by determining the topographic slope ranges. The VACF vegetation percent coverage factor will be determined using G.I.S. software and current or the aerial photography.

4.2.4 Summarization of Existing Conditions

The findings of the field data collection exercise will be combined with data analysis to identify the receptors and determine the anticipated sensitivity of each in comparison with the Visual Landscape Evaluation criterion.

4.3 Assessment of Potential Environmental Effects

Using the evaluation criteria, indicators, rationale, and data sources from Section 4.1 and the characterization of existing conditions as described in Section 4.2, the assessment of potential environmental effects will be carried out as follows:

- Predict the potential environmental effects for each alternative method (Section 4.3.1);
- Identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4.3.4); and
- Conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4.3.5).

4.3.1 Evaluation of Alternative Methods

The potential effects of each alternative method will be identified based upon application of the proposed evaluation criteria, indicators and data sources as outlined in Section 4.1. Potential effects can be positive or negative, direct or indirect, and short or long-term. Mitigation measures will be identified to minimize or mitigate the potential effects and then the net effects are evaluated taking into consideration the application of mitigation measures.

The purpose of the assessment of potential effects is to provide a detailed analysis of visual exposure for the receptors that could potentially be impacted by the proposed landfill optimization initiative, including increased height, operational changes and post-closure conditions. The effects assessment methodology relies upon measurable data, resulting in a quantifiable outcome. The effects assessment methodology relies upon the data and parameters that have been utilized to characterize the existing conditions, supplementary by tasks that are required to define the visual characteristics of the proposed landfill optimization initiative. The methodology for understanding the effect assessment is described in the following sections.

4.3.1.1 Visual Characterization of the Proposed Landfill Optimization Project

A review of the design drawings, implementation plan and optimization strategy for the TCEC will be completed. This review will be focused on defining and assessing the elements of the proposed project that could potentially affect the visual landscape including the following:

- Alternative methods for vertical expansion;
- Staging/timing of the landfill operation; and,
- Operational implications including hours of operation, sequencing of restoration and revegetation.

This exercise will identify the components and characteristics of the project that could potentially have implications on views from the receptors that were identified in the process of characterizing the existing conditions. This exercise will also include a comparison of potential views between the currently permitted and approved landfill and the proposed landfill optimization project at full build-out.

4.3.1.2 Modelling of Proposed Landfill Optimization Project

Utilizing the design drawings and implementation plan, the topography of the proposed landfill optimization project will be generated for each stage of the project. The shape size and form of the optimized landfill area will be generated using AutoCAD Civil 3D software. This model will be utilized in the subsequent task to generate receptor-based visual impact values for the various stages of implementation of the landfill optimization project.

4.3.1.3 Generation of Receptor Based Visual Impact Values

For each receptor, the methodology that was applied to identify the receptors in the process of characterizing the existing condition will be utilized to determine visual impact values for each stage of implementation. This process will comprise the steps as outlined below.

A. Determination of Visible Landfill Area

The height and width of the landfill at each receptor point will be multiplied to obtain the potential landfill area that would be visible from each receptor. As the area of landfill that is exposed to view increase, the potential effect on the receptor increases.

The existing perimeter berming and screening as well as existing woodland areas and structures that perform a screening function will be taken into account in this calculation.

To account for the effect of diminishing scale over the distance, the landfill area determined for each receptor point will be divided by the distance of the receptor from the landfill (in metres). Diminishing scale refers to the phenomenon of an object's mass decreasing in size the farther it is fromthe viewer. Effect values for the perceived area that is visible are indicated in **Table 3**.

Table 3. Perceived Visible Area and Relative Effect Levels

Perceived Area Index	Effect Level	Value
>23.0	Very high	5
18.1 – 23.0	High	4
13.1 – 18.0	Moderate	3
7.51 – 13.0	Low	2
0 – 7.5	Very low	1

B. Distance to the Landfill Optimization Site

The distance to the landfill optimization site from each receptor will be measured in metres. As distance from the landfill increases, the potential visual effect decreases due to the effect of diminishing scale.

The distance in metres equates to a value scale which relates to the limits of foreground, middleground and background as defined by focal perception. The following **Table 4** illustrates the values associated with the distance ranges.

Table 4. Distance in Relation to Relative Effect Levels

Distance in Metres	Effect Level	Value
0 – 600	Very high	5
601 – 800	High	4
801 – 1500	Moderate	3
1501 – 2200	Low	2
2201 - 3500	Very low	1

C. Determination of Horizontal Angle of View

The horizontal angle of view is the measure of the unobstructed view angle from each receptor point to the proposed landfill optimization area. As the horizontal angle of view increases, potential effects increase. Horizontal angles of view are divided into the following ranges and will be assigned visual effect values as indicated in **Table 5**.

Table 5. Angle of View and Relative Effect Levels

Angle of View	Effect Level	Value
>90°	Very high	5
50° - 90°	High	4
31° - 50°	Moderate	3
16° - 30°	Low	2
0° - 15°	Very low	1

Visual research has concluded that the central region of human vision, the region with the greatest clarity or the 'visual cone of clarity', is 124 degrees. Therefore the visual effect ranges for the horizontal angle of view have been established so that the measured angles which are greater than approximately one half of the human visual cone of clarity are classified as having a high effect. Those angles which are greater than one quarter of the visual cone of clarity are defined as having a moderate effect level. The overall visual impact defined as a moderate effect level based upon the horizontal angle of view will be informed by the overall Combined Effect Value calculation.

D. Determination of Visual Absorption Capability Factor (VACF)

Surrounding landscape character is taken into consideration in the assessment. The Visual Absorption Capability is defined as the relative capacity of a landscape to absorb visual alterations and still maintain its visual integrity. VACF parameters include slope and vegetation cover. Existing vegetation and landform determine the extent to which the alternation to the landscape can be visually absorbed. To determine the VACF, the average slope of the land and percent of significant vegetative cover will be calculated based on an analysis utilizing aerial photography and topographic mapping in order to discern slope gradients and vegetation type and cover for each 500m x 500m grid square within the angle of view and a numerical value will be assigned in accordance with the scales that are set out in **Table 6** below.

Table 6. VACF Parameters

Factor	Range	Value	Description	Rationale
Slope	0 percent > 0-5 percent 6-20 percent > 20 percent	(0) (1) (2) (3)	Water Flat Rolling Rugged	No absorption Less absorptive More absorptive
Vegetation (percent coverage)	0 percent 1-10 percent 11-40 percent > 40 percent	(0) (1) (2) (3)	Open Sparse Moderate Dense	Less absorptive More absorptive

The two values for each grid square will be added together to yield the absorption capability value for that square.

The VACF value for each receptor point is the average of the visual absorption capability values for all grid squares within the horizontal viewing angle. The possible spread of averaged VACF values from one to six will be divided evenly into five ranges and will be assigned a visual effect value as set out in **Table 7**.

Table 7. VACF Values

Range	Description	Effect Level	Value
≤ 1.2	very low VACF	Very high	5
1.21 – 2.4	low VACF	High	4
2.41 – 3.6	moderate VACF	Moderate	3
3.61 – 4.8	high VACF	Low	2
4.81 – 6.0	very high VACF	Very low	1

E. Determination of Combined Effect Evaluation Scale

Effect values from the four aforementioned factors will be added together to obtain the combined visual effect value associated with each receptor point. **Table 8** sets out the scale of combined visual effect values accounts for the maximum range of value sums (4 through 20) and defines the moderate and low effect upper limits by multiplying their respective values (3,2) by the total number of factors (4).

Table 8. Combined Effect Values Scale

Combined Effect Value Scale	Visual Effect
13 – 20	High Effect
9 – 12	Moderate Effect
4 - 8	Low Effect

The combined effect values will be used to prepare the figures that will define the potential visual impact zones.

4.3.1.4 Documentation of Visual Effects Assessment

The calculations that will have been utilized to determine the visual effect for each receptor will be tabulated in a matrix format. The findings of the effects assessment will be documented using maps and photo-realistic simulations of potential views from the receptors that have been determined to be subject to High Visual Effect or Moderate Visual Effect. The matrices and illustrative figures will be generated to address each alternative option as well as each stage of implementation of the landfill optimization project.

The documentation materials will also address operational considerations.

4.3.2 Basis for Mitigation Measures

Options to mitigate adverse visual impacts will be explored with the objective of reducing the visual effect value at the receptors for which a 'High' or 'Moderate' effect value had been defined. Mitigation measures will be aimed at reducing the visual prominence of the landfill optimization project utilizing screening elements or other initiatives that will address the specific anticipated effects related to each alternative.

4.3.3 Basis for Monitoring Measures

Recommendations for monitoring will be made with the objective of determining the effectiveness of proposed visual impact mitigation initiatives. Recommendations will be provided to direct the implementation of additional mitigation, where feasible, to address adverse visual effects, as required.

4.3.4 Identification of the Preferred Alternative

The alternative methods will be comparatively assessed and evaluated using the proposed evaluation criteria, indicators, and data sources to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of mitigation/management measures (i.e., net effects) will be used to identify and compare the advantages and disadvantages of each alternative method. The comparison of alternative methods will include a clear rationale for the selection of the preferred alternative.

4.3.5 Effects Assessment of the Preferred Alternative

Following the identification of the preferred alternative, an effects assessment will be carried out on the preferred alternative considering the same evaluation criteria, indicators, and data sources, and additional studies as required, considering possible mitigation and/or management measures and cumulative effects. The potential effects of the preferred alternative will be compared to the 'do nothing' alternative.

4.4 Reporting

Two separate reports will be prepared for Visual Landscape in support of the EA:

1. A report providing a characterization of Existing Conditions; and
2. A report providing the Effects Assessment.

These reports will be appended to the EA Study Report and will be available for review during the EA. A summary of the existing conditions and effects assessment will be included in the EA Study Report.

The characterization of existing conditions will include details of completed field investigations, technical analyses, methods, results, maps of sensitive features within the On-site and Off-site Study Areas, conclusions, and recommendations.

5 References

Baker Turner Inc.

2005 Warwick Landfill Expansion Project – Visual Impact Assessment Report

Province of British Columbia

2001 Visual Impact Assessment Guidebook – 2nd Edition

Smardon Palmer and Felleman

1986 Foundations for Visual Project Analysis

Figures

Figure 1. General On-site and Off-site Study Areas

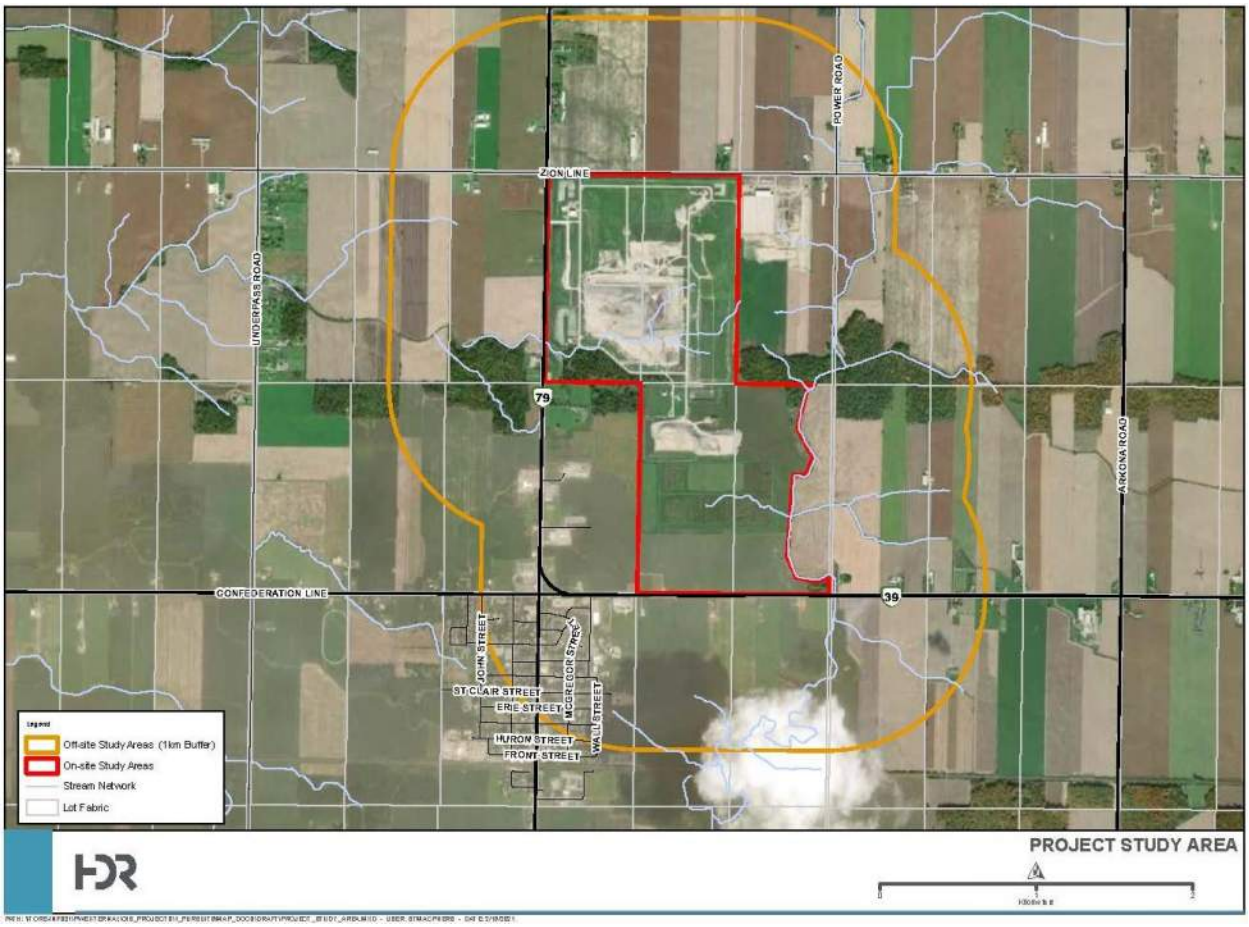

Figure 2. Potential Photographic Inventory Locations Key Plan