Appendix A2

Technical Work Plans

Appendix A2
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DILLON CONSULTING

WASTE CONNECTIONS OF CANADA (WASTE CONNECTIONS)

Ridge Landfill Agricultural Work Plan (Final)

Ridge Landfill Expansion EA

September 2018 – 15-2456

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1.0 Project and Work Plan Overview

This Agricultural Assessment work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion, and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment and Climate Change (MOECC) in May 2018.

Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base, and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

The Ridge Landfill has been in operation since 1966, and was previously expanded in 1999. Waste Connections owns 340 hectares (ha) of land at the Ridge Landfill. The existing Landfill Site Area, which is permitted by an ECA from the MOECC for waste management, and environmental work purposes, is 262 ha. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the Landfill Site Area. As of December 2017, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate.

The current approved capacity for the Ridge Landfill is 21 million cubic metres (m3). The site is approved to accept a maximum of 1,300,000 tonnes of waste per year (the MOECC approved annual waste disposal rate). The EA does not propose to increase the maximum annual fill rate (this would remain as-is); however, Waste Connections is seeking the EA to increase the life of the facility for a 20 year planning period, from 2022-2041.

The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to only the Municipality of Chatham-Kent.

This Agricultural Assessment work plan outlines the tasks to support the evaluation of alternative methods, and to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the Agricultural Assessment work, including protocols and/or standards to be adhered to while work is undertaken.

The Agricultural Assessment will seek to identify, and examine potential agricultural impacts related to the proposed landfill expansion. The objectives of the agricultural assessment are as follows:

- Establish the baseline conditions for agricultural resources within the on-site area including those lands that are designated Waste Management Area, Conservation, Agricultural/Buffer Area and Agricultural that have been identified in Schedule A4 of the Chatham/Kent Official Plan; Establish the

baseline conditions for agricultural resources within the Off-site area which is typically extends a distance of up to 1000 metres from the On-site boundary;

- Establish the baseline conditions for agricultural resources that are located along the designated haul route for the landfill;
- Carry out an assessment of potential impacts to agricultural resources within the on-site area for each of the proposed landfill expansion site development alternatives (i.e., alternative methods);
- Carry out an assessment of potential impacts to agricultural resources within the off-site area for each of the proposed landfill expansion site development alternatives (i.e. alternative methods) and
- Prepare an Agricultural resource management plan for the purpose of mitigating potential impacts.

The scope of the Agricultural Assessment will include a careful review of background information together with a comprehensive field investigation program as well as farm community input from the Social Discipline Survey. This will be, followed by an examination of potential impacts for the proposed landfill expansion alternatives (i.e., alternative methods).

The criteria and indictors that will be applied for the purpose of the assessment will include:

1. Loss of existing or potential agricultural land within the On-site area including those lands within the Waste Management Area, Conservation, Agricultural/Buffer Area and Agricultural that have been identified in Schedule A4 of the Chatham/Kent Official Plan
2. Potential Disturbance to the Agricultural Offsite area including those lands that have been identified as Agricultural in Schedule A4 of the Chatham/Kent Official Plan
3. Potential Disturbance along the Waste Management Truck Route by nuisance effects (i.e. litter and dust) to agricultural crops.

A comparative evaluation and ranking of the proposed landfill expansion alternatives will be undertaken based on the results of the impact assessment with the objective of predicting the potential net effects associated with each alternative.

Following the selection of the preferred landfill expansion alternative, an Agricultural Resources Management Plan will be developed with the goal of preserving existing and potential agricultural land On-site for as long as possible before it is required for the fill area.

This will include examining those lands that are currently designated Agricultural/Buffer, and how their removal may impact adjacent off-site agricultural operations.

The Agricultural Resources Management Plan will also summarize any nuisance impacts along the haul route.

2.0 Work Plan for Agriculture

The work plan for agriculture will follow the same procedure as conducted in 1997, as it will be conducted by the same agrologist who completed the Agricultural component of the Ridge Landfill Expansion EA in 1997. The Ridge Landfill is owned and operated by Waste Connections of Canada (Waste Connections).

2.1 Baseline Conditions

Baseline conditions for agriculture was first investigated through various background and field studies that were conducted in 1990, 1991, 1995, and 1996, with the results of these studies being presented in the Ridge Landfill Expansion Environmental Assessment document in 1997.

From conducting a wind shield analysis of agricultural activity within the Ridge landfill property in 2015, most fields have the same crop type (i.e. corn/soybean) that was encountered in 1997. It was also noted that the apple orchards are also located in the On-Site and Off -Site areas including one that is owned by PWS (located On-Site adjacent to the Southeast woodlot), and a second privately owned orchard and market garden farm in the Off-Site Area at Allison Line and Charing Cross Road (Thompson Orchards). However, further analysis of the agricultural activity is required. This would include walking each field within the On-Site Area to record the crop type, as well as determining if any field abandonment has occurred.

Windshield surveys and air photo analysis will also be required within the Off-Site Area as well as along the Haul route to determine if there are any landfill related nuisance impacts (i.e. Litter, noise and odour).

Special attention will be made to the privately owned orchard and market garden farm to determine potential negative effects. It should be noted that analysis of this farm will also be included in the Social and Air Quality disciplines.

2.2 Study Areas

For the purposes of the Agriculture Scope of Work, the study areas have been defined as follows:

- On-Site Study Area (“on-site”) – includes the property on which the current Ridge Landfill and proposed expansion is situated. This would include the existing Waste Management Area, Conservation and Agricultural/Buffer Areas as well as Agricultural areas within the proposed expansion area.
- Off-Site Study Area (“off-site”) – encompasses the area within one kilometre (1000 metres) from the edge of the On-site area. Note: Impacts from site operations are anticipated to be localized and within the subject property.

- Haul Route Study Area ("haul route") – encompasses lands immediately adjacent to Communication Road, Drury Line and Erieau Road which are identified as the designated haul routes for the site. Note: Potential impacts from the haul route would be limited to litter that has fallen from passing waste trucks and the potential for traffic delays/safety issues due to interactions between traffic and farm vehicles.

2.3 Impact Assessment Criteria and Indicators

The table below summarizes the criteria and indicators to be used in the EA. These are consistent with the criteria and indicators used in the 1997 EA.

Assessment Criteria	Indicators	Rationale	Data Sources
Assess potential for loss of agricultural resource "On Site"	Soil capability	Under the Planning Act, Class 1 to 3 soils that are designated agricultural are considered Prime Agricultural lands and should be preserved for future agricultural usage	Field Investigations Soil Maps Soil Capability mapping Official Plan and policies.
	Presence of tile drainage/surface ditches.	Tiles and drainage ditches represent and investment in land improvements to improve soil productivity.	Field Investigations Soil Maps OMAFRA drainage mapping.
	Area of crop production	Identifies the amount of land in use for agricultural production (e.g. common field crops/orchards/fallow) that will be removed by the facility.	Field investigations Agency and key contacts
	Number and type of farm infrastructure	Identifies the number and condition of farm infrastructure which shows long term capital investment.	Field investigations Agency and key contacts
Assess potential for impact to agricultural resources "Off-Site"	Area of crop production within the off-site study area.	Nuisance impacts from the landfill can cause economic losses and frustration to Off-Site farmers. For example, litter can damage cultivation/seeding and harvest equipment thus causing delays in farming operations. Dust can affect growth and interfere with pest management controls	Field investigations Farm operator interviews

Assessment Criteria	Indicators	Rationale	Data Sources
	Number of livestock infrastructure within the off-site study area.	Identifies the number and condition of farm infrastructure. Such infrastructure which are used for animal housing are considered sensitive.	Field investigations Farm operator interviews
Assess potential for disruption of farm operations along the Haul route	Number of farm building complexes with direct access to Haul Route	Indicates the number of ingress/egress points to farm building complexes where interference is most likely for farm operations along the Haul route.	Roadside Survey
	Number of field entrances with direct access to haul route	Indicates the number of ingress/egress points to farm fields where conflict could occur between slow moving farm machinery and haul trucks.	Field investigations Farm operator interviews

3.0 Reporting and Review of Alternatives for Agriculture

The agricultural assessment will be documented, and will include the update of agricultural activity for the On-Site, Off-site and Haul route boundaries. Changes in cropping trends will be included if there appears to be a change in crops compared to what was found in 1997. The review of the three alternatives will include analysis of how agriculture will be impacted by landfill development.

Action - Reporting will summarize the efforts that have taken place to accurately describe the agricultural conditions that exist On-Site, and its significance. This section will include the results of the comparison of alternatives. Reporting will also occur for the Off-Site Area and Haul Route.

3.1 Mitigation for Agriculture

Agricultural land (aka agricultural soils) is a finite, non-renewable resource which cannot be replaced.

Action - A proposed agricultural soils contingency plan would be developed to determine how existing agricultural soils can be used most effectively. This would include investigating the need for landfill cap material; using soils to amend surrounding fields in the offsite area or using stripped soils as part of a soil mix operation in the local area.

Assumptions for agriculture – It is assumed that some and possibly all agricultural activity will not be possible on the Ridge site once the site is converted to a landfill land use. However, it is assumed that existing Best Management Practices to control litter from leaving the landfill site will continue during the life cycle of this facility.

Project and Work Plan Overview (Final)

This Archaeological Assessment work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment and Climate Change (MOECC) in May of 2018.

Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

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This Archaeological work plan outlines the tasks to support the evaluation of alternative methods, and to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the Archaeological Assessment work, including protocols and/or standards to be adhered to while work is undertaken.

The Archaeological Assessment will seek to identify the potential for cultural heritage or archaeological impacts on-site as a result of the proposed expansion. It is noted that a portion of the on-site area was previously studied for archaeology and heritage in 1997, and the purpose of this study would be to assess the remainder of the landfill property.

The Archaeological Assessment would be comprised of a Stage 1 and /or Stage 2 Archaeological Assessment. The Stage 1 Archaeological Assessment would include desktop evaluation of archaeological potential, and a field visit to confirm findings. If archaeological or heritage potential is deemed likely, a Stage 2 (field investigation) may be required to further identify potential impacts of development.

It is noted that to date, the Stage 1 Archaeological Assessment has been completed, and recommended that a Stage 2 Archaeological Assessment be completed prior to development.

For the purposes of the Archaeology and Heritage Scope of work, the study area has been defined as follows:

- On-Site Study Area ("on-site") – includes the property on which the current Ridge Landfill and proposed expansion is situated.

The focus of the archaeological and cultural heritage assessment is limited to the on-site area as this is the area that has the potential to be disturbed. The off-site area will not be disturbed as a result of the project, and the landfill haul route would remain the same for an expanded landfill. It is expected that the study area for Stage 2 archaeological work (i.e., field investigation) will be further refined within the site, once the preferred site development alternative method is determined.

Following the selection of the preferred landfill expansion alternative, a scope of work will be prepared to complete a Stage 2 Archaeological Assessment. It is anticipated that this would include both pedestrian transect surveys and test pitting in areas that are not able to be ploughed (i.e., woodlots). A full scope of work for Stage 2 activities will be provided to Waste Connections once the preferred site development alternative method is identified.

A summary of additional commitments for the Archaeology assessment is provided below.

Commitment	**Reference to applicable section in EA or supporting document**
Waste Connections will keep Walpole Island First Nation and Aamjiwnaang First Nation updated as to the anticipated timing of the Stage 2 Archaeological Assessment and will coordinate a meeting with the archaeologist if requested by WIFN.	This will be addressed through the consultation program for the Ridge Landfill Expansion EA. This will also be summarized in the EA (section TBD).
The EA will determine the potential effects of the Project on the cultural, environment within the study areas. Potential effects can be short-term or long-term, direct or indirect and positive or negative. The EA will also identify ways to reduce or mitigate potential negative effects on these environments and will consider our changing climate.	Recommendations to mitigate potential effects to cultural heritage or archaeological features will be identified once the Stage 2 Archaeological Assessment has been completed. This will also be summarized in the EA (section TBD).

ASI Archaeological & Cultural Heritage Services
528 Bathurst Street Toronto, ONTARIO M5S 2P9
416-966-1069 F 416-966-9723 asiheritage.ca

May 6, 2016

VIA EMAIL

Megan Bellamy
Dillon Consulting Limited
235 Yorkland Blvd., suite 800
Toronto, ON M2J 4Y8

Dear Megan:

Re: Stage 1 Archaeological Assessment and Cultural Heritage Resource Assessment for Proposed Ridge Landfill Expansion, Blenheim

ASI File # 16EA-143_144

1.0 INTRODUCTION

Further to your Request for Proposal, we are pleased to submit the following proposal for a Stage 1 Archaeological Assessment and Cultural Heritage Resource Assessment for Proposed Ridge Landfill Expansion, Blenheim. Our proposal submission is structured to respond to the requirements of the Request for Proposal and provides a description of the project team, including key personnel and their qualifications, highlights of our firm's relevant experience, our project approach, proposed work plan and schedule, and proposal terms and deliverables.

Archaeological Services Inc. (ASI) acknowledges that this assessment is to be conducted as an individual environmental assessment project under the Environmental Assessment Act. We understand that Dillon Consulting Limited has been retained by Progressive Waste Solutions to complete the IEA for a proposed expansion to the Ridge Landfill located in Blenheim, Ontario. The scope of the archaeological and cultural heritage assessments is to confirm existing conditions within the study areas (on-site, off-site within 1 km of the maximum fill area and along the haul route) and assess the potential impacts of the undertaking.

KEY CONTACTS: Sarah Jagelewski (Assistant Manager) sjagelewski@asiheritage.ca (ext. 237) and Andrew Riddle (Senior Project Manager) ariddle@asiheritage.ca and Lindsay Graves (Senior Project Manager) lgraves@asiheritage.ca (ext. 22).

2.0 STAFF AND CORPORATE EXPERIENCE

The Senior Project Manager for the Archaeological Assessment will be **Dr. Andrew Riddle** (PhD, Anthropology), who will also provide Quality Control for all relevant deliverables. Dr. Riddle is a Senior Archaeologist with Archaeological Services Inc. and has been with the firm since 2009; he is Manager of Environmental Assessment Projects (West). Dr. Riddle has over 10 years experience in Aboriginal and Euro-Canadian archaeology and has completed and/or directed dozens of single and multi-phased assessments and mitigative excavations throughout northern and southern Ontario. For the last three years, he directed ASI's Stage 2 through Stage 4 archaeology for the South Kent Wind Project, as well as numerous other Renewable Energy Approval and infrastructure projects. Dr. Riddle is a member of the Ontario Archaeological Society, the Canadian Archaeological Association, the Society for American Archaeology, and is licensed by the Ministry of Tourism, Culture and Sport (P347).

The Senior Project Manager for the Cultural Heritage Resource Assessment will be **Ms. Lindsay Graves** (MA, Heritage Conservation), Assistant Manager of the Cultural Heritage Division at ASI. Ms. Graves is academically trained in the fields of heritage conservation, cultural anthropology, archaeology, and collections management and has over ten years of experience in the field of cultural heritage resource management. This work has focused on the assessment, evaluation, and protection of above ground cultural heritage resources. Ms. Graves has managed and conducted numerous built heritage and cultural heritage landscape assessments, heritage recordings and evaluations, and heritage impact assessments under the *Ontario Environmental Assessment Act* for Class Environmental Assessments and Individual Environmental Assessments, and as required for various planning studies, throughout the Province of Ontario. Ms. Graves has a specific interest in methods for identifying, analyzing, and evaluating cultural heritage landscapes and has conducted cultural heritage landscape assessments in a wide variety of settings. Ms. Graves is a member of the Canadian Association of Heritage Professionals.

ASI was founded in 1980 in response to increasing public awareness of the importance of Ontario's heritage resources, particularly archaeological sites, cultural landscapes, and heritage buildings. We offer the widest array of heritage consulting services in the province, including research, planning, design and development of cultural heritage resources.

We have completed over 5,000 projects throughout Ontario, and with a full time, permanent, staff of over 50 individuals and an additional seasonal staff of up to approximately 50 field technicians, we have the logistical and human resources necessary to bring any cultural heritage management project to fruition.

ASI's archaeologists are licensed by the Ontario Ministry of Tourism, Culture and Sport to conduct research on sites of all time periods throughout the entire province. Our archaeological staff has the professional depth of expertise and experience to deal with any archaeological resource, ranging from relatively recent Euro-Canadian settlement to the earliest Aboriginal occupations. We are equally adept in rural greenfield and urban or brownfield settings. Our range of archaeological services includes: Stage 1-3 archaeological assessments and Stage 4 mitigations as required under the Environmental Assessment and Planning acts, the Renewable Energy Approval Regulation and by legislation related to natural resource extraction activities; and burial and cemetery investigations under the Funeral, Burial and Cremation Services Act. We also routinely undertake large-scale planning studies for municipalities that include archaeological potential modelling and policy development.

Our cultural heritage specialists, consisting of a team of dedicated and diverse professionals, offer a range of consulting services in built heritage and cultural landscape conservation, planning and management, most notably in the context of environmental assessment or land-use planning and development activities, as well as cultural resource management plans of many types. They frequently provide project management in complex, multi-component cultural heritage projects and have particular strengths in historical research, built heritage and cultural landscape inventories, heritage conservation district studies, and heritage bridge conservation.

We are also leaders in establishing Aboriginal Engagement programs, where appropriate, in recognition of the ongoing interests Aboriginal communities may have concerning the cultural heritage remains left by their ancestors. We undertake engagement and consultation in the context of large-scale land-use planning projects, site-specific archaeological mitigation decisions and Traditional Ecological Knowledge studies.

For more information, visit our website at www.asiheritage.ca

ASI

3.0 WORK PLAN

Stage 1 Archaeological Assessment

For this assessment, ASI will follow the *Standards and Guidelines for Consultant Archaeologists* (*S & G*) administered by the Ministry of Tourism, Culture and Sport (MTCS). Following the S & G is a condition of our licenses to conduct archaeological fieldwork in Ontario. The Stage 1 Archaeological Assessment (S & G Section 1) focuses on conducting background research on the project study area and includes the following tasks:

Task 1: Background Research (S & G Section 1.1)

ASI's existing database of known archaeological sites within the study area will be updated by:

- Reviewing pertinent provincial and federal government files (Ontario Archaeological Sites Database); and

- Reviewing and compiling the results of a literature search (published and unpublished).

Deliverables: none.

Task 2: Archaeological Site Potential Evaluation (S & G Section 1.2)

The archaeological site potential of the study area will be determined by:

- Reviewing archaeological site location data updated during Task 1;

- Evaluating the property's archaeological potential, based on characteristics that indicate where archaeological resources are most likely to be found;

- Reviewing site-sensitive factors: if one or more cemeteries are located within the study area, municipal and/or regional cemetery officials and/or heritage planners will be notified to obtain relevant information if necessary. An on-site visit may be conducted as part of the property inspection; and

- Conducting a property inspection of the project study area. This will be undertaken in order to review the project study area (and layout) and to confirm and photo-document archaeological site potential. The property inspection will occur when weather conditions permit good visibility of land features. The inspection **cannot** occur when weather conditions may reduce the chances of observing features of archaeological potential (e.g., snow cover, frozen ground, excessive rain or drought) (S & G Section 1.2). **PLEASE NOTE:** ASI usually conducts the property inspection from public rights-of-way which does not involve a physical survey of any project lands.

Deliverables: none.

Task 3: Report Preparation (S & G Section 7.7)

A Stage 1 Archaeological Assessment report will be prepared which will describe the results of all background research and the property inspection fieldwork conducted, and will contain all necessary photographic and cartographic documentation. The report will include the following:

- Results of the background research pertaining to previous archaeological investigations;
- Geo-environmental setting and historic settlement;
- Evaluation of archaeological site potential; and
- Result of the property inspection.

The report will provide recommendations for Stage 2 assessment, if necessary.

Deliverables: ASI will prepare one report in digital format for **Dillon Consulting Limited** review and approval. Should changes be required, ASI will prepare and re-submit a revised report to the **Dillon Consulting Limited**. **PLEASE NOTE:** this report will also be submitted to the MTCS for review and in accordance with licensing requirements under the *Ontario Heritage Act*.

Cultural Heritage Resource Assessment Work Plan

The following work plan is guided by the following documents and legislation: Guidelines for Preparing the Cultural Heritage Resource Component of Environmental Assessments (1992); the Ontario Heritage Act (2005); Ontario Heritage Toolkit (2006), and the Chatham-Kent Official Plan (2016). The cultural heritage resource assessment focuses on conducting and analyzing background research and field survey results for the purposes of identifying impacts of the proposed undertaking on cultural heritage resources.

The Cultural Heritage Resource Assessment will involve the following four tasks.

Task 1: Background Historical Research and Preliminary Feature Identification

A brief review of available primary and secondary source material will be undertaken to produce a contextual overview of the study area, including a general description of Euro-Canadian settlement and land use, and the development of transportation infrastructure. Available historic mapping, existing condition mapping, project mapping, and aerial photographs will be reviewed, if available, and relevant agencies and authorities will be contacted as necessary, in order to make a preliminary identification of existing built heritage features and cultural heritage landscapes within the study area. As part of this task, municipal heritage inventories are reviewed to identify properties and resources that have been previously identified as being of potential cultural heritage value, or which have been designated under the *Ontario Heritage Act*.

Deliverables: none

Task 2: Field Survey

A field review will be undertaken to identify and photograph individual built heritage resources and cultural landscapes within accessible portions of the study area. The results of survey will be recorded on survey forms where appropriate. Based on the results of field review, potential impacts to built heritage resources and cultural heritage landscapes will be identified.

Deliverables: none

Task 3: Impact Assessment

Identified impacts to built heritage features and cultural heritage landscapes will be evaluated and recommendations and mitigation measures will be developed as appropriate.

Deliverables: none.

Task 4: Report preparation

Report preparation will be undertaken to describe the results of the background research, cultural heritage field inventory and agency contacts (if any) and to identify sensitivities. Advice will be provided on direct and indirect impacts of construction and mitigation measures will be identified.

Deliverables: ASI will prepare a report in digital format for **Dillon Consulting Limited** review and approval. Should changes be required, ASI will prepare and re-submit a revised report.

5.0 WORK SCHEDULE

The following represents our proposed work schedule, pending confirmation by **Dillon Consulting Limited**, and receipt of requested project documentation:

- Initiate Project: date that signed and completed ASI's "Project Confirmation and Consent Form" is received, or a comparable sub-consultant agreement is executed;

- Conduct Stage 1 Background Research and Property Inspection: ASI will commence Stage 1 Archaeological Assessment activities within two-four weeks of receipt of all mapping and other start-up documentation requested from **Dillon Consulting Limited**, as well as receipt of the Ministry of Tourism, Culture and Sport's "Project Information Form" and Archaeological Site Data Inventory;

- Conduct Cultural Heritage Resource Assessment Background Research and Preliminary Feature Identification: ASI will commence the background historical research activities *within two-four weeks* of receipt of all requested project documentation. Please note that this schedule may be subject to change based on the date of project confirmation;

- Conduct Field Survey for Cultural Heritage Resource Assessment: ASI will commence field review activities following receipt of all requested project documentation and within *four-six weeks* following completion of background research;

- Prepare and Submit Interim Invoices: As applicable, ASI will prepare and submit one or more interim invoices *to cover work tasks completed up to and including all field assessment activities*. **PLEASE NOTE:** all archaeological and heritage assessment work will be billed separately.

- Prepare and Submit Stage 1 Archaeological Assessment Report: ASI will prepare and submit a report to **Dillon Consulting Limited** for review within *four-six weeks* of completion of fieldwork;

- Prepare and Submit Cultural Heritage Resource Assessment Report: ASI will prepare and submit a report to **Dillon Consulting Limited** for review *within four-six weeks* of completion of fieldwork. **PLEASE NOTE:** This work schedule may require revision depending on the quantity and type of cultural heritage resources;

- Prepare and Submit Final Invoices: Once the reports have been submitted to **Dillon Consulting Limited** for review and approval, ASI will prepare and submit final invoices *to cover all remaining project tasks, including data analysis and report preparation.* **PLEASE NOTE:** ASI is bound by professional ethics to complete all outstanding report obligations to **Dillon Consulting Limited** subsequent to final invoicing: Should **Dillon Consulting Limited** request follow-up revisions to the report, ASI will respond as appropriate and re-submit the report within seven (7) days for approval.

  FURTHERMORE, in order for ASI's archaeologists with professional licenses to be compliant with the *Ontario Heritage Act*, they must secure Ministry of Tourism, Culture and Sport acceptance of the project report and concurrence with its recommendations. The report, therefore, must be submitted to the Ministry for review and licensing purposes *in a timely manner*. If **Dillon Consulting Limited** has not provided ASI with any comments and/or approval on the Archaeological Assessment report within 30 days of final report submission, or if special

arrangements have not been made in advance for their receipt, ASI will notify **Dillon Consulting Limited** that it will submit the final Archaeological Assessment report to the Ministry of Tourism, Culture and Sport without further delay.

6.0 TERMS OF PAYMENT

- Net due within **10 days** of **Dillon Consulting Limited's** receipt of payment.
- Requests for clarification, correction, or amendment of invoices must be made within five (5) business days from receipt of invoice.

7.0 DELIVERABLES

7.1 Dillon Consulting Limited to ASI

- Written Project Confirmation: Prior to project initiation, ASI requires written project confirmation either by completing and signing the attached "Project Confirmation and Consent Form" and returning it to ASI by FAX or scanned image (.pdf format), or by a sub-consultant agreement or other formal document. **It is imperative that this written confirmation indicate to whom the invoice(s) will be directed;**
- Permission to Enter Property: Stage 1 Archaeological Assessment property inspections and Cultural Heritage field reviews are typically conducted from public rights-of-way and PTEs are not normally required;
- Mapping: Prior to the initiation of the archaeological and heritage assessments, ASI requests the following:
    - Key plan of project study area (Adobe Acrobat® [.pdf] or .jpg format);
    - GIS data (ESRI shapefiles), including but not limited to the following:
        - **Required**
            - Project Layout (area that will be impacted by the project, including access roads, staging areas etc.);
            - Road network data;
            - Watercourses (including wetlands and drains);
            - Vegetation Cover;
            - Parcel fabric/Lot information (including municipal address and ownership);
        - **Optional**
            - Orthoimagery;
            - Existing building footprints;
            - Elevation data (DEM);
            - Multi-spectral remote sensing data.

PLEASE NOTE: ASI prefers to receive GIS data but will also work with CAD (.dwg or .dxf) files. ASI will not accept Microstation (.dgn) files. Delays in the delivery of required mapping will result in delays to the completion of fieldwork and reporting tasks.

Metadata and documentation is required for any GIS data sent to ASI, this should include:

- Datum and Projection information for all geographic data;
- Date when the data was created and last updated;
- Who created the data (including contact information);
- CAD files require a map name and map number for reference purposes;
- A date for aerial photos and satellite imagery;
- A clear definition/description of each layer in a CAD file;
- A clear description and purpose of every shapefile.

7.2 ASI to Dillon Consulting Limited

- Stage 1 Archaeological Assessment Report: ASI will produce a report and submit it to **Dillon Consulting Limited** for review in Adobe Acrobat® (.pdf) format. Alternate formats are acceptable at **Dillon Consulting Limited** request. If required, ASI will make any revisions, as appropriate, and then produce two (2) bound copies of the report: one to **Dillon Consulting Limited** (including one electronic version in Adobe Acrobat® (.pdf) format); and one to ASI. **PLEASE NOTE:** If additional bound copies are required by **Dillon Consulting Limited**, they will be produced at cost and invoiced separately. If other electronic formats are preferred, please notify ASI at the time of project confirmation; and

Securing the Ministry of Tourism, Culture and Sport's "Letter of Acceptance" and written comments, if necessary, for the archaeological assessment report is a compliance requirement for ASI's archaeologists with professional licenses under the *Ontario Heritage Act*. THIS DOES NOT CONSTITUTE AN ASI DELIVERABLE TO Dillon Consulting Limited.

- Cultural Heritage Resource Assessment Report: ASI will produce a report and submit it to **Dillon Consulting Limited** for review in Adobe Acrobat® (.pdf) format. If required, ASI will incorporate any changes and then issue a report in electronic format to **Dillon Consulting Limited.** One bound copy of the report will be prepared and submitted to **Dillon Consulting Limited** (including one electronic version in Adobe Acrobat® (.pdf) format). **PLEASE NOTE:** If additional bound copies are required by **Dillon Consulting Limited**, they will be produced at cost and invoiced separately. If other electronic formats are preferred, please notify ASI at the time of project confirmation.

If ASI is delayed in the performance of its work by an act or omission of the client, a stop work order issued by a court or other public authority, labour dispute, abnormal adverse weather conditions, any public protest, blockade, agitation, or threat, or any other cause beyond ASI's control (any one or more of the forgoing being a "Delay Event"), then ASI will be afforded a reasonable extension of time commensurate with any such Delay Event to complete its work and entitled to reimbursement by the client for any reasonable costs incurred by ASI resulting from any such Delay Event. ASI reserves the right to stop the performance of its work and vacate its staff and property from the field without penalty if, at ASI's sole discretion, ASI concludes that the safety and well being of its staff and/or property and/or the integrity of ASI's work is threatened by any such Delay Event.

If there is any further information required, please do not hesitate to contact me at the address or telephone number indicated above.

Sincerely,
ARCHAEOLOGICAL SERVICES INC.

Andrew Riddle, PhD
Senior Archaeologist, Manager
Environmental Assessments West

Lindsay Graves, MA
Cultural Heritage Specialist, Assistant Manager
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DILLON CONSULTING

WASTE CONNECTIONS OF CANADA

Atmospheric Scope of Work for Ridge Landfill Expansion Environmental Assessment (EA) - Final

Ridge Landfill Expansion EA

September 2018 – 15-2456

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Figures

1.0 Project and Work Plan Overview

This Atmospheric work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment, Conservation and Parks (MOECP, formerly the Ministry of the Environment and Climate Change) in May of 2018.

Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

The Ridge Landfill has been in operation since 1966 and was previously expanded in 1999. Waste Connections owns 340 hectares (ha) of land at the Ridge Landfill. The existing Landfill Site Area, which is permitted by an ECA from the MOECP for waste management and environmental work purposes, is 262 ha. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the Landfill Site Area. As of December 2017, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate.

The current approved capacity for the Ridge Landfill is 21 million cubic metres (m3). The site is approved to accept a maximum of 1,300,000 tonnes of waste per year (the MOECP approved annual waste disposal rate). The EA does not propose to increase the maximum annual fill rate (this would remain as-is); however, Waste Connections is seeking the EA to increase the life of the facility for a 20 year planning period, from 2022-2041.

The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to just the Municipality of Chatham-Kent.

This Atmospheric work plan outlines the tasks to support the evaluation of alternative methods, and to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the atmospheric work, including protocols and/or standards to be adhered to while work is undertaken.

The Atmospheric work plan has been developed to address indicator air emissions (see Section 1.1), odour, dust, and litter.

The study areas to be considered for the atmospheric assessment are: on-site (i.e., landfill footprint), off-site (encompasses the area within ten kilometres of the centre of site, which will be used to assess air

quality and odour impacts), and along the haul route. The study areas described above may be adjusted during the EA process to address the requirements of the Air Quality assessment.

This work plan has been developed with consideration of the commitments made for the project within the development of the Terms of Reference. These commitments are tabulated below.

Commitment	Reference to applicable section in EA or supporting document
Waste Connections commits to ongoing consultation with the MOECP's Air Quality Specialist to determine the appropriate scope of air, greenhouse gas, and odour assessment during the EA.	Atmospheric work plan.
The EA will include studies related to odour and greenhouse gas emissions when considering the preferred site development alternative.	Atmospheric work plan Tasks 1, 2 and 3 (Section 1.1, 1.2 and 1.3). This will also be incorporated into the EA (section TBD).
The MOECP provides guidance by way of the "D-4 Land Use On or Near Landfills and Dumps" land use guidelines. The guidelines direct that several factors must be considered when land use is proposed near an operating landfill site. These include, but are not limited to, water contamination by leachate, odour, litter, dust, noise, surface runoff and landfill-generated gases. These will be considered as part of the technical studies completed as part of the EA.	Atmospheric work plan Tasks 1, 2 and 3 (Section 1.1, 1.2 and 1.3).
For each alternative method, quantitative/qualitative indicators of air quality, odour, dust and GHGs will be used to evaluate the relative differences between alternative methods. Air Quality will be included as a criteria group as a component of the natural environment.	Atmospheric work plan Task 2 (Section 1.2). This will also be incorporated into the EA (section TBD).

2.0 Study Purpose and Objectives

The proposed expansion of the landfill has the potential to increase air emissions from the site and from increased transportation activity along the haul route. The Atmospheric Scope of Work has been developed to characterize the changes in air emissions, odour, and litter, and will be completed in accordance with the approved amended ToR (May 2018), including the additional commitments made by Waste Connections throughout the stakeholder consultation process.

3.0 Study Area

For the purposes of the Atmospheric Scope of Work, three impact study areas have been defined as follows:

- On-Site Study Area ("on-site") – includes the property on which the current Ridge Landfill and proposed expansion is situated.
- Off-Site Study Area ("off-site") – encompasses the area within ten kilometres of the centre of site, which will be used to assess air quality and odour impacts (as shown in **Figure 1**) The Off-Site Study Area encompasses the area within ten kilometres of the centre of the site. Impacts from site operations are anticipated to be localized and within close proximity to the site's property line, as most sources of emissions are fugitive sources that are emitted at or close to ground level. Within this area, receptors for use within atmospheric dispersion modeling will be placed as follows:
  - For all indicator compounds except odour: multi-tier grid of receptors to be developed in accordance with Section 14 of O.Reg. 419/05. Receptors will not be placed over Lake Erie.
  - For odour: the nearest sensitive receptors will be identified in all directions around the site. In developing the sensitive receptor grid consideration will also be given to historical odour complaints and also houses that may be owned by WCC and leased to local community members.
- Haul Route Study Area ("haul route") – encompasses lands immediately adjacent to Communication Road, Drury Line and Erieau Road which are identified as the designated haul routes for the site.

The extents proposed are based on good practice and anticipated impacts, as discussed above.

Figure 1: Offsite Study Area

4.0 Scope of Work

In order to characterize the changes in air emissions, odour, and litter, the tasks documented in the following sections will be completed.

NOTE: As part of the development of the atmospheric assessment, there will be ongoing engagement of the MOECC's technical reviewer on details of emissions quantification, modeling and results analysis.

4.1 Task 1: Baseline Conditions

Indicator compounds will be selected for the air quality assessments within the EA. Changes in these compounds will be assessed (qualitatively and/or quantitatively) and the anticipated magnitude of these changes used as indicators of impacts to air quality. Ten (10) indicator compounds will be selected for the air emissions assessment, as follows:

1. Total Suspended Particulate (TSP);
2. Particulate Matter with aerodynamic diameter <10µm (PM10);
3. Particulate Matter with aerodynamic diameter <2.5µm (PM2.5);
4. Nitrogen Oxides;
5. Hydrogen Sulphide;
6. Vinyl Chloride;
7. Chloroform;
8. Carbon Monoxide;
9. Sulphur Dioxide; and
10. Odour.

Baseline air quality will be characterized through use of air quality data from the closest Environment Canada NAPS or MOECP air quality monitoring stations. Data will be collected for the indicator compounds identified for the project, for the most recent complete 2 to 3 years of data. Data from these sources will be supplemented by site-specific monitoring that was conducted in 2014. Data for each indicator compound will be sourced as follows (*subject to refinement based on data availability and completeness of datasets*):

- Particulate (TSP, PM_{10} and $PM_{2.5}$) - Ambient data from MOECP Chatham Station with PM_{10} estimated based on typical ratios of PM_{10} to $PM_{2.5}$ in ambient air.
- NOx - Ambient data from MOECP Chatham Station
- CO, SO_2 - NAPS Windsor Station data
- Chloroform, Vinyl Chloride – NAPS London Station data with historical site specific monitoring used to contextualize the NAPS data
- H_2S - MOECP data if available, otherwise average concentration from natural sources or in urban areas for Southwestern Ontario (TABLE A4) from Environment Canada's Draft Screening Assessment for H_2S

- Odour - the environment surrounding the site consists of primarily agricultural land uses. It is expected that the ambient odour would be characteristic of a rural agricultural setting. There have been no odour studies within the local area and therefore no baseline value will be defined for odour.

It is important to note that in some cases the nearest NAPS station may be London or Windsor. Both of these locations represent urban environments and would be anticipated to provide a conservative representation of baseline conditions within the Off-Site Study Area.

4.2 Task 2: Evaluation of Site Development Alternative Methods

An analysis of potential odours and changes in indicator compound emissions will be completed using metrics that would be indicative of differences between each alternative method. The metrics to be used will include:

- Odour: number of potential odour sources, relative significance of odour sources (if such characterization is possible), distance of odour sources to sensitive receptors;
- Particulate matter: relative levels of material movement and vehicular activity (indicator for dust and combustion emissions);
- Nitrogen oxides, sulphur dioxide and carbon monoxide: relative levels of vehicular activity as an indicator for amount of fuel combusted; and
- Hydrogen sulphide, vinyl chloride, chloroform: anticipated differences in landfill gas emissions.

The site development alternative methods all relate to the alternative development options for the landfill. The landfill will accept post-diversion residual waste, and therefore the site development alternative methods will not affect the diversion rate of the regional system (i.e. alternatives that enhance diversion within Waste Connection's system are not being considered as standalone alternative methods as part of the EA). The site's waste acceptance rate will remain the same with the possibility of changes in composition as improvements in diversion is achieved. These composition changes would equally affect all alternative methods, and would represent an improvement on current baseline conditions through enhanced diversion of waste and therefore potential reductions in landfill gas emissions. These improvements in diversion would be driven by provincial policy or regional scale activities, as opposed to the alternative site development methods proposed. As a result, there will not be any waste diversion related changes in GHGs between the site development alternative methods.

4.3 Task 3: Assessment of Preferred Alternative

Based on the fact that the daily waste acceptance rate of the landfill will not be increased, the greatest potential impact to air quality for the landfill expansion will be associated with on-site operations. However, there may be an increase in export soil truck traffic or changes to background traffic levels along the haul route. Therefore the assessment of the preferred alternative will focus on the landfill operations itself, but will also consider changes to haul route traffic. The key steps in the assessment of the preferred alternative are as follows:

1. Quantification of emissions. This will generally be done as documented below (subject to refinement):

Indicator Compound	Emission Source	Emission Estimation Approach
Odour	Active Area	Odour emission factor for landfills found in MOECP Interim Guide to Estimate and Assess Landfill Air Impacts
Particulate (TSP, PM10, PM2.5)	Material Handling Road Dust Tailpipe Emissions	US EPA AP42 Emission Factors (e.g., Aggregate Handling and Storage Piles, Unpaved Roads) Site specific silt sampling from unpaved road surfaces US EPA Exhaust and Crankcase Emission Factors for Non-Road Engine Modeling Compression-Ignition US EPA MOBILE6.2 guidance
SO2, CO, NOx	Tailpipe Emissions LFG Control System (Flare)	US EPA Exhaust and Crankcase Emission Factors for Non-Road Engine Modeling Compression-Ignition US EPA MOBILE6.2 guidance US EPA LandGEM model coupled with capture rate of system and destruction efficiency of flare
H2S, Vinyl Chloride, Chloroform	LFG Control System (Flare) Fugitive Landfill Emissions	US EPA LandGEM model coupled with capture rate of system and destruction efficiency of flare

2. Incorporation of the emission estimates of indicator compounds for current operations into the AERMOD dispersion model to predict the current contributions of the site's operations to local air quality. Results of the current operations model will be compared to baseline monitored air quality to characterize the conservatism of the modeling.

   A separate model will be developed to assess the change in air quality and odour concentrations resulting from the preferred alternative. This model will assess up to three future scenarios for the preferred alternative to capture worst-case emissions. The definition of these scenarios will consider the peak vehicular activity on the site and the peak landfill gas generation period.

   Key dispersion modeling considerations are as follows:

   - Use of the MOECP regulatory version of AERMOD (currently 16216r)
   - Terrain data from the MOECP
   - MOECP processed site specific 5 year meteorological data set

- Emissions represented as volume sources (e.g. material handling, road dust), area sources (e.g. fugitive odour), point sources (e.g. flare)
- Deposition algorithms to be used within particulate modeling

3. Combination of the preferred alternative impacts on air quality with baseline conditions to estimate cumulative air quality. In doing so the following air quality criteria will be used:

Indicator Compound	Criterion (ug/m3)	Averaging Period
Total Suspended Particulate (TSP)	120 (O.Reg. 419/05) 60 (AAQC)	24 hr Annual
Particulate Matter with aerodynamic diameter <10µm (PM10)	50 (AAQC)	24 hr
Particulate Matter with aerodynamic diameter <2.5µm (PM2.5)	30 (AAQC) 28 (CAAQS) 27 (CAAQS future) 10 (CAAQS) 8.8 (CAAQS future)	24 hr 24 hr 24 hr Annual Annual
Nitrogen Oxides	200 (O.Reg. 419/05) 400 (O.Reg. 419/05)	24 hr 1 hr
Hydrogen Sulphide	7 (O.Reg. 419/05); 13 (O.Reg. 419/05)	24 hr 10 minute
Vinyl Chloride	1 (O.Reg. 419/05)	24 hr
Chloroform	1 (O.Reg. 419/05)	24 hr
Carbon Monoxide	6,000 (O.Reg. 419/05)	½ hr
Sulphur Dioxide	690 (O.Reg. 419/05) 100 (O.Reg. 419/05 future) 275 (O.Reg. 419/05) 55 (O.Reg. 419/05) 10 (O.Reg. 419/05 future)	1 hr 1 hr 24 hr Annual Annual
Odour.	1 OU/m3 3 OU/m3 5OU/m3	MOECP Guideline

4. Estimation of emissions of applicable indicator compounds from the haul route traffic sources associated with potential changes to soil truck or background traffic levels, and use of an appropriate transportation dispersion model (e.g. CAL3QHCR) to predict concentrations of indicator compounds at sensitive receptors.

5. Use of 1 year of local meteorological data, combined with the distance of receptors from the working face (for 2 reasonable worst-case future design scenarios) to assess the potential for

blowing litter impacts. This will be completed using the blowing litter threshold wind speed criteria previously defined for the site (1996).

4.4 Task 4: EA Impact Assessment

- Using the data derived from the Tasks above, analysis of the magnitude of the potential changes in air quality (i.e., changes in concentrations of indicator compounds) will be completed for the preferred alternative. The overall impact will be designated as high, medium or low on the sensitive receptors, in accordance with the EA impact assessment approach.
- The results of the blowing litter assessment will be used to characterize the potential impact of the preferred alternative as high, medium or low on the sensitive receptors, in accordance with the EA impact assessment approach.
- The results of the odour assessment will be used to characterize the potential impact of the preferred alternative as high, medium or low on the sensitive receptors, in accordance with the EA impact assessment approach.
- The results of the GHG analysis will be used to characterize the project's contribution to the GHG profile of the region or the province, in accordance with the EA impact assessment approach.
- Where necessary, operations mitigative measures (that are above and beyond the proposed design of the landfill) will be defined to reduce any potential impacts (air quality, odour, and litter).

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WASTE CONNECTIONS OF CANADA

Climate Change Scope of Work for Ridge Landfill Expansion Environmental Assessment (EA) - Final

Ridge Landfill Expansion EA

September 2018 – 15-2456

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1.0 Project and Work Plan Overview

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Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

The Ridge Landfill has been in operation since 1966 and was previously expanded in 1999. Waste Connections owns 340 hectares (ha) of land at the Ridge Landfill. The existing Landfill Site Area, which is permitted by an ECA from the MOECP for waste management and environmental work purposes, is 262 ha. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the Landfill Site Area. As of December 2017, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate.

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The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to only the Municipality of Chatham-Kent.

This climate change work plan outlines the tasks to support the evaluation of alternative methods, and to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the climate change work, including protocols and/or standards to be adhered to while work is undertaken. The climate change work plan is structured to include an assessment of climate change mitigation (Section 3.1) and climate change adaptation (Section 3.2).

The study areas to be considered for the climate change assessment are on-site (i.e., landfill footprint), and along the haul route. The study areas described above may be adjusted during the EA process to address the requirements of the climate change assessment.

This work plan has been developed with consideration of the commitments made for the project within the development of the Terms of Reference. These commitments are tabulated below.

Commitment	Reference to applicable section in EA or supporting document
Waste Connections commits to ongoing consultation with the MOECP's Air Quality Specialist to determine the appropriate scope of air, greenhouse gas and odour assessment during the EA.	Climate Change work plan.
The EA will include studies related to odour and greenhouse gas emissions when considering the preferred site development alternative.	Climate Change work plan Section 3.1.1, 3.1.2, and 3.1.3. This will also be incorporated into the EA (section TBD).
For each alternative method, quantitative/qualitative indicators of air quality, odour, dust and GHGs will be used to evaluate the relative differences between alternative methods. Air Quality will be included as a criteria group as a component of the natural environment.	Climate Change work plan Section 3.1.2. This will also be incorporated into the EA (section TBD).
The estimation of GHGs from the preferred alternative method will be done using established emission factors (e.g., US EPA, Canadian NIR).	Climate Change work plan Section 3.1.3
GHGs from on-site vehicles and the haul route will be quantitatively assessed for the preferred alternative method. The preferred alternative method will have various stages of development over the lifetime of the site. GHG emissions will be estimated for the operational scenarios defined under the air quality analysis. These scenarios typically consider milestones in the development of the site and assess air emissions associated with those milestones. The average of these milestone scenarios will be provided as an estimate of the annual GHG emissions from the site. Additionally, post-closure GHGs will be estimated.	Climate Change work plan Section 3.1.3. This will also be incorporated into the EA (section TBD).
Waste Connections will identify and propose mitigation for the effects of the undertaking on climate change. Waste Connections will consider the climate change impacts of potential woodlot removal in the EA.	Climate Change work plan Section 3.1.3. This will also be incorporated into the EA (section TBD).

Commitment	Reference to applicable section in EA or supporting document
Waste Connections will include an assessment on how the preferred project may contribute to greenhouse gas emissions. Waste Connections will develop a detailed work plan outlining how greenhouse gas emissions will be considered in the environmental assessment for site development activities including woodlot removal, on-site vehicles, the waste haul route as defined in the Terms of Reference, and landfill gas management for the preferred undertaking in consultation with Ministry of the Environment, Conservation and Parks staff. Waste Connections will also consider greenhouse gas emissions as an evaluation criterion for alternative methods. The assessment of landfill gas utilization alternatives will reflect the objective of reducing greenhouse gases from the waste sector as stated in the Climate Change Action Plan.	Climate Change work plan Section 3.1.3. This will also be incorporated into the EA (section TBD).
The EA will also consider how changing climate has the potential to impact the Project and how adaptive measures can be incorporated into the site design. This will be explored, specifically as it relates to the potential for extreme weather events to impact waste management infrastructure through power outages, physical damage, and stormwater management systems and reduced access to the site. Waste Connections will assess the potential effects of climate change on infrastructure components for the preferred undertaking and related potential risks to the environment resulting from these effects. The environmental assessment will include a consideration of climate change adaptation measures to reduce and manage such potential effects during the operation, construction, closure and post-closure phases of the undertaking. Waste Connections will use climate change assessment guidance documents that include, but are not limited to those issued by the Ministry of the Environment, Conservation and Parks in the environmental assessment. The EA will include studies related to odour and greenhouse gas emissions when considering the preferred site development alternative.	Climate Change work plan Task 2 (Section 3.2)
Waste Connections will consider how climate change has the potential to impact the project and how adaptive measures can be incorporated into the site design. Waste Connections will identify and propose mitigation for the effects of the undertaking on climate change, and the effects of climate change on the undertaking, as part of the EA. Discussion of this topic in the EA will consider the MOECP's guidance document, Consideration of Climate Change in Environmental Assessment in Ontario.	Climate Change work plan Tasks 1 and 2 (Sections 3.1 and 3.2)

2.0 Study Purpose and Objectives

The proposed expansion of the landfill has the potential to be impacted by changes in climate, as well as emit greenhouse gases (GHGs) which may have an impact on climate change. The former will be looked at through a climate change risk assessment that will inform the project development. The latter, which relates to the project's potential contribution to GHGs and therefore future climate change, will be addressed through quantification of GHGs and assessment of potential mitigation options (where applicable). The work will be completed in accordance with the approved amended ToR (May 2018), including the additional commitments made by Waste Connections throughout the stakeholder consultation process.

3.0 Study Area

For the purposes of the Climate Change Scope of Work, two impact study areas have been defined as follows:

- On-Site Study Area ("on-site") – includes the property on which the current Ridge Landfill and proposed expansion is situated; and,
- Haul Route Study Area ("haul route") – encompasses lands immediately adjacent to Communication Road, Drury Line and Erieau Road which are identified as the designated haul routes for the site.

The project's potential impact on climate change will be driven from GHGs from the on-site activities and the haul route. An off-site study area is not applicable to this aspect of the analysis. Similarly, the potential impacts of climate change on the project would be through on-site and haul route impacts. Therefore an off-site study area is not applicable to this analysis either.

4.0 Scope of Work

The following sections describe the approaches to be deployed in completing this assessment.

4.1 Task 1: Project Impacts on Climate Change (Climate Change Mitigation)

In order to characterize changes in greenhouse gases, the following will be completed:

4.1.1 Baseline Conditions

Baseline GHGs will be determined from historical annual GHG calculations and reporting done by the site. GHGs are anticipated to have slight variations on an annual basis, so the average of the most recent 3 to 5 years of available data will be used.

4.1.2 Evaluation of Site Development Alternative Methods

An analysis of potential GHGs will be completed using metrics that would be indicative of differences between each alternative method. The metrics to be used will include: anticipated differences in landfill gas and control equipment emissions with the indicator being daily/annual waste volume landfilled (where applicable), anticipated differences in levels of on-site vehicular activity (trucks and non-road equipment) with the indicator being the qualitative comparison of activities levels between alternatives and consideration of woodlot removal with the indicator being amount of woodlot proposed for removal.

The site development alternative methods all relate to the alternative development options for the landfill. The landfill will accept post-diversion residual waste, and therefore the site development alternative methods will not affect the diversion rate of the regional system (i.e. alternatives that enhance diversion within Waste Connection's system are not being considered as standalone alternative methods as part of the EA). The site's waste acceptance rate will remain the same with the possibility of changes in composition as improvements in diversion are achieved. These composition changes would equally affect all alternative methods, and would represent an improvement on current baseline conditions through enhanced diversion of waste and therefore potential reductions in landfill gas emissions. These improvements in diversion would be driven by provincial policy or regional scale activities, as opposed to the alternative site development methods proposed. As a result, there will not be any waste diversion related changes in GHGs between the site development alternative methods.

4.1.3 Assessment of Preferred Alternative

Based on the fact that the daily waste acceptance rate of the landfill will not be increased, the greatest potential impact to air quality for the landfill expansion will be associated with on-site operations. However, there may be an increase in export soil truck traffic or changes to background traffic levels

along the haul route. Therefore the assessment of the preferred alternative will focus on the landfill operations itself, but will also consider changes to haul route traffic.

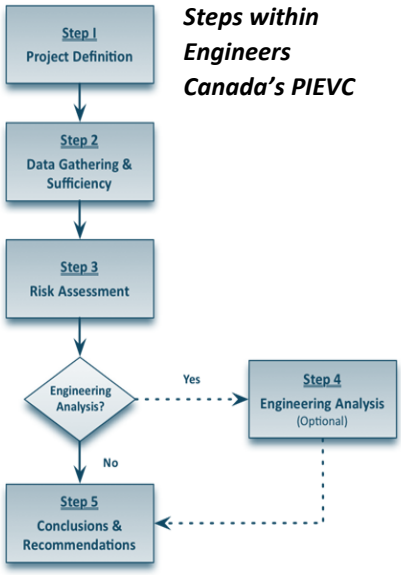
Estimation of GHGs (CO_2, CH_4, N_2O) from on-site activities (e.g., onsite equipment, LFG collection system, flare) will be done using emission factors from established resources including US EPA AP-42, Canada NIR and the LandGEM model. GHGs will be compared to regional (scaled based on population from provincial inventory) and provincial emissions to assess significance.

The preferred alternative method will have various stages of development over the lifetime of the site. GHGs will be estimated for the operational scenarios defined under the air quality analysis (based on peak site activity and peak landfill gas generation). These scenarios typically consider milestones in the development of the site and assess air emissions associated with those milestones. The average of these milestone scenarios will be provided as an estimate of the annual GHGs from the site. Additionally, post-closure GHGs will be estimated. Where applicable, mitigation measures will be identified for GHGs from the site.

4.1.4 EA Impact Assessment

The results of the GHG analysis, described in detail in the previous section, will be used to characterize the project's contribution to the GHG profile of the region or the province.

4.2 Task 2: Climate Change Impacts on the Project (Climate Change Adaptation)



Steps within Engineers Canada's PIEVC

There are a number of methodologies/ frameworks that can be applied to assess and prioritize potential climate change impacts on the Project. One of the more recognized methodologies in Canada and Ontario is the Engineers Canada Public Infrastructure Engineering Vulnerability Committee (PIEVC) Protocol for climate change risk assessment.

The principles of this methodology will be deployed for the Project's major components, to characterize potential climate change risks on the Project. This methodology is a 5 step process as shown in the Figure to the left.

Step 4 within the process is optional, depending on the results of the assessment and the desired outcome.

The preferred alternative will be assessed to identify key components (infrastructure, systems). Selection of components will be guided by their importance to design, construction, management, operation and maintenance of the site. Where possible, similar infrastructure components will be grouped to streamline the analysis.

Components will include those related to:

- Electrical systems (i.e., power lines)
- Stormwater management
- Leachate management
- Landfill gas management
- Landfill cap
- Site access (i.e., roads)

Climate analytics will be completed for the site, and this will be done by Risk Sciences International (RSI). The climate analytics will involve:

1. Extreme rainfall analyses to develop data for variables focusing on impacts to landfill areas such as management of ponds, leachate from solid waste areas, erosion, and site drainage. This includes:
   - IDF (extreme rates)
   - Future IDF (via Clausius-Clapeyron relationship)
   - Accumulated Precipitation (daily, and over 3, 5 and 7-day accumulations)

2. Moderate Winds. This parameter relates to landfill gas management and odour management considerations with site operations. RSI will identify historic ranges and trends using nearby airport stations. Localized projections of wind conditions are not specifically available here, but more regionalized projections from previous literature will be used to provide basis for future wind conditions.

3. High/Extreme Winds - Tornado, Thunderstorm Winds. This parameter relates to danger to site personnel, damage to buildings, wind-carried debris from site, and loss of site access due to downed trees and powerlines. Airport wind data records will be analysed in conjunction with the tornado database. As is the case for moderate winds, projected values are not as reliable for extreme winds from projection models due to the scale (spatial and temporal) and local topographic effects. Research literature for southern Ontario will be used for extreme wind projections.

4. Wildfire Risk/Drought - RSI will review Canadian Wildfire database and summer precipitation deficit frequency and historical/projected water deficits.

5. Higher Average Summer Temperatures - RSI will analyse maximum temperature trends, historical and projected, to support risk assessment impact considerations including: pests and insects, equipment impacts, waste decomposition rate changes, and occupational exposure considerations.

6. Large Hail - to support assessment of exposed fleet vehicles, metal siding/cladding on site buildings and risk to site personnel.

7. Ice Storm - an extreme event that can result in loss of electrical supply.

8. Extreme Snow Events - an extreme event that can result in loss or degradation of access to the landfill facility.

9. Lightning - hazard posing fire risk to landfill site and occupational hazard to staff exposed to lightning events.

The outcome of the climate analytics will be climate hazard **probability** scores for use within the risk assessment.

The risk assessment will look at how the climate hazards identified potentially interact with infrastructure components at the site. Where potential interactions occur, the **severity** of these interactions will be rated by Dillon staff. The risk assessment will be conducted using Dillon staff who have operational and design experience with the site, and will focus on defining **severity** ratings within the PIEVC risk assessment worksheets.

The **severity** ratings will be combined with the probability scores to yield an overall **risk** rating (i.e. Risk = Probability x Severity).

The severity ratings, and overall risk ratings, will be validated through a facilitated PIEVC workshop with site staff. Once this is completed, the highest ranked risk will be identified for consideration of engineered adaptive measures. Within this step, any detailed engineering that may be required will be done under a separate scope of work.

The results of the risk assessment, including the identification of adaptive measures will be documented within a climate change risk assessment report for the preferred alternative.

Project and Work Plan Overview (Final)

This Aviation work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment and Climate Change (MOECC) in May of 2018.

Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

The Ridge Landfill has been in operation since 1966 and was previously expanded in 1999. Waste Connections owns 340 hectares (ha) of land at the Ridge Landfill. The existing Landfill Site Area, which is permitted by an ECA from the MOECC for waste management and environmental work purposes, is 262 ha. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the Landfill Site Area. As of December 2017, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate.

The current approved capacity for the Ridge Landfill is 21 million cubic metres (m3). The site is approved to accept a maximum of 1,300,000 tonnes of waste per year (the MOECC approved annual waste disposal rate). The EA does not propose to increase the maximum annual fill rate (this would remain as-is); however, Waste Connections is seeking the EA to increase the life of the facility for a 20 year planning period, from 2022-2041.

The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to only the Municipality of Chatham-Kent.

This Aviation work plan outlines the tasks to support the evaluation of alternative methods, and to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the Aviation work, including protocols and/or standards to be adhered to while work is undertaken.

The Aviation scope of work will seek to identify potential aviation impacts caused by bird hazards resulting from an expanded landfill. These two technical disciplines will work closely together. The objectives of the aviation assessment are as follows:

- Establish the baseline conditions at Chatham-Kent Municipal Airport, including a review of airport diagrams, operating procedures and current bird hazard conditions.;
- Confirm requirements with Transport Canada and NAV Canada with respect to the Airport Zoning Regulations, including any anticipated changes, aviation safety and anticipated changes to operating procedures;

- Obtain updates on bird populations and flight patterns, current control procedures and planned future mitigation (this will require input from the Bird Hazard technical discipline); and
- Assess the potential impacts of the preferred site development alternative method and make recommendations for mitigation and monitoring, which will include continuation of the current Ridge Landfill Bird Management Plan.

Project and Work Plan Overview (Final)

This Bird Hazard to Aircraft Assessment work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment and Climate Change (MOECC) in May of 2018.

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This Bird Hazard to Aircraft Assessment work plan outlines the tasks to support the evaluation of the level of risk that the project represents to aircraft safety once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the Bird Hazard to Aircraft Assessment work, including protocols and/or standards to be adhered to while work is undertaken.

The Bird Hazard to Aircraft Assessment will identify hazards posed by birds using the proposed landfill expansion, to aircraft using the Chatham Municipal Airport. Field surveys were conducted between September 2016 and April 2017 to gather data for this assessment. The objectives of the field surveys were as follows:

- to determine the current conditions at the site including the numbers and species of birds using the landfill and the effects of the bird control program as currently implemented;

- identify consistent flight lines and locations of roost sites for bird species that can be hazardous to aircraft (e.g. gulls, crows, vultures);
- identify other areas or habitats in the region that are important to or hold particular concentrations of potentially hazardous bird species; and
- quantify the level of aircraft traffic using the Chatham Municipal Airport; including types of aircraft, typical flight paths, traffic levels by time of day and any other information that might be relevant to assessing bird hazard.

Following the selection of the preferred landfill expansion alternative, the bird hazard assessment will be completed and recommendations will be made regarding any potential actions that may be required to mitigate the risk. This assessment will combine the results of the bird surveys, consideration of the aircraft use of the airport and the details of the proposed expansion to determine the hazard posed to aircraft by birds which may be attracted by the landfill.

For the purposes of the Bird Hazard Scope of Work, the study areas have been defined as follows:

- On-Site Study Area ("on-site") – includes the property on which the current Ridge Landfill and proposed expansion is situated. The current use of this site by birds is a key predictor of future bird use after the expansion is complete; and,
- Off-site Study Area – encompasses the area within approximately 15 kilometres of the site. The area of interest for a bird hazard study extends well beyond the landfill property because birds may be attracted to the landfill from a wide area and the flight lines of birds are of primary concern to safety of aircraft. This study area was chosen to include night roosts of gulls on Lake Erie and crow roosts along the river in Chatham.

A summary of additional commitments for the Transportation assessment is provided below.

Commitment	Reference to applicable section in EA or supporting document
The potential risks to aviation and the bird management plan will be revisited as part of this current EA and will form part of the final recommendations of the aviation and bird hazard assessments presented in the EA.	Bird Hazard Work Plan section 3.1. This will also be summarized in the EA (section TBD).

DILLON CONSULTING

WASTE CONNECTIONS OF CANADA (WASTE CONNECTIONS)

Biology Work Plan (Final)

Ridge Landfill Expansion EA

September 2018 – 15-2456

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1.0 Project and Work Plan Overview

This Biology Assessment work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion, and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment and Climate Change (MOECC) in May of 2018.

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The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to only the Municipality of Chatham-Kent.

This Biology Assessment work plan outlines the tasks to support the evaluation of alternative methods, and to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the Biology Assessment work, including protocols and/or standards to be adhered to while work is undertaken.

The Biology Assessment will seek to identify potential impacts to the biology which includes flora and fauna within the On-Site Study Area, that could potential be impacted by the proposed landfill expansion. The objectives of the Biology Assessment are as follows:

- Establish the baseline conditions at the proposed site with respect to biological resources;
- Carry out an assessment of potential biological impacts for each of the proposed landfill expansion site development alternatives (i.e., alternative methods); and

- Prepare a biological management plan for the purpose of mitigating potential impacts.

The scope of the Biological Assessment will include a careful review of background information along with a comprehensive field investigation program which will examine habitat types ranging from crop fields, cultural meadows, woodlots, wetlands, ponds and water courses, and extensive inventories that have been collected to date. This will include an examination of various data sources to determine the local significance of each species documented, followed by an examination of potential impacts from the proposed landfill expansion alternatives (i.e., site development alternative methods) on these species. The criteria and indictors that will be applied for the purpose of the assessment will include:

1. Removal of habitat types as listed above and potential impact on wildlife and flora after mitigation measures are applied (i.e. relocation of wildlife/creation of new habitat).
2. Changes in habitat types, and potential long term impacts on wildlife within the On-Site Study Area.

A comparative evaluation and ranking of the proposed landfill expansion alternatives will be undertaken based on the results of the impact assessment with the objective of predicting the potential net effects associated with each alternative.

Following the selection of the preferred landfill expansion alternative, a biological management plan will be developed with the goal of maintaining remaining woodlots, creating a strategy to replace lost woodlot/wetland habitat, and preserving the overall health of watercourses that may flow through or around the landfill area.

A summary of additional commitments for the Transportation assessment is provided below.

Commitment	Reference to applicable section in EA or supporting document
The EA will determine the potential effects of the Project on the natural, cultural, socio-economic and transportation environments within the study areas. Potential effects can be short-term or long-term, direct or indirect and positive or negative. The EA will also identify ways to reduce or mitigate potential negative effects on these environments and will consider our changing climate.	Section 4.2 and 4.3 of this work plan addresses how natural environment baseline conditions will be documented. Section 4.4 of this work summarizes the impact assessment criteria and indicators. The identification of ways to reduce or mitigate potential negative effects will be addressed in the EA; Section TBD.
Waste Connections will consider the form and function of natural features during the EA.	Sections 4.2 through 4.3 of this work plan addresses how natural environment baseline conditions will be documented. Section 4.4 of this work summarizes the impact assessment criteria and indicators.

Commitment	Reference to applicable section in EA or supporting document
The potential need for a wetland evaluation will be considered during the EA.	Section 4.2.1 of this work plan addresses how natural features will be assessed as part of the EA. The need for wetland evaluation will be completed during agency consultation as part of the EA.
Waste Connections will appropriately consider hedgerows in the evaluation of alternatives and the impact assessment to be completed during the EA.	Section 4.2.1 of this work plan addresses how natural features (include hedgerows) will be assessed as part of the EA while Section 4.4 of this work summarizes the impact assessment criteria and indicators.
Waste Connections will continue to use best practices and MNRF guidelines and requirements for conducting field work.	Section 4.2 and 4.3 of this work plan address how baseline conditions will be documented, of which our field methods are consistent with industry best practices and agency approved methodology. The MNRF have been consulted throughout the biology field program in support of the EA.
Waste Connections will continue to engage the Municipality of Chatham-Kent and the Ministry of Natural Resources and Forestry to ensure that potential effects to woodlots and/or other natural features are mitigated, as appropriate.	Consultation with the Municipality of Chatham-Kent and the Ministry of Natural Resources and Forestry as it relates to the potential effects to woodlots and/or natural features has been, and will continue to be, observed as part of the EA process.
Surveys will be undertaken in accordance with MNRF requirements and industry best practices. Details as to protocols followed, agencies having authority, etc., will be provided in the EA.	Section 4.2 and 4.3 of this work plan address how baseline conditions will be documented, of which our field methods are consistent with industry best practices and agency approved methodology. The MNRF have been consulted throughout the biology field program in support of the EA.
The project will be reviewed for potential *Fisheries Act* implications and next steps.	The determination of whether there is potential for *Fisheries Act* implications and/or next steps will be completed during the EA consultation process.
The significance of natural features will be determined based on MNRF and planning protocols, including the Provincial Policy Statement (PPS)	Section 4.2 and 4.3 of this work plan address how baseline conditions will be documented, and significance assessed, based on industry best practices and agency approved

Commitment	Reference to applicable section in EA or supporting document
and Significant Wildlife Ecoregion Schedules. This will be documented in the EA.	methodology and guidance documents. The significance of natural features will be addressed in the EA; Section TBD.
Waste Connections will consider the following criteria as part of the evaluation of alternative methods and the impact assessment of the preferred alternative method: • Potential loss of habitat of Endangered or Threatened species • Potential loss of medicinal or other culturally sensitive species of importance to First Nations groups	Section 4.4 and 4.5 of this work plan identify the impact assessment criteria and indicators for evaluating the alternative and preferred alternatives methods. Habitat of Endangered or Threatened species as well as transplanting of herbaceous plants and shrubs will be considered as part of the evaluation process.

2.0 Ridge Landfill Biology

This work plan documents how the Biology discipline will be studied to support the Environmental Assessment (EA) for the proposed expansion of the Ridge Landfill, which is owned and operated by Waste Connections of Canada (Waste Connections).

2.1 Baseline Conditions

Baseline conditions for biology were first investigated through various background and field studies that were conducted in 1990, 1991, 1995, and 1996, with the results of these studies being presented in the Ridge Landfill Expansion Environmental Assessment document in 1997.

The stages or tasks examined through the impact assessment included:

1. Identification of biological conditions on the site, in its vicinity (i.e. within 1 km of the site boundary and along the haul route) and in a broader regional context;
2. Identification of biological removals and disturbances caused by the landfill development and operation;
3. Recommended mitigation measures;
4. Assess significance of anticipated net effects; and
5. Identification and development of monitoring programs and contingency measures where necessary.

Field investigations were conducted throughout the entire site which included studies along several municipal drains, woodlots, an orchard and active agricultural land.

The baseline inventory work for biology included documentation of plant, tree, wildlife, breeding birds, herpetofauna (amphibians and reptiles), benthics and fish. The significance of this work was examined by comparing results to applicable policy documents at the time (i.e. pre 1997), and highlighting the occurrence of sensitive flora and fauna within the site boundaries.

Due to changes in site ownership, waste diversion methods (i.e. recycling, composting), changes in vegetation communities, cropping patterns and new legislation (i.e. *Species at Risk Act*/*Endangered Species Act* (both Federal/Provincial); *Migratory Bird Convention Act* and others), and a time frame of approximately 19 years, it is necessary to revisit site work that was conducted at the Ridge landfill site to ensure that the biological information is current.

Some biological investigations were conducted in 2015, and are still ongoing during the 2016 field season; however these were focused on the SE and SW on-site woodlots for the purpose of assessing the possibility of removing them. Changes in flora/fauna significance as well as the applicability of new legislation will provide further baseline conditions and criteria as this project progresses.

3.0 Study Area

For the purposes of the Biology Scope of Work, the study area has been defined as follows:

- On-Site Study Area ("on-site") – includes the property on which the current Ridge Landfill and proposed expansion is situated. Assessment of the entire Ridge Landfill property will identify potential effects of different site development alternative methods (e.g., impacts to significant wildlife habitat or removal of on-site woodlots).

The proposed expansion would not impact biological features off-site or along the designated landfill haul route. Therefore, off-site and haul route study areas are not proposed to be included for the biology discipline.

4.0 Work Plan for Biology

In this regard, most of the stages and tasks identified in 1997 are still valid, and moving forward, should form the genesis of the Biology component of the Ridge Landfill Expansion EA.

4.1 Agency Consultation

While background agency consultation was conducted during the 1997 EA process, agency consultation with the Ministry of Natural Resources and Forestry (MNRF) has become more sophisticated especially in light of the ongoing updates related to endangered species.

From reviewing the results of field studies collected in 2015/2016, and various websites, additional work is needed to characterize the remainder of the site (the 2015/2016 studies were focused on the SE and SW woodlots).

These include: both terrestrial and aquatic studies; species at risk habitat investigations, and strategies to re-establish forest communities that will be removed due to landfill construction.

4.2 Terrestrial Investigations

4.2.1 Ecological Land Classification including Swamp/Wetland Studies

The concept of Ecological Land Classification (ELC) was not introduced as a formal ecological land mapping "tool" until September 1998, when the OMNR released the publication Ecological Land Classification for Southern Ontario: First approximation and its application, SCSS Field Guide FG -02. (Lee et al, 1998).

This system was a method to reduce complex natural landscapes into a small number of community based units namely, Aquatic, Wetland and Terrestrial systems. The classification of these systems was based on a combination of three variables including:

- vegetation characteristics such as structure, composition of the canopy, shrub layer and understory;
- soil characteristics including depth, texture, moisture regime, nutrient regime, and
- water table characteristics including drainage, presence of water table near the soil surface; artesian conditions, and how these characteristics would influence plant growth.

While the 1997 EA did include a detailed account of the tree canopy based on angle prism methods, as well as a vegetation inventory, limited information was provided on the " five woodland" communities as well as old fields (if any)/hedgerows/agricultural headlands that occurred within the On-site Area. In terms of definition, "old fields" refer to agricultural fields that have remained in a fallow or uncultivated state for at least 5 years, and are becoming naturalized with perennial and/or shrub thicket vegetation. "Hedgerows" refer to narrow bands of trees that occur between agricultural fields, while "agricultural land" refer to those fields that are cropped on an annual basis.

These "five woodland" areas included the Northern, SE and SW Woodlots as well as small, clusters of trees that were identified in the 1997 study. It was also noted that the term "swamp" (which is now used in the Ontario Wetland Evaluation System (OWES) to describe wetlands with > 25% wooded cover) was used in very general terms, and no reference was made to topsoil or soil moisture regime within the forest communities.

As a result of recent field investigations in 2015 and 2016, it was also noticed that the condition of the forest canopy had changed significantly from 1997 onwards, due to the "invasion" of emerald ash borer that had rapidly spread through southwestern Ontario, and had killed thousands of ash trees as a result of their feeding activity.

In this regard, the red and white ash that had dominated the forest canopy (i.e. 50 to 69%) within the Ridge forests in 1997 had significantly died back allowing silver maple and other species to dominate the canopy.

It was also noticed that increased light levels in the shrub and understory layers had allowed greater plant diversity to become established in these lower areas.

Through initial ELC work carried out in 2015, several "swamp" communities dominated by silver maple, Freeman's maple, shagbark hickory and white elm did exist, but appeared to have limited to no standing water by the time that all leaves had emerged.

Therefore, these findings do question the need for additional ELC field studies later in the growing season to determine if such communities are true wetlands (as described in the OWES and defined in the

Provincial Policy Statement,), or if they are considered Fresh-moist forests with low lying areas that remain for longer periods of time.

Action - Additional studies would include the inspection of topsoils within the forest community to determine if long term saturation of the soils is widespread or localized. This would include the excavation of soil test pits, and examination and comparison to various manuals to determine if strong mottling or gulleys are present. Such conditions are an indicator of long term soil saturation. Such studies would be conducted in the late summer and early fall by an agrologist and/or staff that have training in Ecological Land Classification.

4.2.2 Significant Tree Species

In the 1997 EA document, several tree species including Big shellbark hickory, pin oak, and Shumard oak were reported to be present in both the Northern and Southeast woodland; however, 2015 field work did not identify these species. Therefore, further studies are required to determine if in fact these species are present.

While none of these species are considered threatened or endangered, they are all considered rare in southwestern Ontario. It should be noted that these species are moisture tolerant, and can grow in wet soils. In this regard, such species (if present) would be considered as part of the scoring criteria if the OWES protocol was applicable to true wetlands or swamps that were 2 ha or greater for each woodland.

Action – Further studies by an ISA certified arborist are required during the late growing season (August to October) to determine if these tree species are present, and if they are growing in saturated conditions.

4.2.3 Grassland Bird Species

The 1997 EA did report the presence of several bird species including chimney swift, barn swallow, bobolink and eastern meadowlark. While these species were not significant in 1997, the introduction of the species at risk lists has found that all four species are now considered to be significant (i.e. Threatened or Endangered according to either the provincial or federal Species at Risk schedules). It should be noted that the 2015 field studies was only focused on the wooded areas of the property, and did not examine agricultural fields that were fallow, fields, the On-Site orchard, or buildings where these species typically reside.

Action – Further studies across the site will be required to determine the presence/absence of these grassland species during the 2017 breeding season. This will also require the inspection of infrastructure (e.g. buildings, culverts) that may provide suitable nesting habitat for barn swallow that is considered Threatened.

4.2.4 Snapping Turtle Investigations

While snapping turtles are often found within streams, ponds, marshes and slow moving rivers, it is now listed in the *Endangered Species Act* as a Species of Special Concern.

Action - Further studies will be required to determine the presence/absence of this species during the 2017 season. Areas of deep water (i.e. storm water ponds) should be observed to determine if this species is present. These studies would be conducted through the summer while the water is still warm and the turtles are active.

4.2.5 Incidental Wildlife and Wildlife Habitat Observations

Dillon biologists completing the above mentioned investigations will document incidental wildlife and wildlife habitat observations including documentation of dens, tracks, scat, cavity trees, snags, etc. The focus of wildlife sightings will be the collection of information on dragonflies, butterflies, amphibians, reptiles, birds and mammal species. Potential significant wildlife habitat, identified in the Ministry of Natural Resource and Forestry's Significant Wildlife Habitat Manual (MNR 2000) will be documented as they are observed.

These significant habitats may include staging areas, vernal pools, snake hibernaculas, wildlife dens, among others. Where identified, such habitats will be mapped and reported on under **Task 3**. To reduce costs, incidental observation recordings will be completed during the same time as breeding bird and amphibian surveys.

The table below provides a summary of the field studies that were undertaken in 2015/2016. This table also recommends where further work is required, and when.

Table 1: Summary of Terrestrial Field Investigations – Ridge Landfill Site

Activity	Area completed	Additional Area to be examined	Timing/Assumptions
Breeding bird surveys	South east/south west woodland	Old fields/grasslands	Late May – early July (2 visits – 15 days apart)
Amphibian surveys	South east/south west woodland	Wet ditches/flooded agricultural fields	Late April – early June (3 visits – 2 weeks apart)
ELC/Botanical inventory	South east/south west woodland	Old fields/orchard/agricultural fields	Early May/ Late June-early July/ Late August to late Sept
Bat habitat surveys	South east/south west woodland and hedgerows	None required.	Not applicable.
Bat activity monitoring	South east/south west woodland	None required.	Not applicable.
Whip-poor- will surveys	South east/south west woodland	None required.	Not applicable.

4.3 Aquatic Investigations

As indicated in the 1997 EA report, the Ridge site does include several municipal drains (i.e. Duke, Howard) that flow through the Ridge property and outlet to off –site drains (i.e. Gales, Scott).

While these drains serve to provide drainage for existing agricultural fields in the area, they also provide habitat for at least nine species of fish that were documented in the 1997 EA as well as habitat for turtles, amphibians, mammals and birds.

As many of these drains could be disrupted or relocated during the Ridge expansion process, it is important to ensure that fish inventories are up-to-date to ensure that future mitigation strategies are appropriate. This will require confirmation with the MNRF that no SAR fish reside or have been collected in the local area, through the completion of the Information Gathering Form (IGF).

Action – Fish inventories were last conducted in the Howard and Duke Drain on May 31, 1996, and no fisheries information is available for the Gales/Scott drain. Therefore, updates are required.

In this regard, the following tasks are recommended to update fish information for the Ridge site.

- Review of background materials and information, including the existing EA report and other project-relevant documents;
- MNRF Agency Consultation to collect existing or new aquatic information, including fish species data and potential Species at Risk (SAR) information. This would include submission of the IGF;
- Procure a Licence to Collect Fish for Scientific Purposes from the MNRF;
- Conduct reconnaissance-level field investigations to document/update the condition of existing drains or drain sections on the property that aren't expected to be directly impacted by the expansion works to assist with the overall characterization of aquatic resources and habitat sensitivity;
- Conduct detailed fish habitat assessment in Duke Drain and Howard Drain where they occur in close proximity to the proposed expansion works, including habitat mapping and targeted backpack electro-fishing, and where possible, sample the fish community and determine habitat usage and type, including general water quality assessment;
- Prepare an Aquatic Habitat Summary Memo to present findings from field investigations, background review and agency input, recommended general mitigation/protection measures and anticipated permitting requirements, if any.

Assumptions for Aquatic work:

As the amount of up-to-date is extremely limited, this Scope does not include any agency permitting work or specific work relating to potential SAR that is found on the property. This would include targeted field surveys or information requests by the MNRF/DFO.

4.4 Criteria, Indicators and Data Sources for Impact Assessment of the Preferred Alternative Method

The table below summarizes the impact assessment criteria and indicators. These are consistent with those that were used during the 1997 EA.

Assessment Criteria	Indicators	Rationale	Data Sources
Assess potential loss of habitat of Endangered or Threatened species as well as medicinal or culturally sensitive species of importance to First Nations groups.	Natural features with the potential to provide habitat for Endangered or Threatened species and/or medicinal or culturally sensitive species of importance to First Nations groups subject to removal or displacement by construction and operation of the landfill expansion. Natural features include woodlands, meadows, hedgerows, watercourses and ponds.	Habitat of Endangered and Threatened species is protected under the *Endangered Species Act*, 2007 while medicinal or cultural sensitive species are considered important to local First Nation groups. The expansion of the landfill may displacement habitat for species at risk as well as medicinal or cultural species relied up by local First Nations groups.	Recent or future field work. Results from other disciplines (e.g. Design and operations/Surface Water/Hydrogeology/Agriculture). Recent Aerial Photography. Publications. ELC mapping. Personal communication with agencies and knowledgeable citizens. Traditional ecological knowledge (TEK) in consultation with First Nations groups.
Assess potential removal or displacement of biological systems.	Amount and quality of, and impact on biological systems subject to removal or displacement by construction and operation of the landfill expansion. Such systems would include: woodlands, hedgerows, watercourses, ponds, selected noteworthy species or specimens.	Biological systems subject to direct removal or displacement may experience total loss of character and function.	Recent or future field work. Results from other disciplines (e.g. Design and operations/Surface Water/Hydrogeology/Agriculture. Recent Aerial Photography. Publications. ELC mapping. Personal communication with agencies and knowledgeable citizens.
Assess potential disruption of biological systems.	Amount and quality of and impact on biological systems disrupted by construction and operation of the landfill and the haul route. Specifically, potential disruptive impacts on: Woodlands, watercourses, ponds, selected noteworthy species or specimens.	Development and operation of the landfill and haul route may disrupt biological systems without removing or displacing them causing some loss of character or function.	Recent or future field work. Results from other disciplines (e.g. Design and operations/Surface Water/Hydrogeology/Agriculture. Recent Aerial Photography. Publications. ELC mapping. Personal communication with agencies and knowledgeable citizens.

4.4.1 Assumptions for Criteria and Indicators:

To date, no Area of Natural and Scientific Interest (ANSI), Provincially Significant Wetlands (PSW) or recognized Environmentally Significant Areas have been identified within the On-Site Area or within 1 Km of the site boundary or along the Haul Route from Hwy 401. It is assumed that the quality of existing biological features and systems may change during severe weather events or other natural events. If this is the case, documentation of these changes will occur.

4.5 Reporting and Review of Alternatives for Biology

The biological assessment will be documented, and will include the updated flora/faunal inventories for the entire site. This will include the significance of each species, and whether it is at risk federally and/or provincially.

The review of the three alternatives will include analysis of how terrestrial and aquatic systems will be impacted by landfill development.

In most cases, removal will occur, but opportunities may be present to relocate/re-establish these forest communities elsewhere on the site.

Action - Reporting will summarize the efforts that have taken place to accurately describe the biological conditions that exist on-site, their significance and whether opportunities are present to avoid loss of habitat. This section will include the results of the comparison of alternatives.

4.6 Mitigation for Biology

As the extent and populations (if any) of SAR on the Ridge property is unknown at the time of writing (with exception of the SW and SE woodlands), a budget and specific details for each SAR is not known.

As with any listed species at risk, thorough knowledge is required to determine how it (or its habitat) can be preserved. For example, the habitat for barn swallows can be recreated by building suitable nesting structures adjacent to feeding areas.

For herbaceous plants and shrubs, transplanting at the appropriate time and monitoring for several years would provide successful results.

In cases where listed species are present, proposed contingency and monitoring plans will be developed for each species where possible. Further details/budget would be presented under a separate cover along with discussions with Waste Connections and MNRF.

5.0 Permitting

5.1 Endangered Species Act, 2007

Based on discussions with the MNRF Aylmer District (the District) regarding the pre-EA species at risk bat habitat and bat activity survey results, the MNRF indicated that the removal of the SE woodland would require an *Endangered Species Act*, 2007 (ESA) Overall Benefit Permit (i.e. 17(2)(c) of the ESA). Generally, the Overall Benefit Permit process involves the submission of three forms:

- Information Gathering Form (IGF);
- Avoidance Alternatives Form (AAF); and,
- Overall Benefit Form or C-PAF (permit application form).

The purpose of the IGF is to gather the information Waste Connections is required to submit to the MNRF as a means to inform the Ministry's determination of whether or not a proposed activity is likely to contravene Section 9 (species protection) or Section 10 (habitat protection) of the ESA, and whether it is advisable for Waste Connections to apply for an Overall Benefit Permit. Based on the species at risk bat habitat and activity survey results, and subsequent discussions with the District, the District has already clarified that an Overall Benefit Permit under the ESA would be required for the removal of the SE woodland. Both the species at risk bat habitat and bat activity survey results reports contain the necessary information to be included in, and appended to the IGF.

The purpose of the AAF is to assist proponents in considering alternatives that would not adversely affect species at risk and/or their habitats. The submission of an AAF is required prior to a proponent applying for an Overall Benefit Permit. Based on our understanding of the proposed Ridge Landfill expansion plan, avoidance alternatives are not possible (i.e. the SE woodland requires removal as part of the expansion plan). The purpose of the Overall Benefit Form is to supply the MNRF with the necessary information for the purposes of obtaining a Minister's decision on the issuance of an Overall Benefit Permit in order to proceed with the removal of the southeast woodland, and subsequently the expansion of the Ridge Landfill. At the Overall Benefit Form or C-PAF stage, the MNRF will post a notice on the Environmental Registry (ER) with a comment period of at least 30 days.

Based on our recent MNRF meeting, the District advised that it could take 12 to 18 months from the time the Overall Benefit Permit process is initiated to the time the Minister issues an executed Overall Benefit Permit. Our fee estimate includes the submission of an IGF, AAF and Overall Benefit Form/C-PAF as well as agency consultation as it relates to the Overall Benefit Permit application for species at risk bats.

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Ridge Landfill Expansion Environmental Assessment

Design and Operations Work Plan (Final)

September 2018 – 15-2456

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1.0 Project and Work Plan Overview

This Design & Operations work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment, Conservation and Parks (MOECP) in May of 2018.

Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

WCC owns approximately 334 hectares (ha) of lands west of Erieau Road and an approximately 21 ha property east of Erieau Road. The existing Landfill Site Area, which is permitted by an ECA from the MOECP for waste management and environmental work purposes, is 262 ha. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the Landfill Site Area. As of December 2017, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate.

The current approved capacity for the Ridge Landfill is 21 million cubic metres (m3). The site is approved to accept a maximum of 1,300,000 tonnes of waste per year (the MOECP approved annual waste disposal rate). The EA does not propose to increase the maximum annual fill rate (this would remain as-is); however, Waste Connections is seeking the EA to increase the life of the facility for a 20 year planning period, from 2022-2041.

The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to only the Municipality of Chatham-Kent.

This work plan outlines the tasks to support the Design and Operations component of the Environmental Assessment approval for the new expansion. This work plan also includes the tasks to address the additional commitments associated with the Terms of Reference submission and approval.

A summary of additional commitments for the Design and Operations discipline is provided below.

Commitment	Reference to applicable section in EA or supporting document
Waste Connections will consider how climate change has the potential to impact the project and how adaptive measures can be incorporated into the site design. Waste Connections will identify and propose mitigation for the effects of the undertaking on climate change, and the effects of climate change on the undertaking, as part of the EA. Discussion of this topic in the EA will consider the MOECP's guidance document, *Consideration of Climate Change in Environmental Assessment in Ontario*.	Design and Operations work plan Section 2.0 with input from the Climate Change discipline
Waste Connections commits to developing a site plan during the EA that demonstrates that the Ridge Landfill property is adequate for the proposed expansion.	Design and Operations work plan Section 2.0.
The leachate contaminating life span for groundwater will be assessed for the alternative methods and the preferred alternative method as follows: • The waste loading (tonnes of waste per footprint area) for each alternative method will be determined • Three leachate generation rates will be assumed per alternative method based on a natural cover, low permeability clay cover and a low permeability geosynthetic cover • Leachate characteristics used in the contaminating life span estimates will be taken from Table 1, Section 10 of O.Reg. 232/98 The contaminating life span for each alternative method will be estimated adapting the method used by "Barrier Systems for Waste Disposal Facilities, 2nd Edition", by R. Kerry Rowe, Robert M. Quigley, Richard W.I. Brachman & John R. Booker.	Design and Operations work plan Section 2.0. with input from the Hydrogeology discipline
The landfill gas contaminating life span will be determined by modelling landfill gas generation rates for the site development alternative methods. The landfill gas generation model will indicate how long landfill gas will occur (contaminating life span). An assessment of the natural subsurface landfill gas migration potential, which is limited by low permeability soil, a shallow water table and surface water features, will also be included in the landfill gas contaminating life span assessment.	Design and Operations work plan Section 2.0. with input from the Hydrogeology discipline
Waste Connections acknowledges that the Design and Operations Report will need to be reviewed by Aamjiwnaang First Nation as it is advanced.	Design and Operations work plan Section 2.0.
The specific site development alternatives will be presented for consultation during the EA.	Design and Operations work plan Section 2.0.
The conceptual design/locations for stormwater management will be incorporated into the site development and the impact assessment of the preferred alternative.	Design and Operations work plan Section 2.0.
Technical cross-sections and a discussion on the relationships between geology, waste, leachate collection and surface water features will be included as part of the EA.	Design and Operations work plan Section 2.0.

Commitment	Reference to applicable section in EA or supporting document
The EA will also consider how changing climate has the potential to impact the Project and how adaptive measures can be incorporated into the site design. This will be explored, specifically as it relates to the potential for extreme weather events to impact waste management infrastructure through power outages, physical damage, and stormwater management systems and reduced access to the site. Waste Connections will assess the potential effects of climate change on infrastructure components for the preferred undertaking and related potential risks to the environment resulting from these effects. The environmental assessment will include a consideration of climate change adaptation measures to reduce and manage such potential effects during the operation, construction, closure and post-closure phases of the undertaking. Waste Connections will use climate change assessment guidance documents that include, but are not limited to those issued by the Ministry of the Environment and Climate Change in the environmental assessment. The EA will include studies related to odour and greenhouse gas emissions when considering the preferred site development alternative.	Design and Operations work plan Section 2.0 with input from the Climate Change discipline and Surface Water discipline
The MOECP provides guidance by way of the "D-4 Land Use On or Near Landfills and Dumps" land use guidelines. The guidelines direct that several factors must be considered when land use is proposed near an operating landfill site. These include, but are not limited to, water contamination by leachate, odour, litter, dust, noise, surface runoff and landfill-generated gases. These will be considered as part of the technical studies completed as part of the EA.	Design and Operations work plan Section 2.0 for landfill gas and leachate. Odour, litter, dust, noise and surface runoff are addressed in their respective technical work plans.
The proposed expansion will be developed in phases over time. As such, the EA will consider the potential for impacts during construction, operation and post-closure of the proposed landfill expansion.	Design and Operations work plan Section 2.0.
Waste Connections will incorporate an assessment of landfill gas treatment or utilization alternatives for the expansion into the EA.	Design and Operations work plan Section 2.0.
A review of the existing leachate management system, including the Blenheim Waste Water Treatment Plant and associated piping, will be undertaken to confirm sufficient capacity for leachate management from an expanded landfill. As part of this review, Waste Connections will assess other reasonable long term leachate treatment alternatives.	Design and Operations work plan Section 2.0.
Mitigation measures will be incorporated into an overall mitigation and monitoring plan which Waste Connections will be required to implement if the EA is approved. The mitigation and monitoring plan will also include auditing of the mitigation measures to ensure they are working as planned. Contingency measures will be developed in the event that mitigation measures are not functioning properly.	Design and Operations work plan Section 2.0.
The proposed expansion will stay within the maximum height allowed for the airport.	Design and Operations work plan Section 2.0.
The design and operations facility characteristics of the preferred alternative method will be determined. Characteristics could include: modifying site contours, site preparation work such as clearing	Design and Operations work plan Section 2.0.

Commitment	Reference to applicable section in EA or supporting document
vegetation; moving existing features such as drains or existing landfill facilities; constructing of new landfill cells; modifying leachate, stormwater, and landfill gas management systems; and ongoing operation of the landfill. Closure and post-closure characteristics will also be developed. Facility design will also consider potential extreme weather effects on landfill infrastructure components and the goals to reduce phosphorus loading to Lake Erie as set forth in the Canada-Ontario Lake Erie Action Plan.	

2.0 Background

2.1 Ridge Landfill Environmental Approvals

An Environmental Assessment (EA) for the first expansion of the Ridge Landfill was completed in January, 1997 by Dillon Consulting Limited (Dillon) for an additional capacity of 21,000,000 m^3. The EA was approved on June 24, 1998. The first expansion received the Waste Environmental Compliance Approval No. A021601 on April 29, 1999.

Approval for a landfill gas management system was received on April 29, 2008 with the issuance of the Air Environmental Compliance Approval No. 7958-7BMQGT.

An Environmental Screening process was undertaken in 2011 to increase the daily maximum fill rate from 4,391 tonnes per day to 6,661 tonnes per day, and the annual maximum fill rate from 899,000 tonnes per year to 1,300,000 tonnes per year, including approved alternative daily cover. An amendment to the Waste Environmental Compliance Approval No. A021601 was issued March 15, 2012, approving these increased tonnage limits.

The Waste Environmental Compliance Approval No. A021601 was reissued on May 1, 2013 to consolidate all previous Waste approvals.

The Sewage Environmental Compliance Approval No. 3-1202-98-996 issued on February 22, 1999 for Ponds 4 and 5 was replaced by the Sewage Environmental Compliance Approval No. 3082-96EQPA issued on April 11, 2013 for Ponds 3, 4 and 5.

2.2 Study Area

For the purposes of the Design and Operations Scope of Work, the study area has been defined as follows:

- On-Site Study Area ("on-site") – includes the property on which the current Ridge Landfill and proposed expansion is situated.

This is an appropriate study area for the Design and Operations discipline because it represents the location where design and operational changes will occur.

2.3 Site Development Alternatives

In anticipation to the proposed new landfill expansion, the Design & Operations (D&O) discipline prepared a Design Alternatives Report in 2015. The 2015 Design Alternatives Report identified the following expansion options:

- Lateral expansion of the West Landfill (Area A).
- Lateral and minor vertical expansion of the South Landfill (Area B).
- Development of a new landform east of the South Landfill (Area C).
- Mining the Old Landfill.
- Vertical expansion of the Old Landfill.

Three expansion alternatives combining the above options were identified in the 2015 Design Alternatives Report to provide landfill capacity for a 20-year planning period.

The expansion alternatives have been revised since the 2015 Design Alternatives Report was issued. **Table 1** below summarizes the current expansion alternative methods.

Table 1: Summary of Site Development Alternatives

Alternative	Composition	Disposal Capacity (millions of m^3)	New Footprint Area (hectares)
1	A, B and full vertical expansion of the Old Landfill	29.8	58.8
2	A, reduced B, and full mining and full vertical expansion of the Old Landfill	29.8	53.7
3	A, B and C	29.8	82.5

3.0 D & O Discipline Work Plan

3.1 Scope of Work Description

We divided our scope into three groups: EA Support, D & O Report and ECA Support as described below.

EA Support

The following tasks are proposed for the EA Support:

- Review and assist with the preparation of the EA criteria and indicator tables. Provide input to the options evaluation matrix. Consult with Dillon's *Drainage Act* specialist to discuss approvability requirements under the *Drainage Act.*
- Revise existing expansion concepts to reflect agreement between Waste Connections and one of their neighbours. The design will change to reflect or add flexibility to meet contractual obligations.
- Prepare figures for expansion alternatives 1, 2 and 3 (combining the Old Landfill and expansion areas A, B and C as currently contemplated).
- Prepare soil balances for expansion alternatives 1, 2 and 3.
- Prepare cost estimates for three expansion alternatives.
- Provide design and operations data, information and figures to air quality, dust and noise studies in regards to internal traffic routes and operation scenarios for different development stages of the landfill expansion.
- Provide input to other disciplines.
- Prepare D&O Report summary for the EA Report.
- Answer questions from MOECP, other stakeholders and the public during the EA approval.

D & O Report

Dillon prepared the Operation and Development Report in December 1996 to support the first landfill expansion approval. The Operation and Development Report was prepared before the Ont. Reg. 232/98 and before the Landfill Standards were published by the Ministry of the Environment, Conservation and Parks (MOECP).

A tentative to update the Operation and Development Report was made in 2011 concurrently with the Environmental Screening process to increase the maximum fill rates. The intent of the 1996 Operation and Development Report update was to reflect current operations and approvals in place at that time. No structural changes or attempt to change format and content to follow the 1998 Landfill Standards were made. The report update was not finalized in 2011 since it was not required for the increased fill rates approval.

In January 2012, the MOECP released a revised version of the Landfill Standards.

Once the preferred expansion alternative is selected through the EA process, we will prepare a D & O Report to support the applications for the proposed Ridge Landfill expansion under the Environmental Assessment Act (EAA), and also to support subsequent Environmental Compliance Approvals (ECA) under the Environmental Protection Act (EPA). A D & O Report will be prepared for the preferred proposed expansion alternative and will consider the approved 1996 Operation and Development Report, the unfinished draft report partially updated in 2011, current and proposed operations, approvals in place, Ont. Reg. 232/98 and the MOECP 2012 Landfill Standards.

The D & O Report will provide a detailed description of the site design and operations that should satisfy the MOECP approval requirements. The D & O Report will also be a document that will be used by operators and future detailed design and construction activities. The D & O Report will address the following key components:

- Regulatory and approval requirements.
- Estimated waste characteristics and quantities to be accepted.
- Site development plans and details, including limits and contours.
- Landfill capacity and soil balance.
- Landfill development sequencing.
- Leachate management. We will estimate leachate quality and quantity. Based on comments received from the MOECP we have included a task to assess on-site and off-site leachate management (see below).
- Landfill gas management. We will estimate landfill gas quality and quantity and prepare a conceptual design for the landfill gas collection system.
- Assessments of potential site impacts.
- Design and operation assumptions for the Site.
- Environmental controls to manage potential impacts from the Site.
- Monitoring, inspection, maintenance and reporting programs.
- Trigger mechanisms for the implementation of remedial measures, as part of a contingency plan.
- Site closure and post-closure description.

The following tasks will be completed for the preparation of the D & O Report:

- Attendance at one site meeting to establish/confirm baseline conditions. Collect information needed to reflect current operation practices and details, such as equipment and recent operations practices.
- Review and update site contours and mapping with the 2016 aerial flyover information that is expected to be available late June 2016.
- Review design files and other relevant background information such as reports prepared for the first landfill expansion and the current Environmental Compliance Approvals (ECAs).
- Refine and finalize waste limit, base and final contours.
- Refine and finalize landfill capacity and soil balance tables for preferred option.
- Review hydrogeo investigation report and other discipline reports for the proposed expansion. In particular, we will look for information that should be addressed in the proposed D & O Report.
- Update LFG generation.

- Update leachate generation model.
- Prepare facility characteristics summary table.
- Prepare a site plan showing current and proposed site features, including waste final contours, roads, berms, stormwater management ponds, ditches, municipal drains and flood control facility.
- Prepare a draft D & O Report. We expect to prepare the following Figures:
    1. Location Plan
    2. Existing Conditions
    3. Approved Final Contours and Stockpiles (Before Proposed Expansion)
    4. Proposed Final Contours and Final Cover Detail
    5. Phasing Plan
    6. Phasing Sections
    7. Landfill Perimeter Cross-Sections
    8. Proposed Base Contours
    9. Proposed Leachate Collection System
    10. Perimeter Road/Waste Interface Sections
    11. Leachate Collection System Details
    12. Landfill Gas Collection System (Final Buildout)
    13. Gas Extraction Well and Condensate Sump Sections and Details
    14. Groundwater Monitoring Program
    15. Surface Water Monitoring Program
- Address client's comments and finalize D & O Report.
- Attend 5 meetings in Oakville or Toronto and various conference calls related to the D & O report.

Assessment of Leachate Management Alternatives

This section outlines the technical review and assessment of options for leachate management. This task will focus on the alternative of the treatment of raw or pre-treated leachate at the Blenheim Sewage Treatment Plant (STP).

We will also add a controlled leachate recirculation option during the active life of the landfill, i.e. direct soaking at the working face as practiced at the Seneca Meadows Landfill.

The Blenheim STP provides treatment of wastewater for the former Town of Blenheim and Charing Cross, as well as for leachate that is pumped intermittently from the Ridge Landfill. The Blenheim STP consists of a variation of the New Hamburg process, and includes the following unit process: belt filter screen, two-cell aerated lagoon, four facultative lagoons and intermittent sand filters. The average day rated capacity of the Blenheim STP is 4,045 m3/d, and the plant is currently operating at 35% of its rated capacity, based on 2015 data.

According to the Municipality of Chatham-Kent's Water and Wastewater Master Plan Report dated May 2012 prepared by Dillon, the Blenheim STP appears to have no hydraulic restrictions or bottlenecks. The

Master Plan identified the need for the replacement of the existing New Hamburg process with a mechanical treatment plant based on:

- Need to meet current Environmental Compliance Approval (ECA) requirements for seasonal discharge.
- Sufficient future demand which approaches rated capacity of the system.

Future additional leachate volumes associated with the proposed Ridge Landfill expansion might trigger the need for expansion.

Dillon previously prepared a report in 2011 that included an assessment of current Ridge Landfill leachate quality and quantity, as well an assessment of the impact of estimated future leachate loading on the Blenheim STP. This report evaluated the pre-treatment of leachate upstream of the Blenheim STP, as well as a plant upgrade. The report noted that the Total Kjeldahl Nitrogen (TKN) and Biological Oxygen Demand (BOD) concentrations in the Ridge Landfill were found to be above the Sewer Use By-Law limits for a long period of time.

This task consists of the following scope of work:

- Review leachate characterization, as a function of landfill expansion and operation, including:
  - Leachate quality.
  - Leachate quantity.
  - This information will be used to identify the design load and flow rate for landfill leachate generated at the Ridge Landfill site. Literature data for leachate quality modeling will be used to estimate leachate quality as function of time for the design horizon. We may adjust the literature data to reflect historical site-specific data.
- Visit the STP site to confirm existing conditions and meet/discuss plant operations with Blenheim STP Operators.
- Review background information including leachate monitoring data and accumulated sludge monitoring data, including these parameters: Total Suspended Solids (TSS), BOD, heavy metals and chloride.
- Estimate combined sewage and leachate flow and loading rates for the design horizon to the Blenheim STP.
- Assess the capacity of existing WCC infrastructure, such as the leachate equalization tank, leachate pumping station and forcemain, as well as Chatham-Kent PUC infrastructure such as the Blenheim STP.
- Work with the Chatham-Kent PUC to prepare a calculation of the uncommitted reserve capacity of the Blenheim STP for current and future conditions, according to MOECP Procedure D-5-1.
- Identify, evaluate and screen alternatives for leachate handling and storage at the Ridge Landfill to satisfy future requirements. This will include controlled leachate recirculation.
- Evaluate alternatives for leachate pumping to the Blenheim STP, including pumping station and forcemain infrastructure, as well as odour control to meet future requirements.

- Evaluate alternatives for upgrade and/or expansion of the Blenheim STP to meet future requirements for Ridge Landfill leachate.
  - Future municipal wastewater projections will be based on the Chatham-Kent's Water and Wastewater Master Plan Report dated May 2012 prepared by Dillon.
  - Leachate pre-treatment requirements will be considered to reduce loadings of heavy metals, total suspended solids (TSS), and biochemical oxygen demand (BOD) to the Blenheim STP.
  - These treatment upgrade alternatives for the Blenheim STF will be evaluated based on their environmental impact to receiver (Cameron Drain), sludge quality and quantity and capital and operating costs, in addition to other evaluation criteria.
  - Plant upgrades will consider:
    - Upgrades to meet present effluent quality requirements as stated in the Blenheim STP CofA/ECA.
    - Upgrades to meet future effluent quality requirements in the case of new ECA for the Blenheim STP, and potentially more stringent effluent criteria.
  - Prepare an opinion of probable cost for the alternatives. This will be presented separately and may not be included in the report to be submitted to MOECP.
  - Present alternatives at a client meeting.
  - Summarize this work as an appendix to the Design and Operations Report, including the preferred design concept (including conceptual-level design details).

ECA Support

Once the EA is approved, an ECA application will be prepared under the EPA. We allowed time to answer questions from MOECP, other stakeholders and the public during the ECA approval.

3.2 Assumptions

We have assumed the following for this scope of work:

- The Howard Drain will be relocated. The other municipal drains will have capacity to accommodate post-development drainage and no changes will be made to those drains.
- The existing wood lots can be replanted to the north of the existing site access road.
- The site will be rezoned to accommodate the proposed expansion with no restrictions.
- No expansion to the north of the site access road.
- The existing site entrance, access road, scale house, administration building and maintenance building will not change.
- Mining will be contemplated at early stages of the EA process. A mining field investigation program will be completed under a separate task to enhance site-specific understanding. The D & O Report will not include a mining component.
- Processing facilities can be located on the east side of Erieau Road (will also require rezoning). Processing facilities will be shown on site plans, with no intent to approve processing operations at

this stage. Separate D & O reports for waste processing facilities will be prepared in the future under a separate scope if needed.

- We will not review technology options for leachate and landfill gas treatment/utilization alternatives. We assume the current concepts will be applied to the new expansion. The relocation of the existing leachate storage tank and the existing landfill gas flare will be considered.
- We assume the existing liner and leachate collection system will be applied to the expansion.
- Supporting documentation for OWRA approval for the proposed stormwater management system and leachate management system will be completed after the EA and EPA approvals under a separate scope.
- Drainage Act approval to relocate the Howard Drain will be completed under a separate scope after the EA approval.
- Conservation Authority approval for the stormwater management system and drain modifications will be completed under a separate scope after the EA approval.
- Climate change will be considered for the flood control facility. Landfill gas, leachate generation and other design components will not include mitigation allowance related to climate change. If available, we will summarize recent feasibility studies for landfill gas utilization such as electricity generation or gas treatment for pipeline grade.
- A geotechnical report will not be needed for the EA approval. Climate change considerations on slope stability will not be reviewed at the EA stage.

3.3 Deliverables

We will deliver a Draft D & O Report. Following review and comment of the draft report from Waste Connections, we will finalize and submit the Final D & O Report as part of the overall EA document.

We allowed time under this task to summarize D & O related information for the applicable sections of the EA Report.

The following is a draft table of contents for the D & O Report:

1.0 Introduction

1.1 Purpose and Scope

1.2 Regulatory Requirements

1.3 Description of the Undertaking

2.0 Site Description

2.1 Site Location

2.2 Site Boundaries

2.3 Land Use

2.4 Topography

2.5 Hydrology

2.6 Hydrogeology

3.0 Waste Quantities and Characteristics

3.1 Service Area

3.2 Waste Quantities

3.3 Waste Characteristics

4.0 Expanded Fill Area Design

4.1 Design Approach

4.2 Design Criteria

4.3 Limits of Landfilling

4.4 Base Contours

4.5 Final Contours

4.6 Landfill Capacity Calculations

5.0 Site Features

4.1 Site Entrance

4.2 On-Site Roads

4.3 Weigh Scale and Scale House

4.4 Administration and Maintenance Buildings

4.5 Landfill Gas Management Facility

4.6 Leachate Pre-Treatment Facility

4.7 Storm Water Management Ponds

4.8 Flood Control Facility

4.9 Municipal Drains

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RIDGE LANDFILL

Ridge Landfill Expansion Environmental Assessment

Hydrogeological Work Plan (Final)

September 2018 – 15-2456

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Project and Work Plan Overview

This hydrogeological assessment work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment and Climate Change (MOECC) in May of 2018.

Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

The Ridge Landfill has been in operation since 1966 and was previously expanded in 1999. Waste Connections owns 340 hectares (ha) of land at the Ridge Landfill. The existing Landfill Site Area, which is permitted by an ECA from the MOECC for waste management and environmental work purposes, is 262 ha. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the Landfill Site Area. As of December 2017, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate.

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The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to the just municipality of Chatham-Kent.

This hydrogeological work plan outlines the tasks to support the evaluation of alternative methods, and to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the hydrogeological work, including protocols and/or standards to be adhered to while work is undertaken.

The purpose of the hydrogeological assessment is to determine whether the site can be developed without causing adverse effects to off-site groundwater.

The hydrogeological discipline is significantly involved in the design of the landfill, particularly in the design of the leachate management system. The assessment will address the requirements of O. Reg. 232/98 Landfilling Sites - in particular, Section 8 of the regulation ("Hydrogeological Assessment"). The

assessment will characterize the hydrogeologic setting of the existing landfill site, and predict the potential impacts that could be expected from the landfill expansion.

The work plan includes the following tasks that are required by O.Reg. 232/98:

i. The drilling of boreholes and obtaining samples to characterize soil or bedrock conditions at the site.
ii. The measurement of groundwater levels and pressures to define groundwater flow characteristics.
iii. The collection of groundwater samples to assess groundwater quality.
iv. The interpretation of collected data including the preparation of site and piezometric contour plans, the determination of groundwater flow paths and contaminant attenuation capabilities, and the identification of any unstable soils or geologic conditions.
v. An assessment of the suitability of the site for landfilling with respect to the design, monitoring and contingency plan requirements.

A substantial amount of hydrogeological information is available for the Ridge Landfill. This information has been obtained since the 1980's and on-going monitoring of groundwater monitoring wells has been completed since 1984. The Ridge Landfill is situated on thick, low permeability silty clay till aquitard. Water levels in monitoring wells installed deep within the clay aquitard take many months to reach a static state (i.e., groundwater very slowly fills the monitoring wells after they are installed). As such, it was decided that the drilling program for this work plan be completed concurrently with the development of the ToR. Notwithstanding this, Waste Connections recognizes that the data collected from the wells will need to be discussed with the MOECC to confirm suitability in the context of the larger work plan for hydrogeology for the EA. It is recognized that the EA scope of work (e.g., number of monitoring wells) may evolve as part of this discussion.

The use of groundwater in the vicinity of the site will be documented. The primary source will be the Ministry of the Environment and Climate Change (MOECC) Water Well Record database supplemented with on-site knowledge of groundwater users. As stated in Section 2 of the work plan, the regional aquifer is the basal aquifer found at the interface of the overburden and bedrock. There is a municipal water supply pipeline along both Charing Cross Road and Erieau Road and therefore many residences are no longer on an individual groundwater well supply. The evaluation of alternative methods will also include details of the off-site residential well water quality monitoring that has been completed as part of the overall monitoring program for the existing site since 1998.

A predictive impact assessment will be completed using contaminant transport computer modelling to assess the suitability of the site, and specifically, compliance with the MOECC Reasonable Use Guideline. Predicted impacts will be compared to the Ontario Drinking Water Standards and the Reasonable Use Guideline. The engineered features of the landfill (such as the leachate collection system) will be included in the model and will include an assessment the required service life of the engineered features and an overall assessment of the contaminating life span of the site.

For the site development alternative methods, the "contaminating life span" of the alternative methods will also be qualitatively determined. The contaminating life span will be determined as part of the assessment of potential impacts for the landfill expansion and will depend on primary factors such as tonnes of waste per hectare and leachate generation rate.

A summary of additional commitments for the Hydrogeological Assessment is provided below.

Commitment	Reference to applicable section in EA or supporting document
Waste Connections commits to further development of the hydrogeology EA work plan with the MOECC's Southwest Region Hydrogeologist. As part of these discussions, Waste Connections commits to discussing groundwater sampling parameters and locations.	Hydrogeological Assessment (all). Groundwater sampling parameters are discussed in Section 4.4 and sampling locations are discussed in Section 4.1.
Waste Connections commits to incorporating a section in the EA that describes potential effects to nearby receptors (i.e., private drinking water wells). This section will include discussion on the private drinking water well supplies in the area and will also demonstrate that compliance with the Reasonable Use Guideline is sufficient to show that off-site receptors are not at risk." The methodology to assess potential effects to nearby receptors is to use the results of the predictive contaminant transport and fate modelling that will be completed as part of the Reasonable Use assessment. The travel time to the drinking water aquifer from the surface through the clay aquitard is many hundreds of years and will protect private drinking water wells. Private water well users in the vicinity of the site will be identified via a door-to-door survey	Hydrogeological Assessment Section 4.6. This will also be incorporated into the EA (section TBD).
The leachate contaminating life span for groundwater will be assessed for the alternative methods and the preferred alternative method as follows: The waste loading (tonnes of waste per footprint area) for each alternative method will be determined	Hydrogeological Assessment Section 4.6.1 to 4.6.3. Design and Operations Report (Section TBD).

Commitment	Reference to applicable section in EA or supporting document
Three leachate generation rates will be assumed per alternative method based on a natural cover, low permeability clay cover and a low permeability geosynthetic cover Leachate characteristics used in the contaminating life span estimates will be taken from Table 1, Section 10 of O.Reg. 232/98 The contaminating life span for each alternative method will be estimated adapting the method used by "Barrier Systems for Waste Disposal Facilities, 2nd Edition", by R. Kerry Rowe, Robert M. Quigley, Richard W.I. Brachman & John R. Booker.	
The landfill gas contaminating life span will be determined by modelling landfill gas generation rates for the site development alternative methods. The landfill gas generation model will indicate how long landfill gas will occur (contaminating life span). An assessment of the natural subsurface landfill gas migration potential, which is limited by low permeability soil, a shallow water table and surface water features, will also be included in the landfill gas contaminating life span assessment.	
Potential impacts to nearby receptors such as private drinking water wells will be assessed in the EA using a predictive impact assessment using contaminant transport computer modelling to predict expected concentrations in groundwater in the bedrock aquifer immediately below the landfill. Predicted concentrations will be compared to both the Ontario Drinking Water Standards and the allowable concentrations determined by the Reasonable Use Guidelines.	Hydrogeological Assessment Section 4.6.

1.0 Introduction

An outline of the hydrogeological assessment for the Ridge Landfill expansion was presented in Appendix A of the approved ToR. This work plan provides the details on how this assessment will be carried out. The purpose of the hydrogeological assessment is to determine whether the site can be developed without causing adverse effects to off-site groundwater. The objective of the hydrogeological assessment is to complete the required investigations and analysis of hydrogeological data to support the *Environmental Assessment Act* and the *Environmental Protection Act* approvals required for the expansion of the landfill site.

The hydrogeological discipline is significantly involved in the design of the landfill, particularly in the design of the leachate management system. The assessment will address the requirements of O. Reg. 232/98 Landfilling Sites - in particular, Section 8 of the regulation ("Hydrogeological Assessment"). The assessment will characterize the hydrogeologic setting of the existing landfill site, and predict the potential impacts that could be expected from the landfill expansion.

The detailed assessment of the site required by O.Reg. 232/98 will identify potential effects on the environment from landfill development, and how these potential effects will be mitigated.

1.1 Study Area

For the purpose of the hydrogeological assessment, the investigative Study Area will extend to the limits of the Ridge Landfill property (on-site). The rationale for this study area is that there has been a significant level of previous hydrogeological investigation completed at the site. Major hydrostratigraphic units have been defined and groundwater flow patterns established. Groundwater movement is very slow at the site which also justifies the study area. The assessment area using secondary sources such as water well records and published hydrogeology / geology reports will extend approximately 5 km from the site. Secondary source information is used to summarize regional geology and hydrogeology and groundwater users in the area of the site. A 5 km study is justified by the slow movement of groundwater which limits the area of potential hydrogeological effects from waste disposal from this site.

1.2 Field Work Completed Concurrently with ToR Development

A substantial amount of hydrogeological information is available for the Ridge Landfill. This information has been obtained since the 1980's and on-going monitoring of groundwater monitoring wells has been completed since 1984. A major hydrogeological assessment was completed 1996/1997 in support of the approval process for the existing site (West Landfill and South Landfill) (Dillon, 1997). The Ridge Landfill is situated on thick, low permeability silty clay till aquitard. Static water levels in monitoring wells installed deep within the clay aquitard take many months to reach static water levels (i.e., groundwater very slowly fills the monitoring wells after they are installed). As such, it was decided that the drilling program for this

work plan be completed concurrently with the development of the ToR. The drilling program was completed in the fall of 2016 and water levels have been monitored in the new monitoring wells since that time. This approach will improve the quality of data that will be available for the hydrogeological assessment related to the current landfill expansion proposal. Notwithstanding this, Waste Connections recognizes that the data collected from the wells will need to be discussed with the MOECC to confirm suitability in the context of the larger work plan for hydrogeology for the EA. It is recognized that the EA scope of work (e.g., number of monitoring wells) may evolve as part of this discussion.

2.0 Hydrogeological Assessment Criteria

The hydrogeological assessment will be documented following the requirements of Section 8 of O.Reg 232/98. It will include borehole logs, geologic cross-sections and piezometric maps. It will document the suitability of the site for landfilling waste disposal purposes and proposed monitoring and contingency plans. A summary of the hydrogeological assessment will be included in the Environmental Assessment document.

The primary environmental assessment criteria, indicators and data sources for the hydrogeological assessment are provided in **Table 1**. The assessment criteria, indicators, and data sources will be utilized for the evaluation of alternative methods and the assessment of net effects.

Table 1: Hydrogeological Assessment Criteria, Indicators, and Data Sources

Assessment Criteria	Indicators	Data Sources
Contaminating Life span	• Prediction based on tonnes of waste per hectare of footprint area and leachate generation rate.	• Three leachate generation rates: based on a natural cover, low permeability clay cover and a low permeability geosynthetic cover. • Leachate characteristics used in the contaminating life span estimates will be taken from Table 1, Section 10 of O.Reg. 232/98. • Estimated adapting the method used by Rowe et. al (2004).
Potential impacts to groundwater quality	• Concentrations based on predictive contaminant transport modelling (i.e., POLLUTE™) (assessment of net effects).	• Site data collected through intrusive investigations. • Leachate characteristics taken from Table 1, Section 10 of O.Reg. 232/98. • Leachate generation rates (HELP™ modelling). • Landfill design input.
Potential impacts to groundwater quantity	• Reduction in infiltration rate to bedrock aquifer.	• Site data collected through intrusive investigations. • Landfill design input.

Assessment Criteria	Indicators	Data Sources
Potential impacts to water supply wells	• Predictive impact assessment using contaminant transport computer modelling to predict expected concentrations in the bedrock aquifer.	• Water supply well survey. • Site data collected through intrusive investigations. • Leachate characteristics taken from Table 1, Section 10 of O.Reg. 232/98. • Leachate generation rates (HELP™ modelling). • Landfill design input.

Furthermore, the assessment will also address compliance with O.Reg. 232/98 (including the MOECC Reasonable Use Policy). Predicted compliance with O.Reg. 232/98 will infer compliance with the Assessment Criteria.

3.0 Hydrogeological Baseline Conditions

This summary of baseline hydrogeological conditions is based on the existing knowledge of hydrogeological conditions at the Ridge Landfill site, notably the hydrogeological assessment that was completed in support of the approval process for the existing landfill (Dillon, 1997). The Ridge Landfill Site lies within the St. Clair Clay Plain physiographic region. The ground surface has little topographic relief in the area of the Ridge Landfill and slopes slightly to the northwest. Surface drainage is poor and has been enhanced through man-made municipal drains. The clay plain is widespread in the west towards Windsor, but narrows near the landfill, extending from Charing Cross south to Lake Erie. A small rise in the land at Charing Cross (north of the site) marks the location of a minor till moraine.

The clay plain consists of slightly stony, clayey silt Port Stanley Till, which ranges in thickness from 38 m to 44 m. Site investigations indicated that the Port Stanley Till has a weathered and fractured upper surface, characterized by vertical to sub-vertical fractions extending to a depth up to 6 m. The unweathered Port Stanley Till found at the Ridge Landfill is a grey, dense to very dense clayey silt till with traces of sand and fine gravel.

The Port Stanley Till overlies unconsolidated glaciolacustrine sands, silts and clays. Underlying the glaciolacustrine soils is Kettle Point formation black shale bedrock, which is found at an average depth of approximately 46 m below ground surface (mbgs). The surface of the bedrock is highly fractured and weathered. Fracturing in the bedrock decreases with depth.

The hydrogeology of the landfill site has been divided into three main hydrostratigraphic units which are shown on **Figure 1**:

- Layer 1 is the surficial aquifer and consists of a variety of soil types including topsoil, sand, silt and gravel. However, the predominant unit is weathered and fractured Port Stanley Till. Groundwater flow in this hydrostratigraphic unit is horizontal and migrates towards surface water drainage features.
- Layer 2 consists of unweathered Port Stanley Till, which does not have significant discontinuities such as fractures. There is a dominant vertical downward groundwater flow direction but there is a very low groundwater flux due to the very low hydraulic conductivity of the till, which is in the order of 10^{-8} cm/s.
- Layer 3 is the regional aquifer and is made up of a basal overburden sand and gravel unit and/or weathered and fractured bedrock. There is a regionally dominant south-southeast horizontal flow direction in Layer 3. The deposits of sand and gravel, as well as the weathered bedrock surface provide the principal pathway for regional groundwater movement. Layer 3 is relatively heterogeneous and varies in composition, thickness and hydraulic conductivity. The approximate thickness of this layer is 3 m. Water level measurements taken in Layer 3 wells indicate that

horizontal groundwater movement is slow, and occurs under very low hydraulic gradients, in the order of 0.0005 m/m. The hydraulic conductivity of Layer 3 is in the order of 10^{-4} cm/s.

The baseline groundwater quality is well understood and a network of monitoring wells was established in the 1980's. The monitoring program has been expanded throughout the years and consists of groundwater, surface water, and landfill leachate and landfill gas. The monitoring data and assessment are included in the Annual Report documenting site development, operations and monitoring. No groundwater quality issues resulting from the existing landfill have been identified in the monitoring program.

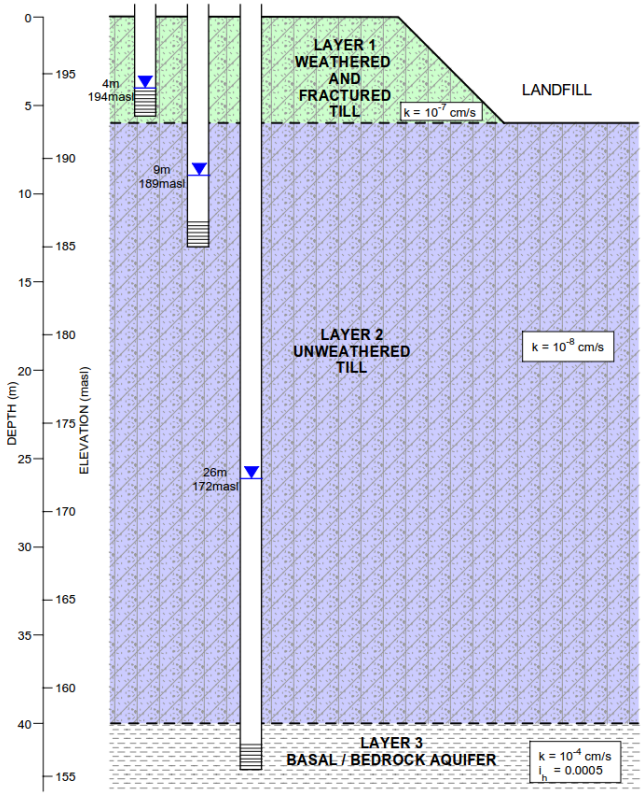

Figure 1 - Conceptual Hydrogeology

4.0 Work Plan Tasks

The hydrogeological work plan has been developed to address the requirements of Ontario Regulation (O.Reg.) 232/98 *Landfilling Sites* and in particular Section 8 of the regulation, "Hydrogeological Assessment". O. Reg. 232/98 under Part V of the *Environmental Protection Act* contains detailed requirements for the design, operation, closure and post-closure care of non-hazardous waste landfills. A detailed assessment of the site is required by O.Reg. 232/98 to identify potential effects on the environment from landfill operations, and how these potential effects can be mitigated.

In addition to O.Reg. 232/98, the MOECC has published a guideline, titled "*Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites"* (MOECC, 2012). These guidelines provide additional technical guidance of the requirements of O.Reg. 232/98.

The guidelines provide the following requirements for the hydrogeological assessment of a landfill site:

i. The drilling of boreholes and obtaining samples to characterize soil or bedrock conditions at the site.
ii. The measurement of groundwater levels and pressures to define groundwater flow characteristics.
iii. The collection of groundwater samples to assess groundwater quality.
iv. The interpretation of collected data including the preparation of site and piezometric contour plans, the determination of groundwater flow paths and contaminant attenuation capabilities, and the identification of any unstable soils or geologic conditions.
v. An assessment of the suitability of the site for landfilling with respect to the design, monitoring and contingency plan requirements. (MOECC, 2012).

4.1 Intrusive Investigation

It is proposed to expand the landfill laterally from the existing west and south mounds, southwards towards Allison Line. The subsurface conditions at the existing landfill site have been investigated and monitored extensively over the past 30 plus years and are well understood. Therefore the focus of the subsurface investigation is in the proposed new landfilling area which is contiguous with the existing landfill area. Six new monitoring well "nests", consisting of a monitoring well installed in each hydrostratigraphic unit (Layer 1, Layer 2 and Layer 3) were installed in the Fall of 2016. These new monitoring well nests are located around the perimeter of the proposed expansion area and will ultimately be incorporated into the monitoring program for the expanded landfill. The locations of the six new monitoring well nests are:

- Two monitoring well nests located along County Line 10 between Allison Line and the former railway track.

- Three monitoring well nests located along Allison Line between County Road 10 and Erieau Road.
- One monitoring well nest located along Erieau Road north of Allison Line.

Approximate locations for the current monitoring well nests are shown on **Figure 2**. It is recognized that as subsurface information is collected, the need for additional, presently unforeseen, subsurface investigation data may be identified. In particular, the monitoring well network that forms the basis of the site groundwater monitoring program may be adjusted based on further investigative results and comments from the Ministry.

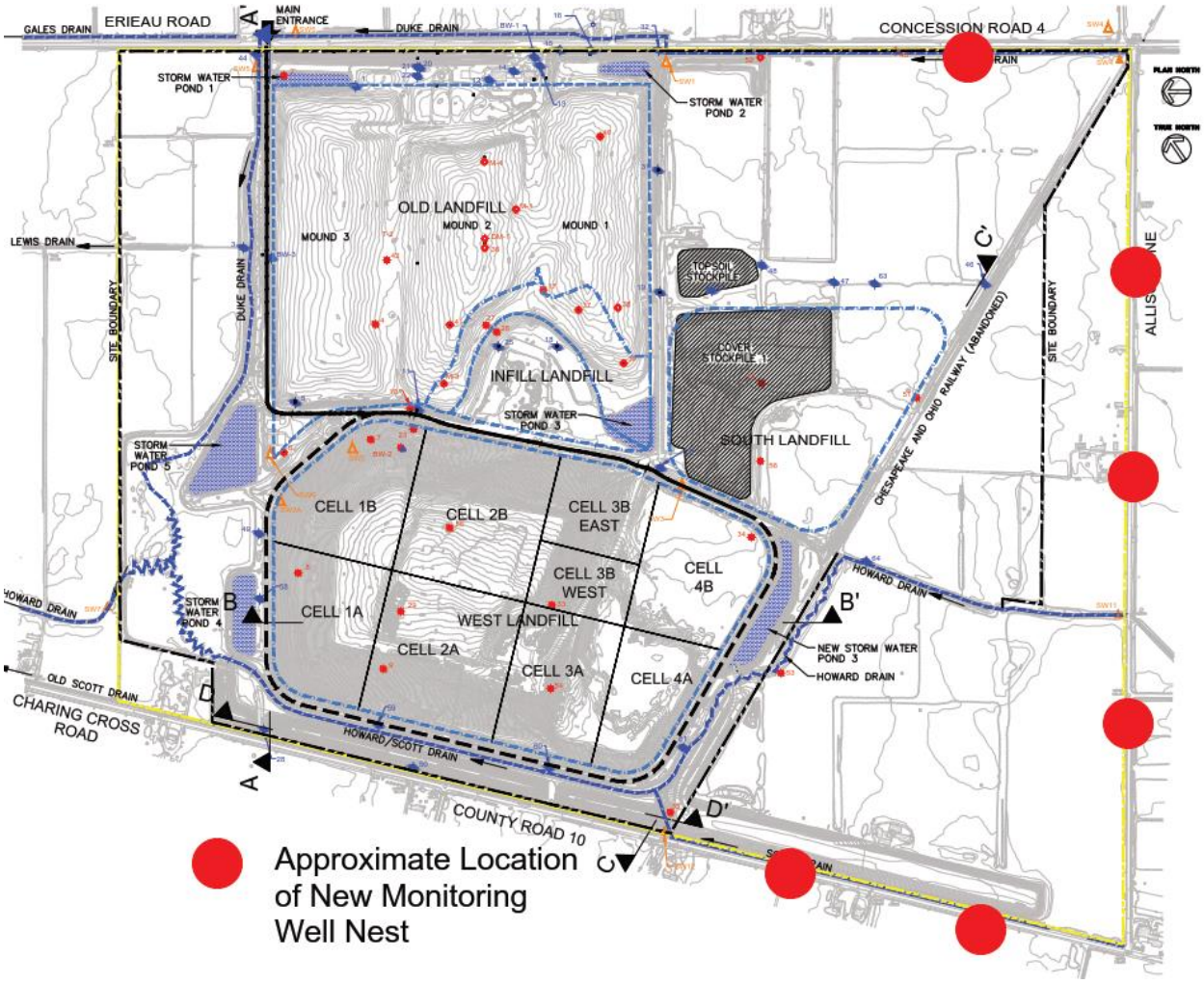

Figure 2 - Approximate New Monitoring Locations

4.1.1 Drilling Program

The new monitoring wells were installed using hollow-stem augers and a continuous soil core sample barrel system, which produces a 1.5 m-long, 65 mm nominal diameter soil core. The continuous-sample barrel is locked inside the lead hollow stem auger, and does not require the use of any drilling fluids

(water, drill muds, etc.) to produce soil cores. The soil cores were logged in the field for the deepest monitoring well (bedrock monitoring well) and stored in the core boxes / sleeves. Select soil samples were submitted for laboratory analysis (described below). The deepest borehole at each monitoring well nest extended into the weathered shale bedrock with the augers to a depth of 3 m or refusal.

4.1.2 Monitoring Well Installations – Lateral Expansion Area

At each monitoring well nest location, a monitoring well consisting of a 50 mm diameter, 1.5 m long PVC well screen connected to riser pipe was installed in the deep borehole (a Layer 3 monitoring well). Silica sand was placed in the annulus of the well screen and extends approximately 0.6 m above the top of the screen. A bentonite seal plug was placed above the silica sand, and bentonite grout was placed above the bentonite seal around the PVC riser pipe via a tremie pipe, which was extended to ground surface. Each well is equipped with a protective steel casing, concreted in place at ground surface. The Layer 2 monitoring well was installed in its own borehole at a nominal depth of 15 mbgs (no soil sampling was completed in this borehole). Layer 2 monitoring wells were constructed in a similar fashion as Layer 3 monitoring wells. The shallow Layer 1 monitoring well was installed at a nominal depth of 5 mbgs, and was also installed in its own borehole similar to the Layer 2 wells. The Layer 1 wells have 3.0 m long well screens. As previously stated, soil cores were only obtained from the deep boreholes (i.e., Layer 3 monitoring well borehole).

4.1.3 Leachate Monitoring Wells – Old Landfill Area

As proposed in the ToR, six leachate monitoring wells drilled to the base of fill in the Old Landfill will be used to evaluate leachate quality and leachate levels in the old landfill. The purpose of this work will be to evaluate the potential of both a vertical expansion, or mining of the Old Landfill (Alternative Methods). Leachate level elevations in these wells will be used to evaluate the amount of leachate mounding present in the Old Landfill. The target parameter list for the leachate wells includes metals, inorganics and volatile organic compounds (VOCs).

4.2 Hydraulic Conductivity Testing

Hydraulic conductivity (also referred to as groundwater permeability) is a measure of the ability of geological formation (soil or rock) to transmit water and is the chief hydrogeological characteristic in assessing the natural protection of the groundwater environment. The hydraulic conductivity of the clay till will be assessed using two different methods: in-situ hydraulic conductivity tests and triaxial permeability tests. In-situ hydraulic conductivity tests will be conducted in each of the monitoring wells and consists of removing water from the well and measuring, with time, the rate of recovery of the water level to its static (or baseline) level. Based on the 1996 hydrogeological investigation, the Layer 2 monitoring wells are very slow to establish a static water level and therefore the rate of recovery after well construction will be used to establish an approximate hydraulic conductivity (i.e., a static water level will be assumed in the calculations).

Triaxial permeability tests were also completed on soil cores. Shelby tubes were taken at two depth intervals at each monitoring well nest location and submitted to a geotechnical laboratory for testing. As well, grain size testing was completed on five soil samples from each monitoring well nest location and submitted to a geotechnical laboratory to determine grain size distribution. The fraction of organic carbon (f_{OC}) was determined in one soil sample taken at an approximate depth of 10 mbgs at each monitoring well nest location.

4.3 Water Level Monitoring

Water levels will be manually monitored in the new monitoring wells periodically after installation. In addition, water level dataloggers were installed in each new well and in two existing monitoring well nests. The top of wells were surveyed to a geodetic benchmark and all water levels converted to geodetic elevations.

4.4 Groundwater Quality

The newly installed monitoring wells were developed and purged. Water samples will be taken once from the new monitoring wells and submitted for laboratory analyses to determine baseline groundwater quality at the new monitoring well nest locations. The target parameter list will be the same as the current groundwater monitoring program:

- pH
- Conductivity
- COD
- BOD
- Chloride
- Phenol
- Sulphate
- Total Kjeldahl Nitrogen
- Calcium
- Volatile organic scan
- Magnesium
- Sodium
- Potassium
- Iron
- Alkalinity
- Total ammonia as N
- Anion scan (nitrate, nitrite, bromide, iodide, fluoride
- Total phosphorus

4.4.1 Groundwater Isotope Assessment

The isotopes of oxygen and hydrogen were used in the 1996 hydrogeological assessment which indicated that the porewater deep in the clay till is many thousands of years old. A similar assessment will be completed at two monitoring well nests where porewater from soil cores and groundwater samples from the monitoring wells will be analyzed for deuterium and oxygen-18.

4.5 Groundwater Use Assessment

The use of groundwater in the vicinity of the site will be documented. The primary source will be the MOECC Water Well Record database supplemented with on-site knowledge of groundwater users. In addition to the MOECC Water Well Record database, a door-to-door well survey will be conducted within a 1,000 m buffer from the site. These property owners / tenants will be asked if there is a water well on the property, if it is actively used and what the water is used for (e.g., lawn watering, livestock, human consumption, etc.). A follow-up, more detailed survey will be completed for those properties that have wells pertaining to such details such as well depth, casing diameter etc.

As stated in Section 2 the regional aquifer is the basal aquifer found at the interface of the overburden and bedrock. There is a municipal water supply pipeline along both Charing Cross Road and Erieau Road and therefore many residences are no longer on an individual well supply. The evaluation will also include details of the off-site residential well water quality monitoring that has been completed as part of the overall monitoring program for the existing site since 1998.

4.6 Predictive Impact Assessment

A predictive impact assessment will be completed using contaminant transport computer modelling to assess the suitability of the site specifically the compliance with the MOECC Reasonable Use Guideline. Impacts to the drinking water aquifer (Layer 3, see Section 2) will be predicted using computer modeling. Predicted impacts will be compared to the Ontario Drinking Water Standards and the Reasonable Use Guideline. The engineered features of the landfill such as the leachate collection system will be included in the model and will include an assessment the required service life of the engineered features and an overall assessment of the contaminating life span of the site.

4.6.1 Contaminating Life span

Ontario Regulation 232/98 defines “contaminating life span of a landfill” as:

(a) in respect of a landfilling site, the period of time during which the site will produce contaminants at concentrations that could have an unacceptable impact if they were to be discharged from the site, and

(b) in respect of a landfilling site and a contaminant or group of contaminants, the period of time during which the site will produce the contaminant or a contaminant in the group at concentrations that could have an unacceptable impact if they were to be discharged from the site.

The three factors that influence the contaminating life span are:

i. The transport pathway (contaminant fate and transport) which will vary from landfill to landfill. The greater the attenuation potential along the transport pathway, the shorter the contaminating life span. At Ridge, the low permeability clay means that it will take many years (in the order of thousands of years) for water to move from the landfill to the underlying bedrock aquifer. Therefore, site development alternatives will not materially affect the influence of the transport pathway on contaminating life span.

ii. The mass of waste per unit area (referred to as "waste loading" in O.Reg. 232/98). The thicker the waste, the more mass of contaminants (and with other factors being equal) the longer the contaminating life span.

iii. The leachate generation rate and initial leachate concentrations. The greater the leachate generation rate, the more contaminants are leached from the waste mound which results in shorter contaminating life spans.

4.6.2 Qualitative Assessment of Contaminating Life Span for Site Development Alternatives

For site development alternatives, the "contaminating life span" of the alternatives will also be qualitatively determined. The contaminating life span will be determined as part of the assessment of potential impacts for the landfill expansion and will depend on primary factors such as tonnes of waste per hectare and leachate generation rate. The contaminating life span for the preferred site development alternative will be quantitatively determined adapting the method used by "Barrier Systems for Waste Disposal Facilities, 2nd Edition" by R. Kerry Rowe et al. (2004).

4.6.3 Landfill Gas Impact Assessment

The landfill gas generation rate and contaminating life span for landfill gas will be assessed by the Design and Operations discipline. The potential for landfill gas to migrate within the subsurface will be included in the hydrogeology impact assessment.

4.7 Monitoring Program and Contingency Planning Development

An expanded monitoring program will be developed that includes new landfill areas and will incorporate the proposed new monitoring well nests located in the southern expansion area of the site. It will also review the existing contingency measures developed for the site and modify these plans as appropriate. The existing triggering mechanism for the contingency plans will also be reviewed and modified as necessary.

5.0 Reporting

The hydrogeological assessment will be documented following the requirements of Section 8 of O.Reg 232/98. It will include borehole logs, geologic cross-sections and piezometric maps. It will document the suitability of the site for landfilling waste disposal purposes and proposed monitoring and contingency plans. The main report will be supported with a set of appendices that will present a thorough description of all elements of the hydrogeological assessment. A summary of the hydrogeological assessment will be included in the Environmental Assessment document.

References

Dillon Consulting Limited, 1997, BFI Ridge Landfill Environmental Assessment, Appendix B – Geology/Hydrogeology Assessment Report.

Rowe, R. K., R.M. Quigley, R.W.I Brachman and J.R. Booker, *Barrier Systems for Waste Disposal Facilities, Second Edition*, Spon Press, 2004.

DILLON CONSULTING

Ridge Landfill Expansion Environmental Assessment

Mining Assessment Work Plan (Final)

September 2018 – 15-2456

Table of Contents

1.0 Project and Work Plan Overview

This Mining Assessment work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment, Conservation and Parks in May of 2018.

Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

WCC owns approximately 334 hectares (ha) of lands west of Erieau Road and an approximately 21 ha property east of Erieau Road. The existing Landfill Site Area, which is permitted by an ECA from the MOECP for waste management and environmental work purposes, is 262 ha. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the Landfill Site Area. As of December 2017, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate.

The current approved capacity for the Ridge Landfill is 21 million cubic metres (m3). The site is approved to accept a maximum of 1,300,000 tonnes of waste per year (the MOECP approved annual waste disposal rate). The EA does not propose to increase the maximum annual fill rate (this would remain as-is); however, Waste Connections is seeking the EA to increase the life of the facility for a 20 year planning period, from 2022-2041.

The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to only the Municipality of Chatham-Kent.

This work plan outlines the tasks to support the Mining Assessment component of the Environmental Assessment approval for the new expansion. This work plan also includes the tasks to address the additional commitments associated with the Terms of Reference submission and approval.

A summary of additional commitments for the Mining Assessment discipline is provided below.

Commitment	Reference to applicable section in EA or supporting document
As part of developing the site development alternatives, a review of other experience at landfill mining operations related to odour will be undertaken.	Mining Assessment work plan Section 2.0.

2.0 Landfill Mining Assessment

2.1 Background

Mining the Old Landfill has been identified as an option to gain additional landfill capacity. Although the Ministry of the Environment and Climate Change (MOECP) has approved some landfill mining projects in Ontario, odours and health and safety are typically the top concerns associated with landfill mining, followed by leachate management and slope stability.

We are proposing to complete a desktop mining assessment at the Old Landfill portion of the Ridge Landfill to assess the technical and economic feasibility of landfill mining and identify the potential for common concerns associated with landfill mining operations. This assessment will include review of the following:

- Dillon's report prepared for the Trail Landfill mining pilot project for the City of Ottawa.
- Dillon's experience with the mining component of the Design and Operations Report prepared for the City of Sault Ste. Marie landfill expansion.
- Notes of site visit and phone calls with the City of Barrie Landfill mining full-scale project.
- Notes of site visit at the Ocean County landfill mining project in New Jersey.
- Literature review of relevant recent mining projects, including in the Town of Blue Mountains in Ontario.

It is expected that the mining assessment will provide information to enhance the site understanding and comfort level related to mining operations. Information gathered in the mining assessment program will confirm capacity estimates at the landfill and will feed into the evaluation criteria for determining the preferred site development alternative method.

2.2 Study Area

For the purposes of the Landfill Mining Scope of Work, the study area has been defined as follows:

- On-Site Study Area ("on-site") – This study area will be modified for the Landfill Mining discipline to be confined to the area of the Old Landfill (including the Infill Area).

This is appropriate since this is the only location on the Ridge Landfill property for which landfill mining is proposed.

3.0 Scope of Work Description

The main goal of the landfill mining desktop assessment is to review background data related to site information such as type or source of waste reported in the annual reports and historical leachate levels (if available). A literature review of the practices implemented at other sites where landfill mining has taken place and best management practice recommendations to address potential impacts (including odours) will also be considered as part of this assessment. We will also conduct an interview with Waste Connections employees that worked on site in the past. The information collected will be used in the EA process as a resource in the development and evaluation of landfill mining in the context of the site development alternatives. Specifically, the following information will be collected and used to assess the viability of landfill mining at the Old Landfill and to assess potential impacts and mitigation measures associated with landfill mining:

The desktop landfill mining assessment will involve:

- Review of the type and quantity of waste disposed at each mound within the Old Landfill.
- Review of the historical leachate and groundwater levels of the Old Landfill, if available.
- Confirmation and refinement of the base design and elevations of the Old Landfill base. This will be achieved using the borehole information obtained in the hydrogeology program and other documents available on file such as historical ground contours, figures and drawings.
- Estimate the quantity of waste and soil cover excavation expected for each mound.
- Prepare a process diagram and identify operational requirements (e.g., maintaining an open working face in another area of the site to take residual waste from the mining operations, stockpiles and processing locations).
- Estimate the soil fraction that can be recovered by waste screening for each mound.
- Estimate the quantity of screened waste requiring disposal assuming different scenarios (i.e. shredding residual waste, no shredding, and percentage of metal material recover).
- Review and assess landfill gas and emissions monitoring data for the Old Landfill such as gas vents data (if available) and surface emission scan reports to estimate areas of higher odour potential within the Old Landfill.
- Identify concerns with waste types, odours, etc. for each mound.
- Identify the equipment required for mining operations.
- Review best practices from other landfills.
- Identify environmental considerations and mitigation measures (e.g., for odour).
- Estimate costs.

4.0 Assumptions

- No field investigations will take place as part of this scope of work.
- We will make up to five (5) phone calls to other landfills to discuss their experience. Each call will be no longer than 30 minutes in length and the calls will be conducted by Dillon's Landfill Mining technical lead.
- Assessment of waste type and quantities will be based on available background information.

5.0 Deliverable

We will deliver a Draft Report of the Landfill Mining Desktop Assessment for Waste Connections review. Following review and comment of the draft report, we will finalize and submit the Final Report.

6.0 Budget

The budget will be presented under a separate cover.

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WASTE CONNECTIONS OF CANADA (WASTE CONNECTIONS)

Noise Work Plan (Final)

Ridge Landfill Expansion EA

September 2018 – 15-2456

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1.0 Project and Work Plan Overview

This Noise Assessment work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment and Climate Change (MOECC) in May of 2018.

Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

The Ridge Landfill has been in operation since 1966 and was previously expanded in 1999. Waste Connections owns 340 hectares (ha) of land at the Ridge Landfill. The existing Landfill Site Area, which is permitted by an ECA from the MOECC for waste management and environmental work purposes, is 262 ha. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the Landfill Site Area. As of December 2017, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate.

The current approved capacity for the Ridge Landfill is 21 million cubic metres (m3). The site is approved to accept a maximum of 1,300,000 tonnes of waste per year (the MOECC approved annual waste disposal rate). The EA does not propose to increase the maximum annual fill rate (this would remain as-is); however, Waste Connections is seeking the EA to increase the life of the facility for a 20 year planning period, from 2022-2041.

The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to only the Municipality of Chatham-Kent.

This Noise Assessment work plan outlines the tasks to support the evaluation of alternative methods, and to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the Noise work, including protocols and/or standards to be adhered to for the work.

The Noise Assessment will seek to identify potential noise impacts related to the proposed landfill expansion. The objectives of the noise assessment are as follows:

- Establish the baseline noise conditions off-site and along the haul route. This will consist of traffic noise modelling and/or long-term ambient noise measurement.
- Determine the potential noise impact associated with the proposed expansion for the preferred alternative.

The existing and potential future use noise receptors in the vicinity of the landfill will be confirmed for the noise assessment purposes. For each alternative, the potential noise impact at the nearby receptors will be assessed qualitatively and the results will be summarized in a matrix. The alternatives will be ranked based on the expected noise impact and the number of receptors that would be potentially impacted.

For the preferred alternative (i.e., one final alternative design), a quantitative analysis consisting of predictive acoustic modelling will be completed. The predicted receptor noise levels will be compared against applicable noise criteria set by the Ontario Ministry of the Environment and Conservation and Parks (MOECP). If the predicted levels exceed the applicable criteria, Dillon will advise on potential noise mitigation options that can be implemented for the site.

2.0 Noise Assessment Scope of Work

The proposed expansion of the landfill is expected to include changes to site layout, including the locations and footprint of active areas / cells. As such, the proposed expansion has the potential to impact the noise environment at the receptors in the vicinity of the landfill (the site).

2.1 Study Areas

For the purposes of the Noise Scope of Work, the study areas have been defined as follows:

- Off-Site Study Area ("off-site") – includes the properties closest to the landfill property, as these are the Points of Reception (PORs) for the noise impact assessment; and,
- Haul Route Study Area ("haul route") – encompasses lands immediately adjacent to Communication Road, Drury Line and Erieau Road which are identified as the designated haul routes for the site.

For noise impact, the assessment of compliance and mitigation requirements are conducted for the closest Points of Reception (PORs) to dominant noise sources. For this project, the closest PORs are expected to experience the maximum noise impact. For the haul route (between Highway 401 and the landfill site), the study area will be limited to the PORs adjacent to / fronting onto the haul route.

3.0 Existing Noise Environment

The landfill is located in a rural setting and based on previous acoustic assessment completed by Dillon for this site, the expected background noise levels are in the low to mid 40's dBA. Dillon will undertake a baseline ambient noise study to establish receptor noise environments along the haul route as well as in the vicinity of the landfill site. The baseline noise study will consist of traffic noise modelling and/or long-term (i.e., 48 hours) ambient noise measurement program.

4.0 Future Noise Environment

For determining the potential noise impact associated with the proposed expansion, and specifically for the preferred alternative design, Dillon will complete the following tasks:

- The existing and potential future noise receptors in the vicinity of the landfill site will be confirmed for use in the acoustic assessment. For the acoustic assessment, receptor mapping (existing and potential future ones) prepared/confirmed by other Dillon disciplines will be used. For each of the alternatives, proposed changes to the site operations and/or layout will be reviewed in the context of noise impact. For each alternative, the potential noise impact at the nearby receptors will be assessed qualitatively and the results will be summarized in a matrix. For a qualitative assessment, the expected change in noise impact will be classified as marginal, low, medium or high. This will be determined based on number of noise sources, vehicle traffic numbers, operating modes, and noise source – receptor distances. The alternatives will be ranked based on the expected noise impact and the number of receptors that would be potentially impacted.
- For the preferred alternative (i.e., one final alternative design), a quantitative analysis consisting of predictive acoustic modelling will be completed. Up to three (3) reasonable worst-case operating scenarios at the site will be determined and the associated noise sources will be modelled using CADNA/A. The noise propagation software will take into account, site layout, topography, ground and atmospheric absorption to predicted receptor noise impact associated with the site. The noise data for the onsite noise sources will be gathered from Dillon's in-house noise database and/or from equipment manufacturers. For each of the three (3) reasonable worst-case scenarios that are foreseen for the site, up to two (2) modelling iterations have been included in this proposal to account for any changes to the site layout / equipment for the selected alternative. For additional modelling, Dillon will advise the client of the level of effort prior to undertaking the work.
- The predicted receptor noise levels will be compared against applicable noise criteria set by the Ontario Ministry of the Environment and Climate Change (MOECC). If the predicted levels exceed the applicable criteria, Dillon will advise on potential noise mitigation options that can be implemented for the site. In collaboration with the client, Dillon will assist in developing operationally feasible noise mitigation plan(s) for up to three (3) reasonable worst-case operating scenarios at the site. For the purposes of this proposal, Dillon has considered up to six (6) modelling iterations to develop and optimize potential noise mitigation measures. If additional effort is required, Dillon will advise the client prior to undertaking the work.
- A stand-alone noise impact study will be prepared which will include all the assumptions and considerations used in the assessment as well as modelling results and findings of the study. If required, the report will also include a noise mitigation section that will provide the details of the proposed noise mitigation plan for the site. The report will be submitted to the client for review prior to finalizing. A

summary of the acoustic assessment for the landfill expansion will be prepared for inclusion in the main EA document.

4.1 Assumptions

- Work plan above does not account for public consultation events and responding to stakeholder questions
- Work plan does not account for attendance at meetings with regulator and/or client
- For the construction phase of the project, the activities will be reviewed against MOECC's publications NPC-115 (Construction Equipment), NPC-118 (Motorized Conveyances) and NPC-207 (Impulsive Vibration in Residential Buildings) and if required, qualitative assessments will be prepared.

Site specific information, including specifics of onsite operations, equipment and schedules, as well as noise data for dominant onsite noise sources (if not available from Dillon's in-house noise database) are to be provided by the client. Dillon's in-house noise database includes noise data for typical landfill equipment, including those used in the previous Ridge Landfill EA for increase fill rate (e.g., Bulldozer, Compactor, Excavator, Articulated Dump Truck, Grader, 3-axle Truck, Backhoe, Loader).

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WASTE CONNECTIONS OF CANADA (WASTE CONNECTIONS)

Socio-economic Impact Assessment Work Plan (Final)

Ridge Landfill Expansion EA

September 2018 – 15-2456-1200

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1.0 Project and Work Plan Overview

This Socio-Economic Assessment work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment and Climate Change, which is now the Ministry of Environment, Conservation and Parks (MOECP), in May of 2018.

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This Socio-Economic Assessment work plan outlines the tasks to support the evaluation of alternative methods, and to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the Socio-Economic Assessment work, including processes to be followed to complete the impact assessment.

The Socio-Economic Assessment will seek to identify potential social and economic impacts related to the proposed landfill expansion. The objectives of the Socio-Economic Assessment are as follows:

- Establish the baseline conditions on-site, off-site, along the haul route, and in the Municipality of Chatham-Kent with respect to socio-economic conditions related to the Ridge Landfill;

- Carry out an assessment of potential socio-economic impacts for each of the proposed landfill expansion site development alternatives (i.e., alternative methods); and
- Prepare a social and economic impact management plan for the purpose of mitigating potential impacts.

The scope of the Socio-Economic Assessment will include a careful review of existing background information, a review of input from the Municipality of Chatham-Kent, a review of public consultation input and the completion of interviews of potentially affected households and businesses (including agriculture). Based on the baseline information, an examination of potential socio-economic impacts for the proposed landfill expansion alternatives (i.e., alternative methods) will be completed. The criteria and indictors that will be applied to assess socio-economic impacts and mitigation recommendations are detailed in **Table 1** of this report. Identification of socio-economic impacts will be supported through input from a range of study disciplines including noise, air quality, transportation/traffic, visual and agriculture studies being undertaken as part of the EA.

Impacts and mitigation will be identified for four study areas. Three primary impact study areas have been identified and are illustrated in **Figure 1.** These include:

- **On-Site Study Area ("on-site")** – includes the property on which the current Ridge Landfill and proposed expansion is situated;
- **Off-Site Study Area ("off-site")** – encompasses the area within one kilometre of the proposed fill area limits. The Off-Site Study Area would be used to conduct surveys of local residents to determine the impact of the preferred alternative method to those neighbours and businesses within 1 kilometre of the landfill. This group will also be part of economic considerations due to their proximity to the site; and,
- **Haul Route Study Area ("haul route")** – encompasses lands immediately adjacent to Communication Road, Drury Line and Erieau Road which are identified as the designated haul routes for the site. The designated haul route will not change as a result of the expansion.

A fourth study area of relevance for the socio-economic environment includes consideration of wider social and economic impacts and benefits for the Municipality of Chatham-Kent (referred to as the wider regional economy). **Figure 2** illustrates the extents of the Municipality of Chatham-Kent that is considered in the broader assessment of socio-economic impacts and benefits.

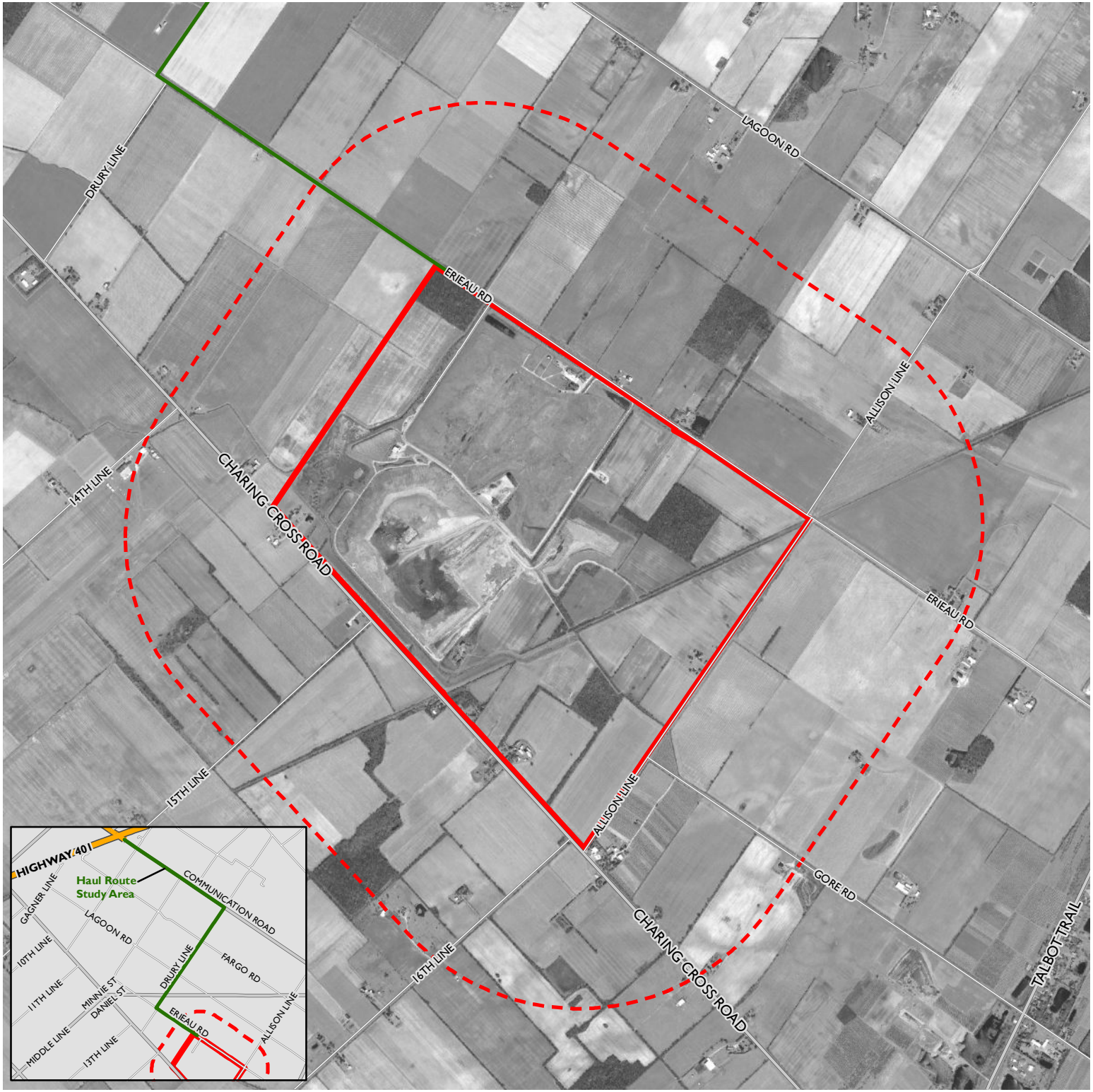
The study areas have been identified based on the potential for impacts to residents and businesses related to the proposed Ridge Landfill project. Impacts may vary depending on the location of the residents/business and depending on the issue. Different study areas will experience different impacts and ultimately have different mitigation recommendations. As such we have identified multiple study areas to capture the differences in potential impacts and provide recommendations for mitigation that reflect the different conditions in impact areas.

A comparative evaluation and ranking of the proposed alternative methods will be undertaken based on the results of the impact assessment with the objective of predicting the potential net effects associated with each alternative.

Following the selection of the preferred alternative method, a more detailed socio-economic impact assessment of the preferred alternative and the development of an impact management plan will be completed that will include considerations for land owner compensation and community benefits programs.

A summary of additional commitments for the socio-economic discipline is provided below.

Commitment	Reference to applicable section in EA or supporting document
The socio-economic impact assessment will assess potential effects within a regional study area that includes communities in the Municipality of Chatham-Kent.	Socio-economic work plan Figure 2. This will also be summarized in the EA (section TBD).



RIDGE LANDFILL

FIGURE 1: STUDY AREAS

Haul Route
On-Site Study Area
Off-Site Study Area

1:25,000

0 100 200 400 m

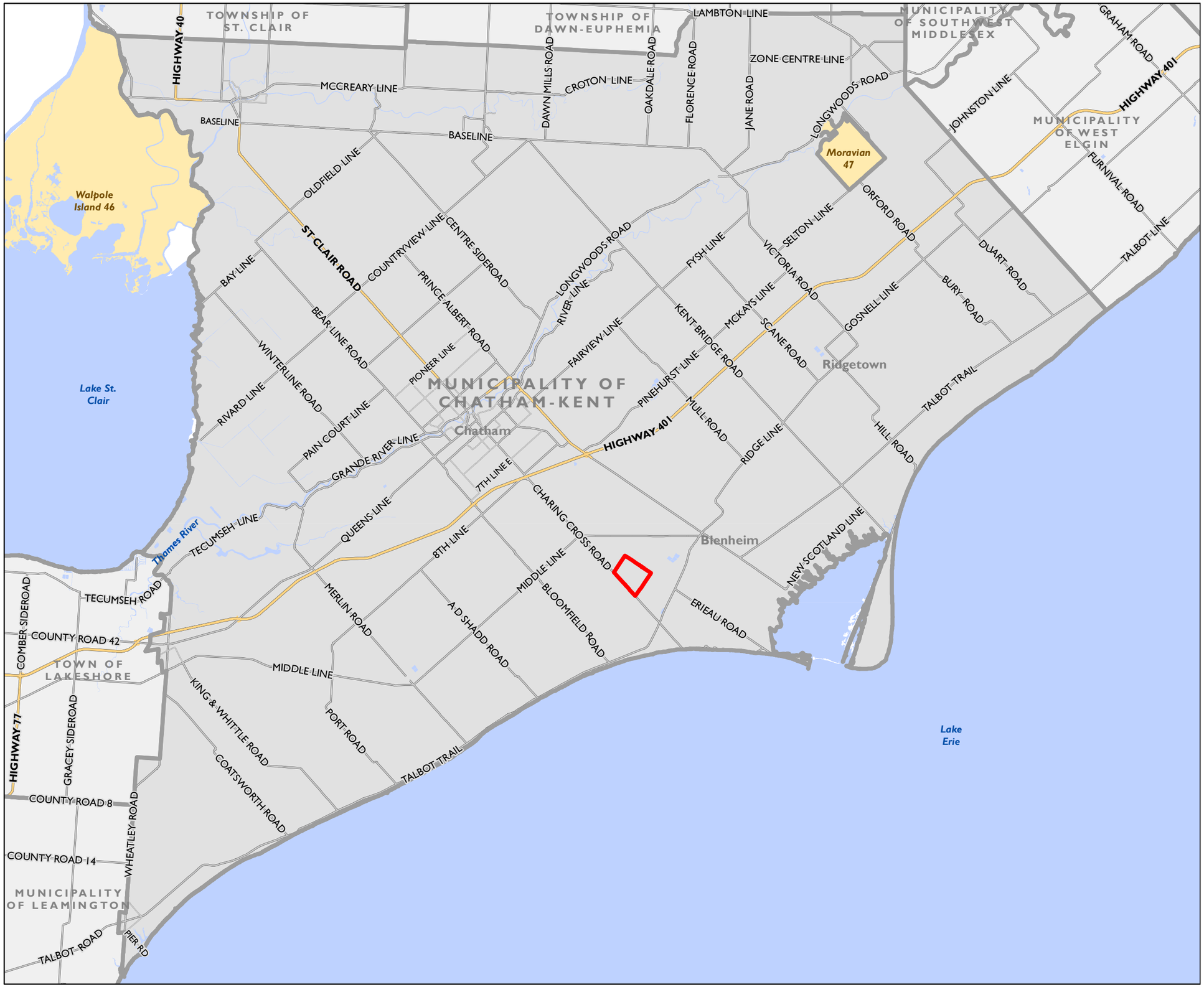
MAP DRAWING INFORMATION:
IMAGERY PROVIDED BY DIGITAL GLOBE/
DATA OBTAINED FROM MNRF

MAP CREATED BY: GM
MAP CHECKED BY: MB
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 152456
STATUS: FINAL
ATE: 6/20/2016

File Location: I:\GIS\141382 - Ridge Landfill\Mapping\Ridge Landfill Study Areas.mxd



RIDGE LANDFILL
PRE-ENVIRONMENTAL ASSESSMENT

FIGURE 2:
MUNICIPALITY OF CHATHAM-KENT, BROADER SOCIO-ECONOMIC STUDY AREA

Ridge Landfill

1:250,000
0 1 2 4 km

N
W E
S

MAP DRAWING INFORMATION:
DATA OBTAINED FROM MNRF

MAP CREATED BY: GM
MAP CHECKED BY: MB
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 152456
STATUS: FINAL
ATE: 2018-06-11

2.0 Socio-Economic Assessment Criteria

Based on the work completed for the Terms of Reference (ToR), the socio-economic impact assessment for the EA includes two assessment phases. The first is the assessment/evaluation of Alternative Methods of carrying out the proposed Project. The second is the impact assessment for the preferred site development alternative method.

For the evaluation of socio-economic environmental effects for each Alternative Method, the potential for effects will be identified based on a set of evaluation criteria. Preliminary evaluation criteria and indicators for the evaluation of Alternative Methods are presented in **Table 1**. Criteria are based on the approved ToR and focus on the issues that allow for differentiation between alternatives. The evaluation criteria and indicators will be confirmed during the EA and in consultation with the public, agencies and stakeholders. Criteria groups for the Alternative Methods evaluation include Socio-Economics (effects on residents and businesses), Agriculture, and Archaeology and Cultural Heritage.

Once the evaluation of the Alternative Methods is complete and the identification of a preferred site development alternative method is confirmed, a more detailed socio-economic impact assessment of the preferred method will be completed. Preliminary criteria for the preferred method impact assessment are presented in **Table 2** and are focused on specific impacts on-site, off-site within 1 km, and along the haul route**.** Criteria groups for the impact assessment include Socio-Economics (effects on residents and businesses), Regional Economy, Agriculture, Land Use, Archaeology, and Cultural Heritage. Many of the criteria are repeated from Table 1 with some additions, such as impact to property values, land use designations and regional economic benefits. In conjunction with the preferred site development alternative method impact assessment, this effort will include the identification of mitigation and monitoring measures to minimize potential socio-economic impacts.

It should be noted that to complete the socio-economic assessments, nuisance effects (traffic, noise, odour, dust, visual, etc.) will be identified in consultation with other disciplines. Receptors in the vicinity of the landfill expansion area (on-site and off-site) and along the haul route will be confirmed through mapping and site visits.

For the effects assessment of the preferred site development alternative method, the magnitude and duration of cumulative impacts to each resident/business in the vicinity of the landfill expansion area (on-site and off-site) and along the haul route will be identified. In order to account for the varying cumulative effects that combined nuisance impacts may have on any one property, and to recognize the differences between properties that experience several impacts and those that may experience one or two types of impact, an assignment of high (H), moderate (M), and low (L) cumulative impact ratings will be assigned to each residence/business. Considerations for assigning high, moderate and low ratings will include identification of whether direct interference with activities is likely for a given nuisance or whether the impact represents more of a nuisance rather than interference. For residences that may be

affected by nuisance impacts from both the landfill operations and the haul route, the cumulative impact rating will take into account both sources of impacts. The impact rating will also take into account the temporary or intermittent nature of some impacts.

Table 1: Alternative Methods – Socio-Economic Effects Assessment Criteria and Indicators

Criteria Group	Assessment Criteria	Indicators	Rationale	Data Sources
Socio-Economic	Potential for displacement of residents on-site	Number of residents displaced	Identify impacted residents required to move.	Personal communication; GIS Mapping; Public consultation activities;
	Potential for disruption (due to noise, dust, odour, litter and visual) of residents and/or businesses off-site	Number of occupied households/businesses disrupted and nature of disruption.	The degree of disruption will depend on the characteristics of the households/businesses, the extent of and proximity to the predicted nuisance effects.	Public consultation activities; Results of noise/air quality studies and visual assessment; Secondary sources
	Potential for disruption (due to noise, dust and traffic) of residents and/or businesses along the haul route for soil import or export	Number of occupied households/businesses disrupted; Number of trucks for soil import/export.	The degree of disruption will depend on the characteristics of the households/businesses, the extent of and proximity to the predicted nuisance effects, and the use of the route for other transportation purposes.	Public consultation activities; Results of other studies (noise, air quality, traffic); Secondary sources
	Potential for odour disruption as a result of landfill mining	Number of occupied households/businesses disrupted.	The degree of disruption will depend on the characteristics of the households/businesses, and the extent of and proximity to the predicted nuisance effect.	Results of noise/air quality studies; Secondary sources
	Potential for impacts on financial livelihoods	Potential for change in compensation Potential for change in financial contributions to the municipality and community trust.	If the landfill was no longer operating there may be changes to current compensation based on the terms of the existing community benefits and Ridge Landfill Trust agreements.	Public consultation Existing community benefits agreement

Criteria Group	Assessment Criteria	Indicators	Rationale	Data Sources
Agriculture[1]	Loss of agricultural products and employment on-site.	Area disturbed by landfill development; Number and extent of agricultural businesses impacted and employment at each.	The expansion will result in the permanent loss of agricultural lands.	GIS mapping; Personal Communication; Agricultural study
Archaeology	Potential for impact to as-yet undiscovered archaeological resources on-site	Potential for undocumented archaeological features within new landfill footprint on-site.	Potential to uncover archaeological resource(s) as part of expansion	Archaeological Assessment

Table 2: Preferred Expansion Method – Socio-Economic Impact Assessment Criteria and Indicators

Criteria Group	Assessment Criteria	Indicators	Rationale	Data Sources
Socio-Economic				
On-site	Loss of agricultural products and employment.[2]	Area disturbed by landfill development; Number and extent of agricultural businesses impacted and employment at each.	The expansion will result in the permanent loss of agricultural lands.	Interviews; GIS mapping; Agricultural Assessment
	Potential for displacement of on-site residences.	Number of residents displaced.	Impact to residents required to move.	Interviews; Public consultation activities

[1] The Agricultural Assessment Report will provide extensive investigation into the agricultural conditions, impacts and mitigation for the project. The Socio-Economic work will refer to the Agricultural report where required.

[2] The Agricultural Assessment Report will provide extensive investigation into the agricultural conditions, impacts and mitigation for the project. The Socio-Economic work will refer to the Agricultural report where required.

Criteria Group	Assessment Criteria	Indicators	Rationale	Data Sources
Off-site	Potential impacts to property values.	Home and property value in local area and comparable jurisdictions.	Expansion may or may not affect property values in the local area or along the haul route.	Review and evaluation of nuisance generating facilities; Comparison of property values between before and after previous expansion; Available literature
	Potential visual impacts.[3]	Number of occupied households with impacted views.	The degree of disruption will depend the extent of visual impacts for each impacted household.	Interviews; Public consultation activities; Results of Visual Assessment
	Potential nuisance effects to residences and businesses from odour, noise, litter and dust.	Number of occupied households and businesses disrupted.	The degree of disruption will depend on the characteristics of the affected residents/ businesses, the extent of and proximity to the predicted nuisance effects.	Interviews; Public consultation activities; Results of noise/air quality studies; Secondary sources
Haul Route	Potential nuisance effects to businesses and residences from dust and noise along the haul route	Number of occupied households and businesses disrupted.	The degree of disruption will depend on the characteristics of the affected households/ businesses, the extent of and proximity to the predicted nuisance effects.	Interviews; Public consultation activities; Results of noise/air quality studies
Regional Economy				
Off-site, Haul route and Municipality wide	Potential benefits to the wider economy in the Municipality of Chatham-Kent	Additional municipal revenue;	Expansion may result in benefits to the local and broader economy of the Municipality.	Waste Connections employment and spending estimates; Agency consultation;

[3] The Visual Assessment Report will provide extensive investigation into the agricultural conditions, impacts and mitigation for the project. The Socio-Economic work will refer to the Agricultural report where required.

Criteria Group	Assessment Criteria	Indicators	Rationale	Data Sources
		Additional employment opportunities (local and municipality wide)		Secondary sources; Municipal data.
Cultural Heritage				
Off-site	Potential disturbance of cultural heritage resources	Number of cultural heritage resources within the off-site study area and the change in the use/experience of those resources	Potential for the project to result in a change in the use/experience of cultural heritage resources	Cultural Heritage Assessment
Archaeology				
On-site	Potential disturbance of as-yet undiscovered archaeological resources	Area disturbed by landfill development	Potential to uncover archaeological resource(s) as part of expansion	Archaeological Assessment
Land Use				
On-site	Potential for changes to land use designations.	Change in existing land use designations	The expansion will result in the permanent change to the existing land use as designated in the municipal Official Plan	Official Plan Review; Agency consultation; GIS Mapping
	Potential for additional approvals or permits (e.g., zoning by-law)	Change in municipal and/or regional permitting or approvals as a result of landfill expansion	The identification of permits or approvals required from the local municipality and/or Region to ensure that the landfill expansion is in conformity with municipal plans and by-laws.	Agency consultation; Official Plan and Zoning-By-law Review

2.1 Data Collection

To complete the Alternative Methods evaluation and the preferred method impact assessment, data collection for the Socio-Economic Impact Assessment will include the following:

- review background data, including previous Ridge Landfill EA reports and Ridge Landfill annual reporting;
- review of secondary sources, such as Statistics Canada data and reports, MOECP records, municipal planning/land use/strategic planning documents and land use/development activity; local and municipal business directories;
- confirm existing municipal assessment roll information and mapping to identify property owners, as well as potential new receptors, within the off-site study area, along the haul route and within the study area;
- undertake socio-economic interviews of residents and businesses on-site, off-site (within 1,000m of site) and along the haul route. The purpose of the interviews will be to gather baseline information regarding potentially affected properties and people. Interviews will be conducted in-person through door-to-door visits and by arranged meeting as appropriate;
- undertake interviews with property owners within the off-site study area who do not reside on their property (non-resident owners). The interview questions will be mailed to property owners with the purpose of identifying the nature of their use of the property and any future plans they may have for the property;
- information and findings of other disciplines to assist in the characterization of the existing socio-economic environment and determine potential effects resulting from the Project, as well as mitigation measures to address such potential effects;
- information received through public comments received through public engagement activities;
- review of public input/complaints that Waste Connections has received over the last few years regarding existing landfill operations;
- review of municipal financial contributions by Waste Connections and the impact the Ridge Landfill operation has on municipal finances and local and regional employment (including economic spin-offs); and,
- review of how Waste Connections community financial contributions have been used and the benefits that have resulted from these contributions.

Specific correspondence related to participation in interviews will be prepared and provided to residents and businesses in the study area. The interview questions will be identified in consultation with Waste Connections. During the data collection phase, two (2) attempts at in-person interviews will be made, along with a follow-up call/letter as necessary.

2.2 Other Socio-economic Input

Other technical disciplines will be involved in establishing baseline conditions and conducting the associated effects assessment. These include:

- Cultural Heritage;
- Archaeology;
- Agriculture;
- Indigenous Peoples and Traditional Use of Land;
- Air Quality;
- Noise;
- Visual Impacts; and,
- Transportation.

The results of these assessments will inform the Socio-economic Impact Assessment and assist in the identification of mitigation measures as necessary to address potential effects.

3.0 Impact Management

Standard and customized (site specific) mitigation measures will be developed for the Project to minimize potential adverse Project-related effects. These will be further described in the EA. For example, mitigation as part of typical operating practices may include limited hours of operation, daily cover of waste, security fencing around the perimeter of the site, as well as leachate and gas emission management systems that are installed, monitored and maintained in accordance with provincial regulations. Mitigation measures will be developed in consultation with the public, stakeholders and interest groups, agencies, and Indigenous Peoples, as applicable. The Report will also identify potential effects resulting from the Project and consider appropriate avoidance, mitigation and monitoring options. Agreed upon avoidance, mitigation and monitoring options will be identified in contract specifications to be adhered to by Waste Connections staff and contractors.

As indicated in **Section 1.1** the socio-economic impact assessment will also include an assignment of high (H), moderate (M), and low (L) cumulative impact ratings to be assigned to each residence/business. Assignments of high, moderate and low will inform the impact management and mitigation program.

4.0 Reporting

The Socio-economic Impact Assessment Report will be structured based the major components of the socio-economic environment identified in Section 3, using the criteria and indicators to address

potential socio-economic effects resulting from the Project. The assessment of social and economic effects will rely on the input of other disciplines including air, noise, dust and visual to inform recommended avoidance, and/or mitigation and monitoring programs to address identified effects. Supporting information collected during the EA will be appended to the Socio-economic Impact Assessment.

DILLON CONSULTING

Ridge Landfill Expansion Environmental Assessment

Surface Water Assessment Work Plan (Final)

September 2018 – 15-2456-1200

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1.0 Project and Work Plan Overview

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This Surface Water Assessment work plan outlines the tasks to support the evaluation of alternative methods, and to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the Surface Water Assessment work, including protocols and/or standards to be adhered to while work is undertaken.

The Surface Water Assessment will seek to identify potential surface water impacts related to the proposed landfill expansion. The objectives of the surface water assessment are as follows:

- Establish the baseline conditions at the proposed site with respect to surface water resources;
- Carry out an assessment of potential surface water impacts for each of the proposed landfill expansion site development alternatives (i.e., alternative methods); and

- Prepare a surface water management plan for the purpose of mitigating potential impacts.

The scope of the Surface Water Assessment will include a careful review of background information together with a comprehensive field investigation program, followed by an examination of potential impacts for the proposed landfill expansion alternatives (i.e., alternative methods). The criteria and indictors that will be applied for the purpose of the assessment will include:

1. Changes in surface water quality (chemistry, benthics, and fish habitat).
2. Changes in surface water quantity (peak flows, flood conditions, streambank erosion, base flows).

A comparative evaluation and ranking of the proposed landfill expansion alternatives will be undertaken based on the results of the impact assessment with the objective of predicting the potential net effects associated with each alternative.

Following the selection of the preferred landfill expansion alternative, a surface water management plan will be developed with the goal of maintaining and preserving the overall health of the Howard Drain subwatershed and downstream surface water resources.

A summary of additional commitments for the Surface Water assessment is provided below.

Commitment	Reference to applicable section in EA or supporting document
Waste Connections commits to developing the EA Surface Water work plan with the MOECP's Southwest Region Surface Water Specialist. This will include a discussion of surface water sampling locations.	Surface Water work plan (all). Sampling locations are discussed in Section 4.1.3. This will also be incorporated into the EA (Section TBD).
Impact assessment criteria for surface water will include water chemistry, fish and bethics.	Surface Water work plan Section 3.0.
Waste Connections' approach to surface water management is to mitigate surface water quantity/quality impacts to meeting pre-development conditions at the surface water release point to the Howard Drain. As such, each alternative method will be evaluated on its ability to release pre-development flows downstream, i.e., baseline conditions.	Surface Water work plan Section 3.0 and 4.2.2. This will also be incorporated into the EA (Section TBD).
The conceptual design/locations for stormwater management will be incorporated into the site development and the impact assessment of the preferred alternative.	Surface Water work plan Section 4.0. Design and Operations Report (Section TBD). This will also be incorporated into the EA (Section TBD).
The surface water technical studies will include the assessment of on-site drains and requirements under the *Drainage Act*, as needed. Waste Connections will also consult with the Municipality of Chatham-Kent for *Drainage Act* requirements as they pertain to planning approvals.	Surface Water work plan Section 4.1.6.

2.0 Study Purpose and Objectives

The purpose of the study is to complete a surface water assessment for the ***Ridge Landfill Expansion Environmental Assessment*** (EA) proposed by Waste Connections of Canada (Waste Connections). The surface water assessment involves both water quality (contamination, riparian rights) and water quantity considerations (flows, flooding, bank erosion).

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

i) 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.

ii) 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 Terms of Reference (ToR).

iii) Undertake an evaluation of any additional actions that may be necessary to **prevent, change or mitigate environmental effects**.

iv) 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.

v) Prepare monitoring, contingency and impact management plans to **mitigate the environmental effects** of the proposed undertaking.

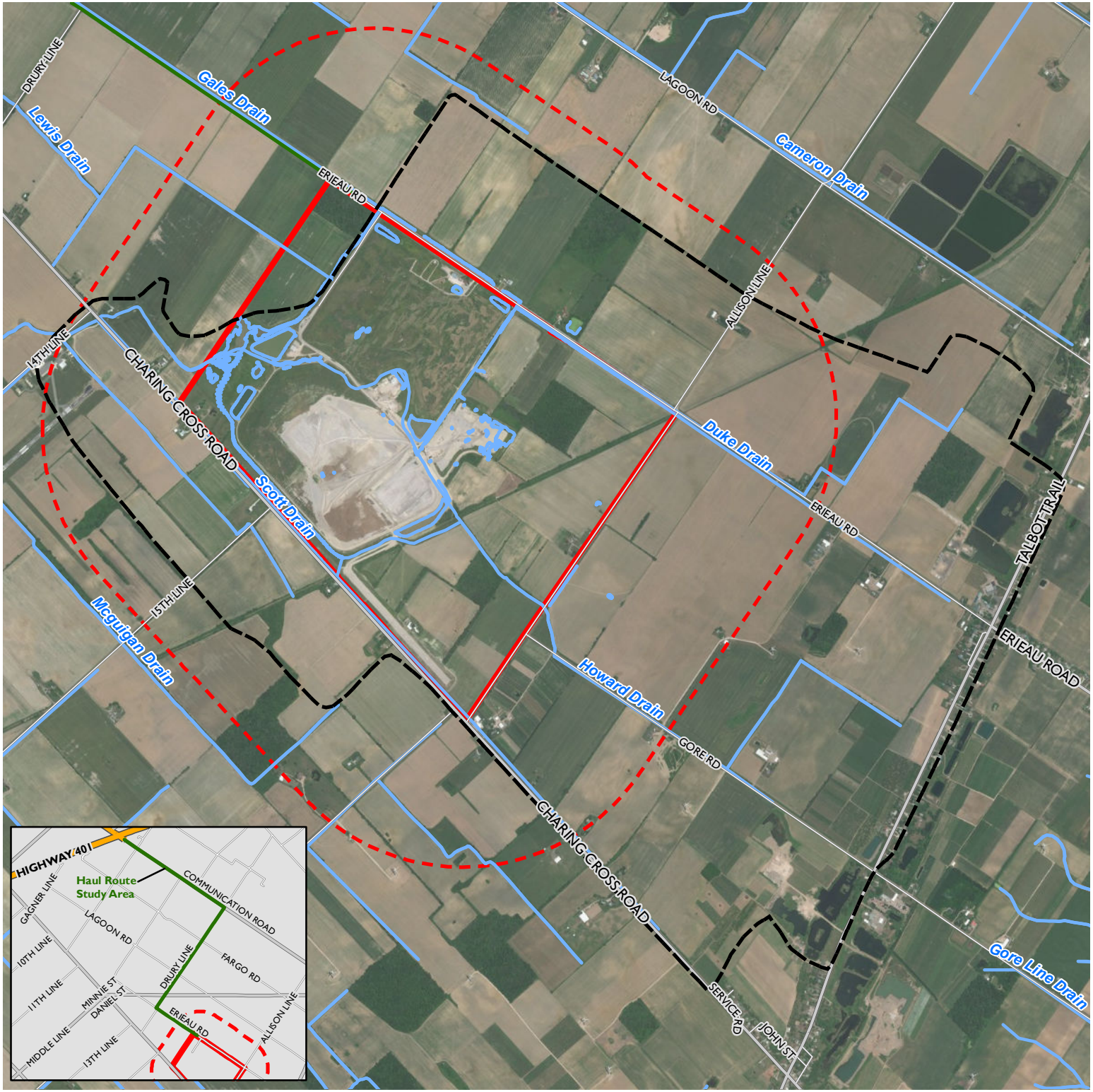
The surface water assessment will be undertaken in accordance with the amended ToR (May 2018), including the additional commitments made by Waste Connections throughout the stakeholder consultation process.

3.0 Study Area

For the purposes of the EA, three impact study areas include the following (as shown on **Figure 1)**:

- **On-Site Study Area** ("on-site") – includes the property on which the current Ridge Landfill and proposed expansion is situated;
- **Off-Site Study Area** ("off-site") – encompasses the area within one kilometre of the proposed fill area limits; and
- **Haul Route Study Area** ("haul route") – encompasses lands immediately adjacent to Communication Road, Drury Line and Erieau Road which are identified as the designated haul routes for the site.

For the purpose of the surface water assessment, the Study Area will extend to the limits of the watershed boundary of the Howard, Scott, Duke and McDowell Drains. This will enable a more comprehensive characterization of baseline conditions and assessment of potential surface water impacts at a watershed scale for the watercourses that transect the off-site Study Area (1 km from maximum fill area). The Study Area for the surface water assessment will not include the haul route.



RIDGE LANDFILL
Ridge Landfill Expansion EA
Surface Water Impact Assessment

FIGURE 1: STUDY AREAS

- Subwatershed Boundary
- On-Site Study Area
- Off-Site Study Area
- Haul Route
- Watercourse / Constructed Drain

1:27,000
0 250 500 1,000 m

MAP DRAWING INFORMATION:
IMAGERY PROVIDED BY DIGITAL GLOBE/
DATA OBTAINED FROM MNRF

MAP CREATED BY: GM
MAP CHECKED BY: MB
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 15-2456
STATUS: FINAL
ATE: 2018-05-29

File Location: G:\GIS\2014\141382 Ridge Landfill\MXD\Ridge Landfill Study Areas.mxd

4.0 Surface Water Assessment Criteria

The primary environmental assessment criteria, indicators and data sources for the surface water assessment are provided in **Table 1**. The assessment criteria, indicators, and data sources will be utilized for the evaluation of alternative methods and the assessment of net effects.

Table 1: Surface Water Assessment Criteria, Indicators, and Data Sources

Assessment Criteria	Indicators	Data Sources
Changes in surface water quality	• Temperature • Water quality (i.e., suspended solids, metals, inorganics) • Benthos • Fish*	• MOECP published water quality data • Water quality monitoring data • Surface water quality program • Benthic community inventory • Fish habitat survey
Changes in surface water quantity	• Upstream flood levels • Downstream flood levels • Hydrograph timing/duration • Changes in baseflows • Streambank erosion potential • Ability to release post-development peak flows to downstream watercourses at or below pre-development conditions	• Topographic mapping and aerial imagery • Climate data • Soils and land use mapping • Previous drainage studies • Existing and proposed facility characteristics • Field work and results from other disciplines (e.g., Design and Operations). • Aerial photography & GIS mapping. • Past monitoring reports

*Aquatic investigations are proposed as part of the Biology work plan, which involves a detailed fish habitat assessment in Duke Drain and Howard Drain where they occur in close proximity to the proposed expansion works.

Furthermore, the surface water assessment is also intended to provide key input information/data to criteria that will be addressed through other impact assessment studies. Most notably, these include the following:

- Effects on any stream baseflow quantity/quality.
- Loss/disturbance of terrestrial resources.
- Loss/disturbance of aquatic ecosystems.

For each of the primary criteria to be addressed in this study, two periods will be considered in which potential environmental effects can occur:

1. **Operational Period** – the timeframe during which the waste disposal facility is constructed, filled with waste, capped and closed.
2. **Post-Closure Period** – the period following closure of the site to receive any waste (typically limited to operation of control systems, routine property maintenance and monitoring).

5.0 Surface Water Assessment

The assessment will seek to identify potential surface water impacts related to the proposed landfill expansion by completing the tasks described below.

1. Establish the baseline conditions at the proposed site and along receiving drainage system with respect to physical attributes (i.e., watercourses, hydraulic structures), hydrologic characteristics, water quality, and biologic integrity (benthic community).
2. Undertake an assessment of potential surface water impacts for each of the proposed landfill expansion site development alternatives (i.e., alternative methods).
3. Prepare a surface water management plan for the purpose of mitigating potential impacts to surface water resources, which will incorporate best practices for managing stormwater, together with monitoring and contingency planning.

The scope of the surface water assessment has been developed in accordance with Regulation 232/98 and is based on the applicable requirements and criteria prescribed in the *Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites* (January 2012).

The scope of work for the surface water assessment is based on the following understanding and assumptions:

i) Information related to the design and operation of the landfill under 'existing' and 'expanded' site conditions will be furnished to the study team, including site layout, landfill configuration, drainage system, SWM pond configuration and outlet rating curves, and historical surface water quality monitoring results.

ii) Additional surface water quality sampling and analysis will be required for the purpose of characterizing baseline conditions.

5.1 Baseline Assessment

5.1.1 Background Data Collection & Review

The background review will involve a desktop exercise completed at a broad spatial and temporal scale to gain a comprehensive understanding of the recently completed studies and relevant supporting information.

The initial phase of the background review will involve a review of the surface water assessment that was completed as part of the 1997 EA. The focus of this review will be to identify pertinent sources of background information that was available at the time of that assessment, which will be followed by the compilation and review of current sources of background information, including:

- Topographic mapping;
- Aerial photography;
- Local climate data (temperature, rainfall, snow);
- Hydrometric stream flow data;
- Watershed/subwatershed reports and SWM studies;
- Surface water drainage mapping;
- Artificial drainage system mapping (i.e., tile drainage);
- Surficial soils mapping;
- Annual monitoring reports;
- Design and operations reports;
- Ministry of the Environment, Conservation and Parks (MOECP) water well records (WWRs) and permits to take water (PTTWs); and
- Historical data and reports on the quantity and quality of local surface and groundwater resources.

5.1.2 Proposed Field Program

Following the background review, field investigations will be undertaken to address data gaps and needs for the current EA. The field reconnaissance and inventory work will assist with the characterization of existing conditions, and will include the collection of the following information:

- Confirmation of overland flow routes, drainage boundaries, and outlet locations through field observations;
- Inventory of existing hydraulic structures (i.e., location, size, material) through field measurements and GPS data;
- Survey measurements of typical stream channel geometry (i.e., bottom width, side slopes, depth);
- Verification of land uses and surface cover through field observations;
- Confirmation of stream channel and floodplain characteristics through field observations;
- Water quality sampling (refer to *Section 5.3* for additional information); and
- Benthic community inventory (refer to *Section 5.4* for additional information).

The above-listed information will be supplemented with data collected as part of the ongoing climate and stream flow monitoring program that was initiated in the fall of 2015, which is comprised of:

1. Collection of local rainfall data and ambient temperature data at the site using climate station equipped with a tipping-bucket rain gauge, which is located near the site office;
2. Continuous measurements of temperature and water levels at 3 locations within the onsite drainage system, including:
   - Along the Howard Drain upstream of the flood control facility;
   - Along the Duke Drain upstream of the flood control facility;
   - At the outlet of the flood control facility; and
3. Stream gauging at the above locations.

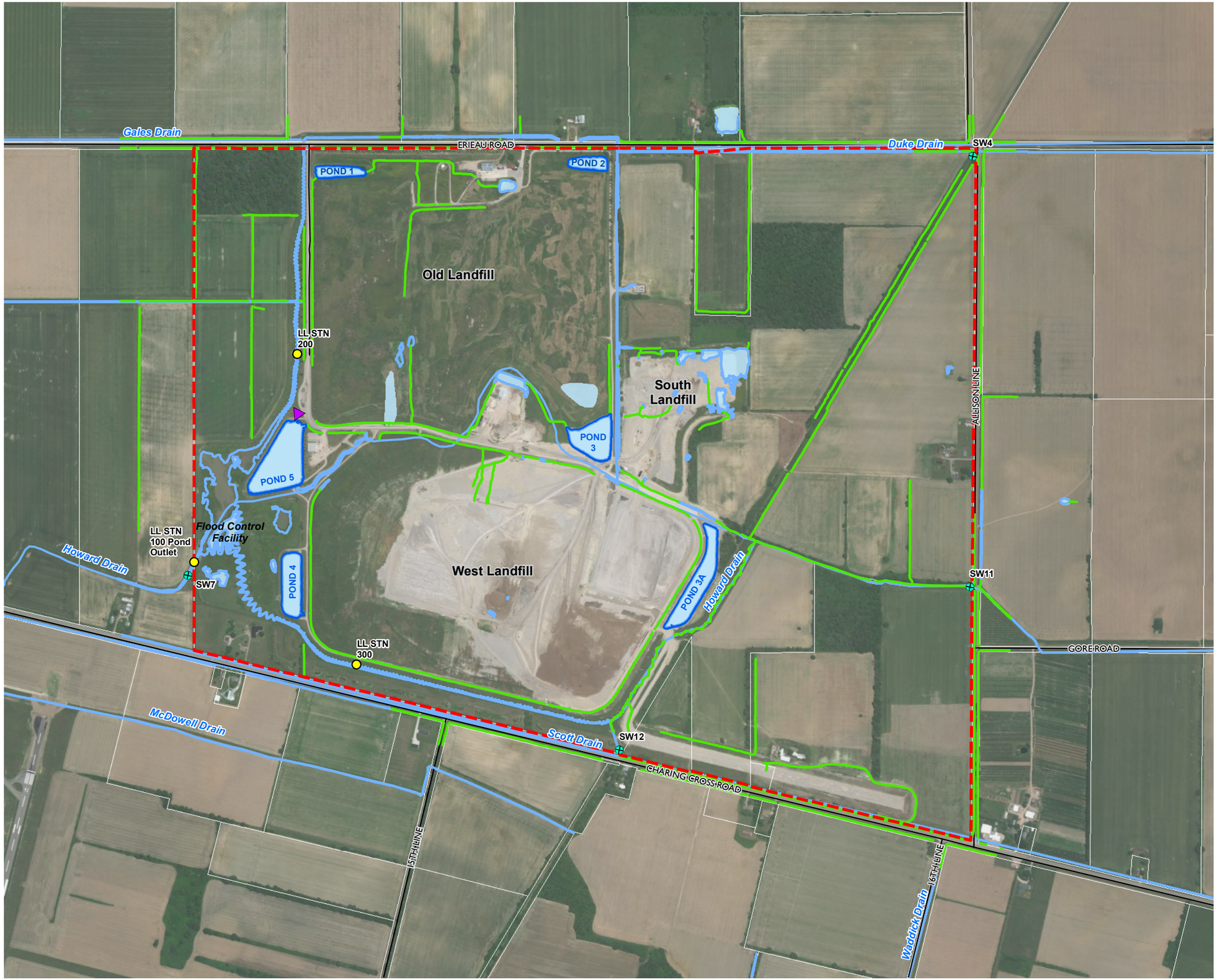
5.1.3 Surface Water Quality

An assessment of surface water quality will be undertaken to determine whether any impacts are anticipated for the indictor parameters (i.e., temperature, suspended sediment, nutrients, pesticides and herbicides) as a result of the proposed landfill expansion. The objective of the surface water quality assessment is to establish existing (baseline) conditions, which will ultimately assist with the identification potential impacts related to the proposed landfill expansion and mitigation strategies to address these impacts.

The assessment will involve a detailed review and interpretation of water quality data collected as part of the ongoing monitoring program at the Ridge Landfill. In addition, it is proposed that further surface water sampling is conducted to characterize baseline conditions. The proposed monitoring program involves surface water quality field measurements and sampling during suitable flow conditions at four (4) locations, including SW4, SW7, SW11, and SW12. A duplicate sample will be collected at location SW7 (identified as SW7A).

The surface water sampling program will involve up to eight (8) sampling events over a 12 month assessment period.

Information regarding the surface water quality sampling stations selected for the site assessment is provided in **Table 2**. The sampling locations are shown on **Figure 2**.



RIDGE LANDFILL

Ridge Landfill Expansion Environmental Assessment
Surface Water Impact Assessment

FIGURE 2: Sampling and Monitoring Locations

LEGEND

- Stream Gauge Location
- Benthic Invertebrate and Water Quality Sampling Location
- Climate Station
- Property Boundary
- Road
- Watercourse / Constructed Drain
- Ditch
- Waterbody
- Stormwater Management Pond
- Parcel

0 200 400 METERS

SCALE 1:10000

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNR, ESRI BASEMAPS, DILLON CONSULTING LTD

MAP CREATED BY: NR
MAP CHECKED BY: JW
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 15-2456
STATUS: FINAL
DATE: 3/7/2018

FILENAME: G:\GIS\2014\141382 Ridge Landfill\MXD\141382 Sampling Monitoring Locations.mxd

Table 2: Surface Water Sampling Locations

ID	Watercourse	Location	Rationale
SW4	Duke Drain	Allison Line and Concession Road 4	Location is representative of surface water quality in the Duke Drain upstream of the proposed expansion site
SW7/SW7A	Howard Drain	Downstream of Site boundary	Location is representative of surface water quality in the Howard Drain downstream of the proposed landfill expansion area.
SW11	Howard Drain	Downstream of Allison Line culvert	Location is representative of surface water quality in the Howard Drain upstream of the proposed expansion site
SW12	Scott Drain	Upstream of outlet to Howard Drain	Location is representative of surface water quality in the Scott Drain at its confluence with the Howard Drain.

The sampling parameters for the proposed surface water sampling program are listed in **Table 3**. The analysis results will be compared to the *Provincial Water Quality Objectives* (MOEE, 1994) or the Canadian Water Quality Guidelines, where applicable (e.g., chloride).

Table 3: Surface Water Quality Parameters

Laboratory Analysis Parameters		Field Parameters
• Alkalinity (as CaCO3) • Total Ammonia (as N) • Unionized ammonia (calculated) • Arsenic • Barium • Boron • Cadmium • Chloride • Chromium • Conductivity • Copper • Hardness (calculated) • Iron • Lead • Magnesium • Mercury	• Nitrate (as N) • Nitrite (as N) • Nitrate + Nitrite (as N) • Total Kjeldhal Nitrogen (TKN) • pH • Potassium • Sodium • Total Phosphorus • Total Suspended Solids • Total Dissolved Solids • Sulphate • Zinc • Biological Oxygen Demand • Chemical Oxygen Demand • Phenols A	• pH • Temperature • Dissolved Oxygen • Conductivity

The water quality program for the surface water assessment will be carried out in conjunction with the annual monitoring activities to avoid duplication of sampling activities. The results of the surface water quality assessment completed for the EA will include the compiled data from all sampling activities conducted over the course of the EA.

Please note that a 12 month water quality sampling program for the Surface Water Assessment was commenced in May 2017 and ended in May 2018. The program was advanced in the early stages of the EA to facilitate an assessment of baseline conditions prior to examining potential surface water impacts associated with the proposed landfill expansion alternatives. DOC was included in the list of parameters analyzed for three (3) of the sampling events over the monitoring period (in December 2017, March 2018, and May 2018). Notably, BOD was analyzed for all sampling events, which is an appropriate indicator that measures the presence of organic matter.

5.1.4 Benthic Community Inventory

Benthic community monitoring will be conducted to identify and inventory invertebrates within the watercourses that could potentially be impacted by the proposed landfill expansion. This task will involve taxonomic sorting and identification of the benthic macro-invertebrate composition to the genus level.

It is proposed that benthic samples should be collected at up to four (4) locations within the watercourses that transect the landfill site (Duke, Scott and Howard Drains). The benthic samples will be collected near the surface water sampling locations, including SW-4, SW-11, SW-12 (upstream of landfill site) and SW-7 (downstream of site). Three replicates will be collected at each location. Benthic sampling and analysis will follow the *Ontario Benthos Biomonitoring Network: Protocol Manual* (January 2007).

The sampling locations and sampling methods will be established based on channel characteristics and flow conditions at the time of the field investigations. Sampling activities will be conducted during the fall season.

5.1.5 Surface Water Flow Conditions

The assessment of surface water flow conditions will involve a combination of technical analyses to determine the baseline conditions relative to each of the easement indicators (i.e., upstream/ downstream flood levels, hydrograph timing/duration, changes in baseflow, and streambank erosion potential). A description of the tasks that will be completed as part of the flow condition assessment is provided in the following sections.

5.1.5.1 Hydrologic Modelling

The surface water assessment will include hydrologic modelling for the purpose of addressing flood hazards, riparian flow and erosion considerations. This will involve the development of a hydrologic model of the site and surrounding area to a reasonable point downstream of the discharge point, including the watershed areas for the Howard, Scott, Duke and McDowell Drains. The modelling exercise will be undertaken to determine peak flows and runoff volumes generated by existing land use conditions (existing site), based on topographic mapping, land use, surface cover, and drainage system details, and will include all existing SWM ponds.

5.1.5.2 Water Balance Assessment

A water balance is an annual water budget of which the main components are precipitation, surface runoff, infiltration and evapotranspiration. The objective of the analysis is to determine the potential changes to the natural balance of the hydrologic cycle, which could require mitigation to avoid/minimize offsite effects.

A monthly water balance model will be developed for the 'existing site' and 'expanded site' scenarios using the Thornthwaite method. Model inputs include long-term climate data (temperature and precipitation), soil water holding capacity, and latitude of location. The results of the water balance calculations will provide the monthly soil water surplus/deficit.

5.1.5.3 Hydraulic Analyses and Flood Hazard Delineation

Hydraulic analyses will be undertaken for the purpose of assessing flood conditions upstream and downstream of the site. To this end, hydraulic modelling will be completed using HEC-RAS, which is a river analysis computer program developed by the Hydrologic Engineering Centre for the US Army Corps of Engineers. The program computes a water surface profile (i.e., hydraulic grade line) along the length of the subject watercourse.

The hydraulic model for the 'existing site' (i.e., baseline conditions) will be created using the hydraulic model developed during the 1997 EA to reflect the post-closure scenario. Similar to the 1997 EA, the model will assess the Howard, Duke and Scott Drains – extending from upstream of Allison Line to downstream of Concession Road 14. The model will be reviewed and updated as necessary to represent 'existing site' conditions, with respect to stream channel geometry, roughness values, and boundary conditions.

To assess the potential impacts related to flooding effects within the study area, the model will be modified to account for hydraulic conditions under the 'expanded site' (i.e., post-closure) scenario, including the re-alignment of the Howard Drain.

The 'existing site' and 'expanded site' models will be simulated for a series of flow conditions (i.e., 2, 5, 10, 25, 50, 100 year return periods) for the purpose of establishing the design requirements for the proposed re-alignment of the Howard Drain, in addition to calculating the water levels and floodplain limits associated with the Regional Storm (250 year event) flow scenario.

A comparison of the floodplain for the different conditions within the study area will demonstrate the potential effect on the flood hazard associated with the facility expansion. Appropriate mitigation and management measures will then be examined to eliminate or ameliorate any identified potential effects.

5.1.6 Municipal Drain Modifications

Modifications to the existing onsite municipal drains may be required to facilitate the proposed landfill expansion alternatives (i.e., relocation of a segment of the Howard and Scott Drains). An assessment will be undertaken to determine the required modifications for each of the alternatives and identify the associated regulatory requirements under the *Drainage Act*.

5.2 Assessment of Potential Surface Water Impacts

The assessment of potential impacts to surface water resources will involve both water quality and quantity considerations, as outlined below.

5.2.1 Water Quality

A qualitative assessment will be conducted for each of the proposed landfill expansion alternatives to determine potential impacts based on the surface water quality indicators identified in *Section 3.0*. The objective of the assessment will be to predict potential impacts related to water temperature, sediment loading, and other parameters (i.e., metals, nutrients) on downstream watercourses. The assessment will involve an examination of water chemistry, benthic invertebrates, and fish habitat.

5.2.2 Water Quantity

Further to the hydrologic and hydraulic modelling carried out under the baseline assessment, additional analyses will be conducted to assess the proposed landfill expansion alternatives, as outlined below.

i) Develop a hydrologic model for each of the proposed landfill expansion alternatives, which will incorporate the landfill configuration and SWM system for the 3 expanded site options).

ii) The 'existing site' and 'expanded site' models will be simulated for a series of single-event scenarios (i.e., 2, 5, 10, 25, 50, 100 year return periods) and Regional Storm (250 year event) to calculate peak flows and runoff volumes..

iii) In addition, the models will be assessed under a continuous simulation scenario to determine streamflow characteristics resulting from the proposed landfill expansion for the purpose of assessing potential impacts related to streambank erosion.

iv) Update the hydraulic model to incorporate proposed modifications to the onsite municipal drain system (i.e., relocation) and simulate the model using flow conditions calculated for the landfill expansion alternatives.

Each of the landfill expansion alternatives will be evaluated based on the following assessment alternatives:

- Ability to release pre-development (i.e., existing condition) flows to the receiving drainage system;
- Upstream and downstream flood levels;
- Hydrograph timing/duration;
- Changes in baseflows; and
- Streambank erosion potential

The calculated peak flows will be used to establish the design flows and sizing for the internal drainage system, including the open ditches, culverts, and SWM ponds.

5.2.2.1 Climate Change Considerations

In addition to incorporating updated intensity-duration-frequency (IDF) statistics into the hydrologic analysis, an assessment of the largest ten storms events recorded in the region over the past five years will be undertaken. The objective of this assessment will be to account for climate change through an evaluation of the performance of the proposed SWM system for the preferred landfill expansion alternative, which reflects recent extreme rainfall conditions.

The assessment will include a discussion of potential contingency plans to address extreme weather events in the future should the frequency increase and potentially impact the capacity of the proposed SWM system.

5.2.3 Net Effects Assessment

A comparative evaluation and ranking of the proposed landfill expansion alternatives will be undertaken based on the results of the impact assessment. The purpose of this task will be to predict the potential net effects associated with each alternative.

5.3 Surface Water Management Plan

A surface water management plan will be developed for the preferred landfill expansion alternative, with the goal of maintaining and preserving the overall health of the Howard Drain subwatershed and downstream surface water resources. The integrated management plan will include recommended mitigation strategies, contingency measures, and future monitoring requirements.

6.0 Reporting

The surface water assessment report will be structured to address each of the major objectives set out in *Section 1.0* of this Work Plan, and will also provide a comprehensive account of the field investigations completed, the technical analyses conducted, the methodologies employed, the results obtained, and the conclusions and recommendations of the Study.

The documentation will also include updated base maps that will identify the sensitive features within the regional Study Area. The main report will be supported with a set of appendices that will present a thorough description of all elements of the surface water assessment. The surface water assessment report will be summarized for incorporation into the main EA document

DILLON CONSULTING

WASTE CONNECTIONS OF CANADA (WASTE CONNECTIONS)

Transportation Scope of Work Description (Final)

Ridge Landfill Expansion EA

September 2018 – 15-2456

Table of Contents

1.0 Project and Work Plan Overview

This Transportation Assessment work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment and Climate Change (MOECC) in May of 2018.

Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

The Ridge Landfill has been in operation since 1966 and was previously expanded in 1999. Waste Connections owns 340 hectares (ha) of land at the Ridge Landfill. The existing Landfill Site Area, which is permitted by an ECA from the MOECC for waste management and environmental work purposes, is 262 ha. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the Landfill Site Area. As of December 2017, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate.

The current approved capacity for the Ridge Landfill is 21 million cubic metres (m3). The site is approved to accept a maximum of 1,300,000 tonnes of waste per year (the MOECC approved annual waste disposal rate). The EA does not propose to increase the maximum annual fill rate (this would remain as-is); however, Waste Connections is seeking the EA to increase the life of the facility for a 20 year planning period, from 2022-2041.

The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to only the Municipality of Chatham-Kent.

Transportation analysis will be undertaken to assess the ability of the existing roads to accommodate the traffic generated by the expansion and continued operation of the landfill site. The analysis will assess the traffic operation and safety requirements of both off-site (adjacent roadway and haul routes) and on-site (operations for trucks, auto vehicles and potential conflicts with pedestrians and general operating equipment at the site access to Erieau Road) conditions. The assessment will focus on quantifying the impacts and needs of the preferred site development alternative method, and two resource recovery options (centralized processing at Ridge for all of Ontario, or centralized processing at Ridge for Chatham-Kent and surrounding 4 counties).

A summary of additional commitments for the Transportation assessment is provided below.

Commitment	Reference to applicable section in EA or supporting document
The transportation impact assessment of the undertaking will consider anticipated traffic associated with any additional diversion occurring at the site confirmed through the EA process.	Transportation work plan Section 4.0. This will also be incorporated into the EA (Section TBD).
Baseline collision data will be considered and analyzed as part of the overall safety assessment during the EA.	Transportation work plan Section 4.0. This will also be incorporated into the EA (Section TBD).
Waste Connections will consult with the Ministry of Transportation on the preparation of a traffic impact study that considers the impacts of the existing waste haul route, as defined in the Terms of Reference, on the Highway 401/Highway 40 interchange.	Transportation work plan Section 4.0. This will also be incorporated into the EA (Section TBD).

2.0 Study Purpose and Objectives

The purpose of the study is to complete a transportation impact assessment for the Ridge Landfill Expansion Environmental Assessment (EA) proposed by Waste Connections of Canada (Waste Connections).

In accordance with the Environmental Assessment Act, the objectives of the study are as follows:

i) 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.

ii) Carry out an evaluation of the transportation effects of the proposed undertaking, using the transportation assessment criteria and studies that have been established through the development of the Terms of Reference (ToR).

iii) Undertake an evaluation of any additional actions that may be necessary to prevent, change or mitigate transportation effects.

The transportation assessment will be undertaken in accordance with the amended ToR (May 2018), including the additional commitments made by Waste Connections throughout the stakeholder consultation process.

The analysis will be structured as follows:

- Initiate Traffic Assessment
- Data Collection
- Existing Environment
- Future Environment
- Identify and Quantify Alternative Site Conditions
- Assessment of Effects and Development of Mitigation
- Management and Documentation

The following describes the specific tasks required to address this scope of work.

3.0 Study Area

For the purposes of the Transportation Scope of Work, the study areas have been defined as follows:

- On-Site Study Area ("on-site") – includes the property on which the current Ridge Landfill and proposed expansion is situated; and
- Haul Route Study Area ("haul route") – encompasses lands immediately adjacent to Communication Road, Drury Line and Erieau Road which are identified as the designated haul routes for the site.

The On-Site Study Area will consider the potential for increased traffic due to potential diversion activities that could take place at the site (as committed to in the approved amended Terms of Reference). The haul route includes all of the intersections and access points that will need to be assessed, including road sections along Communication Road, Drury Line and Erieau Road, including ramp interchanges with Highway 401.

4.0 Work Plan

4.1. Initiate Traffic Assessment Task

- Confirm details of development proposal (hours of operation, types of vehicles, number of employees on site throughout hours of operation, general activity to/from site throughout hours of operation).
- Confirm analysis conditions (time periods of interest, horizon years).
- Confirm key intersections/ network elements for analysis.
- Consult with Ministry of Transportation to confirm approach to, and foundations for transportation assessment.
- Prepare final schedule, including identification of field work and transportation deliverables.

4.2. Data Collection

- Review available background documentation.
- Prepare inventory of existing geometric conditions on the study area road network. A site visit will be required to take inventory of study area infrastructure and equipment (lane arrangements, speed zones, traffic control, and site specific design characteristics/issues [sight distance, obstructions to visibility]).
- Collect existing intersection turning movement counts at key study area intersections, including Highway 401 interchange ramp terminals. Available counts will be obtained from municipality and province and supplemented as required (fill gaps, update older counts) with in-field counts

for a.m., midday, and p.m. peak periods (8 hours in total). Our work program assumes that data will need to be collected for a maximum of 7 key intersections along the haul route. Data collection would occur over a 2-week period.

- Collect daily traffic volumes on boundary roads (historical Annual Average Daily Traffic [AADT]). Our work program assumes in-field data will need to be collected for a maximum 3 stations (Erieau Road, Drury Line West of Middle Line and Drury Line East of Middle Line). Remaining area AADT's would be provided by respective governing agencies. Data collection would occur over a 2 week period, corresponding with data collection for the intersections.

4.3. Existing Environment

- Generate profile of existing transportation conditions.
- Prepare base mapping for significant transportation features and characteristics (i.e., volumes, lane geometry, haul routes, etc.).
- Assess performance of road network under existing conditions and verify traffic operations assumptions.

4.4. Future Environment

- Identify area developments that would contribute traffic to study area roads.
- Identify reasonable general background growth rate for study area roads.
- Identify planned changes to the study area road network for inclusion in the future baseline assessment. This will include the planned improvements to the Highway 401/Highway 40 interchange.
- Forecast background traffic conditions on study area roads without expanded site development.
- Assess performance of road network under future background (without expanded site development) conditions.

4.5. Identify and Quantify Alternative Site and Service Conditions

- Identify a trip generation rate for subject site operations and development.
- Forecast site trips.
- Develop trip distribution for site trips and assign trips to future road network.
- Forecast post-development traffic volumes (add site traffic and future background traffic forecasts) at study area intersections.
- The above tasks will be undertaken using a spreadsheet model to facilitate calculations related to trip generation, trip distribution, and assignment. This will be undertaken for a maximum of 3 options: 1 on-site concept (the preferred site development concept) and 2 resource recovery system alternatives (centralized processing at Ridge for all of Ontario, or centralized processing at Ridge for Chatham-Kent and surrounding 4 counties).

4.6. Assessment of Effects and Development of Mitigation

- Assess performance (level of service and safety) of study area road network with expanded site operations (off-site) for the peak hour of the design day (p.m. peak hour).
- Identify mitigation measures required to ensure network performance.
- Assess performance (level of service and safety) of on-site activity.
- A high level traffic safety review will be undertaken to confirm intersection and roadway link collisions rates, based on historical experience in the area.
- Assess on-site traffic circulation and storage issues as it relates to the operation of the Erieau Road accesses (main site and parking entrances).
- Identify mitigation measures required to insure network performance.
- Confirm feasibility of design elements for required modifications to road network and or site operations.
- For the purpose of costing, it has been assumed only the preferred site designs will be considered.
- Criteria will be defined for the transportation service evaluation. These criteria will include, but not necessarily be limited to, those identified below.

Criteria Group	Description / Rationale	Indicators	Data Sources
Transportation Service	Performance of the network along the haul route Levels of service and other performance metrics will provide the opportunity to assess and compare impacts of alternative traffic activity levels on- and off-site	• Level of Service – Volume to Capacity Assessment of in mid-block links and intersections • % truck traffic • Travel times • Collision Rates	• Observed traffic data • Calculations in spreadsheet models
(Input to) Air Quality	Level of Greenhouse Gas Emissions along haul route The greater the volume and the greater the delay for travel along the haul route, the more vehicle emissions will be realized.	• Vehicle kilometers of travel • Average vehicle speed along haul route • Vehicle hours of delay	• Observed traffic data • Calculations in spreadsheet models
(Input to) Noise	Exposure of receptors to volume. Increased volume and the truck component of that volume, will result in increased noise levels. Depending on the location of sensitive receptors, this may or may not be a significant differentiator.	• Peak hour and AADT estimates along haul route sections	• Observed traffic data • Calculations in spreadsheet models

- Transportation performance output will be used to inform other discipline assessments (i.e., on-site and off-site operations and maintenance costs, air quality, and noise, etc.)

4.7. Documentation

- Draft Transportation Appendix.
- Final Transportation Appendix.
- Conceptual / Functional Design Drawings for site and roadway modifications.
- Summarize transportation analysis and findings for input to the E.A.

5.0 Schedule

It is anticipated that the transportation assessment can be delivered within 10 weeks of the execution of the study initiation tasks (to draft report). This timeline is dependent on the timely provision of traffic data from public agencies and the finalization of on-site development alternatives to be assessed.

Elapsed Time from execution of Study Initiation:

- Data Collection – 3 weeks
- Existing Environment – 1 week
- Future Environment – 1 week
- Identify and Quantify Alternative Site Conditions – 1 week
- Assessment of Effects and Development of Mitigation – 3 weeks
- Documentation – Draft Report – 1 week

DILLON CONSULTING

WASTE CONNECTIONS OF CANADA (WASTE CONNECTIONS)

Visual Impact Assessment and Landscape Architecture (Final)

Ridge Landfill Expansion EA

September 2018 – 15-2456

Table of Contents

1.0 Project and Work Plan Overview

This Visual Assessment work plan has been prepared to support the environmental assessment (EA) for the Ridge Landfill expansion and is based on the commitments made in the final amended Terms of Reference (ToR) for the EA that was approved by the Ministry of the Environment and Climate Change (MOECC) in May of 2018.

Waste Connections of Canada (Waste Connections) is proposing an expansion of the Ridge Landfill in order to continue to provide long-term residual disposal capacity for the company's large IC&I customer base and as a regional and inter-regional waste management facility to serve the projected increase in population and economic growth in southern and central Ontario.

The Ridge Landfill has been in operation since 1966 and was previously expanded in 1999. Waste Connections owns 340 hectares (ha) of land at the Ridge Landfill. The existing Landfill Site Area, which is permitted by an ECA from the MOECC for waste management and environmental work purposes, is 262 ha. The area within which waste disposal is permitted, called the Waste Fill Area, is 131 ha or half of the Landfill Site Area. As of December 2017, it is estimated that the existing Waste Fill Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate.

The current approved capacity for the Ridge Landfill is 21 million cubic metres (m3). The site is approved to accept a maximum of 1,300,000 tonnes of waste per year (the MOECC approved annual waste disposal rate). The EA does not propose to increase the maximum annual fill rate (this would remain as-is); however, Waste Connections is seeking the EA to increase the life of the facility for a 20 year planning period, from 2022-2041.

The waste being landfilled is approximately 98% IC&I waste and 2% residential waste. As part of the EA approval, Waste Connections would agree to reduce their IC&I service area from all of Ontario to just southern and central Ontario, and their residential service area from Chatham-Kent and the neighbouring counties of Essex, Lambton, Middlesex and Elgin, to only the Municipality of Chatham-Kent.

This visual impact assessment work plan outlines the tasks to undertake an impact assessment once the preferred alternative method is determined. The following paragraphs provide a brief summary of the scope of the visual impact assessment work, including protocols and/or standards to be adhered to while work is undertaken.

2.0 Visual Impact Assessment Work Plan

The scope of the Visual Assessment will include a careful review of background conditions and data collection in the field, followed by an examination of potential impacts for the preferred landfill alternative. The criteria and indictors that will be applied for the purpose of the assessment will include:

- Landscape character units
- Visual absorption capacity
- Visual Quality
- Proximity
- Magnitude of visibility; and
- Visual sensitivity.

The visibility of the waste fill area and ancillary building will be assessed from a three kilometers (3 km) radius, specifically public roads including Middle Line, Erieau Road, Charing Cross Road, Drury Line and the Talbot Trail. GIS referenced photography will be undertaken from the locations where the fill area is expected to be visible. The visual impact is expected to be the most noticeable within 500 m in locations where berms and roadside hedgerows are not present.

In addition to the waste fill area, other facilities associated with managing the disposal process that are also visible, including the trucking entrance and truck queuing zone and support buildings, will also be assessed.

The work plan will include selecting five (5) locations (GIS referenced) that best represent the impacts from a range of vantage points. Three (3) before and after (photo-realistic) conditions photos will be prepared to illustrate the pre-expansion and post expansion conditions.

Mitigation measures including berms, planting and seeding will be overlain on the Preferred Site Plan to document how landscape screening can reduce the visibility of the facility. The Conceptual Mitigation Measures Plan will focus on localized impacts (within 500m), in locations where they are most impactful.

A summary of additional commitments for the Visual assessment is provided below.

Commitment	Reference to applicable section in EA or supporting document
The EA will determine the potential for negative impacts from the proposed expansion including potential impacts such as litter and visual impacts. To minimize these impacts, mitigation will be proposed which could include planting vegetation on berms.	Visual impact assessment work plan Section 3.0. This will also be incorporated into the EA (Section TBD).
Native species and/or beneficial plantings will be considered as part of landscape planning for the Mitigation Measures	Visual impact assessment work plan Section 3.0. This will also be incorporated into the EA (Section TBD).
The results of previously used strategies to reduce off-site visual impact of the landfill will be considered as part of the EA.	Visual impact assessment work plan Section 3.0. This will also be incorporated into the EA (Section TBD

3.0 Scope of Work

3.1 Description

As part of the environmental assessment of a preferred alternative, consideration of the proposed landfill expansion's visual impact on the surrounding landscape must be studied. The visual impact assessment will be undertaken in several stages:

1. Initiate Visual Assessment Task
2. Data Collection
3. Visual Impact Assessment of the Preferred Alternative
4. Development of Mitigation Measures Plan
5. Report and Recommendations

In addition to the evaluation of the potential visual impacts on the surrounding landscape, a recommendation of mitigation measures will be developed in order to limit the negative impacts of expanding the landfill site. A conceptual Mitigation Measures Plan for the site will be created to minimize where possible the site's overall visual impact and better integrate it into the surrounding landscape.

3.2 Study Area

For the purpose of the Visual Scope of Work, the study area has been defined as follows:

- Off-Site Study Area ("off-site") – this will address localized impacts (within 500 m from the landfill property) as well as the change in visibility within a 3 km radius of the site. The visual impact is the greatest within 500 m of the site specifically in locations where berms and hedgerows are not present.

This study area is based on best practices for conducting visual impact assessments and will be refined as needed based on feedback obtained during consultation activities.

3.3 Sources of Data

In order to perform the visual impact assessment, reliable and available data relating to the existing and proposed landfill conditions as well as the surrounding landscape must be collected. Civil 3D models of the existing and proposed landfill site configuration will be required to show landfill shape, size and height, while GIS shapefiles containing, at minimum, data relating to topographic (DEM is acceptable – minimum of 10m resolution), woodlot, roads, and water features of the surrounding area. Other sources of data including reference materials for methodologies for evaluating the contextual landscape be applied. The primary source of data will include on-site photography, field investigations, and visibility mapping.

3.4 Impact Assessment

The landscape visual impact assessment is largely based on qualitative concepts which are considered in combination with one another to determine the relative impact of a proposed landscape intervention. The process considers both the intervention itself, in this case the expansion of the Ridge Landfill, and the landscape within which it sits. It is important not only to identify the impact of the intervention on receptor points based on its proximity and magnitude, but also to consider the greater landscape's relative sensitivity, character and ability to absorb the impact. The following table summarizes some of the considerations which will form the basis of the visual assessment for this study.

Consideration	Definition	Assessment
Landscape Character Units	A zone or area within a landscape that has a common or distinctive visual quality; reflects a combination of landform and geology, vegetation, hydrological systems, land use and human settlement.	Determine the landscape character zones based on landscape features and attributes, land uses, and natural conditions identified in the visual quality assessment.
Visual Absorption Capacity	A calculation of the ability of a landscape to absorb physical development without resulting in a significant change in visual character or reduction in scenic quality.	Determined by comparing the identified landscape character units and their visual quality against the nature of the proposed intervention.
Visual Quality	An evaluation of the relative aesthetic quality and visual preference of a given landscape or landscape character unit. Qualities contributing to visual preference may include varied topography, natural diversity, the presence of water, the presence of significant cultural features, etc.	Visual preference is validated by consulting directly with local residents/visitors/special interest groups to develop an understanding of local community perceptions, values and preferences that hold importance to those who live in the vicinity of the intervention. Ranking of visual quality shall be based on the categories of high, medium, or low and will be determined based on a combination of best practices, professional knowledge of the evaluator and local input.
Proximity	The distance from which an intervention is from an impacted receptor point.	Determine the distance of receptor sites from the intervention can mean the difference between a new feature in the landscape being an intrusion vs. being accepted as a background feature of the overall view. Generally speaking, the farther the distance the lesser the impact.
Magnitude of Visibility	The measure of the extent to which an intervention may be seen from the surrounding area, from selected viewpoints or sensitive use areas.	Determine the overall size and scale of the intervention that is visible from sensitive receptor points.
Visual Sensitivity	The consideration of the combined evaluation criteria of the landscape character, visual absorption capacity, visual quality, proximity, and magnitude of visibility.	Determined by comparing all other criteria evaluated in this assessment. The visual sensitivity of particular areas shall be ranked based on categories of high, medium, or low.

4.0 Work Plan

1. Initiate Visual Assessment Task

    - Confirm details of proposed landfill development preferred alternative
    - Confirm study area
    - Prepare final schedule for field work and deliverables

2. Data Collection & Analysis

    - Review available background information
    - Collection of digital base information
    - On-site physical data collection (must be completed when trees are in leafless condition)
    - Confirm baseline visual conditions
    - Identify changes from 1997 EA
    - Confirm current visual impact assessment evaluation criteria

3. Visual Impact Assessment of Preferred Alternative

    - Confirm current baseline visibility mapping up to 3km out from landfill extents to illustrate the visibility of the existing landfill
    - Prepare visibility mapping up to 3km out from landfill extents to illustrate the visibility of the proposed landfill
    - Prepare visibility mapping up to 3km out from landfill extents in order to compare the level of increased visibility associated with landfill expansion
    - Identify areas of concern and new visual impact – select five (5) locations within 500m that best represent the overall impacts from all vantage points around the site
    - Confirm visibility mapping results on-site
    - Identify potential mitigation measures
    - Prepare visualization renderings – to illustrate potential visual impacts from areas of concern and mitigation measures
        - Prepare one set of visualizations from each of the three (3) identified viewpoints of concern that illustrate the pre expansion vs. post expansion conditions
        - Prepare one set of visualizations from each of the three (3) identified potential mitigation viewpoints that illustrate the pre mitigation vs. post mitigation conditions
        - Prepare one set of technical cross-sections to show the level of visibility from each of the three (3) identified viewpoint and illustrate the effectiveness of various mitigation measures

4. Development of Mitigation Measures Plan

   - Use the Site Plan for the Preferred Alternative develop a preliminary Mitigation Measures concept plan including berms, planting, seeding and protecting (where feasible) existing roadside vegetation.
   - Consider the use of native vegetation and ecologically beneficial plantings for the screening landscapes.
   - Identify measures to screen truck queuing and support buildings where feasible.
   - Receive comments from the client and other technical teams for input to refine the concept plan.
   - Finalize Mitigation Measures Plan

5. Report and Recommendations

   Prepare Visual Impact Assessment and Mitigation Measures Report including:

   - Visual impact assessment comparing the existing condition with the preferred alternative;
   - Summary of the contextual landscape character and magnitude of the proposed change in condition
   - Location of sensitive receptors within 500m radius that represent the nature of the impacts
   - Provide three (3) visualizations for viewpoints of concern that illustrate the pre expansion vs. post expansion conditions.
   - Provide three (3) renderings that illustrate the pre mitigation vs. post mitigation conditions.
   - Provide one set of technical cross-from each of the three (3) identified viewpoint and illustrate the effectiveness of proposed mitigation measures.
   - Provide a draft final report for client review.
   - Finalize Visual Impact Assessment and Mitigation Measures Report.