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Terrapure Stoney Creek Regional Facility Environmental Assessment

Draft Alternative Methods Report Assessment of Landfill Expansion Alternatives

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1. Introduction

1.1 Background

Terrapure Environmental (Terrapure) is preparing an Environmental Assessment (EA) for a proposed undertaking to increase the total approved capacity for post-diversion solid, non-hazardous industrial residual material at the Stoney Creek Regional Facility (SCRF, Site, See **Figure 1.1**) by 3,680,000 m^3, so that Terrapure can continue to operate its business and receive this material to support local industry. Terrapure has undertaken and received approval of a Terms of Reference (ToR) which included the identification of six Alternative Methods or landfill footprints (referred to as Alternatives and Options in this report) to increase the capacity at the SCRF by 3,680,000 m^3 of post-diversion solid, non-hazardous industrial residual material. The approved ToR included a brief overview of the Alternative Methods (i.e., footprint options) to be examined during the EA, with a commitment that further details on the Alternative Methods would be provided during the EA.

The purpose of this report is as follows:

- to present further details on the Alternative Methods;
- to present the assessment and evaluation of alternative landfill footprints; and,
- provide the rationale for the selection of the preferred landfill footprint.

2. Generation & Evaluation of Alternative Methods

2.1 Overview

A series of criteria and assumptions were established to guide the development of the Alternative Methods for the SCRF. These include Terrapure's projected waste disposal capacity requirements, and regulatory requirements relating to SCRF design geometry. In addition, O. Reg. 232/98 and the accompanying Landfilling Standards Guideline specify requirements and/or provide recommendations for key Site design parameters. Assumptions were also made relating to operational traffic levels, leachate generation rates, and aspects of Site design and operations. The criteria and assumptions used in the development of the Alternative Methods are discussed in the sections that follow. The conceptual designs of the Alternative Methods were developed to a conceptual level of detail and will be further developed during the technical design stage for the Preferred Alternative Method. The conceptual designs are based on the following characteristics:

- Site capacity and fill rate
- Footprint size
- Final contours and slopes
- Peak elevation and height relative to surrounding landscape
- Buffer areas between the SCRF footprint and the property boundary
- Setbacks to surrounding developments
- Infrastructure requirements
- Leachate management
- Stormwater management
- Gas management
- Traffic
- Operations

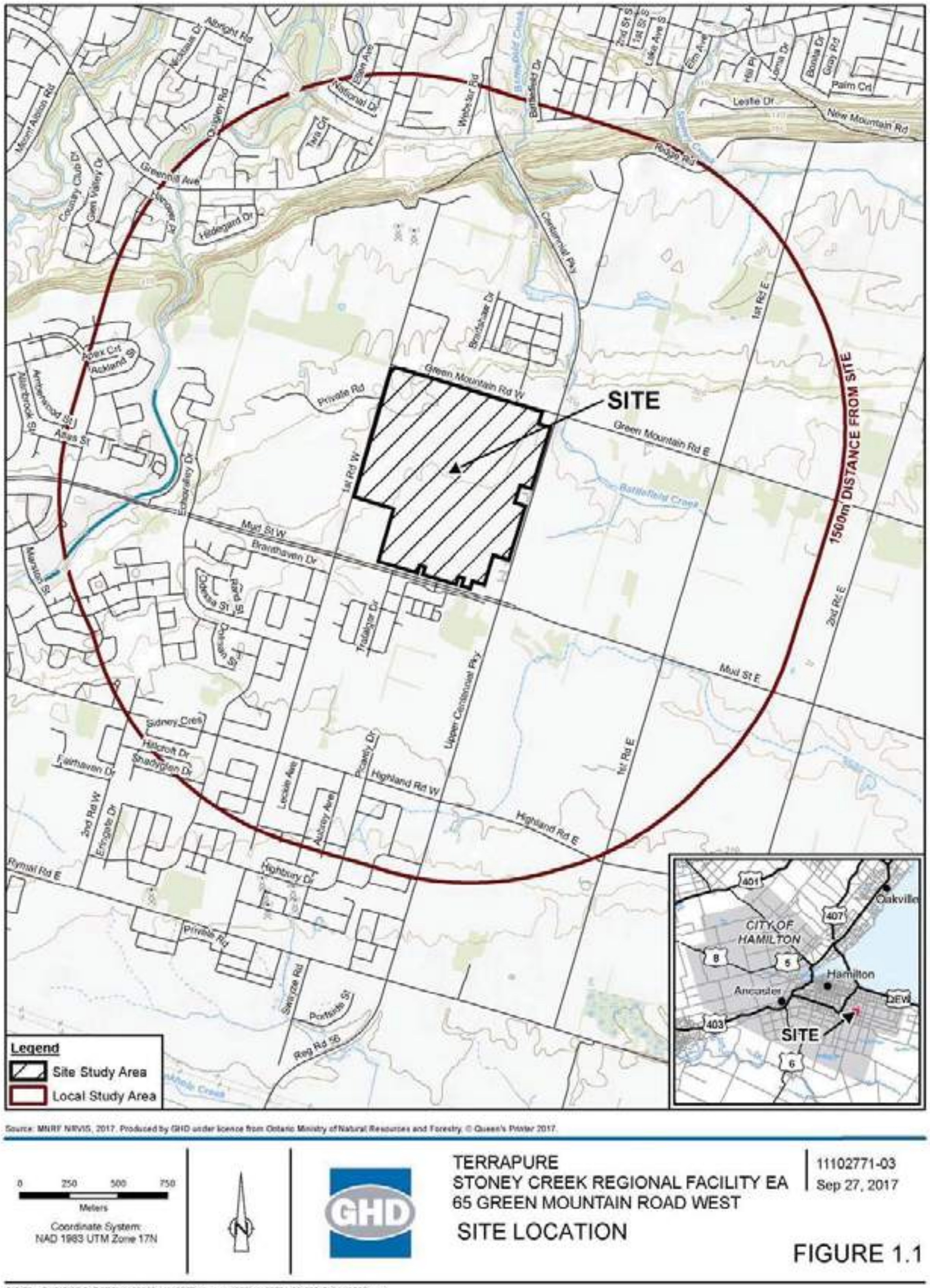


Figure 1.1 Stoney Creek Regional Facility – Site Location

Furthermore, the Alternative Methods were prepared in consideration of the requirements outlined in the following documents:

- Approved Amended Terms of Reference, SCRF EA, GHD, November 2017
- O. Reg. 101/07 – Waste Management Projects, under the *EA Act*
- O. Reg. 232/98 – Landfilling Sites, under the *Environmental Protection Act* (Last amendment: O. Reg. 268/11, October 31, 2011)
- Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites, Ontario Ministry of the Environment (Last revision: January, 2012)
- ECA No. A110302 for Waste, and ECA Nos. 6869-9EAT28 and 1907-99NSF2 for Industrial Sewage Works

These parameters and criteria are discussed in more detail in the following sections. The full Conceptual Design Report (CDR) has been included in Appendix A for reference.

2.2 Conceptual Design Basis

2.2.1 Site Capacity and Fill Rate

Currently, the SCRF has a total approved site capacity of 8,320,000 m^3 (6,320,000 m^3 for solid, non-hazardous residual material and approximately 2,000,000 m^3 for industrial fill), with an approved maximum annual volume of 750,000 tonnes of residual material. The expansion proposed under this EA is to increase the total approved capacity for post-diversion solid, non-hazardous industrial residual material at the SCRF by 3,680,000 m^3. No changes are being proposed to the maximum approved fill rate of up to 750,000 tonnes per year.

2.2.2 Footprint Size

As shown in **Figure 2.1**, the current approved footprint for the residual material is 41.5 ha, while the industrial fill material covers a footprint of approximately 17.6 ha. The maximum allowable footprint for the Site is limited by the size of the property currently owned by Terrapure. The property currently covers a total area of 75.1 ha, and is bounded by Green Mountain Road West in the north, Upper Centennial Parkway in the east, Mud Street in the south, and First Road West in the west. There are a few properties around the periphery of the Site that are privately owned and are not being considered for expansion of the SCRF footprint. Additional requirements surrounding buffers and setbacks from these properties are discussed further below.

Figure 2.1 Current Approved Footprint

2.2.3 Final Contours and Slopes

The regulatory requirements specify a maximum slope of four units horizontal to one unit vertical (4H to 1V, or 25%) and a minimum slope of 20H to 1V (5%), but allow variance where it can be shown to be appropriate with respect to slope stability, erosion potential, end uses, and infiltration requirements for groundwater protection. Slopes of a minimum 33.3H to 1V (3%) are currently approved at the SCRF. Final contours for the Alternative Methods were developed based on these slope requirements and in consideration of other aspects such as footprint configuration and stormwater management.

2.2.4 Peak Elevation and Height

The peak elevation of the SCRF refers to the highest point of the Site measured in metres above mean sea level (mAMSL), while the height of the SCRF is measured relative to the surrounding landscape. There are no regulatory requirements specifically constraining peak elevations or landfill height. However, the peak elevation is limited by the geometry of the Site and the maximum height is indirectly governed by regulatory requirements, to ensure that adequate foundation conditions exist and that slopes are stable. The suitability of the proposed height increase relative to the subsurface conditions will be evaluated in more detail, once a Preferred Alternative is chosen. Screening measures are currently in place at the Site to mitigate potential impacts from a visual and noise standpoint, including earth berms and fences. Additional screening measures will be implemented as required, based on the development of the Site and surrounding area.

2.2.5 Buffer Areas

Regulatory requirements specify a minimum buffer width of 100 metres (m) between the limit of the residual footprint and the Site boundary, but allow this to be reduced to 30 m if it is shown to be appropriate based on a site specific assessment (e.g., if the buffer provides adequate space for vehicle movements, ancillary facilities, and ensures that potential effects from the Site operations do not have unacceptable impacts outside of the Site). As shown in **Figure 2.1**, minimum buffer areas of 30 m are currently approved around the perimeter of the residual material area. These buffers extend to approximately 65 m in various areas along the east and south side of the Site, and up to approximately 130 m in the vicinity of the existing stormwater management facility in the northwest corner of the Site.

2.2.6 Setbacks to Surrounding Developments

In addition to the on-site buffers noted above that will be maintained in relation to the SCRF, additional buffer separation is achieved through road allowances and setbacks for other developments required in accordance with local planning by-laws. The closest residential dwellings to the south of the Site is situated approximately 60 m from the property line, while the closest residential dwelling (currently under construction) to the property line in the north is situated approximately 35 m away. The closest existing residential dwelling to the east is situated approximately 150 m from the property line, while the closest residential dwellings in the west are situated approximately 795 m from the property line.

2.2.7 Infrastructure requirements

The SCRF requires various infrastructure components in order to operate the Site, including:

- Site entrance and exit
- Scale facility
- Administrative facility
- Maintenance facility
- Groundwater management system
- Leachate management system
- Stormwater management system

The existing Site entrance from Upper Centennial Parkway and the existing Site exit to First Road West are anticipated to be maintained in their current locations. However, if they need to be relocated to accommodate other infrastructure or Site operations, Upper Centennial Parkway and First Road West will remain as the preferred connection points. The scale facility, administrative facility, and maintenance facility will be relocated as required, in order to accommodate development of the Site. This may include relocation to the buffer area, the industrial fill area, residual material area, or to an off-site location. The groundwater management system, leachate management system, and stormwater management system will be reconfigured as required to accommodate the Alternative Methods. Further details are provided in the sections that follow.

2.2.8 Groundwater Management

Groundwater is currently collected through a network of trenches and piping excavated within the bedrock below the base liner system. Groundwater drains by gravity to a pumping station in the southeast corner of the Site, where it is subsequently recovered for use in Site operations (i.e., dust control) or discharged to the sanitary sewer. The groundwater collection system trenches and piping will be extended as required underneath any new residual material areas. No changes are anticipated to the groundwater pumping station or the discharge to the sanitary sewer.

2.2.9 Leachate Management

Leachate is currently collected through a network of perforated pipes on top of the base liner system, under the residual material area, where it drains by gravity to a leachate pumping station in the southeast of the Site. Leachate is then pumped to the surface, where it is discharged to a gravity main that flows to the equalization pond within the adjacent closed west Site, before being discharged to the sanitary sewer under Mistywood Drive. However, Terrapure has started discussions with relevant stakeholders in order to establish a new connection to the sanitary trunk sewer currently under construction under Upper Centennial Parkway. Should a new discharge connection be established, it may allow the existing gravity main and equalization pond to be decommissioned.

The leachate collection system piping will be extended as required in any residual material areas where a new liner system is proposed. Alternate and/or additional locations for the leachate pumping station(s) and discharge location(s) may be required based on the Alternative Methods.

The leachate generation rate is an important parameter used in assessing the operational and environmental performance of a landfill site. Estimated leachate generation rates for each Option are summarized in Section 4, and are supported by the calculations presented in **Appendix A**. However, it should be noted that the leachate generation rate will vary over the operational and post-closure period of the Facility, and is influenced by factors including precipitation, degree of landfill development (e.g., area of landfill that is actively undergoing development versus areas where interim/final cover has been placed), final cover design, and other factors.

2.2.10 Stormwater Management

O. Reg. 232/98 requires that landfill sites be designed to protect surface water to specified performance standards based on the following principles:

- Divert or control clean surface water flowing onto the site.
- Control quality and quantity of runoff discharging from the site to control erosion, sediment transport, and flooding.

Under the current design, clean runoff is shed from the final cover into perimeter drainage ditches, where it drains by gravity to a series of ponds (i.e., sediment forebay and detention pond) in the northwest corner of the Site, before being discharged to the storm sewer under First Road West.

While the overall function of the stormwater management system is not expected to change, the location and alignment of the existing ponds and ditches may need to be relocated to accommodate the Alternative Methods. The outlet to the existing storm sewer under First Road West will remain under all Alternative Methods. The capacity of the existing stormwater management system will be confirmed against each Alternative Method, although significant changes to the capacity are not expected to be required, since the overall catchment area of the Site will remain largely unchanged.

The design of the final cover system will not change under any of the Alternative Methods, with each consisting of 0.60 m of compacted clay and 0.15 m of vegetated topsoil.

2.2.11 Gas Management

Because the SCRF does not accept waste capable of decomposing and generating gases, it has received a MOECC exemption[1] from the requirement to have a gas collection system (as stated in O. Reg. 232/98), based on supporting documentation, including a gas emission study and annual confirmatory monitoring. Under the current ECA for the SCRF, Terrapure is required to monitor for landfill gas and provide the results in the Annual Monitoring Report submitted to the MOECC by June 30th every calendar year. A Landfill Gas Assessment was conducted in 2011, demonstrating that very little gas is generated at the SCRF. Notwithstanding this, a commitment was made in the Approved Amended ToR that an update of the 2011 Assessment will be carried out as part of the SCRF EA, to determine the necessity, or lack thereof, of a landfill gas collection system being required. This assessment will be carried out once a Preferred Alternative Method (i.e., footprint) has been identified.

[1] Confirmed by MOECC in 2011 when the then owners of the site (Newalta) successfully applied for an exemption from a landfill gas collection requirement. Annual reports submitted by Terrapure identify the site as exempt from landfill gas collection requirements under O. Reg. 232/98.

2.2.12 Traffic

Vehicle traffic associated with the development of the Site is important in assessing the potential impacts of the Site on various receptors. Traffic levels were estimated based on the following:

- Each Alternative Method is projected to increase the total approved capacity for post-diversion solid, non-hazardous industrial residual material at the SCRF by up to 3,680,000 m^3
- Some Alternative Methods will also include the placement of up to 2,000,000 m^3 of industrial fill
- Although some material stockpiles currently exist on-site (i.e., liner clay, topsoil, aggregate), to be conservative, all construction materials are assumed to be imported from off-site
- Total vehicle traffic volumes were calculated based on assumed vehicle types and average capacities
- Traffic associated with staff vehicles or other Site operations is assumed to be negligible
- Traffic levels are kept within the approved limit of 250 vehicles/day

Estimated traffic levels for each Option are summarized in Section 4 and are supported by the calculations presented in **Appendix A**. However, it should be noted that traffic levels will vary depending on Site operations and construction scheduling. Traffic volumes will be further refined during the detailed impact assessment of the Preferred Alternative.

2.2.13 Operations

O. Reg. 232/98 requires that landfills be designed and operated to ensure that nuisance impacts are minimized, and the regulation requires that the proponent prepare a report describing all aspects of the operation, as well as maintenance procedures that will be followed. A key objective in planning Site operations is to minimize nuisance impacts, including noise, litter, vectors, dust, and odour. Typical operating practices relating to these issues include:

- Vehicles transporting waste to and around the Site are covered to prevent odour and dust
- All materials received at the Site are verified and recorded to ensure compliance with regulatory conditions
- On-site equipment is operated in such a manner as to minimize noise and visual impacts wherever possible
- All equipment required for the development, operation, or closure of the Site should comply with the noise levels outlined in applicable MOECC guidelines and technical standards
- All vehicles leaving the Site must drive through a wheel-wash to minimize track-out of mud/dirt
- The Site design includes screening features, such as fences, berms and tree plantings, which mitigate visual impact and noise

These operating practices will be common to all Alternative Methods. While these would not significantly influence the comparative analysis, they should nevertheless be considered in reviewing the Alternative Methods. Any modifications to the design and operations will be outlined during the detailed impact assessment of the Preferred Alternative.

3. Description of Landfill Footprint Options

The Approved SCRF ToR presented six Alternative Methods that have been refined and developed further for comparative analysis, and have been identified herein as Options 1 to 6. It should be noted that as committed to in the Approved SCRF ToR, the Status Quo or Do Nothing Option will be considered to assist in the assessment of Options 1-6. The Status Quo or Do Nothing option is represented as the currently approved footprint and has been included to represent what would happen if none of the six options were carried out. The 'Do Nothing' alternative has been considered as a benchmark (but not as a viable option to implement) against the Recommended Alternative Method as a way of measuring and comparing the environmental advantages and disadvantages. Further discussion is included in Section 9 of this report.

The intent of the Alternative Methods described below are to provide a maximum increase in capacity for post-diversion solid, non-hazardous industrial residual material pf 3,680,000 m^3 in at the SCRF.

The six Alternative Methods were identified in consideration of the criteria and assumptions outlined in Section 2, and based on agency and public input received during the ToR. These Options are described further in subsequent sections.

3.1 Description

3.1.1 Alternative Option 1- Reconfiguration

Option 1 is shown in **Figure 3.1** and has the following general attributes:

- The area at the SCRF currently approved for receiving industrial fill would be replaced with post-diversion solid, non-hazardous industrial residual material. As a result, the SCRF would no longer be approved to receive industrial fill with Option 1.
- The area at the SCRF currently approved for receiving residual material would remain unchanged.
- Option 1 would not include either a horizontal or vertical expansion.

3.1.2 Alternative Option 2 – Footprint Expansion

Option 2 is shown in **Figure 3.2** and has the following general attributes:

- The area at the SCRF currently approved for receiving industrial fill would remain unchanged. Therefore, the SCRF would still be approved to receive industrial fill with Option 2.
- The areas at the SCRF not currently approved for receiving either industrial fill or residual material would be expanded into, so that they would be able to receive post-diversion solid, non-hazardous industrial residual material.
- A minimum 30 m buffer would be established around the entire area for receiving industrial fill or post-diversion solid, non-hazardous industrial residual material.
- Option 2 would include a horizontal expansion, but not a vertical expansion. The peak height currently approved would remain unchanged.

3.1.3 Alternative Option 3 – Height Increase

Option 3 is shown in **Figure 3.3** and has the following general attributes:

- The area at the SCRF currently approved for receiving industrial fill would remain unchanged. Therefore, the SCRF would still be approved to receive industrial fill with Option 3.
- The area at the SCRF currently approved for receiving residual material would be expanded vertically, so that additional post-diversion solid, non-hazardous industrial residual material could be received.
- Option 3 would not include a horizontal expansion, but would include a vertical expansion, increasing the overall height of the area currently approved to receive post-diversion solid, non-hazardous industrial residual material.

3.1.4 Alternative Option 4 – Reconfiguration and Footprint Expansion

Option 4 is shown in **Figure 3.4** and has the following general attributes:

- Option 4 reflects a combination of Options 1 and 2. The currently approved area at the SCRF for receiving industrial fill would be replaced with post-diversion solid, non-hazardous industrial residual material. In addition, the areas at the SCRF not currently approved for receiving either industrial fill or residual material would be expanded into, so that they would be able to receive post-diversion solid, non-hazardous industrial residual material.
- The SCRF would no longer be approved to receive industrial fill, but only post-diversion solid, non-hazardous industrial residual material.
- A minimum 30 m buffer would be established around the entire area for receiving post-diversion solid, non-hazardous industrial residual material.
- Option 4 would include a horizontal expansion, but would not include a vertical expansion. The peak height currently approved would remain unchanged.

3.1.5 Alternative Option 5 – Reconfiguration and Height Increase

Option 5 is shown in **Figure 3.5** and has the following general attributes:

- Option 5 reflects a combination of Options 1 and 3. The currently approved area at the SCRF for receiving industrial fill would be replaced with post-diversion solid, non-hazardous industrial residual material. The entire area at the SCRF currently approved for receiving either industrial fill or post-diversion solid, non-hazardous industrial residual material would be expanded vertically, so that additional residual material could be received.
- The SCRF would no longer be approved to receive industrial fill, but only post-diversion solid, non-hazardous industrial residual material.
- A minimum 30 m buffer would be established around the entire area for receiving post-diversion solid, non-hazardous industrial residual material.
- Option 5 would not include a horizontal expansion, but would include a vertical expansion. The peak height currently approved would be increased.

3.1.6 Alternative Option 6 – Footprint Expansion and Height Increase

Option 6 is shown in **Figure 3.6** and has the following general attributes:

- Option 6 reflects a combination of Options 2 and 3. The existing approved area at the SCRF for receiving industrial fill would remain unchanged. Therefore, the SCRF would still be approved to receive industrial fill with Option 6.
- The area at the SCRF currently approved for receiving post-diversion solid, non-hazardous industrial residual material would be expanded vertically, and the areas at the SCRF not currently approved for receiving either industrial fill or post-diversion solid, non-hazardous industrial residual material would be expanded into, so that they would be able to receive post-diversion solid, non-hazardous industrial residual material.
- A minimum 30 m buffer would be established around the entire area for receiving industrial fill or post-diversion solid, non-hazardous industrial residual material.
- Option 6 would include both horizontal and vertical expansions, thus increasing the currently approved peak height

3.2 Summary

A summary table comparing the details of each of the Options is presented in **Appendix A (Table 4.1)**.

Figure 3.1 Option 1 - Reconfiguration

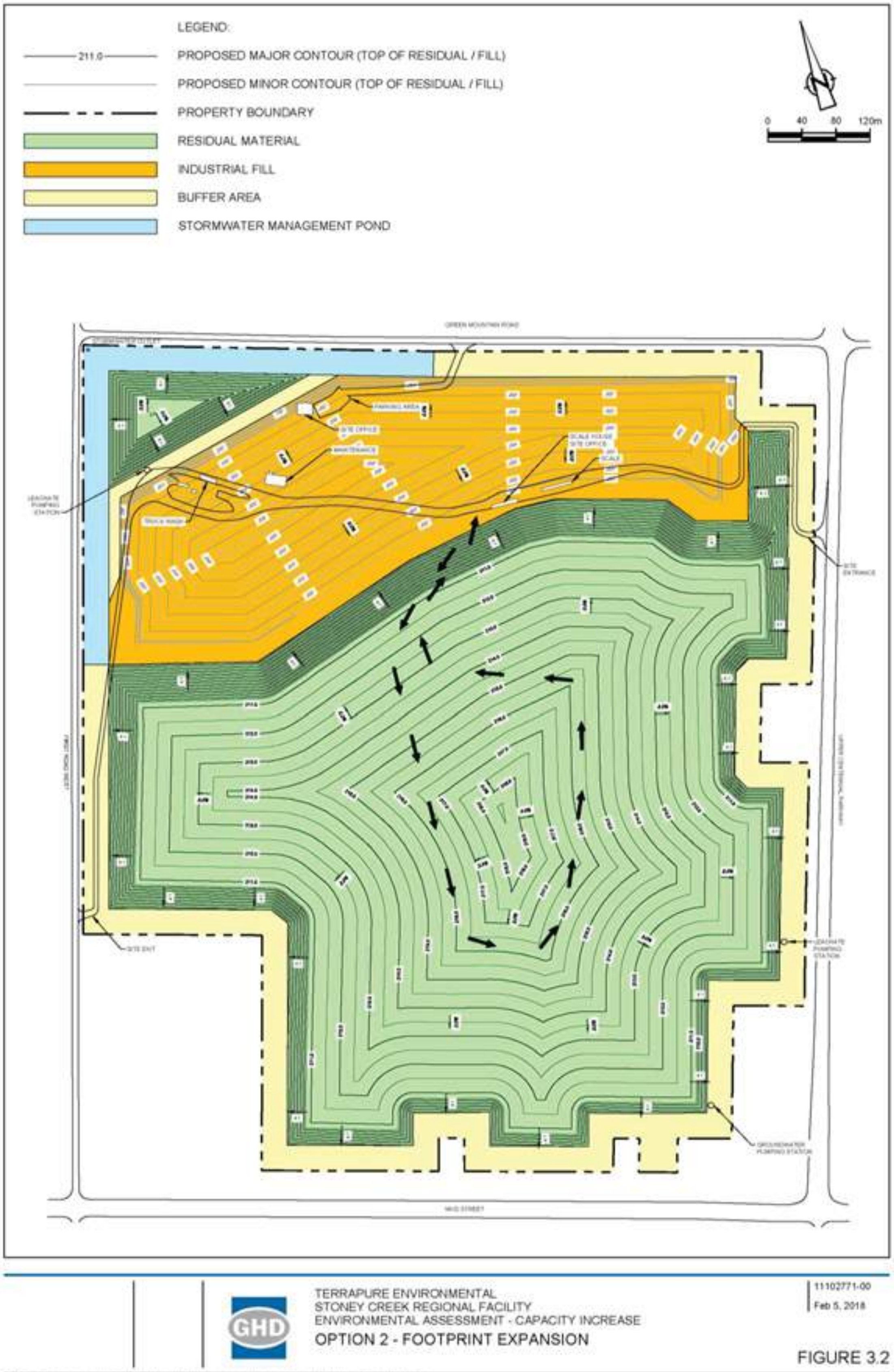


Figure 3.2 Option 2 – Footprint Expansion

Figure 3.3 Option 3 – Height Increase

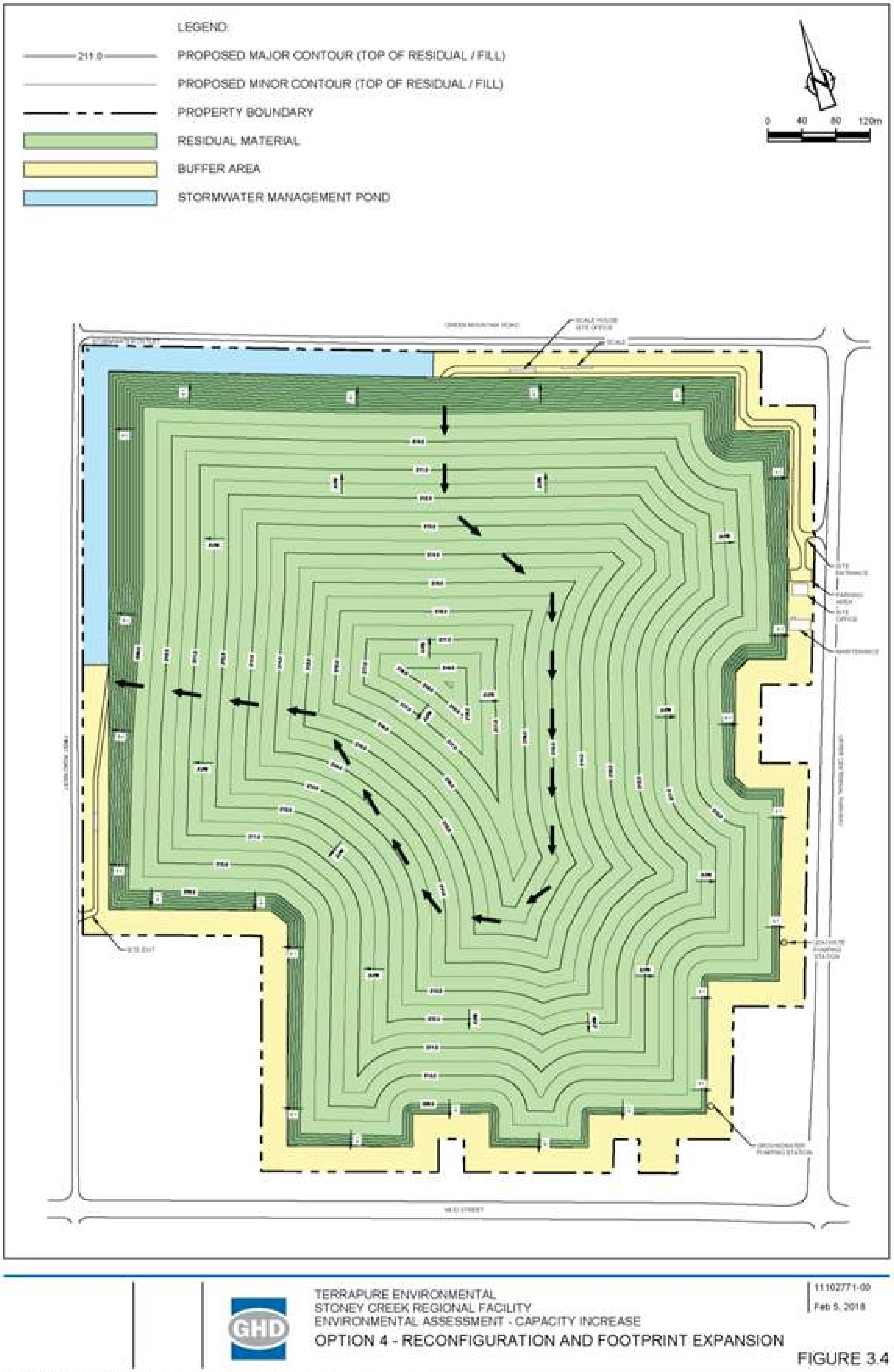


Figure 3.4 Option 4 - Reconfiguration and Footprint Expansion

Figure 3.5 Option 5 Reconfiguration and Height Increase

Figure 3.6 Option 6 - Footprint Expansion and Height Increase

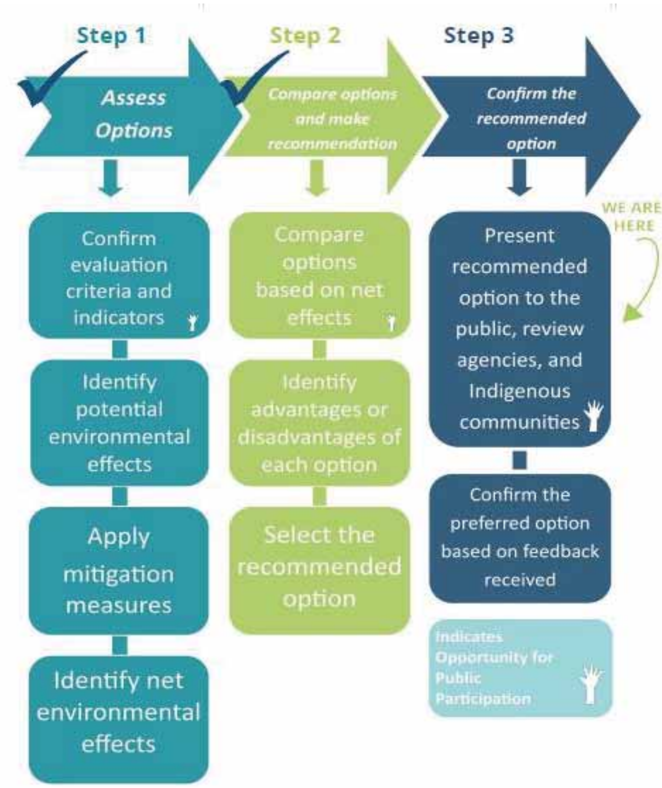
4. Assessment of the Alternative Methods

Following the identification of the alternative landfill footprints, a detailed assessment and evaluation of the four footprints was undertaken. The multi-step process began with confirming the evaluation criteria and indicators proposed in approved ToR and confirmed at public meetings, including Open House #1. With a final list of evaluation criteria and indicators established, they were applied to each of the four footprint options through a “net effects analysis” to determine the net positive or negative environmental effects. Next, a Reasoned Argument or Trade-off method was carried out using this information to determine a preferred landfill footprint. **Figure 4.1** below highlights the process of the Alternative Methods assessment.

The assessment and evaluation of the alternative landfill footprints was conducted in three steps:

- **Step 1** – Confirm Evaluation Criteria and Indicators/Measures
- **Step 2** – Undertake the Net Effects Analysis
- **Step 3** – Carry out the Comparative Evaluation

Figure 4.1 Alternative Methods Assessment



Each step is described in further detail below.

Step 1 – Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during Open House events and confirmed for application to each of the landfill footprint alternatives. As part of the amended ToR, a commitment to analyze the potential effects to human health during Alternative Methods assessment and evaluation utilizing the existing data and methodology established as part of the on-going SRCF Community Health Assessment was made. Given that the studies in the EA will be completed and be benchmarked against human health parameters, such as air quality and groundwater, Terrapure will not only continue to complete the annual Community Health Assessment Review as part of the ongoing operation of the SCRF (as required under the current approvals), but will also utilize the existing data and methodology established as part of the Community Health Assessment for the past 20 years, to analyze the potential effects to human health during the Alternative Methods assessment and evaluation. Evaluation criteria were developed for each Environmental Component listed below:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use
- Atmospheric Environment (Air Quality, Odour and Noise);
- Human Health
- Transportation
- Economic
- Archaeology and Built Heritage; and,
- Design and Operations.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the 'Alternative Methods' (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives. Specifically, the criteria and indicators were modified in consultation with review agencies and the public to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative. The list of criteria and indicators can be seen in **Table 4.1** below.

Table 4.1 Evaluation Criteria and Indicators

Component	Criteria	Indicators
Geology and Hydrogeology	Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site Predicted effects to Source Water Protection Area
	Groundwater Flow	Predicted effects to groundwater flow at property boundaries and off-site
Surface Water Resources	Surface Water Quality	Predicted effects on surface water quality on-site and off-site
	Surface Water Quantity	Predicted change in drainage areas Predicted occurrence and degree of off-site effects
Terrestrial and Aquatic Environment	Terrestrial ecosystems	Predicted impact on vegetation communities Predicted impact on wildlife habitat Predicted impact on vegetation and wildlife including rare, threatened or endangered species
	Aquatic ecosystems	Predicted impact on aquatic habitat Predicted impact on aquatic biota
Atmospheric Environment	Air quality on off-site receptors	Predicted off-Site point of impingement concentrations (ug/m^3) of indicator compounds Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)

Table 4.1 Evaluation Criteria and Indicators

Component	Criteria	Indicators
	Odours on off-site receptors	Predicted off-Site odour concentrations (ug/m^3 and odour units) Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)
	Noise on off-site receptors	Predicted off-Site noise level Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)
Land Use	Effect on existing land use	Current land use
	Effect on views of the facility	Predicted changes in views of the facility from the surrounding area
Human Health	Air Quality	Predicted impacts to air quality and their potential effects on human health
	Leachate Quantity	Predicted effects of leachate quality (inorganic and organic chemicals) on human health
	Groundwater Quality	Predicted impacts to groundwater quality and their potential effects on human health
	Surface Water Quality	Predicted impacts to surface water quality and their potential effects on human health
	Soil Quantity	Predicted impacts to soil and their potential effects on human health
Transportation	Effect on Traffic	Potential for traffic collisions Level of Service at intersections around the SCRF
Economic	Effect on approved/planned land uses	Number, extent, and type of approved/planned land uses affected
	Economic benefit to the City of Hamilton and Local Community	Total Employment at site (number and duration)
Archaeology and Built Heritage	Effect on known or potential significant archaeological resources	Number and type of potentially significant, known archaeological sites affected Area (ha) of archaeological potential (i.e., lands with potential for the presence of significant archaeological resources) affected
	Effect on built heritage resources and cultural heritage landscapes	Number and type of built heritage resources and cultural heritage landscapes displaced or disrupted
Design and Operations	Potential to Provide Service for Disposal	Ability to provide 3,680,000 m^3 of additional disposal capacity for post diversion solid, non-hazardous industrial residual material
	Leachate Management	Design and operating complexity
	Stormwater Management	Design and operating complexity
	Construction	Complexity and constructability of components
	Site Operations	Complexity and operability of components
	Closure and Post-Closure	Flexibility of design and operations
	Cost of Facility	Approximate relative cost of Alternative Methods

Step 2 – Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out, consisting of the following activities:

- Identify potential effects on the environment;
- Develop and apply impact management measures (avoidance/ mitigation/ compensation/ enhancement measures); and,
- Determine net effects on the environment.

Each of these activities will be documented in a separate table for each alternative landfill footprint options.

Identify the Potential Effects

Potential effects on the environment are based on the information contained in the Existing Conditions reports. After determining the alternatives, the evaluation criteria will be applied to each alternative landfill footprint option to determine the potential environmental effects. Specifically, this will be accomplished by applying the indicators to each alternative landfill footprint option. The results of applying these indicators will be expressed in the context of their corresponding measures, either quantitatively or qualitatively, as appropriate, in the potential effects column of the net effects table.

Develop and Apply the Impact Management Measures

Once the potential effects on the environment have been identified for each alternative landfill footprint options, the appropriate impact management measures (avoidance/ mitigation/ compensation/ enhancement measures) will be developed and documented in the net effects table for each indicator. The intent of these measures is as follows:

Avoidance: The first priority is to prevent the occurrence of negative effects (adverse environmental effects) associated with implementing an alternative.

Mitigation: Where adverse environmental effects cannot be avoided, it will be necessary to develop the appropriate measures to remove or alleviate to some degree the negative effects associated with implementing the alternative.

Compensation: In situations where appropriate mitigation measures are not available, or significant net adverse effects will remain following the application of mitigation, compensation measures may be required to counterbalance the negative effect through replacement in kind, or provision of a substitute or reimbursement.

Enhancement: Wherever possible, the opportunity should be taken to enhance the positive environmental effects associated with implementing an alternative rather than simply mitigate and/or compensate.

With these intentions in mind, the impact management measures will be developed based on the professional expertise of the Project Team reflecting current procedures, historical performance, and existing environmental conditions. These developed measures will be documented in the avoidance/ mitigation/ compensation/ enhancement measures column of the net effects table.

Determine the Net Effects

Once the appropriate impact management measures have been developed and applied to the potential environmental effects of each alternative landfill footprint option, the remaining net negative or net positive effect will be determined and documented by the Project Team members in the "net effects" column of the net effects table. In cases where the net negative or net positive effect cannot be addressed through the application of avoidance/ mitigation/ compensation/ enhancement measure(s), the potential net effect will remain unchanged and therefore, will still be identified as the "net effect".

The net effects associated with each alternative landfill footprint option will be identified and carried forward to Step 3.

Step 3 – Carry out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another in order to identify a "recommended landfill footprint". The comparison of net effects was completed using a "Reasoned Argument" or "Trade-off" evaluation methodology, as provided for in the approved SCRF EA ToR.

This method is based on the following two activities:

- **1st Activity:** Identify the level of effect ('No', 'Low', 'Moderate' or 'High') associated with each alternative landfill footprint option for each indicator
- **2nd Activity**: Rank each alternative landfill footprint option from most preferred to least preferred through:
- Criteria rankings for each landfill footprint option (1st through 6th, tied for 1st, etc based on the identified level of effect from each indicator
- Factor specific rankings (preferred) for each landfill footprint option; and,
- Overall landfill footprint rankings (most preferred to least preferred).

The process followed in Step 3 and the results of these two activities are described in further detail in the following sections.

Level of Effect Determination of the Alternative Landfill Footprint Options

As mentioned, the "Reasoned Argument" or "Trade-off" method will be used to highlight the relative level of effect of each landfill footprint option based on the net effects determined in Step 2. More specifically, a level of effect ranging from 'No effect', 'Low effect', 'Moderate effect' or 'High effect' will be determined for each landfill footprint option by each indicator.

Ranking of the Alternative Landfill Footprint Options

The net effects identified for each alternative in the previous step will then be compared to one another in order to identify a "recommended" footprint location. The comparison of net effects will be completed using a "Reasoned Argument" or "Trade-off" method, as provided for in the approved ToR.

Under the Reasoned Argument approach, the difference in net effects associated with the various alternatives is highlighted. Based on these differences, the advantages and disadvantages of each alternative are identified according to the evaluation of tradeoffs between the various evaluation criteria and indicators. The relative significance of potential impacts is examined to provide a clear rationale for the selection of a Preferred Alternative.

The term Trade-offs is defined as “things of value given up in order to gain different things of value”. Each alternative will be compared against the others to distinguish relative differences in impacts to the environment, taking into account possible mitigation measures.

For example, during the detailed Comparative Evaluation of the alternative landfill footprints, the rankings (1^{st}-6^{th}) will be combined (aggregated) for each Environmental Indicator and Criteria into preference ranking/rationale for each environmental component. These results will be aggregated further into a single preference rating for each alternative landfill footprint in order to rank the alternatives (incorporating tradeoffs and professional judgement) and identify a Recommended Alternative landfill footprint.

This method is based on the following two activities (example provided below):

- **1st Activity:** Identify the level of effect (‘No Effect’, ‘Low’, ‘Medium’ or ‘High’) associated with each alternative for each indicator
- **2nd Activity:** Rank each alternative from most preferred to least preferred based on the identified level of effect from each indicator; Criteria rankings for each alternative landfill footprint option (1^{st}-6^{th}); component specific rankings based on rationale for preference for each alternative landfill footprint option; and, overall alternative landfill footprint option rankings (most preferred to least preferred).

Each team member first assigned rankings for each individual Criteria based on the level of effect determined for each Indicator under that Criteria. For example, the “Atmospheric Environment” Environmental Component has three Criteria, each of which have two Indicators that will be given a level of effect (‘No’, ‘Low’, ‘Medium’ or ‘High’) and then consolidated to determine an overall Criteria ranking. After each Criteria are ranked, a rationale will be provided to rank by preference each Environmental Component based on the rankings (1^{st}-6^{th}) from each evaluation criteria. For example, in the case of the Atmospheric Environment component, the Technical Consultant will consider the identified rankings for an alternative corresponding to their evaluation criteria (incorporating trade-offs and their professional judgment) in determining the Atmospheric Environment component ranking.

Following this, the Project Team determined an overall ranking of each alternative based on the individual Environmental Component preference rankings. With this in mind, the Team will then assign an overall ranking of Most Preferred to Least Preferred for the overall landfill evaluations demonstrating key trade-offs advantages/disadvantages to the environment.

4.1.1 Do Nothing or Status Quo

In addition and as previously mentioned, the *Status Quo* (“Do Nothing”) option has been included to serve as a benchmark against other alternatives. The Status Quo represents the currently approved footprint and would mean that all existing approvals for the SCRF would be maintained and the current SCRF would no longer have the capacity to accept post-diversion solid, non-hazardous industrial residual material after the currently approved capacity for waste is exhausted in the coming years, but would still be continue to operate by accepting industrial fill. Under the

Status Quo option, a number of long-standing users of the SCRF, including major Hamilton steel making businesses, would be forced to haul their industrial residual material further to an appropriately sized and approved facility (the closest facility is approximately 50 km further east from the SCRF, one way travel). This would increase the cost to users to manage their residual material, and would increase the associated carbon footprint. In addition, the SCRF has provided the Hamilton and Greater Toronto Area (H&GTA) with the closest regional option for waste generated during major infrastructure and development projects in the H&GTA, including the McMaster Children's Hospital expansion, the new James Street GO Station, and the Stoney Creek Dairy future site remediation, thereby negating long-haul trips and reducing GHG output.

The "Do Nothing" option is included as part of the SCRF EA to serve as a benchmark against all other landfill options (Alternative Methods). The "Do Nothing" option does not address the Purpose of the Undertaking, as described in the Approved Amended Terms of Reference for the SCRF EA, dated November 9, 2017, and is therefore not a viable option. The "Do Nothing" option is used as a matter of best practice, in order to establish a "benchmark" when evaluating and assessing the advantages and disadvantages of following alternative landfill footprint options (Alternative Methods) being considered.

5. Net Effects Assessment

Now that the methodology of the Assessment of Alternative Methods has been presented, the following sections will review the net effects analysis for each of the Landfill footprint options by technical discipline, followed by a summary for each Option. The net effects analysis has taken into account the construction, operation and closure/post-closure periods of the proposed undertaking and, where possible, used highly conservative estimates which will be refined at the Detailed Impact Assessment stage of the EA when more construction, operation and closure/post-closure details are provided on the preferred Alternative is outlined

5.1 Geology and Hydrogeology

The net effects relating to the Geology and Hydrogeology for all Options considered the following criteria and indicators;

Groundwater Quality:

- Predicted effects to groundwater quality at property boundaries and off-site
- Predicted effects to Source Water Protection Area

Groundwater Flow:

- Predicted effects to groundwater flow at property boundaries and off-site
- Predicted effects to Source Water Protection Area

5.1.1 Considerations and General Assumptions

In order to fully characterize these indicators and to adopt measures by which potential effects could be identified, several considerations were developed for each indicator. These considerations are shown below in **Table 5.1**:

Table 5.1 Considerations for Indicators

Criteria	Indicators	Considerations
Groundwater Quality	• Predicted effects to groundwater quality at property boundaries and off-site • Predicted effects to Source Water Protection Area (SWPA)	• Leachate generation estimates • Leachate quality – how will leachate leakage from the SCRF affect existing groundwater quality? • Existing groundwater quality – what is background groundwater quality? Is it impacted by the existing landfill or other sources? What is the predicted future quality? • Leachate breakthrough – how does the design of the Alternatives affect the ability for leachate to break through the liner? • Monitorability – the ability to define, identify and monitor the hydrostratigraphic units; to understand the groundwater flow gradients & velocities; to define low head areas; and to distinguish impacts from the new landfill versus other sources. • Ability to mitigate effects on groundwater quality • SWPA impacts – how will the impacts to groundwater quality change the quality of groundwater and surface water within the SWPA?
Groundwater Flow	• Predicted effects to groundwater flow at property boundary and off-site	• Hydraulic characteristics of hydrostratigraphic units – ability to identify units; hydraulic conductivity, flow directions • Results of flow modelling – predicted changes to the groundwater flow with each alternative

The potential effects for each alternative were then identified on the basis of these considerations. As described above, the two groundwater criteria (groundwater quality and groundwater flow) were assessed by evaluating the indicators presented in **Table 5.1**. The following sections explains the evaluation methodology used to assess the criteria.

5.1.2 Groundwater Quality

The effects on groundwater quality for each alternative were assessed by:

- Estimating the leachate generation rate;
- Predicting the leachate discharge through the liner;
- Assessing the leachate quality;
- Determining the effect on downgradient groundwater quality; and,
- Determining the effect on groundwater and surface water within the SWPA.

The groundwater quality was assessed for each alternative under closed conditions (i.e., final cover in place) and assumed the leachate collection system was operating to minimize leachate head. The alternatives were assessed under closure conditions in order to allow a comparative analysis of the effects of each alternative on the indicators.

The leachate generation rate was estimated using the Hydrologic Evaluation of Landfill Performance (HELP) model for each of the alternatives. The HELP model is a USEPA recognized program that is commonly used to estimate water balance for landfill sites. Local or site-specific data is used in the calculations, including precipitation, vegetation, soil/ geosynthetic liner types, layer thicknesses, hydraulic conductivities, and slopes. The HELP model was used to calculate daily, monthly, and annual averages for the amount of surface water runoff, evapotranspiration, drainage, and leachate collection. The HELP model was also used to predict the leachate discharge through the liner. Separate HELP models were created to simulate the differing final landfill configurations for each alternative. A more detailed description of the HELP modelling undertaken as part of this evaluation is included in **Appendix B**.

In order to estimate groundwater quality at the downgradient Site boundary for the various Site closure configurations, a generalized water balance and mass balance approach was used. A water balance was developed to quantify the hydrogeologic characteristics and functioning in the vicinity of the landfill. The water balance was used to estimate groundwater flow (flux) beneath the landfill and to incorporate predicted leachate discharge through the liner (calculated using the HELP model). A contaminant mass balance using the groundwater flux and predicted leachate discharge (mass loading) was used to calculate the contaminant concentrations at the Site boundary. Contaminant concentrations were compared to established trigger levels for the Site in order to identify potential compliance issues for each alternative. The impacts on local groundwater quality will be used to determine potential effects on groundwater and surface water within the SWPA.

5.1.3 Groundwater Flow

Groundwater flow could be impacted by the alternatives by affecting the groundwater flow direction and/or groundwater flow rates. The direction and flow rate of groundwater is dependent on hydraulic conductivities, saturated thicknesses, and hydraulic gradients (i.e., the change in hydraulic head over a horizontal length).

Of these parameters, the hydraulic gradient is the variable that could potentially be impacted. An increase in leachate leakage through the liner could affect the distribution of hydraulic head under the landfill footprint, and thus changing horizontal hydraulic gradients. The results of the HELP modeling were used to calculate the potential change in hydraulic head through the use of the estimated leakage rate through the liner system under each alternative. The change in hydraulic head was used to determine the potential alterations of hydraulic gradients and subsequently, impacts on groundwater flow rates and direction. A detailed description of the groundwater flow calculations is provided in **Appendix B**.

5.1.4 Contaminating Lifespan

In order to evaluate the differences in contaminating lifespans for the various alternatives, the contaminating lifespan for each alternative was calculated using two different modelling approaches. The first approach involved simulating the degradation of leachate indicator parameters utilizing the 1DTRANSEN model (One-Dimensional Mass Transport and Sensitivity Analysis). The second approach utilized a model developed by Rowe (1991), which projects the decrease in leachate strength for a conservative contaminant species (e.g., chloride) where the decrease in strength is essentially due to dissolution as water infiltrates through the waste over time. A detailed description of the contaminating lifespan calculations using the models referenced above is provided in **Appendix B**.

5.1.5 Evaluation Results

Groundwater Quality

This section discusses the evaluation results in terms of the predicted effects of each alternative on groundwater quality. Discussions of predicted leachate generation and leakage through the liner are included as these are integral parts of the groundwater quality evaluation.

Leachate Generation

As discussed in Section 4, the HELP model was used to predict the leachate generation rates for each alternative. Leachate generation rates are provided by the HELP model as leakage through the final cover system into the waste mound. Based on the HELP modelling conducted, **Table 5.2** summarizes the predicted leachate generation rates under closure conditions for the six alternatives, as well as the existing approved configuration.

Table 5.2 Predicted Leachate Generation Rates

Landfilling Section	Area (ha)	Leachate Generation Rate (m^3/yr)
Existing Approved	54.4	121,143
Alternative 1	54.4	158,891
Alternative 2	59.3	135,509
Alternative 3	54.4	121,182
Alternative 4	62.3	181,948
Alternative 5	54.4	158,896
Alternative 6	59.3	135,373

The results presented in Table 5.2 demonstrate that leachate generation rates for all six Alternatives being considered are similar, however Alternatives 1, 4 and 5 result in greater leachate generation than the remainder of the alternatives. Further details on the HELP model is provided in **Appendix B.**

Effects on Downgradient Water Quality

A generalized water balance and mass balance approach was used to estimate groundwater quality at the downgradient Site boundary for each of the six alternatives. The water balance considered the primary inputs, and movements of water across the Site using both Site hydrogeologic data and theoretical calculations. The water balance and groundwater flow beneath the landfill was estimated by using Site specific groundwater elevations, gradients, and hydraulic conductivities. Based on the groundwater flux and contaminant mass loadings from predicted leachate leakage, downgradient groundwater quality was then estimated for each alternative.

A detailed description of calculation methodology and individual parameter results are provided in **Appendix B**.

It is important to note the following with respect to the results of the groundwater quality assessment:

1. The downgradient groundwater quality predictions have not taken into account the groundwater control systems incorporated into the landfill design. These systems are currently in operation and will be expanded as part of continued landfill development. These systems are discussed further in Section 6 (Mitigation Measures).
2. The predicted downgradient groundwater quality for each of the six Alternatives is very similar to the predicted downgradient groundwater quality for the existing approval under closure conditions, modelled using the same methodology.

Effects on Source Water Protection

Any potential impacts to groundwater and/or surface water quality within the SWPA will be dependent on groundwater quality from the alternative options migrating into the IPZ for the City of Hamilton water intake. As detailed in Table 5.3, conservative predictions of downgradient groundwater quality show very similar results for all six Alternatives, as well as the existing approval. All six Alternative options show minimal effects on predicted groundwater quality prior to implementation of mitigation measures.

It is important to note that these predictions to downgradient groundwater and/or surface water quality within the SWPA do not consider the use of the groundwater control systems (mitigation measures). These systems will be operated and expanded as part of the continued landfill development and will mitigate the migration of potentially contaminated groundwater offsite. With the continued operation of the groundwater control systems, it is anticipated there will be no impacts on groundwater quality entering the IPZ.

Groundwater Flow

The estimated leakage rate of leachate through the liner, calculated using the HELP model, was used to determine the potential impacts of each alternatives on groundwater flow (See **Appendix B**). The HELP outputs show that leakage from the landfill liner will contribute approximately 0.064 mm each year. This leakage will predominantly enter the Vinemount Flow Zone (which directly underlies the base of the landfill footprint in each of the six alternatives), which could increase the hydraulic head beneath the landfill footprint. The increase in hydraulic head could affect groundwater flow by altering horizontal hydraulic gradients.

Based on the 2017 groundwater elevations measured at the Site, groundwater levels within the Vinemount Flow Zone are heavily influenced by groundwater extraction at M4 as well as the Phase One Centennial Parkway Trunk Sanitary Sewer (CPTSS) construction; however, historic reports (Taro East Quarry Environmental Assessment Hydrogeological, Impact Assessment Final Report, Gartner Lee, January 1995) show that the baseline potentiometric surface ranges from 201.0 to 192.6 mAMSL across the Site. Thus, the change in hydraulic head across the Site is on the order of several metres across a distance of approximately 900 m (i.e., i = (201mAMSL – 192.6mAMSL) / 900 m = 0.093 m/m).

Under each scenario of landfill expansion (Alternatives 1 through 6), landfill leakage contributes, an additional hydraulic head of 0.064 mm/year. Conservatively assuming this will happen instantaneously, the hydraulic gradient under the various alternatives is equal to the additional hydraulic head added to the downgradient groundwater elevation. Thus, the maximum increase in hydraulic gradient due to leachate leakage under all alternatives is negligible. The change in hydraulic gradient will produce negligible changes to groundwater flow rate and no observable change in direction.

Contaminating Lifespan

As discussed above, a detailed description of the predicted contaminating lifespan for each alternative is provided in **Appendix B**.

Three scenarios were modeled using the Rowe Model, as follows.

- **Scenario 1:** Maximum anticipated indicator parameter concentration in leachate and average indicator parameter percentage in waste
- **Scenario 2:** Average anticipated indicator parameter concentration in leachate and average indicator parameter percentage in waste
- **Scenario 3:** Maximum anticipated indicator parameter concentration in leachate and maximum indicator parameter percentage in waste

The Rowe model differentiates between alternatives by taking into consideration waste area, volume and mass. The following table summarizes the contaminating lifespans calculated for chloride, as estimated using the Rowe Model, for each of the three scenarios for the approved existing conditions and the six alternatives.

Table 5.3 Contaminating Lifespan using the Rowe Model

Alternative Option	Contaminating Lifespan (years)		
	Scenario 1	Scenario 2	Scenario 3
Approved	19	31	29
Alternative 1	19	31	30
Alternative 2	19	31	29
Alternative 3	26	43	41
Alternative 4	18	30	28
Alternative 5	21	35	34
Alternative 6	19	32	30

A comparison of the contaminating lifespan values indicates that Alternatives 1, 2, 4, and 6 perform similarly to the existing approved design. Calculated contaminating lifespans are longer for Alternatives 3 and 5, both of which involve height increases without an expansion of the landfill footprint. The contaminating lifespan for Alternative 3 is significantly higher than the other options, primarily due to the increased elevation, and subsequent waste thickness, relative to the other options.

5.1.6 Potential Environmental Effects

Alternative Option 1

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area. Minimal anticipated impacts to water quality within the SWPA.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns.

Alternative Option 2

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area. Minimal anticipated impacts to water quality within the SWPA.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns.

Alternative Option 3

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area. Minimal anticipated impacts to water quality within the SWPA.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns. Minimal anticipated impacts to water quality within the SWPA.

Alternative Option 4

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns. Minimal anticipated impacts to water quality within the SWPA.

Alternative Option 5

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns. Minimal anticipated impacts to water quality within the SWPA.

Alternative Option 6

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area. Minimal anticipated impacts to water quality within the SWPA.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns.

5.1.7 Mitigation Measures

The evaluation of potential environmental effects provided above has been completed without taking into consideration several environmental control systems incorporated into the landfill design. These control systems are important aspects of the Site’s groundwater protection strategy and accordingly they are being taken into consideration as mitigation measures for each of the six alternatives. The following paragraphs describe the environmental control systems in place at the SCRF and their relevance to the predicted environment performance of the six alternatives.

Groundwater Extraction Well M4

Around 1985, the Lower Excavation portion of the active quarry (at the time), was made through the Vinemount Shale floor to allow access to the Goat Island Dolostone. Dewatering for this quarrying operation from the Lower Excavation created a draw of impacted groundwater from the closed landfill located immediately to the west. The Lower Excavation ceased to be used and was backfilled in 1990 with clean rock rubble with a 3m thick clay plug installed to simulate the low permeability of the former Vinemount Shale floor of the quarry. The contact between the clay plug was imperfect and flow from the VFZ and UFZ mixed within the rock rubble with groundwater from the lower flow zones. In order to control movement and extract contaminated groundwater migrating from the closed landfill, M4 extraction well was established in one corner of the former Lower Excavation.

Based upon observations of the system performance, a target pumping level was set for the M4 pumping well as a means of maintaining inward gradients toward the pumping well. Monitoring well observations during initial testing indicated that monitors across the length of the north boundary responded to the pumping of M4.

Potentiometric groundwater surfaces provided in the 2016 Annual Monitoring Report (Jackman, June 2017) show groundwater flow in each of the flow zones was heavily influenced by the operation of M4. Inwards, horizontal hydraulic gradients are shown across the northern Site boundary of both the SCRF and closed landfill.

In 2016, M4 extracted an average of 70,000 L/day (when in operation) which is greater than the combined flux estimates for the VFZ, UFZ, and UMFZ/LMFZ. It should be noted that in 2016, groundwater levels at the SCRF were being affected by dewatering associated with sewer construction along HWY. 20 which resulted in a historically low extraction volume from M4.

Based on data presented in the 2016 Annual Monitoring Report (Jackman, June 2017) (extraction greater than estimated flux values and measured inward horizontal hydraulic gradients), operation of M4 will be sufficient to capture potential future landfill-related water quality impacts within the VFZ, UFZ, and UMFZ/LMFZ.

Groundwater Collection Trench Network

The existing developed portion of the SCRF includes a network of shallow groundwater collection trenches that surround the landfill footprint and connect through a network of trenches underlying the landfill liner. These trenches are excavated through the VFZ and keyed into the underlying Vinemount Shale aquitard. The trenches are connected to a groundwater pumping station located at the southeast corner of the SCRF. Accordingly, the groundwater collection trench system is capable of containing all groundwater flow within the VFZ below the landfill footprint. As the VFZ would be the primary receptor of direct leachate leakage from the liner, this system is capable of mitigating leakage from the liner, should this condition be observed in the future.

Hydraulic Control Layer

The liner system for the SCRF includes a hydraulic control layer (HCL) between the two 1 m sections of compacted clay liner. The HCL consists of a coarse granular material, which, once fully constructed, will be flooded and maintained at a specified hydraulic head to induce an upward vertical gradient across the upper portion of the compacted clay liner. Maintaining an upward hydraulic gradient across the clay liner will ensure that downward leaking of leachate across the clay cannot occur. Accordingly, operation of the HCL will provide a substantial degree of additional protection against discharge of leachate through the liner into the natural environment.

5.1.8 Geology/Hydrogeology Net Effects

The result of the Net Effects Analysis is that for each of the alternatives, no effects to groundwater quality or groundwater flow are anticipated to be affected. The key factors leading to this result are the use of the mitigation measures described above in Section 5.1.7 and the use of these mitigation measures at this location for over 2 decades.

5.2 Surface Water

The net effects relating to the Surface Water components for all Options considered the following criteria and indicators;

Surface Water Quality:

- Predicted effects to surface water quality at property on and off-site

Surface Water Quantity:

- Predicted change in drainage areas;
- Predicted occurrence and degree of off-site effects.

5.2.1 Surface Water Modelling

Predictive modelling was performed using PCSWMM Version 7.1 with SWMM5 version 5.1.012 for the current approved design of the SCRF (baseline condition) and each of the alternate options being considered. This modelling served to evaluate the changes to the peak flows and runoff volumes for each of the alternatives when compared to the baseline condition. The results of the modeling of the peak flows and runoff volume for each condition are summarized in the tables below. The modelling results assume uncontrolled flows, meaning it was assumed that there were no measures to contain and capture the runoff (i.e., perimeter ditches and stormwater management ponds).

Table 5.4 Peak Flow Comparison

Options	Uncontrolled 2-year Storm		Uncontrolled 100-year Storm	
	Peak Flow (m^3/s)	Percent Difference to Baseline	Peak Flow (m^3/s)	Percent Difference to Baseline
Existing/Baseline	0.969	N/A	6.616	N/A
Option 1 (Reconfiguration)	0.967	-0.21%	5.929	-10.38%
Option 2 (Footprint Expansion)	0.929	-4.13%	5.932	-10.34%
Option 3	0.971	0.21%	6.927	4.70%

Table 5.4 Peak Flow Comparison

Options	Uncontrolled 2-year Storm		Uncontrolled 100-year Storm	
	Peak Flow (m^3/s)	Percent Difference to Baseline	Peak Flow (m^3/s)	Percent Difference to Baseline
(Height Increase)				
Option 4 (Reconfiguration and Footprint Expansion)	0.925	-4.54%	5.641	-14.74%
Option 5 (Reconfiguration and Height Increase)	0.969	0.00%	6.313	-4.58%
Option 6 (Footprint Expansion and Height Increase)	0.933	-3.72%	6.631	0.23%

Table 5.5 Total Runoff Volume Comparison

Options	Uncontrolled 2-year Storm		Uncontrolled 100-year Storm	
	Runoff Volume (m^3)	Percent Difference to Baseline	Runoff Volume (m^3)	Percent Difference to Baseline
Existing/Baseline	14,051	N/A	57,985	N/A
Option 1 (Reconfiguration)	15,501	10.32%	61,676	6.37%
Option 2 (Footprint Expansion)	14,343	2.08%	58,795	1.40%
Option 3 (Height Increase)	14,108	0.41%	58,069	0.14%
Option 4 (Reconfiguration and Footprint Expansion)	15,881	13.02%	62,624	8.00%
Option 5 (Reconfiguration and Height Increase)	15,564	10.77%	61,735	6.47%
Option 6 (Footprint Expansion and Height Increase)	14,438	2.75%	58,876	1.54%

As can be seen in the tables, the options that involve reconfiguration or a footprint expansion result in increased runoff volume. Most options showed a decrease in peak flows. This can be attributed to the fact that the average slopes in most of the options was slightly less than in the baseline condition. Generally, an increase in height resulted in an increase in peak flows. In some cases, there was very little or no increase in peak flows due to a height increase and this may be attributed to other factors, such as reconfiguration of the site changing the flow length or travel time of flows over the site and to the outlet. The Net effects analysis is described for each option below.

5.2.2 Potential Effects to Surface Water Quality and Quantity

Alternative Option 1

Option 1 maintains the same footprint and height as the current approved design of the SCRF (baseline condition). The area currently approved for industrial fill will be used for residual material that will require a less pervious final cover during closure conditions. The final cover for the residual material will produce more runoff than the final cover for industrial fill since the residual material final cover requires a layer of clay that is 600mm thick. The clay layer will be less pervious than the cover for the industrial fill resulting in a larger runoff volume.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition, as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is total suspended solids (TSS) which occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels. The height of the residual material is also the same as the baseline, which will result in similar peak flows, minimizing any additional TSS that may be collected from the final cover during a storm event.

Surface Water Quantity - Change in Drainage Areas

The overall drainage area is the same as in the baseline condition. The area will be less permeable due to the increased area of residual material with the clay layer as part of the final cover. This will result in an increase in runoff volume.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce a larger runoff volume than the baseline condition. The predicted increase in runoff volume is approximately 10% during the 2-year event and 6% during the 100-year event. There is no expected increase in peak flows due the height of the residual fill staying the same as baseline conditions. Runoff will flow off-site and cause an increase in flows in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Alternative Option 2

Option 2 maintains the same height as the current approved design of the SCRF (baseline condition) and the SCRF will continue to receive industrial fill. The buffer area will be reduced to a minimum of 30m and the SWM pond will be placed within the buffer area in the northwest corner of the site. This results in an increased area for residual material. An increase in residual material area with a final cover that requires a layer of less pervious clay will result in a larger runoff volume.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is TSS that occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels. The height of the residual material is also the same as the baseline that will result in similar peak flows, minimizing any additional TSS that may be collected from the final cover during a storm event.

Surface Water Quantity - Change in Drainage Areas

The overall residual/fill drainage area is larger than the baseline condition. The area will be less permeable due to the increased area of residual material with the clay layer as part of the final cover. This will result in an increase in runoff volume.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce a larger runoff volume than the baseline condition. The predicted increase in runoff volume is approximately 2% during the 2-year event and 1% during the 100-year event. There is no expected increase in peak flows due the height of the residual fill staying the same as baseline conditions. Runoff will flow off-site and cause an increase in flows in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Alternative Option 3

Option 3 maintains the same footprint area as the current approved design of the SCRF (baseline condition). The SCRF will continue to receive both industrial fill and residual material. The volume of runoff produced from the site will be similar to baseline conditions due to similar areas being reserved for both industrial fill and residual material. The final cover in Option 3 will be similar to the final cover in the currently approved design. The residual material will have a vertical expansion, resulting in a larger area with steeper slopes. This will cause an increase in peak flows.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition, as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is TSS that occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels. The height of the residual material will increase which will result in higher peak flows, which may cause additional TSS to be collected from the final cover during a storm event.

Surface Water Quantity - Change in Drainage Areas

The overall drainage area is the same as in the baseline condition but there will be a height increase. The area will have a similar permeability due to similar areas of industrial fill and residual material. This will result in an increase to peak flows but similar runoff volumes.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce a similar runoff volume than the baseline condition but having higher peak flows. The predicted increase in peak flows is less than 1% during the 2-year event and approximately 5% during the 100-year event. Runoff will flow off-site and cause an increase in peak flows in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Alternative Option 4

Option 4 maintains the same height as the current approved design of the SCRF (baseline condition) and the SCRF will no longer receive industrial fill. The buffer area will be reduced to a minimum of 30m and the SWM pond will be placed within the buffer area in the northwest corner of the site. This results in an increased area for residual material. An increase in residual material area with a final cover that requires a layer of less pervious clay will result in a larger runoff volume.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is TSS that occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels. The height of the residual material is also the same as the baseline that will result in similar peak flows, minimizing any additional TSS that may be collected from the final cover during a storm event.

Surface Water Quantity - Change in Drainage Areas

The overall residual material drainage area is larger than the baseline condition. The area will be less permeable due to the increased area of residual material with the clay layer as part of the final cover. This will result in an increase in runoff volume.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce a larger runoff volume than the baseline condition. There is no expected increase in peak flows due the height of the residual fill staying the same as baseline conditions. The predicted increase in runoff volume is approximately 13% during the 2-year event and 8% during the 100-year event. Runoff will flow off-site and cause an increase in flows in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Alternative Option 5

Option 5 maintains the same footprint area as the current approved design of the SCRF (baseline condition) but there will be an increase in height. SCRF will no longer receive industrial fill so the area currently approved for industrial fill will be used for residual material. The additional residual material will require a less pervious final cover during closure conditions. The final cover for the residual material will produce more runoff than the final cover for industrial fill since the residual material final cover requires a layer of clay that 600mm thick. The clay layer will be less pervious than the cover for the industrial fill resulting in a larger runoff volume. The residual material will have a vertical expansion, resulting in steeper slopes. The reconfiguration of the site to have additional residual area will cause an increase in flow length and travel time of the runoff. This will cause a reduction in peak flows.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition, as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is TSS that occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels.

Surface Water Quantity - Change in Drainage Areas

The overall drainage area is the same as in the baseline condition but there will be a height increase. The area will have lower permeability due the replacement of industrial fill with residual material. This will result in an increase peak flows and runoff volumes.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce more runoff volume and higher peak flows than the baseline condition. The predicted increase in runoff volume is approximately 11% during the 2-year event and 6% during the 100-year event. Runoff will flow off-site and cause increased flows in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Alternative Option 6

Option 6 provides an increase in footprint and height from the current approved design of the SCRF (baseline condition). The SCRF will continue to receive industrial fill. The buffer area will be reduced to a minimum of 30m and the SWM pond will be placed within the buffer area in the northwest corner of the site. This results in an increased area for residual material. An increase in residual material area with a final cover that requires a layer of less pervious clay will result in a larger runoff volume.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition, as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is TSS that occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels. The height of the residual material will increase which will result in higher peak flows, which may cause additional TSS to be collected from the final cover during a storm event.

Surface Water Quantity - Change in Drainage Areas

The overall residual material drainage area is larger than the baseline condition and there will be a height increase. The area will be less permeable due to the increased area of residual material with the clay layer as part of the final cover. This will result in an increase in peak flows and runoff volume.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce a larger runoff volume than the baseline condition. There will also be an increase in peak flows due the height increase of the residual fill. The predicted increase in runoff volume is approximately 3% during the 2-year event and 2% during the 100-year event. Peak flows are expected to only increase by less than 1% during the 100-year event. The increased runoff volume will flow off-site which will cause increased peak flows and flow volumes in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

5.2.3 Mitigation

The addition of perimeter ditches that can convey up to the 100-year storm event will prevent any flows from leaving the site. A stormwater management pond with two forebays can be designed to treat the runoff to the required levels and to control the release of the 2-year- through 100-year storm events to pre-development levels. This will prevent erosion and flooding off-site.

The allocated SWM pond area is large enough to size a pond that can treat and control the site runoff. There may be some complications in the design of the pond due to the elevation difference between the residual material toe of slope and the elevations of the roads adjacent to the SWM pond. The berm separating the SWM pond from Green Mountain Road West and First Road West will need to have significant design considerations. This may result in a costly design and construction of the SWM pond. Since the SWM pond will be built within the 30m buffer area, the berm sloping from the SWM pond to the roads will take up more than half the width allocated for the pond. This will cause additional design and construction constraints.

The pond design will include emergency shut-off valves so that stormwater will not be released into the storm sewer system below First Road West, which ultimately discharges into Davis Creek, if water quality testing determines that the water quality is not suitable for discharge. Contingency measures include “status quo”, which is to discharge stormwater to the sanitary sewer for treatment at the City’s water pollution control plant.

5.2.4 Surface Water Net Effects

The SWM pond and perimeter ditches will able to treat and control the runoff from the Site to the same level as the current approved design and results in low net environmental effects from all Alternative Options.

5.3 Terrestrial and Aquatic (Natural) Environment

The net effects relating to the Natural Environment for all Options considered the following criteria and indicators:

Effect on terrestrial ecosystems:

- Predicted impact on vegetation communities, wildlife habitat including rare, threatened or endangered species.

Effect on Aquatic Ecosystems:

- Predicted impact on aquatic habitat and aquatic biota

5.3.1 Potential Effects on Terrestrial Ecosystems

Through the Net Effects Analysis process, potential effects on terrestrial ecosystems were identified for all alternatives. Potential effects included temporary loss of existing vegetation communities (e.g., marsh, meadow, and thicket habitat) and associated wildlife habitat as a result of regrading activities and expansion into buffer areas (for Options 2, 4 and 6) as well as temporary loss of approximately 13 ha of habitat of a threatened species (eastern meadowlark) in the dry-fresh graminoid meadow ecosite at the south and west portion of the Site. No off-site impacts are anticipated as a result of any of the alternatives. The effects were identified as 'Temporary' based on the assumptions that not all vegetated areas will be disturbed simultaneously and that habitats will be re-established on-site following landfill closure. Additional details are provided in **Appendix B**.

5.3.2 Effects on Aquatic ecosystems

Through the Net Effects Analysis process, potential effects on aquatic ecosystems were identified for all alternatives. This included:

- Loss of on-site aquatic habitat and disturbance of aquatic biota associated with open water habitats in stormwater infrastructure due to regrading activities and modifications to stormwater ponds at the northwest corner of the Site (for Alternatives 2, 4 and 6).

No off-site impacts are anticipated as a result of any of the alternatives. Additional details are provided in **Appendix B**.

5.3.3 Mitigation Measures

In order to mitigate these potential effects to terrestrial ecosystems, the following mitigation measures will be employed:

- Conduct any vegetation removal activities outside of the breeding bird window (i.e., no removals between late March - late August).
- Consult with MNRF to determine if there is a need for any registrations, permits or approvals related to the presence of eastern meadowlark to avoid contravention of the provincial *Endangered Species Act*. Incorporate graminoid meadow habitats into the closure landscape plan, managed for grassland birds.
- Compensation for the loss of vegetation communities could occur elsewhere on-site where there are areas that could be revegetated. Where possible, salvage plant material for restoration from areas where vegetation is removed.

Best Management Practices (BMPs) that are recommended across all alternatives include the following:

- Use of dust suppressants;
- Installation of protective fencing (where required);
- Conduct a nest survey of on-site facilities and infrastructure prior to relocation or removal of structures to mitigate impacts to bird species which may use anthropogenic structures for nesting. If nests are found, consult a biologist/MNRF for further direction;

- Any wildlife incidentally encountered during Site operation activities will not be knowingly harmed and will be allowed to move away from the area on its own;
- In the event that an animal encountered during Site operation activities does not move from the area, or is injured, the Site Supervisor, a biologist, and MNRF will be notified;
- In the event that the animal is a known or suspected SAR, the Site Supervisor will contact MNRF SAR biologists for advice; and,
- Include naturalized landscape features into the stormwater management facilities design (e.g., emergent robust vegetation, shallow slope).

In order to mitigate the potential effects to aquatic ecosystems, the following mitigation measures will be employed:

- Characterize use of on-site aquatic features by fish and wildlife prior to modification/removal. Obtain necessary permits for and complete fish/wildlife rescue activities prior to initiation of any in-water works, as appropriate.
- Install erosion and sediment control (ESC) measures to mitigate impacts to water quality and to act as wildlife exclusion fencing prior to construction, and maintain them appropriately throughout landfill construction and operation.

5.3.4 Natural Environment Net Effects

With the implementation of the mitigation measures described above including BMPs, net effects on terrestrial and aquatic ecosystems are anticipated to be low for all Alternative Options.

5.4 Land Use

5.4.1 Land Use

The net effects relating to the Land Use components for all Options considered the following criteria and indicators:

Effect on existing Land Use:

- Current land Use

Effect on views of the Facility:

- Predicted changes in views of the Facility from the surrounding area

5.4.2 General Considerations for Land Use

The current land use of the SCRF is designated under the Urban Hamilton Official Plan and is designated as Open Space. The Site is currently zoned as ME-1 under City of Stoney Creek Zoning By-law No. 3692-92, which is a special designation that permits operations associated with non-hazardous waste from industrial, commercial and institutional sources. Land uses within 500m of the Site and within the 1500m Local Study Area are identified and consist of a mix of residential, commercial, institutional, recreational, and agricultural uses. For each of the alternatives, the environmental effects with respect to existing land uses are primarily the removal or loss of the existing land uses and their replacement with a waste management facility. There are no mitigation measures proposed with respect to the existing land use indicator; consequently, the potential and net effects are considered the same. Further detail is provided below.

Residential

The nearest existing residential dwelling is approximately 60m south of the Site (across Mud Street). Approximately 1,200 existing residential units registered under a plan of subdivision post 1996 are located within 500m of the Site. These residential properties are primarily located within the Urban Area, as identified in the Urban Hamilton Official Plan (2013). The majority of the existing residential uses within the Local Study Area are located south of the SCRF. Lands to the south consist of existing and proposed phases of the Penny Lane Estates subdivision. In accordance with the City of Hamilton's filed registered and draft approved plans of subdivision, there are approximately 6,800 residential units both existing and proposed within the preliminary Study Area. Of the approximate 6,800 residential units within the Local Study Area, approximately 5,800 (registered) residential units currently exist. All landfill footprint options do not physically extend or impede on the existing residential parcel fabric of the Local Study Area. As such, neighbouring residential uses to the site and within the Local Study Area are not subject to direct physical impact requiring alteration of land or change in land use or zoning.

Commercial

A cluster of 11 existing commercial properties resides within 500m of the Site, along the arterial roads along Upper Centennial Parkway and Mud Street towards Red Hill Valley Parkway (i.e., Gas station(s), Golf course, Restaurants, Mixed Use, etc). The locations of these commercial properties are located in both the Urban Area and Rural Area, as identified in the Urban Hamilton Official Plan (2013). All landfill footprint options do not physically extend or impede on the potential use and/or operations of the 11 commercial facilities within 500m of the Site. As such, the 11 existing commercial facilities are not subject to direct physical impact requiring alteration of land or change in land use or zoning.

Recreational

Heritage Green Community Sports Park, Heritage Green Passive Park, and Heritage Green Community Trust Leash Free Dog Park reside within 500 m of the Site. All landfill footprint options do not physically extend or impede on the potential use and/or operations of the recreational facilities within 500m. As such, these facilities are not subject to direct physical impact requiring alteration of land or change in land use or zoning.

Parks and recreational facilities located within the Local Study Area include Felker's Falls Conservation Area, Dofasco Park, Felker Park, Maplewood Park, and Maplewood Green Park. All landfill footprint options do not physically extend or impede on the potential use and/or operations of the recreational uses within the Local Study Area. As such, the recreational uses within the Local Study Area are not subject to direct physical impact requiring alternation of land or change in land use or zoning.

Institutional

Institutional uses within 500 m of the Site include St. James the Apostle Catholic Elementary School. This property is not subject to direct physical impact requiring alternation of land or change in land use or zoning. The Local Study Area consists of 15 existing institutional uses, including primary and secondary schools, public facilities and community services. Institutional uses within the Local Study Area are not subject to direct physical impact requiring alternation of land or change in land use or zoning. As such, no net effects to the physical location of institutional uses resulting from the landfill footprint options considered are anticipated.

Agricultural

Four agricultural properties/parcels are located within 500m of the Site and are located along Upper Centennial Parkway between Mud Street and Green Mountain Rd. and at the corner of Mud St. As per the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) soil classifications, the four agricultural properties consist of Class 1, 2, and 6 soils. Soil classes 1 and 2 are described as moderately high to high productivity of common field crops. Soil class 6 is consistent with severe limitations to soil capabilities. All landfill footprint options do not physically extend or impede on the potential use and operations of the four agricultural properties within 500m of the Site. As such, no net effects to agricultural lands as a result of the landfill footprint options considered are anticipated.

A total of 41 additional properties within the Local Study Area are currently zoned for agricultural use, as in accordance with City of Hamilton Zoning By-law No. 05-200 and City of Stoney Creek Zoning By-law No. 3692-92. All landfill footprint options do not physically extend or impede on the potential use and operations of the agricultural properties within Local Study Area. As such, no net effects to agricultural lands within the Local Study Area as a result of the landfill footprint options considered are anticipated.

5.4.3 Mitigation

Mitigation Measures are not required for existing land uses within the Local Study Area, since each landfill footprint option and relative 30m buffer requirement is not anticipated to expand or impede on these properties. Mitigation measures would be established to manage any potential nuisance influenced by site operations of each landfill footprint options relative to noise, air quality (including odour), and traffic, as described in the Comparative Analysis Memos for noise, air quality, and traffic.

5.4.4 Existing Land Use Mitigation and Net Effects

All landfill footprint options considered do not warrant a change to the existing land use designation or zoning designation of the Site and do not warrant a change to existing land use designations or zoning designations of the adjacent properties, properties and land uses within 500m, and properties and land uses within the Local Study Area. As such, no physical impact to properties or change in land use of properties within the Local Study Area are anticipated resulting from the potential implementation of the landfill footprint options considered.

5.4.5 General Considerations for Visual Aspects

Photographic renderings of the 6 options were developed (**Appendix B**) to show what each of the options would look like from various viewpoints. The viewpoints include;

- First Road West looking South
- Morrissey Blvd. looking South
- Green Mountain Rd. West looking South

- Green Mountain Rd. West and Centennial Parkway looking southwest
- First Rd. East Looking West
- Upper Centennial Parkway and Mud Street East looking North West
- Trafalgar Drive Looking North
- Mud Street East and First Rd. West Looking Northeast
- Heritage Green Community Trust Leash Free Dog Park Looking East

5.4.6 Potential Effects – Visual Perspectives

The visual net effects analysis used the renderings described above to determine how the views of the Facility might change.

Alternative Option 1

Option 1 does not result in a height change, but a reconfiguration of the waste within the landfill. Views are therefore minimally affected by the reconfiguration. Application of visual screening and vegetation would mitigate the views and result in low effects.

Alternative Option 2

Option 2 maintains the same height as the current approved design of the SCRF (baseline condition) but requires a change to the current footprint and the buffer areas are reduced to 30m minimum. The change in footprint results in increased views of the Facility from neighboring residential properties, as the residual material will be closer to the property boundary. Application of visual screening and vegetation would mitigate the views and result in low effects.

Alternative Option 3

Option 3 maintains the same footprint area and buffer areas as the current SCRF (baseline condition), but results in a height increase of 12m. From a visual perspective, a 12m increase results in a noticeable change to the views of the Facility from adjacent and surrounding properties in all directions. The residual material would be highly visible from all viewpoints. The installation of additional visual screens will help to mitigate some of the view, however, some views will still be visible particularly from adjacent residential properties along Mud Street and Green Mountain Road. Option 3 results in High Net Effects.

Alternative Option 4

Option 4 maintains the same height as the current approved design of the SCRF (baseline condition) but requires a change to the current footprint and the buffer areas are reduced to 30m minimum. The views of the Facility are minimally affected by the reconfiguration and expansion. Application of visual screening and vegetation would mitigate the views and result in low effects

Alternative Option 5

Option 5 results in a small height increase of 2.5m and reconfiguration, but maintains current buffers and footprint. The slight height increase will result in slight view change to the Facility in all directions. However, the application of additional visual screens will mitigate the view. Application of visual screening and vegetation would mitigate the views and result in low effects.

Alternative Option 6

Option 6 results in a height increase of 8m, and the buffer areas are reduced to 30m minimum. The height increase as well as changes to the current footprint will result in changes to views of the Facility. The residual material will not only become closer to the property boundary, but will also become quite visible with an 8m increase. The material will be visible from all directions, but particularly from adjacent properties. Installation of visual screens and added vegetation will mitigate views, but will not be able to mitigate all views. Option 6 results in a high change to the viewsheds analyzed.

5.4.7 Mitigation

A combination of earth berms, vegetation, and fences are established around the perimeter of the site to screen the views of the SCRF from the surrounding built-up areas. Installation of additional visual screening elements, such as adding additional vegetation or increasing the berm height would help to mitigate the view from surrounding areas. However, visual mitigation measures may not be able to sufficiently block or mitigate all changing views, particularly for Options 3 and 6.

5.4.8 Visual Net Effects

In regards to visual impacts, it was determined that there would be varying levels of effects from the options. All of the Options will cause a change to view sheds from neighboring and adjacent properties. However, Options 3 and 6 will result in high effects as the height increases will be difficult to mitigate completely.

5.5 Economic

The net effects relating to the Economic components for all Options considered the following criteria and indicators;

Effect on approved/planned Land Uses:

- Number, extent, and type of approved/planned land uses affected

Economic benefit to the City of Hamilton and Local Community:

- Employment at site (number and duration)

5.5.1 Potential Effects – Approved/Planned Land Uses

Located within 500m of the Site are several planned residential and institutional uses. The net effects of the landfill footprint options considered on these planned land uses, relative to potential economic implications, is further assessed, as follows:

Residential

The closest residential dwelling (currently under construction) is located approximately 35m north of the Site.

There are currently four draft approved plans of subdivision within the Local Study Area, as well as eight proposed plans of subdivision currently under municipal review, totaling approximately 2,100 future residential units to be developed within the Local Study Area. This includes a development application (ZAC-17-077) to re-zone 50 Green Mountain Road West from ND (Neighbourhood

Development) to RM-3 (Multiple Residential). The effects on approved/planned and proposed residential uses within the Local Study Area is contingent on direct physical impact requiring alteration of land or change in land use or zoning required as a result of the landfill footprint options considered. However, all landfill footprint options considered, and relative 30m buffer, do not physically extend or impede on planned residential uses. Therefore, no net effects to the physical location of planned residential uses resulting from the landfill footprint options considered are anticipated. Further, application of landfill operation best management practices and mitigation measures from other environmental components (i.e., noise, dust, traffic) will ensure there are no effects on future planned land uses.

Institutional

In accordance with the Nash Neighbourhood Secondary Plan, an institutional land use designation is present at the northwest corner of Green Mountain Road West and First Road West (435 First Road West). This land is reserved for the future development of a school (zoned Neighbourhood Institutional (I1), as approved by council on November 11, 2015, By-law No. 15-260); however, at this time the property is owned by a developer. All landfill footprint options do not physically extend or impede on the potential future use and/or operation of 435 First Road West. As such, no net effects to the physical location or site alteration of this property resulting from the options considered are anticipated. Further, application of landfill operation best management practices and mitigation measures from other environmental components (i.e., noise, dust, traffic) will ensure there are no effects on future planned land uses.

5.5.2 Mitigation

Mitigation Measures are not required for approved/planned and/or proposed land uses within the Local Study Area, since each landfill footprint option and relative 30m buffer requirement is not anticipated to expand or impede on these properties. Mitigation measures would be established to manage any potential nuisance influenced by site operations of each landfill footprint options relative to noise, air quality (including odour), and traffic, as described in the Comparative Analysis Memos for noise, air quality, and traffic.

5.5.3 Approved/Planned Land Use Net Effects

In regards to the economic indicators, specifically the potential effect on approved/planned land uses including; number, extent, and type of approved/planned land uses affected, all six of the alternative options result in no net effects. Landfill operation best management practices and mitigation measures such as; storm water management pond, landfill liner system, dust and noise control measures will ensure potential effects to land uses are managed and mitigated. None of the presented landfill footprint options results in a change to proposed land uses within the site or local study area. Therefore, there are no net effects and no mitigation steps required for the approved/land use indicator.

5.5.4 Potential Effects - Economic Benefits to the City of Hamilton and Local Community

Alternative Option 1

Option 1 allows for an increase in capacity at the SCRF, but does not meet the economic opportunity for Terrapure. The economic benefits to the City and local community are low as the City and community compensation would be reduced based on the current $ per tonne agreements. Further, reduced expansion capacity would not allow for maximum economic activity as demonstrated through the economic analysis.[2] Employment opportunities at the site would be reduced (year over year) under Option 1 based on the reduced amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 180 years.

Alternative Option 2

Option 2 allows for an increase in capacity at the SCRF, but does not meet the economic opportunity for Terrapure. The economic benefits to the City and local community are low as the City and community compensation would be reduced based on the current $ per tonne agreements. Further, reduced expansion capacity would not allow for maximum economic activity as demonstrated through the economic analysis (RIAS Inc). Employment opportunities at the site would be reduced (year over year) under Option 2 based on the reduced amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 170 years.

Alternative Option 3

Option 3 allows for an increase in capacity at the SCRF and meets the economic opportunity for Terrapure to allow for a 3.68 million m3 increase in capacity. Option 3 would result in total economic activity of $349 million to $372 million, with GDP from $218 million to $232 million. The economic benefits to the City and local community are high as the City and community compensation would be maintained and maximized based on the current $ per tonne agreements. Employment opportunities at the site would be increased (year over year) under Option 3 based on the increased amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 250 years.

Alternative Option 4

Option 4 allows for an increase in capacity at the SCRF, but does meet the economic opportunity for Terrapure (slightly under the increase of 3.68 million m3) Option 4 would result in total economic activity similar to Options 3, 5 and 6 based on the total increase in capacity for post diversion solid, non-hazardous residual material. The economic benefits to the City and local community are high as the City and community compensation ($ per tonne) would be slightly lower than other options based

[2] Economic Impacts of the Stoney Creek Regional Facility, RIAS Inc., 2017

on the total increase in capacity. Employment opportunities at the site would be increased (year over year) under Option 4 based on the increased amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 240 years.

Alternative Option 5

Option 5 allows for an increase in capacity at the SCRF and meets the economic opportunity for Terrapure to allow for a 3.68 million m3 increase in capacity. Option 5 would result in total economic activity of $349 million to $372 million, with GDP from $218 million to $232 million. The economic benefits to the City and local community are high as the City and community compensation would be maintained and maximized based on the current $ per tonne agreements. Employment opportunities at the site would be increased (year over year) under Option 5 based on the increased amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 250 years.

Alternative Option 6

Option 6 allows for an increase in capacity at the SCRF and meets the economic opportunity for Terrapure to allow for a 3.68 million m3 increase in capacity. Option 6 would result in total economic activity of $349 million to $372 million, with GDP from $218 million to $232 million. The economic benefits to the City and local community are high as the City and community compensation would be maintained and maximized based on the current $ per tonne agreements. Employment opportunities at the site would be increased (year over year) under Option 6 based on the increased amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 250 years.

5.5.5 Economic Net Effects

In regards to the potential economic benefit to the City of Hamilton and local community, specifically in regards to total economic activity, city and community compensation and employment at the site, all of the options presented result in positive effects. An economic impact assessment was completed in 2017 (RIAS Inc.) regarding the reconfiguration and vertical expansion of the SCRF and the potential output to the local economy. Based on the historical fill rate, it was determined that the current SCRF site generates $28.7 million in economic activity in the Hamilton area, adding 17.9 million in GDP and 51 jobs for local workers. Based on the current configuration and remaining lifespan, the SCRF will generate between $94 and $104 million in total economic activity and 164 to 190 local jobs. It was concluded in the assessment that if an expansion of 3.68 million m^3 of residual material was approved, total economic activity is expected to range between $349 and $372 million, with GDP from $218 million to $232 million and an estimated total jobs between 662 and 671 (RIAS Inc., 2017). Further, the options that allow for Terrapure to realize the economic opportunity for the SCRF (i.e., increase the capacity by 3.68 million m^3) would ensure maximum return with respect to the compensation agreements ($ per tonne). Based on the above estimated figures, it was determined that Options 3,5 and 6 result in high positive effects as the option allows for potential capacity of 3.68 million m3 of residual material. Option 1, 2 and 4 were ranked as having medium positive effects because although they will result in increased residual material, they would not yield the 3.68 million m3 of residual material and therefore would yield a lower overall economic benefit and would result in fewer jobs. Further details are provided in **Appendix B**.

5.6 Atmospheric Environment - Air and Odour

Atmospheric Environment criteria were evaluated with indicators for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

Effect of Air Quality on Off-Site Receptors

- Predicted off-site point of impingement concentrations of particulate matter size fractions

Effect of Odours on off-Site Receptors

- Predicted off-site point of impingement concentrations of volatile organic compounds

5.6.1 General Assumptions

Assumptions included in the assessment for each indicator include the following, for each alternative:

Air Quality

- Predicted concentrations of three size fractions of particulate matter (TSP, PM10 and PM2.5) at off-site receptors compared to the Ministry of Environment and Climate Change's Point of Impingement Standards and Ambient Air Quality criteria (for 24-hour and annual averaging periods)
- Likelihood of predicted concentrations of the particulates to be similar to, greater than, or less than the concentrations resulting from the currently approved plan for the facility
- Location and extent of potentially affected off-site receptors
- The maximum permitted 250 trucks per day was assumed for all alternative landfill footprints – this is highly conservative as the vehicle movements on-site are typically half. This was used as a starting point and will be refined during the impact assessment stage in concert with mitigation measures to more realistic and current truck per day movements

Odour

- Predicted concentrations of volatile and semi-volatile compounds present in the impacted leachate (such as benzene, toluene, xylenes and others, which are odourous)
- Likelihood of predicted concentrations of odourous species to be similar to, greater than, or less than the concentrations resulting from the currently approved plan for the Facility
- Location and extent of potentially affected off-site receptors

5.6.2 Net Effects for Air and Odour

The following assumptions were made for the emissions estimates and dispersion modelling:

- All numerical modelling was carried out using the U.S. EPA AERMOD model (v. 16216r, for the inclusion of annual averages), and MOECC-provided terrain and meteorological data for the vicinity of the Facility.
- Operational hours of the landfill are from 7 AM to 5 PM (10 hours per day).
- A single footprint and elevation was assessed for each alternative. Elevations were assumed to conform to final (maximum) elevations.
- Unpaved roads were assumed for all scenarios.
- The maximum permitted 250 trucks per day was assumed for all alternative landfill footprints – this is highly conservative as the vehicle movements on-site are typically half. This was used as a starting point and will be refined during the impact assessment stage in concert with mitigation measures to more realistic and current truck per day movements
- The active area was assumed to be within the area defined by the proposed haul route for each alternative.
- Material handling was assumed to consist of drop operations, as 250 trucks per day unloaded their waste; and earth moving/bulldozing of the waste material into the working area – this is highly conservative as the vehicle movements on-site are typically half. This was used as a starting point and will be refined during the impact assessment stage in concert with mitigation measures to more realistic and current truck per day movements
- The annual average was assessed assuming maximum daily operations at the site, 365 days per year – this is a conservative estimate as the site's ECA allows for normal operating hours from Monday to Friday only (The ECA explicitly states that the site shall be closed on weekends and statutory holidays).
- Odour emissions were assumed to be mostly originating from the leachate pumping station, where pre-treated leachate is brought to the surface for treatment, prior to be being pumped back underground, and diverted to holding areas or the municipal sanitary sewer.

These assumptions are **highly conservative**, and take into account Best Management Practices (BMP), but will require more specific mitigation measures at the impact assessment stage (discussed further in Section 3.2) and so a qualitative analysis has been undertaken, comparing the worst-case for each option. It is understood that a refinement to the existing customized BMP for dust mitigation will be required for the facility, which will ensure suitable and appropriate mitigation is implemented to allow the facility to operate within MOECC guidelines.

The greatest differences between the various alternative scenarios consisted of the location and length of the on-site haul route, and the final elevation of the landfill. Two alternatives also included the addition of a second pre-treatment leachate pumping station, potentially affecting the emission of odourous compounds.

5.6.3 Air and Odour Potential Effects

Under worst-case (maximum) operating conditions, with minimum dust mitigation, predicted off-site concentrations of particulate species (TSP, PM_{10}, and $PM_{2.5}$) were predicted to exceed existing AAQC or POI standards at one or more off-site receptors for all options. Once a recommended option is selected, specific mitigation measures will be designed in order for the Facility to meet Ministry of Environment and Climate Change (MOECC) air quality criteria.

From an odour perspective, there is little difference between the identified options for this site. The addition of a second leachate pumping station at the opposite side of the site may potentially reduce some odours because pre-treatment leachate will be split between the two pumping stations. Odours are not anticipated to change significantly between the proposed options and currently approved operations. Odour mitigation measures currently implemented at the site will be required to be adequately maintained and operated in order for the Facility to meet MOECC odour guidelines.

5.6.4 Mitigation

Mitigation measures and effectiveness will be determined based on the recommended alternative and will include Best Management Practices (BMPs) as well as other options including:

- Paving on-site roads
- Road cleaning (watering, application of calcium chloride or other dust suppressants)
- Re-routing on-site roads so they are further from the site fenceline
- Limiting vehicle speeds on on-site roads
- Review of the number of vehicles accessing the site on a daily basis
- Detailed assessment of the progression of the site operations for the Preferred Alternative
- Other options as identified during the design of the Preferred Alternative

Based on the identified mitigation required for the Preferred Alternative, a refined Dust Management Plan will be developed and implemented at the Facility.

5.6.5 Air and Odour Net Effects

From an atmospheric environment perspective, the facility will be required to meet MOECC criteria for air quality and odour. Through the implementation of effective and best practice mitigation measures, the facility will operate in accordance with MOECC criteria for air quality. All six Options will be able to implement mitigation measures to meet the specified criteria to ensure there are no off-site exceedances and meet MOECC criteria.

5.7 Atmospheric Environment – Noise

The net effects relating to the Atmospheric Environment Noise components for all Options considered the following criteria and indicators;

Effect on Noise:

- Predicted off-site noise level
- Number of off-site receptors potentially affected (residential, commercial, institutional)

5.7.1 General Assumptions

The worst-case equipment locations were selected based on proximity and elevated line-of-sight exposure to the off-site residential dwellings. The worst-case elevation was selected based on landfill cell development and the corresponding topography detail.

The analysis also accounts for the potential residential development on the residentially zoned vacant lots to the north and the agricultural zoned lot to the East which allows a single detached dwelling to be built.

5.7.2 Environmental Effects to Noise and Mitigation

Up to 75 off-site residential dwellings located in the Study Area will be potentially impacted by noise from the landfill activities. The predicted noise impacts at the residential areas range from 40 to 59 dBA (rounded). The existing and potential residences near the northwest corner of the landfill are the most impacted as they are either approaching or exceeding the 55 dBA daytime noise limit for the six landfill design Alternatives.

- From a potential noise impact exposure perspective, Alternative Methods 1, 2 and 4 are nearly identical as the final landfill height is similar to existing conditions as discussed below. However, the now shortened separation distance from Site activities to adjacent residential areas due to the expansion will result in a potential change to the line-of-sight noise impact exposure for the off-site residential dwellings.
- The increased height of the final landfill in addition to the shortened separation distances to residential areas for Alternative methods 3, 5 and 6 will result in a potential changes to the line-of-sight noise impact exposure to the off-site residential dwellings.
- Landfill activities and on-site operations are compared directly against a daytime one-hour Leq sound level limit of 55 dBA for landfill operations that are limited to 7 a.m. to 7 p.m. under the MOECC “Noise Guidelines for Landfill Sites” (N-1).

In order to meet the noise limit, the north property line berm height needs to be constructed at an appropriate height to block the line of sight to the residential areas to the north. The required height of the berm varies between 7 and 10 meters above the base landfill elevations. Further information is provided in **Appendix B**.

Alternative Method 1

Potential change to the predicted off-site noise impacts occur due to increased line-of-sight due to the landfill reconfiguration associated with Alternative Method 1 and the decrease in the separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 7 meters above existing base elevations (199m ASL to 207m ASL).

Alternative Method 2

Potential changes to the predicted off-site noise impacts occur due to the Footprint Expansion associated with Alternative Method 2 and the decrease in the separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 10 meters above existing base elevations (203m ASL to 210m ASL).

Alternative Method 3

Potential changes to the predicted off-site noise impacts occur due increased line-of-sight due to the elevation change associated with Alternative Method 3 and the decrease in the separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 7 meters above existing base elevations (200m ASL to 207m ASL).

Alternative Method 4

Potential changes to the predicted off-site noise impacts occur due to the Reconfiguration and Footprint Expansion associated with Alternative Method 4 and the decrease in the separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 9 meters above existing base elevations (201m ASL to 208m ASL).

Alternative Method 5

Potential changes to the predicted off-site noise impacts occur due increased line-of-sight from the elevation change associated with Alternative Method 5 and the decrease in the separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 8 meters above existing base elevations (201m ASL to 208m ASL).

Alternative Method 6

Potential changes to the predicted off-site noise impacts occur due increased line-of-sight from the elevation change associated with Alternative Method 6 and the decrease in separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 9 meters above existing base elevations (202m ASL to 209m ASL).

5.7.3 Noise Net Effects

After mitigation measures, noise levels at receptors will be below the applicable noise criteria at the each receptor, which is based on the higher of the background sound level and the MOECC's minimum sound level limits. Further details are provided in **Appendix B**.

5.8 Human Health

As previously mentioned, the amended ToR made a commitment to analyze the potential effects to human health during Alternative Methods assessment and evaluation utilizing the existing data and methodology established as part of the on-going SRCF Community Health Assessment Review (CHAR), which is completed on an annual basis. Given that the studies in the EA will be completed and be benchmarked against human health parameters, such as air quality and groundwater, data from the technical disciplines net effects analysis as was coupled with the data collected and used to complete the annual CHAR (20+ years of data) to analyze the potential effects to human health for each of the footprint options. With the exception of impacts to soil, the criteria below have been evaluated in the annual Community Health Assessment Review that Intrinsik has conducted since 1996. The evaluation of potential human health effects with these five (5) indicators has been completed by utilizing the existing annual CHAR report as a basis and enhancing it to sufficiently meet the MOECC's requirements. The proposed approach will incorporate existing data and any new modelled data provided by other technical disciplines (Hydrogeology, Surface Water, Air Quality) as part of the EA process, and compare the current projected data to those used in the original 1996 Community Health Assessment Study (CHAS) to determine, much like the annual CHAR, whether the proposed expansion would result in any potential change in the conclusions of the original CHAS. Further, more detailed analysis will be completed during the impact assessment stage of the EA.

Five criteria were evaluated for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

Effect on Air Quality:

- Predict impacts to air quality and their potential effects on human health

Effect of Leachate Quality:

- Predict effects of leachate quality (inorganic and organic chemicals) on human health

Effect on Groundwater Quality

- Predict impacts to groundwater quality and their potential effects on human health
- Effect on Surface Water Quality
- Predict impacts to surface water quality and their potential effects on human health

Effect on Soil Quality

- Predict impacts to soil and their potential effects on human health

Alternative Option 1

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (i.e., 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this Alternative Method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this Alternative Method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative Method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigation measures be considered at the design phase to reduce ambient PM10 particulate concentrations. Standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

Marginal increase in larger particulate size fractions (i.e., PM10) compared to the existing approved landfill design with the potential for transient short-term health concerns. All of the other criteria do not result in any net effects when compared to the existing approved landfill design.

Alternative Option 2

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (i.e., 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this Alternative Method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this Alternative Method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative Method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigation measures be considered at the design phase to reduce ambient PM10 particulate concentrations. Standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

Marginal increase in larger particulate size fractions (i.e., PM10) compared to the existing approved landfill design with the potential for transient short-term health concerns. All of the other criteria do not result in any net effects when compared to the existing approved landfill design.

Alternative Option 3

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of the PM10 and PM2.5 size fractions would be marginally higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this Alternative Method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this Alternative Method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative Method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that standard mitigation measures be employed to minimize dust generation, as well as standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

No predicted net effects when compared to existing approved landfill design.

Alternative Option 4

Option 4 maintains the same height as the current approved design of the SCRF (baseline condition) and the SCRF will no longer receive industrial fill. The currently approved area at the SCRF for receiving industrial fill would be replaced with post-diversion solid, non-hazardous industrial residual material. In addition, the areas at the SCRF not currently approved for receiving either industrial fill or residual material would be expanded into so that they would be able to receive post-diversion solid, non-hazardous industrial residual material.

A minimum 30 m buffer would be established around the entire area for receiving post-diversion solid, non-hazardous industrial residual material. Therefore, this option would include a horizontal expansion, but would not include a vertical expansion, with the peak height currently approved remaining unchanged.

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (i.e., 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this Alternative Method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this Alternative Method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative Method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigation measures be considered at the design phase to reduce ambient PM10 particulate concentrations. Standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

Marginal increase in larger particulate size fractions (i.e., PM10) compared to the existing approved landfill design with the potential for transient short-term health concerns. All of the other criteria do not result in any net effects when compared to the existing approved landfill design.

Alternative Option 5

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (i.e., 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this Alternative Method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this Alternative Method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative Method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigation measures be considered at the design phase to reduce ambient PM10 particulate concentrations. Standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

Marginal increase in larger particulate size fractions (i.e., PM10) compared to the existing approved landfill design with the potential for transient short-term health concerns. All of the other criteria do not result in any net effects when compared to the existing approved landfill design.

Alternative Option 6

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (i.e., 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this Alternative Method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this Alternative Method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative Method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigation measures be considered at the design phase to reduce ambient PM10 particulate concentrations. Standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

Marginal increase in larger particulate size fractions (i.e., PM10) compared to the existing approved landfill design with the potential for transient short-term health concerns. All of the other criteria do not result in any net effects when compared to the existing approved landfill design.

Further details are provided in **Appendix B**.

5.9 Transportation

The net effects relating to the Transportation components for all Options considered the following criteria and indicators;

Effect on Traffic:

- Potential for traffic collisions
- Level of Service at intersections around the SCRF

5.9.1 Traffic Effects

With respect to the "Potential for traffic collisions" indicator, the expected effect of each alternative option on future frequency and severity of traffic collisions within the Local Study Area was assessed. All alternative options are not expected to impact average daily SCRF truck volumes. Therefore with no expected change in SCRF truck volumes within the Local Study Area for any of the alternative options, all alternative options are considered to have an equally negligible impact on the potential for traffic collisions in the Local Study Area. No mitigation measures are required, with no resulting net effects.

New residential housing is being planned and built adjacent to the property in the North and it is expected that this new housing will bring additional traffic to the area. However, despite an increase in background traffic, the number of trucks on the site will not be increasing and therefore potential for collisions will not increase. For example, if 10 site trucks occur in one hour, with each Alternative, the maximum number of collisions with a site truck is still 10.

With respect to the "Level of Service at intersections around the SCRF" indicator, the expected effect of each alternative option on intersection Level of Service within the Local Study Area was assessed. Level of Service, with respect to intersection traffic operations, is a measure of the average delay for each turning movement at the selected intersection. As per the completed Existing Traffic Conditions Report, it was concluded that existing SCRF truck volumes servicing the Site are not having any negative identifiable operational impact on the Local Study Area intersections, including with respect to Level of Service among other key measures.

5.9.2 Mitigation

All alternative options are not expected to impact average daily SCRF truck volumes. Therefore with no expected change in SCRF truck volumes within the Local Study Area for any of the alternative options, all alternative options are considered to have an equally negligible impact on the Level of Service at intersections in the Local Study Area. No mitigation measures are required, with no resulting net effects

5.9.3 Traffic Net Effects

Based on the fact that the site will continue to operate under current conditions and there won't be an increase in additional vehicles at the site on a daily basis, no net effects are expected for Traffic for all Alternative Options. Further details are provided in **Appendix B**.

5.10 Archaeology and Built Heritage

The net effects relating to the Archaeology and Built Heritage components for all Options considered the following criteria and indicators;

Effect on known or potential significant archaeological resources:

- Number and type of potentially significant, known archaeological sites affected
- Area (ha) of archaeological potential (i.e., lands with the potential for the presnence of significant archaeological resources) affected.

Effect on built heritage resources and cultural heritage landscapes:

- Number and type of built heritage resources and cultural heritage landscapes displaced or disrupted

5.10.1 Archaeology and Built Heritage Potential Effects

Alternative Option 1

Option 1 does not require a change to the current footprint. The site has been previously excavated and quarried and only one cultural heritage landscape exists within 1.5km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 1 does not affect a known or potential archaeological resource and therefore no mitigation measures are required.

Alternative Option 2

Option 2 requires a slight change to the footprint. However, the change in footprint occurs within previously excavated lands. One cultural heritage landscape exists within 1.5km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 2 does not affect a known or potential archaeological resource and therefore no mitigation measures are required.

Alternative Option 3

Option 3 does not require a change to the current footprint. The site has been previously excavated and quarried and only one cultural heritage landscape exists within 1.5km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 3 does not affect a known or potential archaeological resource and therefore no mitigation measures are required.

Alternative Option 4

Option 4 requires a slight change to the footprint. However, the change in footprint occurs within previously excavated lands. One cultural heritage landscape exists within 1.5km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 4 does not affect a known or potential archaeological resource and therefore no mitigation measures are required.

Alternative Option 5

Option 5 requires a slight change to the footprint. However, the change in footprint occurs within previously excavated lands. One cultural heritage landscape exists within 1.5km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 5 does not affect a known or potential archaeological resource and therefore no mitigation measures are required.

Alternative Option 6

Option 6 requires a slight change to the footprint. However, the change in footprint occurs within previously excavated lands. One cultural heritage landscape exists within 1.5km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 6 does not affect a known or potential archaeological resource and therefore no mitigation measures are required.

5.10.2 Mitigation

No mitigation is required as no potentially significant archaeological resources or built heritage landscapes will be disturbed or displaced because of any of the Alternative Options.

5.10.3 Archaeology and Built Heritage Net Effects

The current SCRF site is located within a former quarry and is therefore considered to be previously disturbed from a cultural heritage and archaeological perspective. A copy of the quarry license and permit is included as Appendix A to demonstrate the extent of the quarry limits/ disturbed area relative to the alternative footprint options. All of the lands have been previously excavated and therefore it is concluded that there will be no potentially significant or known archeological sites or lands with the presence of archaeological resources disturbed or affected. No Net Effects or Mitigation measures are anticipated or required from an archaeological perspective.

A review of the designated culturally significant built heritage and cultural landscapes was completed to assist in the *Land Use Existing Conditions report*. The review determined that there was only one designated built heritage resource, known as the Billy Green House, 30 Ridge Rd (Appendix B) located within the 1.5km of the SCRF. None of the 6 Options will result in the designated resource to be disturbed or displaced and therefore No Net Effects and no mitigation measures are anticipated or required from a built/cultural heritage resource perspective.

It should be noted that as part of the 1996 Taro East EA, which established the currently approved facility, the Ministry of Culture, Tourism and Recreation (now known as Ministry of Tourism, Culture and Sport) confirmed that there was a low potential for impacting cultural heritage resources on site due to the fact that the study area (for the landfill footprint) is limited to an exhausted quarry pit[3].

5.11 Design and Operations

Seven criteria were evaluated with seven indicators for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings. It should be noted that this factor area was expanded upon to include additional criteria and indictors based on commitments made within the Approved SCRF ToR. This includes a commitment to review how the existing leachate system would be able to accommodate the proposed alternatives and whether further upgrades would be required. This has been captured in the criteria "Leachate Management". Further, a commitment around closure and post-closure was also made in the SCRF ToR, which has been assessed under the Criteria "Closure and Post Closure". Further details on the broad framework for closure and post-closure is described in Section 12.

- Potential to Provide Service for Disposal
- Ability of Alternative Methods to provide disposal capacity for post-diversion, solid, non-hazardous residual material
- Cost of Facility
- Approximate relative cost of Alternative Methods
- Leachate Management
- Design and operating complexity
- Stormwater Management
- Design and operating complexity
- Construction
- Complexity and constructability of components
- Site Operations
- Complexity and operability of components
- Closure and Post-Closure
- Flexibility of design and operations

5.11.1 Effects Analysis

The net effects analysis serves to assess the changes to the additional design and operational requirements associated with each of the options when compared to the current approved design of the SCRF (baseline condition).

[3] See Supporting Document #2 to the Stoney Creek Regional Facility Environmental Assessment Minister Approved Amended Terms of Reference for correspondence.

The changes for each of the options are discussed in further detail below.

Alternative Option 1

Potential to Provide Service for Disposal

Option 1 only provides 8,830,000 m^3 of total disposal capacity for residual material. Option 1 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 1 requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are generally uniform. The larger footprint of the residual material area will see a moderate increase to the leachate generation rate.

Stormwater Management

Option 1 includes a triangular stormwater pond layout which is consistent with the current approved design. The layout of the stormwater pond provides design and operational flexibility.

Construction

Option 1 will require the construction of additional base liner and leachate collection system for the expanded residual material area. Option 1 does not require expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has an open layout with a simple configuration and dedicated areas for the various components.

Site Operations

Option 1 does not include the importing of industrial fill, meaning that his material will no longer need to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond provides operational flexibility. Access and egress from the site will be maintained in their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 1 reflects an open and uniform configuration that will simplify site closure requirements. The overall layout and contours of the site do not limit the flexibility of potential post-closure uses.

Cost of Facility

Option 1 will see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be no additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure. Potential savings could be realized by no longer having to manage industrial fill material.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 1, the magnitude of the potential effects is anticipated to be small relative to the current approved layout since many aspects of the site will only require minor modifications from their existing configuration.

Net Effect

Option 1 will have low net effects relative to the current approved layout since many aspects of the site will only require minor modifications from their existing configuration. However, Option 1 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Alternative Option 2

Potential to Provide Service for Disposal

Option 2 only provides 7,420,000 m^3 of total disposal capacity for residual material. Option 2 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 2 requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in two separate areas with two separate leachate pumping stations. The shape and contours of the residual area are irregular. The larger footprint of the residual material area will see a small increase to the leachate generation rate.

Stormwater Management

Option 2 includes an "L" shaped stormwater pond layout which is not consistent with the current approved design. The layout of the stormwater pond limits design and operational flexibility.

Construction

Option 2 will require the construction of additional base liner and leachate collection system for the expanded residual material area. Option 2 requires expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has a complex layout with an integrated configuration of the various components.

Site Operations

Option 2 includes the importing of industrial fill, meaning that his material will continue to be managed. Leachate will be managed from two separate areas with two separate leachate pumping stations. The proposed layout of the stormwater management pond limits operational flexibility. Access and egress from the site will be modified from their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 2 reflects a complex layout with an integrated configuration that may complicate site closure requirements. The overall layout and contours of the site limit the flexibility of potential post-closure uses.

Cost of Facility

Option 2 will see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 2, the magnitude of the potential effects is anticipated to be large relative to the current approved layout since many aspects of the site will require significant modifications from their existing configuration.

Net Effect

Option 2 will have high net effects relative to the current approved layout since many aspects of the site will require significant modifications from their existing configuration. However, Option 2 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Alternative Option 3

Potential to Provide Service for Disposal

Option 3 provides 10,000,000 m^3 of total disposal capacity for residual material. Option 3 meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 3 does not require the design and construction of additional base liner and leachate collection system for an expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are irregular. Since the footprint of the residual material area is consistent with the current approved design, the leachate generation rate is also expected to remain relatively consistent with the current rate.

Stormwater Management

Option 3 includes a triangular stormwater pond layout which is consistent with the current approved design. The layout of the stormwater pond provides design and operational flexibility.

Construction

Option 3 will not require the construction of additional base liner and leachate collection system for an expanded residual material area. Option 3 does not require expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has a complex layout with an integrated configuration of the various components.

Site Operations

Option 3 includes the importing of industrial fill, meaning that his material will continue to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond provides operational flexibility. Access and egress from the site will be maintained in their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 3 reflects a complex layout with an integrated configuration that may complicate site closure requirements. The overall layout and contours of the site limit the flexibility of potential post-closure uses.

Cost of Facility

Option 3 will not see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be no additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 3, the magnitude of the potential effects is anticipated to be small relative to the current approved layout since some aspects of the site will require modifications from their existing configuration.

Net Effect

Option 3 will have low net effects relative to the current approved layout since many aspects of the site will only require minor modifications from their existing configuration. Option 3 also meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Alternative Option 4

Potential to Provide Service for Disposal

Option 4 only provides 9,580,000 m^3 of total disposal capacity for residual material. Option 4 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 4 requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are generally uniform. The larger footprint of the residual material area will see a large increase to the leachate generation rate.

Stormwater Management

Option 4 includes an “L” shaped stormwater pond layout which is not consistent with the current approved design. The layout of the stormwater pond limits design and operational flexibility.

Construction

Option 4 will require the construction of additional base liner and leachate collection system for the expanded residual material area. Option 4 requires expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has an open layout with a simple configuration and dedicated areas for the various components.

Site Operations

Option 4 does not include the importing of industrial fill, meaning that his material will no longer need to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond limits operational flexibility. Access and egress from the site will be modified from their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 4 reflects an open and uniform configuration that will simplify site closure requirements. The overall layout and contours of the site do not limit the flexibility of potential post-closure uses.

Cost of Facility

Option 4 will see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will also be additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure. Potential savings could be realized by no longer having to manage industrial fill material.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site’s design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 4, the magnitude of the potential effects is anticipated to be small relative to the current approved layout since some aspects of the site will require modifications from their existing configuration.

Net Effect

Option 4 will have moderate net effects relative to the current approved layout since some aspects of the site will require significant modifications from their existing configuration. However, Option 4 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Alternative Option 5

Potential to Provide Service for Disposal

Option 5 provides 10,000,000 m^3 of total disposal capacity for residual material. Option 5 meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 5 requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are generally uniform. The larger footprint of the residual material area will see a moderate increase to the leachate generation rate.

Stormwater Management

Option 5 includes a triangular stormwater pond layout which is consistent with the current approved design. The layout of the stormwater pond provides design and operational flexibility.

Construction

Option 5 will require the construction of additional base liner and leachate collection system for the expanded residual material area. Option 5 does not require expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has an open layout with a simple configuration and dedicated areas for the various components.

Site Operations

Option 5 does not include the importing of industrial fill, meaning that his material will no longer need to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond provides operational flexibility. Access and egress from the site will be maintained in their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 5 reflects an open and uniform configuration that will simplify site closure requirements. The overall layout and contours of the site do not limit the flexibility of potential post-closure uses.

Cost of Facility

Option 5 will see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be no additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure. Potential savings could be realized by no longer having to manage industrial fill material.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 5, the magnitude of the potential effects is anticipated to be small relative to the current approved layout since some aspects of the site will require modifications from their existing configuration.

Net Effect

Option 5 will have low net effects relative to the current approved layout since many aspects of the site will only require minor modifications from their existing configuration. Option 5 also meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Alternative Option 6

Potential to Provide Service for Disposal

Option 6 provides 10,000,000 m^3 of total disposal capacity for residual material. Option 6 meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 6 requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in two separate areas with two separate leachate pumping stations. The shape and contours of the residual area are irregular. The larger footprint of the residual material area will see a small increase to the leachate generation rate.

Stormwater Management

Option 6 includes an "L" shaped stormwater pond layout which is not consistent with the current approved design. The layout of the stormwater pond limits design and operational flexibility.

Construction

Option 6 will require the construction of additional base liner and leachate collection system for the expanded residual material area. Option 6 requires expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has a complex layout with an integrated configuration of the various components.

Site Operations

Option 6 includes the importing of industrial fill, meaning that his material will continue to be managed. Leachate will be managed from two separate areas with two separate leachate pumping stations. The proposed layout of the stormwater management pond limits operational flexibility. Access and egress from the site will be modified from their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 6 reflects a complex layout with an integrated configuration that may complicate site closure requirements. The overall layout and contours of the site limit the flexibility of potential post-closure uses.

Cost of Facility

Option 6 will see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will also be additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 6, the magnitude of the potential effects is anticipated to be high relative to the current approved layout since some aspects of the site will require significant modifications from their existing configuration.

Net Effect

Option 6 will have moderate net effects relative to the current approved layout since some aspects of the site will require significant modifications from their existing configuration. Option 6 also meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Further details are provided in **Appendix B**.

6. Summary of Net Effects

The net effects for each environmental component and details on the mitigation for each of the 6 options can be viewed in the Net Effects Tables (6 total) as part of **Appendix C**. However, a brief overview of the net effects is summarized below.

Option 1

Table 6.1 summarizes the net effects of each environmental component for Option 1:

Table 6.1 Option 1 – Summary of Net Effects

Environmental Component	Summary of Net Effects
Geology and Hydrogeology	No Net Effects to groundwater quality or groundwater flow are anticipated. Off-site groundwater receptors and source water protection areas are not anticipated to be affected upon implementation of mitigation measures.
Surface Water	No Net Effects to surface water quality or quantity are anticipated.
Terrestrial and Aquatic	Low Net Effects to terrestrial and aquatic ecosystems are anticipated. Predicted effects on vegetation communities, wildlife habitat, aquatic habitat and biota would be mitigated through the implementation of Best Management Practices.
Land Use	No Net Effects to existing land uses within the Local Study area are anticipated. Low Net Effects to views of the facility are anticipated. Installation of visual screening elements would obscure views of the facility from sensitive receptors.
Economic	No Net Effects to approved or planned land uses within the Local Study Area are anticipated. Low (positive) Net Effects on economic benefits to the City of Hamilton and local community are anticipated.
Atmospheric	Low Net Effects to air quality affecting off-site receptors are anticipated. Application of Dust BMPs and reduction in daily vehicle limits will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors. No Net Effects to odours affecting off-site receptors are anticipated. Low Net Effects to noise affecting off-site receptors are anticipated upon implementation of on-site mitigation measures.
Human Health	No Net Effects to human health resulting from predicted effects to leachate quantity, groundwater quality, surface water quality, or soil quantity are anticipated. Low Net Effects to human health resulting from effects to air quality are anticipated. VOC emissions would be equivalent to the existing approved landfill design, where concentrations are expected to be below heath-based benchmarks.
Transportation	No Net Effects to road user safety or intersection Level of Service are anticipated in the Local Study Area.
Archaeology and Built Heritage	No Net Effects to known or potential archaeological resources or built and cultural heritage resources are anticipated.
Design and Operations	Option 1 fails to meet the objectives for disposal and requires a small increase in cost relative to expansion.

Option 2

Table 6.2 summarizes the net effects of each environmental component for Option 2:

Table 6.2 Option 2 – Summary of Net Effects

Environmental Component	Summary of Net Effects
Geology and Hydrogeology	No Net Effects to groundwater quality or groundwater flow are anticipated. Off-site groundwater receptors and source water protection areas are not anticipated to be affected upon implementation of mitigation measures.
Surface Water	Low Net Effects to surface water quality and quantity are anticipated. There may be the potential for limitations to the design and construction of perimeter ditches and the stormwater management pond within the allocated areas.
Terrestrial and Aquatic	Low Net Effects to terrestrial and aquatic ecosystems are anticipated. Predicted effects on vegetation communities, wildlife habitat, aquatic habitat and biota would be mitigated through the implementation of Best Management Practices.
Land Use	No Net Effects to existing land uses within the Local Study area are anticipated. Low Net Effects to views of the facility are anticipated. Installation of visual screening elements would obscure views of the facility from sensitive receptors.
Economic	No Net Effects to approved or planned land uses within the Local Study Area are anticipated. Low (positive) Net Effects on economic benefits to the City of Hamilton and local community are anticipated.
Atmospheric	Low Net Effects to air quality affecting off-site receptors are anticipated. Application of Dust BMPs and reduction in daily vehicle limits will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors. No Net Effects to odours affecting off-site receptors are anticipated. Low Net Effects to noise affecting off-site receptors are anticipated upon implementation of on-site mitigation measures.
Human Health	No Net Effects to human health resulting from predicted effects to leachate quantity, groundwater quality, surface water quality, or soil quantity are anticipated. Low Net Effects to human health resulting from effects to air quality are anticipated. VOC emissions would be equivalent to the existing approved landfill design, where concentrations are expected to be below heath-based benchmarks.
Transportation	No Net Effects to road user safety or intersection Level of Service are anticipated in the Local Study Area.
Archaeology and Built Heritage	No Net Effects to known or potential archaeological resources or built and cultural heritage resources are anticipated.
Design and Operations	Option 2 fails to meet the objectives for disposal and requires a large increase in cost relative to expansion.

Option 3

Table 6.3 summarizes the net effects of each environmental component for Option 3:

Table 6.3 Option 3 – Summary of Net Effects

Environmental Component	Summary of Net Effects
Geology and Hydrogeology	No Net Effects to groundwater quality or groundwater flow are anticipated. Off-site groundwater receptors and source water protection areas are not anticipated to be affected upon implementation of mitigation measures.
Surface Water	No Net Effects to surface water quality or quantity are anticipated.
Terrestrial and Aquatic	Low Net Effects to terrestrial and aquatic ecosystems are anticipated. Predicted effects on vegetation communities, wildlife habitat, aquatic habitat and biota would be mitigated through the implementation of Best Management Practices.
Land Use	No Net Effects to existing land uses within the Local Study area are anticipated. High Net Effects to views of the facility are anticipated. Option 3 results in a height increase of 12m and cannot be sufficiently mitigated.
Economic	No Net Effects to approved or planned land uses within the Local Study Area are anticipated. High (positive) Net Effects on economic benefits to the City of Hamilton and local community are anticipated.
Atmospheric	Low Net Effects to air quality affecting off-site receptors are anticipated. Application of Dust BMPs and reduction in daily vehicle limits will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors. No Net Effects to odours affecting off-site receptors are anticipated. Low Net Effects to noise affecting off-site receptors are anticipated upon implementation of on-site mitigation measures.
Human Health	No Net Effects to human health resulting from predicted effects to air quality, leachate quantity, groundwater quality, surface water quality, or soil quantity are anticipated.
Transportation	No Net Effects to road user safety or intersection Level of Service are anticipated in the Local Study Area.
Archaeology and Built Heritage	No Net Effects to known or potential archaeological resources or built and cultural heritage resources are anticipated.
Design and Operations	Option 3 does not deviate in current design and supports adequate disposal capacity and results in high economic benefits.

Option 4

Table 6.4 summarizes the net effects of each environmental component for Option 4:

Table 6.4 Option 4 – Summary of Net Effects

Environmental Component	Summary of Net Effects
Geology and Hydrogeology	No Net Effects to groundwater quality or groundwater flow are anticipated. Off-site groundwater receptors and source water protection areas are not anticipated to be affected upon implementation of mitigation measures.
Surface Water	Low Net Effects to surface water quality and quantity are anticipated. There may be the potential for limitations to the design and construction of perimeter ditches and the stormwater management pond within the allocated areas.
Terrestrial and Aquatic	Low Net Effects to terrestrial and aquatic ecosystems are anticipated. Predicted effects on vegetation communities, wildlife habitat, aquatic habitat and biota would be mitigated through the implementation of Best Management Practices.
Land Use	No Net Effects to existing land uses within the Local Study area are anticipated. Low Net Effects to views of the facility are anticipated. Installation of visual screening elements would obscure views of the facility from sensitive receptors.
Economic	No Net Effects to approved or planned land uses within the Local Study Area are anticipated. Low (positive) Net Effects on economic benefits to the City of Hamilton and local community are anticipated.
Atmospheric	Low Net Effects to air quality affecting off-site receptors are anticipated. Application of Dust BMPs and reduction in daily vehicle limits will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors. No Net Effects to odours affecting off-site receptors are anticipated. Low Net Effects to noise affecting off-site receptors are anticipated upon implementation of on-site mitigation measures.
Human Health	No Net Effects to human health resulting from predicted effects to leachate quantity, groundwater quality, surface water quality, or soil quantity are anticipated. Low Net Effects to human health resulting from effects to air quality are anticipated. VOC emissions would be equivalent to the existing approved landfill design, where concentrations are expected to be below heath-based benchmarks.
Transportation	No Net Effects to road user safety or intersection Level of Service are anticipated in the Local Study Area.
Archaeology and Built Heritage	No Net Effects to known or potential archaeological resources or built and cultural heritage resources are anticipated.
Design and Operations	Option 4 fails to meet the objectives for disposal and requires a small increase in cost relative to expansion.

Option 5

Table 6.5 summarizes the net effects of each environmental component for Option 5:

Table 6.5 Option 5 – Summary of Net Effects

Environmental Component	Summary of Net Effects
Geology and Hydrogeology	No Net Effects to groundwater quality or groundwater flow are anticipated. Off-site groundwater receptors and source water protection areas are not anticipated to be affected upon implementation of mitigation measures.
Surface Water	No Net Effects to surface water quality or quantity are anticipated.
Terrestrial and Aquatic	Low Net Effects to terrestrial and aquatic ecosystems are anticipated. Predicted effects on vegetation communities, wildlife habitat, aquatic habitat and biota would be mitigated through the implementation of Best Management Practices.
Land Use	No Net Effects to existing land uses within the Local Study area are anticipated. Low Net Effects to views of the facility are anticipated. Installation of visual screening elements would obscure views of the facility from sensitive receptors.
Economic	No Net Effects to approved or planned land uses within the Local Study Area are anticipated. High (positive) Net Effects on economic benefits to the City of Hamilton and local community are anticipated.
Atmospheric	Low Net Effects to air quality affecting off-site receptors are anticipated. Application of Dust BMPs and reduction in daily vehicle limits will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors. No Net Effects to odours affecting off-site receptors are anticipated. Low Net Effects to noise affecting off-site receptors are anticipated upon implementation of on-site mitigation measures.
Human Health	No Net Effects to human health resulting from predicted effects to leachate quantity, groundwater quality, surface water quality, or soil quantity are anticipated. Low Net Effects to human health resulting from effects to air quality are anticipated. VOC emissions would be equivalent to the existing approved landfill design, where concentrations are expected to be below heath-based benchmarks.
Transportation	No Net Effects to road user safety or intersection Level of Service are anticipated in the Local Study Area.
Archaeology and Built Heritage	No Net Effects to known or potential archaeological resources or built and cultural heritage resources are anticipated.
Design and Operations	Option 5 supports adequate disposal capacity and results in high economic benefits.

Option 6

Table 6.6 summarizes the net effects of each environmental component for Option 6:

Table 6.6 Option 6 – Summary of Net Effects

Environmental Component	Summary of Net Effects
Geology and Hydrogeology	No Net Effects to groundwater quality or groundwater flow are anticipated. Off-site groundwater receptors and source water protection areas are not anticipated to be affected upon implementation of mitigation measures.
Surface Water	Low Net Effects to surface water quality and quantity are anticipated. There may be the potential for limitations to the design and construction of perimeter ditches and the stormwater management pond within the allocated areas.
Terrestrial and Aquatic	Low Net Effects to terrestrial and aquatic ecosystems are anticipated. Predicted effects on vegetation communities, wildlife habitat, aquatic habitat and biota would be mitigated through the implementation of Best Management Practices.
Land Use	No Net Effects to existing land uses within the Local Study area are anticipated. High Net Effects to views of the facility are anticipated. Option 6 results in a height increase of 8m and cannot be sufficiently mitigated.
Economic	No Net Effects to approved or planned land uses within the Local Study Area are anticipated. High (positive) Net Effects on economic benefits to the City of Hamilton and local community are anticipated.
Atmospheric	Low Net Effects to air quality affecting off-site receptors are anticipated. Application of Dust BMPs and reduction in daily vehicle limits will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors. No Net Effects to odours affecting off-site receptors are anticipated. Low Net Effects to noise affecting off-site receptors are anticipated upon implementation of on-site mitigation measures.
Human Health	No Net Effects to human health resulting from predicted effects to leachate quantity, groundwater quality, surface water quality, or soil quantity are anticipated. Low Net Effects to human health resulting from effects to air quality are anticipated. VOC emissions would be equivalent to the existing approved landfill design, where concentrations are expected to be below heath-based benchmarks.
Transportation	No Net Effects to road user safety or intersection Level of Service are anticipated in the Local Study Area.
Archaeology and Built Heritage	No Net Effects to known or potential archaeological resources or built and cultural heritage resources are anticipated.
Design and Operations	Option 6 fails to meet the objectives for disposal and requires a large increase in cost relative to expansion.

7. Comparative Evaluation Results

As described in Section 4, the comparative evaluation of the Alternative Methods was completed using a “Reasoned Argument” or “trade-off” method, with evaluation criteria as the basis for comparison. Under the Reasoned Argument approach, the differences in the net effects associated with each Alternative Method are highlighted in a Comparative Evaluation Table included in **Appendix D**. Based on these differences, the advantages and disadvantages of each alternative can be identified according to the evaluation of trade-offs between the various evaluation criteria and indicators. The comparative evaluation results are summarized within the sections below with additional details provided in the technical memo’s described in Section 5 of this report and included within the analysis of each technical discipline memo in **Appendix B**. **Table 7.1** provides a summary of the results, while full details are provided within **Appendix D.**

Table 7.1 Comparative Evaluation Options Summary

	Environmental Component	Evaluation Criteria	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Built	**Land Use**	Effect on existing land uses	🟢	🟢	🟢	🟢	🟢	🟢
		Effect on views of the facility	🟡	🟡	🔴	🟡	🟡	🔴
		Rationale	Options 1,2,4 and 5 are all more preferred because there is either no proposed height increase or a relatively low height increase and the views can be minimized through screening. Options 3 and 6 are less preferred because there is a relatively greater height increase and the views cannot be fully minimized through screening.					
Economic	**Economic**	Effect on approved/planned land uses	🟢	🟢	🟢	🟢	🟢	🟢
		Economic benefit to the City of Hamilton and local community	🟠	🟠	🟢	🟠	🟢	🟢
		Rationale	Options 3,5 and 6 are all more preferred because they would yield the highest benefit to the City of Hamilton and local economy in terms of economic activity and jobs. Options 1, 2 and 4 are less preferred because they all result in the lowest economic benefit to the City and local economy.					
Cultural	**Archaeology and Built Heritage**	Effect on known or potential significant archaeological resources	🟢	🟢	🟢	🟢	🟢	🟢
		Effect on built heritage resources and cultural heritage landscapes	🟢	🟢	🟢	🟢	🟢	🟢
		Rationale	All Options are equally preferred from a Cultural Environment perspective because no cultural or heritage landscapes would be disturbed or displaced and the site has been previously excavated and disturbed for quarrying. Therefore, no archaeological resources would be adversely affected.					
Natural	**Geology & Hydrogeology**	Effect on groundwater quality	🟢	🟢	🟢	🟢	🟢	🟢
		Effect on groundwater flow	🟢	🟢	🟢	🟢	🟢	🟢
		Rationale	All Options are equally preferred from a groundwater quality and flow perspective because no adverse effects are expected.					
	Surface Water Resources	Effect on surface water quality	🟢	🟡	🟢	🟡	🟢	🟡
		Effect on surface water quantity	🟢	🟡	🟢	🟡	🟢	🟡
		Rationale	Options 1,3 and 5 are all more preferred because they maintain the site's existing stormwater management ponds. Options 2, 4 and 6 are all less preferred because the site's existing stormwater management ponds would need to be relocated/redesigned to accommodate the proposed footprint.					
	Terrestrial & Aquatic Environment	Effect on terrestrial ecosystems	🟡	🟡	🟡	🟡	🟡	🟡
		Effect on aquatic ecosystems	🟡	🟡	🟡	🟡	🟡	🟡
		Rationale	All Options are equally preferred because they would all have a low potential for adverse effects to the terrestrial and aquatic ecosystems, which would be further minimized through the use of standard mitigation measures.					

Table 7.1 Comparative Evaluation Options Summary (cont'd)

	Environmental Component	Evaluation Criteria	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Natural	**Atmospheric Environment**	Effect of air quality on off-site receptors	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
		Effect of odours on off-site receptors	Green	Green	Green	Green	Green	Green
		Effect of noise on off-site receptors	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
		Rationale	All Options are equally preferred because there would be a low potential for adverse effects to area residents from a dust and noise perspective, which would be further minimized through the use of standard mitigation measures and no effects from an odour perspective.					
Social	**Transportation**	Effect on traffic	Green	Green	Green	Green	Green	Green
		Rationale	All Options are equally preferred because the number of trucks permitted at the site would remain unchanged resulting in no adverse effects on road user safety or intersection capacity.					
	Human Health	Air Quality	Yellow	Yellow	Green	Yellow	Yellow	Yellow
		Leachate Quantity	Green	Green	Green	Green	Green	Green
		Groundwater Quality	Green	Green	Green	Green	Green	Green
		Surface Water Quality	Green	Green	Green	Green	Green	Green
		Soil Quality	Green	Green	Green	Green	Green	Green
		Rationale	Option 3 is considered preferred from a human health perspective. All other options are considered less preferred, but would have a low potential for adverse effects with the continuation of the existing site's mitigation measures augmented with additional Best Management Practices, where proposed, and on-going monitoring.					
Technical	**Design & Operations**	Potential to provide service for disposal	Red	Red	Green	Red	Green	Green
		Leachate Management	Yellow	Orange	Green	Orange	Yellow	Orange
		Stormwater Management	Green	Orange	Green	Orange	Green	Orange
		Construction	Yellow	Red	Green	Red	Yellow	Red
		Site Operations	Green	Red	Green	Orange	Green	Red
		Closure and Post-Closure	Green	Orange	Yellow	Green	Green	Orange
		Cost of facility	Yellow	Red	Green	Red	Yellow	Red
		Rationale	Options 3 and 5 are both considered more preferred compared to the other Options from a design and operations perspective including their ability to provide the additional capacity being sought through the EA, but Option 3 is more preferred because it would be easier to construct and have a lower overall capital cost.					

Green: **No Negative or Positive Net Effect** | Yellow: **Low Negative Net Effect** | Orange: **Moderate Negative Net Effect** | Red: **High Negative Net Effect**

Geology and Hydrogeology

All six alternatives are considered equivalent from the perspective of net environmental effects on the geologic and hydrogeological receptors and therefore all alternatives are all are 'preferred.'

Surface Water Resources

The triangular pond layout from Options 1, 3 and 5 is preferred over the narrower "L" shaped layout from Options 2, 4 and 6. This preference is due to the limitations and complications that may occur during the design and construction of the SWM pond in the "L" shaped layout within the buffer zone. The berm that will need to be constructed will utilize more than half the area allocated to constructing the SWM pond (conservatively estimated 30% compared to the conservative 50% assumed for the triangular SWM pond layout). This will be slightly more limiting and complex in design and construction that the triangular pond layout. For these reasons, Options 1, 3 and 5 are more preferred.

Terrestrial and Aquatic

Although Options 2, 4, and 6 result in a greater initial amount of vegetation and associated wilidlife habitat (in the buffer areas) as well as disturbance to aquatic habitat and biota (stormwater pond relocations), the loss is temporary and can be mitigated to the same levels as Options 1, 3 and 5. Therefore, all options are equally preferred because they would all have a low potential for adverse effects to the terrestrial and aquatic ecosystems, which would be further minimized through the use of standard mitigation measures.

Land Use and Economic

All options are preferred from a current land use perspective, as no change or effects to the current land use both on site and to surrounding properties. From a visual perspective, Options 1,2,4 and 5 are more preferred, because there is either no proposed height increase or a relatively low height increase and the views can be minimized through screening. Options 3 and 6 are less preferred because there is a relatively greater height increase and the views cannot be fully minimized through screening.

Further, Options 3, 5 and 6 are all more preferred because they would yield the highest benefit to the City of Hamilton and local economy in terms of economic activity and jobs. Options 1, 2 and 4 are less preferred because they all result in the lowest economic benefit to the City and local economy.

Air and Odour

From an atmospheric environment perspective, the Facility will be required to meet MOECC criteria for air quality and odour. The desired facility footprint and operations will be required, regardless of the option selected, to implement effective mitigation such that the Facility will operate in accordance with MOECC criteria. During the detailed impact assessment, more in-depth and detailed mitigation measures/ plan will be applied to the recommended option demonstrating that the Facility can operate in accordance with provincial air quality and odour criteria.

All Options are equally preferred because there would be a low potential for adverse effects to area residents from a dust perspective, which would be further minimized through the use of standard mitigation measures. All six options are capable of operating within MOECC guidelines with suitable dust mitigation measures implemented.

Human Health

All of the options, except Option 3, have low net effects due to a marginal increase in larger airborne particulate size fractions (i.e., PM10) modelled in the surrounding community compared to the existing approved landfill design with the potential for transient short-term health concerns. Option 3 did not have this concern. However, it is expected that these predicted exceedances are due to conservatism built into the Air Quality assessment.

Option 3 is considered preferred from a human health perspective. All other options are considered less preferred, but would have a low potential for adverse effects with the continuation of the existing site's mitigation measures augmented with additional Best Management Practices, where proposed, and on-going monitoring.

Noise

The mitigation measure considered in this assessment are building a barrier on top of the future built screening berm at landfill perimeter at the North of the landfill perimeter. All of the alternatives can achieve the required noise limits. The construction of a berm along the north property line will effectively shield the residences to the north. The height of the berm is dependent on the alternative and the final detailed design put forward for approval. All Options are equally preferred because there would be a low potential for adverse effects to area residents from a noise perspective, which would be further minimized through the mitigation measures proposed.

Transportation

There is no distinction between the alternative options in terms of their effects on the potential for collisions and Level of Service at intersections in the Local Study Area. All Options are equally preferred because the number of trucks permitted at the site would remain unchanged resulting in no adverse effects on road user safety or intersection capacity.

Archeology and Built Heritage

All of the footprint changes will occur on already previously excavated and quarried lands and the one designated heritage landscape (located off-site) will not be disturbed or displaced. Therefore, all options are equally preferred from a Cultural Environment perspective because no cultural or heritage landscapes would be disturbed or displaced and as the site has been previously excavated and disturbed for quarrying, no archaeological resources would be adversely affected.

Design and Operations

Options 3 and 5 are both considered more preferred compared to the other Options from a design and operations perspective including their ability to provide the additional capacity being sought through the EA, but Option 3 is more preferred because it would be easier to construct and have a lower overall capital cost.

7.1 Ranking of the Options and Selection of the Recommended Option

Based the relative rankings and preference rankings for each alternative at the criteria and factor levels summarized above (See **Appendix D** for further detail), the overall ranking for each Option is as follows:

- Option 1 – Less Preferred
- Option 2 – Least Preferred
- Option 3 – Less Preferred
- Option 4 – Less Preferred
- Option 5 – Most Preferred
- Option 6 – Less Preferred

Using the ‘trade-off’ or reasoned argument approach, the Recommended Alternative as “Most Preferred” is #5: Reconfiguration and Height Increase. Alternative #5 is Recommended as it represents:

- A technically feasible design that provides for the additional capacity being sought through the EA. This will allow Terrapure to continue to support the growing local economy by providing disposal capacity for industrial residual material generated within Hamilton and the GTA
- A lower height increase compared to Options 3 and 6, which can be screened through such measures as constructed berms, tree plantings, fencing, etc.
- A low potential for adverse effects to the natural environment which would be further minimized through the use of standard mitigation measures
- Maintains the existing stormwater management ponds
- A low potential for adverse effects to area residents which would be further minimized through the use of standard mitigation measures
- Maximizes the economic benefits to the City of Hamilton, Upper Stoney Creek, and local industry

Option 5 is therefore put forward at this point in the process as the Recommended Option for consultation and feedback. Following this feedback, we will confirm the Preferred option, which will be carried forward to the impact assessment stage, which will allow for additional details to be developed from a design and operations perspective, as well as more detail on the impact management measures (mitigation/avoidance/compensation/enhancement).

8. Climate Change Considerations

A commitment was made in the SCRF ToR to complete an analysis on the alternative methods from a climate change adaptation and mitigation perspective. Therefore, climate change, as it may affect or be affected by the Proposed Undertaking, is being considered as part of the SCRF EA. This will occur at this stage in the EA process (Alternative Methods) as well as at the Impact Assessment stage once the Preferred alternative has been identified. In support of the province of Ontario’s *Climate Change Action Plan* the MOECC has developed a Guide entitled “Consideration of Climate

Change in Environmental Assessment in Ontario" (the Guide). The guide provides direction on ways to incorporate climate change consideration into environmental assessments, including the consideration of:

- greenhouse gas (GHG) emissions;
- the effects of a project on climate change;
- the effects of climate change on a project; and,
- identifying and minimizing negative effects during project design.

The guide was consulted in preparation of this report, in particular the Guide was reviewed when considering the Alternative Methods from a Climate Change perspective and addressing potential climate risks to key infrastructure components at the landfill site.

8.1 Historical Climate and Meteorological Trends

In order to sufficiently analysis the Alternative Methods from a climate change perspective, considering accepts such as potential power outages, physical damage, stormwater management and reduced access to the site and to develop potential climate change adaptation and mitigation measures, an in-depth understanding of the historical climate/meteorological trends, as well as the potential for extreme weather events must be established. The following sections provides a brief summary of the historical climate/meteorological trends Hamilton, which is in the southern part of Ontario. Southern Ontario, has a humid continental climate influenced by the Great Lakes with warm summers and no dry season. The Great Lakes moderate the effects of the weather of the surrounding areas. Hamilton, Ontario wraps around the westernmost part of Lake Ontario and has an escarpment that divides upper and lower parts of the city, which creates noticeable differences in weather over short distances. Hamilton experiences warm summers, moderate temperatures in the spring and fall with higher precipitation rates and cold winters.

Temperature

Regional baseline climate data (climate normal data) were obtained from Environment Canada (EC). The closest EC climate station to the SCRF with 30-year climate normal data from 1981 to 2010 available is the Hamilton A (John C. Munro Hamilton International Airport) Station (climate ID 6153194) approximately 14 km south-west of the SCRF. The Hamilton A Station is located at latitude 43.10 N, longitude 79.56 W (Elevation: 237.7 m). The temperature data for the Hamilton A Station are provided in **Table 8.1**. The annual mean temperature is estimated as 7.9˚C. The mean summer high temperature is 20.9˚C for July, while the winter mean low temperature is -5.5˚C in January. The lowest extreme minimum temperature was in January of 2004 at -30.0˚C, and the highest extreme maximum was in July of 1988 at 37.4˚C (**Table 8.2**).

Table 8.1 Mean Temperature Profiles from 1981 to 2010 at Hamilton A Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Daily Average (˚C)	-5.5	-4.6	-0.1	6.7	12.8	18.3	20.9	20.0	15.3	9.3	3.7	-2.3	7.9
Daily Maximum (˚C)	-1.7	-0.5	4.3	11.8	18.5	23.9	26.5	25.3	21.2	14.1	7.5	1.2	13.7
Daily Minimum (˚C)	-9.3	-8.6	-4.5	1.5	7.1	12.6	15.2	14.5	10.4	4.5	-0.2	-5.8	3.1

Note:
1 Source: EC 1981 to 2010 Canadian Climate Normals (climate ID: 6153194)

Table 8.2 Minimum and Maximum Temperature Extremes

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Extreme Maximum (˚C)	16.7	15.8	25.0	29.7	33.1	35.0	**37.4**	36.4	34.4	30.3	24.4	20.7
Year	2005	1997	1998	1990	2006	1988	**1988**	2001	1973	2007	1961	1982
Extreme Minimum (˚C)	**-30.0**	-26.7	-24.6	-12.8	-3.9	1.1	5.6	1.1	-2.2	-7.8	-19.3	-26.8
Year	**2004**	1994	2003	1972	1966	1998	1961	1965	1974	1965	2000	1980

Note:
1 Source: EC 1981 to 2010 Canadian Climate Normals (climate ID: 6153194)

Precipitation

The mean climate normal monthly precipitation data are provided in **Table 8.3**. The mean annual average precipitation is 929.8 mm. Approximately 85 percent of the total precipitation was in the form of rain and 15 percent as snowfall. The extreme daily participation amounts are shown form 1981 to 2010 (**Table 8.4**). The highest rainfall experienced was 107.0 mm in 1989 and the highest snowfall experienced was 43.2 cm in 1966.

Table 8.3 Mean Monthly Precipitation Profiles from 1981 to 2010 at Hamilton A Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Precipitation (mm)	64.0	57.8	68.4	79.1	79.4	84.9	100.7	79.2	81.9	77.4	84.3	73.0	929.8
Rainfall (mm)	29.7	28.2	42.6	71.3	78.7	84.9	100.7	79.2	81.9	76.5	74.4	43.8	791.7
Snowfall (cm)	40.8	35.1	26.5	8.4	0.5	0.0	0.0	0.0	0.0	0.7	11.0	33.5	156.5

Note:
1 Source: EC 1981 to 2010 Canadian Climate Normals (climate ID: 6153194)

Table 8.4 Extreme Daily Precipitation at Hamilton A Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Extreme Daily Precipitation (mm)	44.6	54.1	42.8	45.2	39.9	66.6	**107.0**	90.8	59.4	91.0	58.8	56.8
Year	1982	1990	2010	1996	1969	1984	**1989**	1981	1996	1995	1999	1990
Extreme Daily Rainfall (mm)	39.3	54.1	41.0	45.2	39.9	66.6	**107.0**	90.8	59.4	91.0	58.8	56.8
Year	1995	1990	2010	1996	1969	1984	**1989**	1981	1996	1995	1999	1990
Extreme Daily Snowfall (cm)	**43.2**	30.4	28.0	29.2	11.0	0.0	0.0	0.0	0.0	23.6	21.5	35.6
Year	**1966**	2007	1999	1979	1989	1960	1960	1960	1960	1962	1997	1969

Note:
1 Source: EC 1981 to 2010 Canadian Climate Normals (climate ID: 6153194)

Rainfall Intensity Duration Frequency (IDF) data for 2010 were obtained from the Ontario Ministry of Transportation's (MTO) IDF Curve Look-up for the site at latitude 43.19, longitude -79.77 (Table 7.5). The maximum estimated amount of rain is 127.8 mm for a 100-year 24 hour storm event. It should be noted that the information presented in **Table 8.5** is not a prediction of the future, but an estimation of the probability of a storm occurring within a certain time period (return period) for a certain duration and the intensity of that storm based on statistical analysis of past data.

Table 8.5 Extreme Daily Precipitation

Return Period (year)	Rainfall Depth (mm) by Storm Duration								
	5 min	10 min	15 min	30 min	1 hr	2 hr	6 hr	12 hr	24 hr
2	10.5	12.9	14.6	18.0	22.2	27.4	38.1	46.9	57.8
5	13.9	17.1	19.4	23.9	29.4	36.2	50.4	62.1	76.5
10	16.2	19.9	22.5	27.8	34.2	42.1	58.6	72.3	89.0
25	19.0	23.4	26.5	32.6	40.2	49.5	68.9	84.9	104.6
50	21.2	26.1	29.5	36.3	44.7	55.1	76.7	94.4	116.3
100	23.2	28.6	32.3	39.9	49.1	60.5	84.2	103.7	127.8

Source:
MTO IDF Curve Look-up for the SCRF (latitude 43.19, longitude -79.77)

Wind

The speed of the monthly maximum gust obtained from 2000 to 2010 data from Hamilton A Station (climate ID: 6153194) are representative of those that typically occur in much of Ontario and are presented in Table 7.6 (EC 2016b). Predominate wind comes from the west (36 percent of the time), south west (13 percent of the time), and east (12 percent of the time)[4]. In winter, typically there are more high-speed winds coming mainly from the west. The average maximum gust speed was the highest in December, which was approximately 78 km/h. Winds are the lowest in the summer months; the lowest average maximum gust speed was in August, which was approximately 60 km/h. In the summer, the southwestern component is the strongest, with roughly 17 percent of the wind coming from the southwest.

Table 8.6 The Average Observed Speed of the Max Gust from Hamilton A Station from 2000 to 2011

Month	Observed Average Speed of Max Gust (2000-2011) (km/h)
January	71.00
February	75.27
March	74.64
April	77.09
May	71.55
June	66.64
July	67.09
August	60.18
September	71.55
October	71.45
November	73.18
December	77.82

Source:
EC Historical Data (climate ID: 6153194)

4 Based on historical records from Hamilton RBG CS Station (climate ID: 6153301) from 2005 to 2012.

The historical climate and climate trends described above were used to identify any possible climate change risks of concern for the construction, operation, closure, and post closure stages of the landfill.

8.2 Potential Effects of the Undertaking on Climate Change

The SCRF receives primarily non-hazardous industrial fill with very little waste containing organics such as municipal solid waste (MSW). As a result, the potential to produce methane and other GHGs is significantly lower than a MSW landfill of the same size. Any gas produced at the Site migrates to the surface and dissipates into the atmosphere; there is currently no landfill gas collection system in place, nor is one required under O. Reg. 232/98 and the "Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfill Sites" (MOECC, 2012). Terrapure is required (under current approval) to monitor for landfill gas and provide results in the Annual Monitoring Report (submitted to the MOECC every calendar year on June 30th). A landfill gas assessment was conducted in 2011, which confirmed that very little gas is generated at the SCRF. It should be noted that a commitment was made within the SCRF ToR that an update to the 2011 landfill gas assessment would be carried out as part of the SCRF EA. This will be done during the impact assessment stage and potential effects of the undertaking on climate change will be revisited based on the results.

Upon closure, the landfill will be sealed with a clay cap. This will significantly reduce the already low amount of GHGs released by the landfill. During post-closure the landfill will release less and less GHG emissions as each year passes.

8.2.1 Mitigation

In order to minimize or offset the effects of the Undertaking on climate change, in particular to reduce the GHG emissions associated with the construction, operation, closure and post-closure stages of the landfill, mitigation measures will be implemented. The MOECC Guide defines mitigation as "The use of measures or actions to avoid or reduce greenhouse gas emissions, to avoid or reduce effects on carbon sinks, or to protect, enhance, or create carbon sinks" (MOECC 2016, Page 40). Mitigation measures include actions such as utilizing different technologies and construction materials. Mitigation measures and BMPs to reduce the Undertaking's effect on the environment will be determined and implemented at the onset of each stage of the landfill. Possible BMP/mitigation measures for the four stages of the landfill include:

- Implement and enforce an anti-idling policy for all vehicles and machinery on site during the construction stage and operation stage
- Try to use materials that have a lower carbon footprint and a long lifespan
- Reduce the size of the uncovered/working area
- Replace and plant additional vegetation to create a carbon sink

In addition to the above mitigation measures the Air Quality Monitoring Program will continue to ensure all emissions fall within accepted standards.

As the GHGs released by the landfill are already below required standards and with the implementation of BMP/mitigation measures, none of the six Alternative Methods for carrying out the Undertaking are anticipated to have a potential effect on climate change. Further analysis will be conducted during the impact assessment of the Preferred Method to ensure the Undertaking will result in no potential effects on climate change.

8.3 Effect of Climate Change on the Undertaking

Key potential effects of climate change that may occur during the Undertaking may include:

- Increasing frequency of unusually high or low daily temperature extremes.
- Long-term increasing or decreasing mean annual temperatures and/or precipitation.
- Increasing or decreasing frequency of storm events (e.g., rainfall, snowfall, extreme wind).

Extreme and adverse weather could affect the Site operations. As an example, an increase in storm events could affect the facilities and systems that have been engineered for the Site as part of the Undertaking, such as the stormwater management system. Furthermore, extreme weather events could also cause potential power outages, physical damage and reduced access to the site. The potential impacts for all six alternative methods are considered to be "low" or "nil". "Low" indicates that the effect may cause a minor impact on the site, site operations or the site design/features. "Nil" indicates that no effect is projected due to the potential change. **Table 8.7**, below, summarizes the assessment of potential adverse effects of climate change on the landfill for the six Alternative Methods.

Table 8.7 Estimated Sensitivity of the Six Alternative Methods to Potential Climate Change Effects[5]

Climate Parameters	Alternative Method						Explanation
	1	2	3	4	5	6	
Mean Temperature	NIL	NIL	NIL	NIL	NIL	NIL	A slight change in mean temperature and an increase in frequency and/or severity of extreme temperatures will not impact any of the six Alternative Methods. There will be no impact to the stormwater management system or any of the other operational systems as Landfill operations varying in design are successfully conducted in areas with significantly higher/lower mean and extreme temperatures.
Frequency and/or Severity of Extreme Temperature	NIL	NIL	NIL	NIL	NIL	NIL	
Total Annual Rainfall	NIL	LOW	NIL	LOW	NIL	LOW	A slight change in annual precipitation will not impact landfill operations. Perimeter ditches and the stormwater management pond with two forebays can mitigate all the effects of increased runoff flows and volumes caused by the six Alternative Methods. Furthermore, landfill operations are successfully conducted in areas with significantly higher/lower annual precipitation. Alternative Methods 2, 4 and 6 may have the possibility to have low sensitivity to increase in annual precipitation as there are increased complications/concerns associated with the design of the stormwater management ponds within the 30m buffer in the northwest corner of the site.
Total Annual Snowfall	NIL	LOW	NIL	LOW	NIL	LOW	

5 Table modified from: "Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners" (Federal-Provincial-territorial Committee on Climate Change, November 2003).

Climate Parameters	Alternative Method						Explanation
	1	2	3	4	5	6	
Frequency and/ or Severity of Precipitation and Weather Extremes	NIL	LOW	NIL	LOW	NIL	LOW	The landfill components have been designed to accommodate a Regional storm event. The Site has sufficient operating flexibility to allow for additional stormwater generated through larger storms. Given that the site is permitted to (and currently does) discharge to the City's sanitary sewer system, this would allow for a contingency measure for a larger storm and ensure the stormwater management system returns to normal operating conditions within approximately two days. Alternative Methods 2, 4 and 6 may have the possibility to have low sensitivity to increase the frequency and/or severity of precipitation and weather extremes as there are increased complications/concerns associated with the design of the stormwater management ponds within the 30m buffer in the northwest corner of the site.
Soil Moisture & Groundwater	LOW	LOW	LOW	LOW	LOW	LOW	These items relate to potential weather changes. Landfill operations with varying footprint configurations and sizes, slopes and buffer distances are successfully conducted in areas with significantly different weather conditions. All six Alternative Methods are anticipated to have no to very low sensitivity to these climate parameters.
Evaporation Rate	LOW	LOW	LOW	LOW	LOW	LOW	
Wind Velocity	LOW	LOW	LOW	LOW	LOW	LOW	

A slight change in annual precipitation and frequency and/ or severity of precipitation and weather extremes does not have the potential to impact specific stages (construction, operation, closure and post closure) of the undertaking or cause any severe damage to any of the landfill components associated with the six Alternative Methods, except potentially the leachate management system and the stormwater system during closure and post-closure. However, the leachate and stormwater management systems have been designed to accommodate a Regional storm even, which is much greater than the historical daily maximum precipitation amount of 107 mm (**Table 8.4**) and the rainfall depth estimated for the 100-year storm event for the SCRF of 127.8 mm (**Table 8.5**). The leachate and stormwater management systems and are designed to return to normal operating conditions within approximately two days. There is also a slight potential for the berms to be impacted through erosion and impact to vegetation cover due to an increase in intensity and frequency of precipitation events. Changes to soil moisture and groundwater, evaporation rate and wind velocity as a result of changes to temperature and precipitation will have little to no impact to the landfill components during any stage of the landfill. There is a slight potential for an increase in wind velocity, changes to soil moisture and evaporation rates to lead to issues with erosion and vegetation establishment on the final cover during post-closure affecting the quality of surface water runoff.

Monitoring of groundwater and surface water is currently carried out for the Site, and a report summarizing these results and other Site conditions is submitted to the MOECC annually. These measures mitigate the kinds of potential extreme adverse effects and events noted above; longer-term, more gradual changes are managed through regulatory changes and adaptive management by Terrapure.

The stages (construction, operation, closure and post closure) of the Undertaking's potential sensitivity to climate change will be further investigated during the impact analysis of the Preferred Method, along with an analysis of the potential severity of climate impacts on components of the waste management infrastructure.

8.3.1 Adaptation

Additional analysis was undertaken to determine what adaptation measures may be required for the site. Adaptation will be focused on addressing effects of climate change on the Undertaking. The MOECC's Guide defines adaptation as "The process of adjustment in the built and natural environments in response to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects" (MOECC 2016, Page 38). Although it was determined climate change will have no appreciable adverse effects on the proposed Undertaking identification of possible adaptation measures was undertaken to increase both the project's and the local ecosystem's resilience to climate change.

To increase the project's and the local ecosystem's resilience to climate change, the project's and local ecosystem's vulnerability to climate change need to be reduced. The degree of vulnerability is associated with unpredictability of climate change. The unpredictability of climate change increases over time. Therefore the stage with the greatest vulnerability (e.g., most likely to be impacted by climate change) is the stage that occurs over a long period of time, which is post-closure. As such resources will be focused on employing adaption measures upon closure of the landfill to ensure the landfill is resilient to climate change during post-closure stage.

Adaptation measures will be aimed at strengthening and increasing the resilience of the landfill cover and leachate management system. Such measures could include:

- Choosing vegetation known, to withstand erosion and climatic stressors such as extreme heat, drought tolerance, and flood resistance;
- Planting additional vegetation every five to ten years; and
- Modification of existing stormwater management ponds, if necessary.

The above is by no means a comprehensive list of the additional adaption measures that will be considered upon closure of the site. As required by Section 31 of the O. Reg. 232/98 a Closure Report is to be created two years before the anticipated closure date of a landfill or when 90 percent of the waste disposal volume is reached. In addition to detailing the activities for post-closure care the Closure Report will state the commitments to climate change adaptation and how they will be implemented. Emerging technologies and current climate projections will be reviewed during the development of the adaptation measures in the Closure Report. In addition, the development of BMP’s will be prepared such that they can flexible enough to adapt to a changing climate.

9. The Recommended Alternative: Option 5

Based on the comparative analysis and trade-off/reasoned argument approach as seen in Section 7 (further detail in Appendix D) and climate change considerations in Section 8, Option 5 is the recommended or most Preferred Alternative. Option 5 is a combination of reconfiguration and height increase. The currently approved area at the SCRF for receiving industrial fill would be replaced with post-diversion solid, non-hazardous industrial residual material. The entire area at the SCRF currently approved for receiving either industrial fill or post-diversion solid, non-hazardous industrial residual material would be expanded so that additional residual material could be received. The SCRF would no longer be approved to receive industrial fill, but only post-diversion solid, non-hazardous industrial residual material and a minimum 30 m buffer would be established around the entire area for receiving post-diversion solid, non-hazardous industrial residual material, with greater buffer areas remaining in place on the east and south sides of the property. The peak height currently approved would be increased by approximately 2.5 meters. Section 10 below summarizes the advantages and disadvantages of Option 5 and further describes why it has been put forward as the Recommended Option.

10. Advantages and Disadvantages of the Preferred Option

In accordance with the Approved SCRF ToR, the advantages and disadvantages to the environment of the Preferred Undertaking compared to the *Do Nothing* or status quo alternative are summarized in **Table 10.1**, below. The advantages and disadvantages are based on the net effects, comparative evaluation and the rationale for the recommendation. The advantages and disadvantages were determined by comparing the Recommended Alternative to the *Do Nothing* or Status Quo alternative which serves as a benchmark when considering the benefits and drawbacks of Alternative Option 5. The proposed expansion, with specific mitigation and impact management programs in place, will have low and acceptable net effects on all environmental components and the Facility construction and operation will have a positive economic impact in the community. It should be noted that the advantages and disadvantages of the Recommended Alternative will be reviewed and analyzed again at the impact assessment stage when a Preferred Alternative has been developed to a greater level of detail.

Table 10.1 Advantages & Disadvantages of the Preferred Alternative (Option 5)

	Environmental Component	Advantages	Disadvantages
NATURAL	**Geology & Hydrogeology**	Existing Leachate control measures and groundwater monitoring will mitigate any effects to groundwater quality and quantity.	There are no disadvantages to Geology and Hydrogeology components.
NATURAL	**Surface Water Resources**	Maintains existing storm water management ponds.	Minor increases in run-off associated with slight height increase.
NATURAL	**Terrestrial & Aquatic Environment**	Through implementation of Best Management Practices (BMPs) effects to Terrestrial and Aquatic environment are minimal and can be mitigated. Additional plantings in post-closure will enhance the natural environment and can also assist in climate change adaptation.	Temporary loss of existing vegetation and habitat communities during construction/operation.
NATURAL	**Atmospheric Environment**	Effects to air quality (dust) can be mitigated to acceptable and regulated levels. Noise levels will remain below acceptable regulated levels. No change in odour.	Requires increase in berm height to remain below acceptable regulated levels for noise.
BUILT	**Land Use**	No changes to existing Land Uses. Lower height increase compared to Options 3 and 6 and effects to views can be adequately mitigated.	Mitigates effects to viewsheds, but views of the site during the operation/ construction cannot be fully mitigated.
SOCIAL	**Human Health**	Through existing operational and other BMP mitigation measures, no effects to Human Health are expected.	There are no disadvantages to Human Health components.
SOCIAL	**Transportation**	No effects on level of service at intersections or increases in traffic collisions	There are no disadvantages to Transportation components.
ECONOMIC	**Economic**	Maximizes the economic benefits to City and Upper Stoney Creek Community through increases to number and duration of employment.	There are no disadvantages to Economic components.
CULTURAL	**Archaeology and Built Heritage**	No disturbance to Built Heritage or Archaeological artifacts/sites.	There are no disadvantages to Archaeological or Built Heritage components.
TECHNICAL	**Design & Operations**	Technically feasible design that provides for additional capacity.	Increases to cost and construction of facility. Will require upgrades to leachate management controls.

11. Leachate Collection and Treatment Considerations

A commitment to carry out an assessment of the existing leachate collection and treatment system as part of the SCRF EA relative to the Alternative Methods was made in Section 5.1 of the approved amended ToR. An assessment of the existing leachate collection and treatment system relative to the Alternative Methods was completed as part of the alternative assessment evaluations for several of the environmental components including; Hydrogeology and Geology, Surface Water Human Health as well as Design and Operations.

Leachate Collection and Treatment considerations for each of the Options are presented in Section 5. These include:

- the design, construction, and operating complexity of the leachate management system;
- the configuration of the base liner and leachate collection system;
- the leachate generation rate; and
- leachate pumping and discharge requirements.

For all of the Options, leachate discharge was assumed to be via the sanitary sewer for treatment at the City of Hamilton's wastewater treatment plant. An existing sewer use agreement established with the City of Hamilton outlines requirements regarding the quantity and quality of the leachate that can be discharged from the site. All of the Options can incorporate additional measures on-site as required to satisfy these requirements. These could include the pre-treatment of leachate and/or the temporary storage of excess leachate volumes in order to meet requirements of the discharge agreement. The agreement will be revised as required through consultation with the City of Hamilton in order to ensure that the treatment system is able to handle the leachate discharged from the site.

Further considerations for Leachate Collection and Treatment will be completed during the Impact Assessment Stage once the preferred option is selected.

12. Construction, Closure and Post-Closure Considerations

The Construction, Closure, and Post-Closure considerations for each of the Options are presented in Section 5. These include:

- the complexity and constructability of each of the landfill components;
- the configuration and layout of the base liner system, including potential expansion into other areas of the site;
- the integration of the landfill components (e.g., residual material area, industrial fill area, stormwater management system);
- site infrastructure requirements (e.g., site access and egress, scale facility, administrative facility, maintenance facility, wheel wash facility);

- site closure requirements such as final cover and drainage;
- post-closure requirements such as environmental monitoring; and,
- the flexibility of potential post-closure uses of the site.

Closure and post-closure (or decommissioning) of the SCRF will take place in accordance with O. Reg. 232/98, which includes the future requirement to develop a closure plan. Terrapure is required to prepare a closure plan when the SCRF has reached 90 percent of its approved capacity or two years of remaining capacity (whichever comes first).

The Closure and Post-Closure Plan for the site will also be developed with an Advisory Panel which will be made up of stakeholders such as the City of Hamilton, the Hamilton Conservation Authority, and neighbourhood residents. The plan will address broad considerations such as whether the existing SCRF infrastructure not related to post closure management and monitoring (e.g., site access, berms, landscaping) will remain in place beyond the closure date, long-term beneficial uses for the site, and integration into the surrounding community. The post-closure use will also need to reflect the City of Hamilton land use planning controls, which currently intends for the site to become open space and/or recreational uses and may include a golf course. Any deviation from the current land use controls would require amendments.

Appendix A

Draft Conceptual Design Report

Terrapure is proud to have received the 2016 Industry Excellence Award for Health & Safety from Natural Resources Magazine.

Stoney Creek Regional Facility Environmental Assessment

Draft Conceptual Design Report

1195 Stellar Drive, Unit #1 Newmarket Ontario L3Y 7B8 Canada
11102771 | Report No 24 | December 7, 2017

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Appendices

1. Introduction

1.1 Background

The Stoney Creek Regional Facility (SCRF) is owned and operated by Revolution Landfill LP, operating as Terrapure Environmental, herein referred to as Terrapure (Owner, Proponent). The SCRF is located at the northwest corner of Mud Street and Upper Centennial Parkway in the City of Hamilton (formerly the City of Stoney Creek, **Figure 1.1**), and has been in operation since it was approved by the Ministry of the Environment and Climate Change (MOECC) in 1996. The SCRF, which operates under Environmental Compliance Approval (ECA) No. A181008, as amended, has a total approved site capacity of 8,320,000 cubic metres (m^3) (6,320,000 m^3 for solid, non-hazardous residual material and approximately 2,000,000 m^3 for industrial fill), with an approved maximum annual volume of 750,000 tonnes of residual material.

Terrapure is proposing to increase the total approved capacity for post-diversion solid, non-hazardous industrial residual material at the SCRF by 3,680,000 m^3, so that Terrapure can continue to operate its business and receive this material to support local industry. The proposal would not change the type or annual volume of residual material currently accepted at the Facility, nor the maximum number of vehicles to the Site per day. The Minister of the Environment and Climate Change (Minister) approved the Terms of Reference (ToR) for the Environmental Assessment (EA) on November 9, 2017, which included a brief overview of the alternative methods (i.e., footprint options) to be examined during the EA. The ToR made a commitment that further details on the alternative methods would be provided during the EA. This report provides a greater level of detail on each of the alternative footprint options for further evaluation.

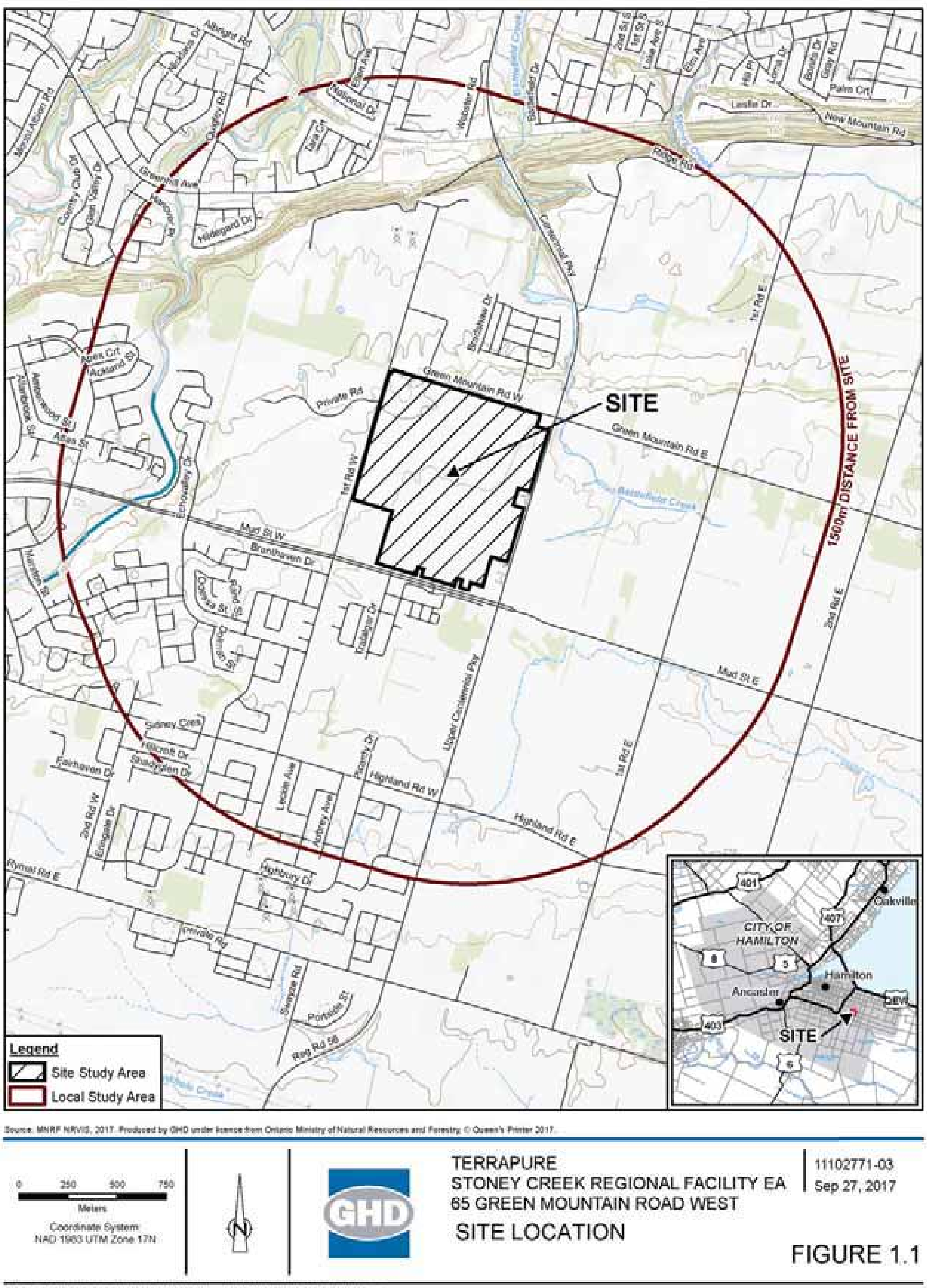

Figure 1.1 Stoney Creek Regional Facility Site Location

1.2 Objectives of the Document

This document is a Conceptual Design Report (CDR) which presents conceptual designs for the Alternative Methods of Carrying Out the Undertaking (Alternative Methods) within the existing Site boundaries. The report is intended to form the basis of a comparative analysis of the Alternative Methods by the project team technical disciplines. The comparative analysis will lead to the identification of a preferred Alternative Method, which will be subject to further design development and a detailed impact assessment.

The Alternative Methods presented in this report were developed to a conceptual level of detail based on the following characteristics:

- Site capacity and fill rate
- Footprint size
- Final contours and slopes
- Peak elevation and height relative to surrounding landscape
- Buffer areas between the SCRF footprint and the property boundary
- Setbacks to surrounding developments
- Infrastructure requirements
- Leachate management
- Stormwater management
- Gas management
- Traffic
- Operations

Furthermore, the expansion alternatives were prepared in consideration of the requirements outlined in the following documents:

- Approved Amended Terms of Reference, SCRF EA, GHD, November 2017
- O. Reg. 101/07 – Waste Management Projects, under the *EA Act*
- O. Reg. 232/98 – Landfilling Sites, under the Environmental Protection Act (Last amendment: O. Reg. 268/11, October 31, 2011)
- Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites, Ontario Ministry of the Environment (Last revision: January, 2012)
- ECA No. A110302 for Waste, and ECA Nos. 6869-9EAT28 and 1907-99NSF2 for Industrial Sewage Works

It should be noted that different approaches may be possible to achieve the same or better design objectives. The conceptual designs for the Alternative Methods presented herein will be further developed during the technical design stage for the preferred alternative.

2. Conceptual Design Basis

2.1 Overview

A series of criteria and assumptions were established to guide the development of the Alternative Methods for the Site. These include Terrapure's projected waste disposal capacity requirements and regulatory requirements relating to Site design geometry. In addition, O. Reg. 232/98 and the accompanying Landfilling Standards Guideline specify requirements and/or provide recommendations for key Site design parameters. Assumptions were also made relating to operational traffic levels, leachate generation rates, and aspects of Site design and operations. The criteria and assumptions used in the development of the Alternative Methods are discussed in the sections that follow.

For reference, the currently approved design for the SCRF is presented in **Figure 2.1**.

Figure 2.1 Current Approved Footprint

2.2 Site Capacity and Fill Rate

As noted above, the SCRF has a total approved site capacity of 8,320,000 m^3 (6,320,000 m^3 for solid, non-hazardous residual material and approximately 2,000,000 m^3 for industrial fill), with an approved maximum annual volume of 750,000 tonnes of residual material. The expansion proposed under this EA is to increase the total approved capacity for post-diversion solid, non-hazardous industrial residual material at the SCRF by 3,680,000 m^3. No changes are being proposed to the maximum approved fill rate of up to 750,000 tonnes per year.

2.3 Footprint Size

As shown in **Figure 2.1**, the current approved footprint for the residual material is 41.5 ha, while the industrial fill material covers a footprint of approximately 12.9 ha. The maximum allowable footprint for the Site is limited by the size of the property currently owned by Terrapure. The property currently covers a total area of 75.1 ha, and is bounded by Green Mountain Road West in the north, Upper Centennial Parkway in the east, Mud Street in the south, and First Road West in the west. There are a few properties around the periphery of the Site that are privately owned and are not being considered for expansion of the SCRF footprint. Additional requirements surrounding buffers and setbacks from these properties are discussed further below.

2.4 Final Contours and Slopes

The regulatory requirements specify a maximum slope of four units horizontal to one unit vertical (4H to 1V, or 25%) and a minimum slope of 20H to 1V (5%), but allow variance where it can be shown to be appropriate with respect to slope stability, erosion potential, end uses, and infiltration requirements for groundwater protection. Slopes of a minimum 33.3H to 1V (3%) are currently approved at the SCRF. Final contours for the Alternative Methods were developed based on these slope requirements and in consideration of other aspects such as footprint configuration and stormwater management.

2.5 Peak Elevation and Height

The peak elevation of the SCRF refers to the highest point of the Site measured in metres above mean sea level (mAMSL), while the height of the SCRF is measured relative to the surrounding landscape. There are no regulatory requirements specifically constraining peak elevations or landfill height. However, the peak elevation is limited by the geometry of the Site and the maximum height is indirectly governed by regulatory requirements to ensure that adequate foundation conditions exist and that slopes are stable. The suitability of the proposed height increase relative to the subsurface conditions will be evaluated in more detail, once a preferred alternative is chosen. Screening measures are currently in place at the Site to mitigate potential impacts from a visual and noise standpoint, including earth berms and fences. Additional screening measures will be implemented as required based on the development of the Site and surrounding area.

2.6 Buffer Areas

Regulatory requirements specify a minimum buffer width of 100 metres (m) between the limit of the residual footprint and the Site boundary, but allow this to be reduced to 30 m if it is shown to be appropriate based on a site specific assessment (e.g., if the buffer provides adequate space for vehicle movements, ancillary facilities, and ensures that potential effects from the Site operations do not have unacceptable impacts outside of the Site).

As shown in **Figure 2.1**, minimum buffer areas of 30 m are currently approved around the perimeter of the residual material area. These buffers extend to approximately 65 m in various areas along the east and south side of the Site, and up to approximately 130 m in the vicinity of the existing stormwater management facility in the northwest corner of the Site.

2.7 Setbacks to Surrounding Developments

In addition to the on-site buffers noted above that will be maintained in relation to the SCRF, additional buffer separation is achieved through road allowances and setbacks for other developments required in accordance with local planning by-laws.

The closest residential dwellings to the south of the Site is situated approximately 60 m from the property line, while the closest residential dwelling (currently under construction) to the property line in the north is situated approximately 35 m away. The closest existing residential dwelling to the east is situated approximately 150 m from the property line, while the closest residential dwellings in the west are situated approximately 795 m from the property line.

2.8 Infrastructure Requirements

The SCRF requires various infrastructure components in order to operate the Site, including:

- Site entrance and exit
- Scale facility
- Administrative facility
- Maintenance facility
- Groundwater management system
- Leachate management system
- Stormwater management system

The existing Site entrance from Upper Centennial Parkway and the existing Site exit to First Road West are anticipated to be maintained in their current locations. However, if they need to be relocated to accommodate other infrastructure or Site operations, Upper Centennial Parkway and First Road West will remain as the preferred connection points.

The scale facility, administrative facility, and maintenance facility will be relocated as required in order to accommodate development of the Site. This may include relocation to the buffer area, the industrial fill area, residual material area, or to an off-site location.

The groundwater management system, leachate management system, and stormwater management system will be reconfigured as required to accommodate the Alternative Methods. Further details are provided in the sections that follow.

2.9 Groundwater Management

Groundwater is currently collected through a network of trenches and piping excavated within the bedrock below the base liner system. Groundwater drains by gravity to a pumping station in the southeast corner of the Site, where it is subsequently recovered for use in Site operations (i.e., dust control) or discharged to the sanitary sewer. The groundwater collection system trenches and piping will be extended as required underneath any new residual material areas. No changes are anticipated to the groundwater pumping station or the discharge to the sanitary sewer.

2.10 Leachate Management

Leachate is currently collected through a network of perforated pipes on top of the base liner system, under the residual material area, where it drains by gravity to a leachate pumping station in the southeast of the Site. Leachate is then pumped to the surface where it is discharged to a gravity main that flows to the equalization pond within the adjacent closed west Site before being discharged to the sanitary sewer under Mistywood Drive. However, Terrapure has started discussions with relevant stakeholders in order to establish a new connection to the sanitary trunk sewer currently under construction under Upper Centennial Parkway. Should a new discharge connection be established, it may allow the existing gravity main and equalization pond to be decommissioned.

The leachate collection system piping will be extended as required in any residual material areas where a new liner system is proposed. Alternate and/or additional locations for the leachate pumping station(s) and discharge location(s) may be required based on the Alternative Methods.

The leachate generation rate is an important parameter used in assessing the operational and environmental performance of a landfill site. Estimated leachate generation rates for each Option are summarized in Section 4.0 and are supported by the calculations presented in **Appendix A**. However, it should be noted that the leachate generation rate will vary over the operational and post-closure period of the Facility, and is influenced by factors including precipitation, degree of landfill development (e.g., area of landfill that is actively undergoing development versus areas where interim/final cover has been placed), final cover design, and other factors.

2.11 Stormwater Management

O. Reg. 232/98 requires that landfill sites be designed to protect surface water to specified performance standards based on the following principles:

- Divert or control clean surface water flowing onto the site.
- Control quality and quantity of runoff discharging from the site to control erosion, sediment transport, and flooding.

Under the current design, clean runoff is shed from the final cover into perimeter drainage ditches, where it drains by gravity to a series of ponds (i.e., sediment forebay and detention pond) in the northwest corner of the Site before being discharged to the storm sewer under First Road West.

While the overall function of the stormwater management system is not expected to change, the location and alignment of the existing ponds and ditches may need to be relocated to accommodate the Alternative Methods. The outlet to the existing storm sewer under First Road West will remain under all Alternative Methods. The capacity of the existing stormwater management system will be confirmed against each Alternative Method, although significant changes to the capacity are not expected to be required since the overall catchment area of the Site will remain largely unchanged.

The design of the final cover system will not change under any of the Alternative Methods, with each consisting of 0.60 m of compacted clay and 0.15 m of vegetated topsoil.

2.12 Gas Management

Because the Site does not accept waste capable of decomposing and generating gases, it has received a MOECC exemption[1] from the requirement to have a gas collection system, (as stated in O. Reg. 232/98), based on supporting documentation, including a gas emission study and annual confirmatory monitoring.

Under the current ECA for the SCRF, Terrapure is required to monitor for landfill gas and provide the results in the Annual Monitoring Report submitted to the MOECC by June 30th every calendar year. A Landfill Gas Assessment was conducted in 2011, demonstrating that very little gas is generated at the SCRF. Notwithstanding this, a commitment was made in the Approved Amended ToR that an update of the 2011 Assessment will be carried out as part of the SCRF EA to determine the necessity or lack thereof of landfill gas collection system being required. This assessment will be carried out once a Preferred Alternative Method (i.e., footprint) has been identified.

2.13 Traffic

Vehicle traffic associated with the development of the Site is important in assessing the potential impacts of the Site on various receptors. Traffic levels were estimated based on the following:

- Each Alternative Method is projected to increase the total approved capacity for post-diversion solid, non-hazardous industrial residual material at the SCRF by up to 3,680,000 m^3
- Some Alternative Methods will also include the placement of up to 2,000,000 m^3 of industrial fill
- Although some material stockpiles currently exist on-site (i.e., liner clay, topsoil, aggregate), to be conservative all construction materials are assumed to be imported from off-site
- Total vehicle traffic volumes were calculated based on assumed vehicle types and average capacities
- Traffic associated with staff vehicles or other Site operations is assumed to be negligible
- Traffic levels are kept within the approved limit of 250 vehicles/day

Estimated traffic levels for each Option are summarized in Section 4.0 and are supported by the calculations presented in **Appendix B**. However, it should be noted that traffic levels will vary depending on Site operations and construction scheduling. Traffic volumes will be further refined during the detailed impact assessment of the preferred alternative.

[1] Confirmed by MOECC in 2011 when the then owners of the site (Newalta) successfully applied for an exemption from a landfill gas collection requirement. Annual reports submitted by Terrapure identify the site as exempt from landfill gas collection requirements under O. Reg. 232/98.

2.14 Operations

O. Reg. 232/98 requires that landfills be designed and operated to ensure that nuisance impacts are minimized, and the regulation requires that the proponent prepare a report describing all aspects of the operation as well as maintenance procedures that will be followed.

A key objective in planning Site operations is to minimize nuisance impacts including noise, litter, vectors, dust, and odour. Typical operating practices relating to these issues include:

- Vehicles transporting waste to and around the Site are covered to prevent odour and dust
- All materials received at the Site are verified and recorded to ensure compliance with regulatory conditions
- On-site equipment is operated in such a manner as to minimize noise and visual impacts wherever possible
- All equipment required for the development, operation, or closure of the Site should comply with the noise levels outlined in applicable MOECC guidelines and technical standards
- All vehicles leaving the Site must drive through a wheel-wash to minimize track-out of mud/dirt
- The Site design includes screening features, such as fences, berms and tree plantings, which mitigate visual impact and noise

These operating practices will be common to all Alternative Methods. While these would not significantly influence the comparative analysis, they should nevertheless be considered in reviewing the Alternative Methods. Any modifications to the design and operations will be outlined during the detailed impact assessment of the preferred alternative.

3. Alternative Methods

Six Alternative Methods have been developed for comparative analysis, and have been identified herein as Options 1 to 6. The Alternative Methods were identified in consideration of the criteria and assumptions outlined in Section 2.0, and based on agency and public input received during the ToR. These Options are illustrated on **Figures 3.1 to 3.6**.

The sections that follow outline the attributes that are unique to each of the six proposed Alternative Methods.

3.1 Option 1 – Reconfiguration

Option 1 is shown in **Figure 3.1** and has the following general attributes:

- The area at the SCRF currently approved for receiving industrial fill would be replaced with post-diversion solid, non-hazardous industrial residual material. As a result, the SCRF would no longer be approved to receive industrial fill with Option 1.
- The area at the SCRF currently approved for receiving residual material would remain unchanged.
- Option 1 would not include either a horizontal or vertical expansion.

3.2 Option 2 – Footprint Expansion

Option 2 is shown in **Figure 3.2** and has the following general attributes:

- The area at the SCRF currently approved for receiving industrial fill would remain unchanged. Therefore, the SCRF would still be approved to receive industrial fill with Option 2.
- The areas at the SCRF not currently approved for receiving either industrial fill or residual material would be expanded into so that they would be able to receive post-diversion solid, non-hazardous industrial residual material.
- A minimum 30 m buffer would be established around the entire area for receiving industrial fill or post-diversion solid, non-hazardous industrial residual material.
- Option 2 would include a horizontal expansion, but not a vertical expansion. The peak height currently approved would remain unchanged.

3.3 Option 3 – Height Increase

Option 3 is shown in **Figure 3.3** and has the following general attributes:

- The area at the SCRF currently approved for receiving industrial fill would remain unchanged. Therefore, the SCRF would still be approved to receive industrial fill with Option 3.
- The area at the SCRF currently approved for receiving residual material would be expanded vertically so that additional post-diversion solid, non-hazardous industrial residual material could be received.
- Option 3 would not include a horizontal expansion, but would include a vertical expansion, increasing the overall height of the area currently approved to receive post-diversion solid, non-hazardous industrial residual material.

3.4 Option 4 – Reconfiguration and Footprint Expansion

Option 4 is shown in **Figure 3.4** and has the following general attributes:

- Option 4 reflects a combination of Options 1 and 2. The currently approved area at the SCRF for receiving industrial fill would be replaced with post-diversion solid, non-hazardous industrial residual material. In addition, the areas at the SCRF not currently approved for receiving either industrial fill or residual material would be expanded into so that they would be able to receive post-diversion solid, non-hazardous industrial residual material.
- The SCRF would no longer be approved to receive industrial fill, but only post-diversion solid, non-hazardous industrial residual material.
- A minimum 30 m buffer would be established around the entire area for receiving post-diversion solid, non-hazardous industrial residual material.
- Option 4 would include a horizontal expansion, but would not include a vertical expansion. The peak height currently approved would remain unchanged.

3.5 Option 5 – Reconfiguration and Height Increase

Option 5 is shown in **Figure 3.5** and has the following general attributes:

- Option 5 reflects a combination of Options 1 and 3. The currently approved area at the SCRF for receiving industrial fill would be replaced with post-diversion solid, non-hazardous industrial residual material. The entire area at the SCRF currently approved for receiving either industrial fill or post-diversion solid, non-hazardous industrial residual material would be expanded vertically so that additional residual material could be received.
- The SCRF would no longer be approved to receive industrial fill, but only post-diversion solid, non-hazardous industrial residual material.
- A minimum 30 m buffer would be established around the entire area for receiving post-diversion solid, non-hazardous industrial residual material.
- Option 5 would not include a horizontal expansion, but would include a vertical expansion. The peak height currently approved would be increased.

3.6 Option 6 – Footprint Expansion and Height Increase

Option 6 is shown in **Figure 3.6** and has the following general attributes:

- Option 6 reflects a combination of Options 2 and 3. The existing approved area at the SCRF for receiving industrial fill would remain unchanged. Therefore, the SCRF would still be approved to receive industrial fill with Option 6.
- The area at the SCRF currently approved for receiving post-diversion solid, non-hazardous industrial residual material would be expanded vertically, and the areas at the SCRF not currently approved for receiving either industrial fill or post-diversion solid, non-hazardous industrial residual material would be expanded into so that they would be able to receive post-diversion solid, non-hazardous industrial residual material.
- A minimum 30 m buffer would be established around the entire area for receiving industrial fill or post-diversion solid, non-hazardous industrial residual material.
- Option 6 would include both horizontal and vertical expansions, thus increasing the currently approved peak height

Figure 3.1 Option 1 – Reconfiguration

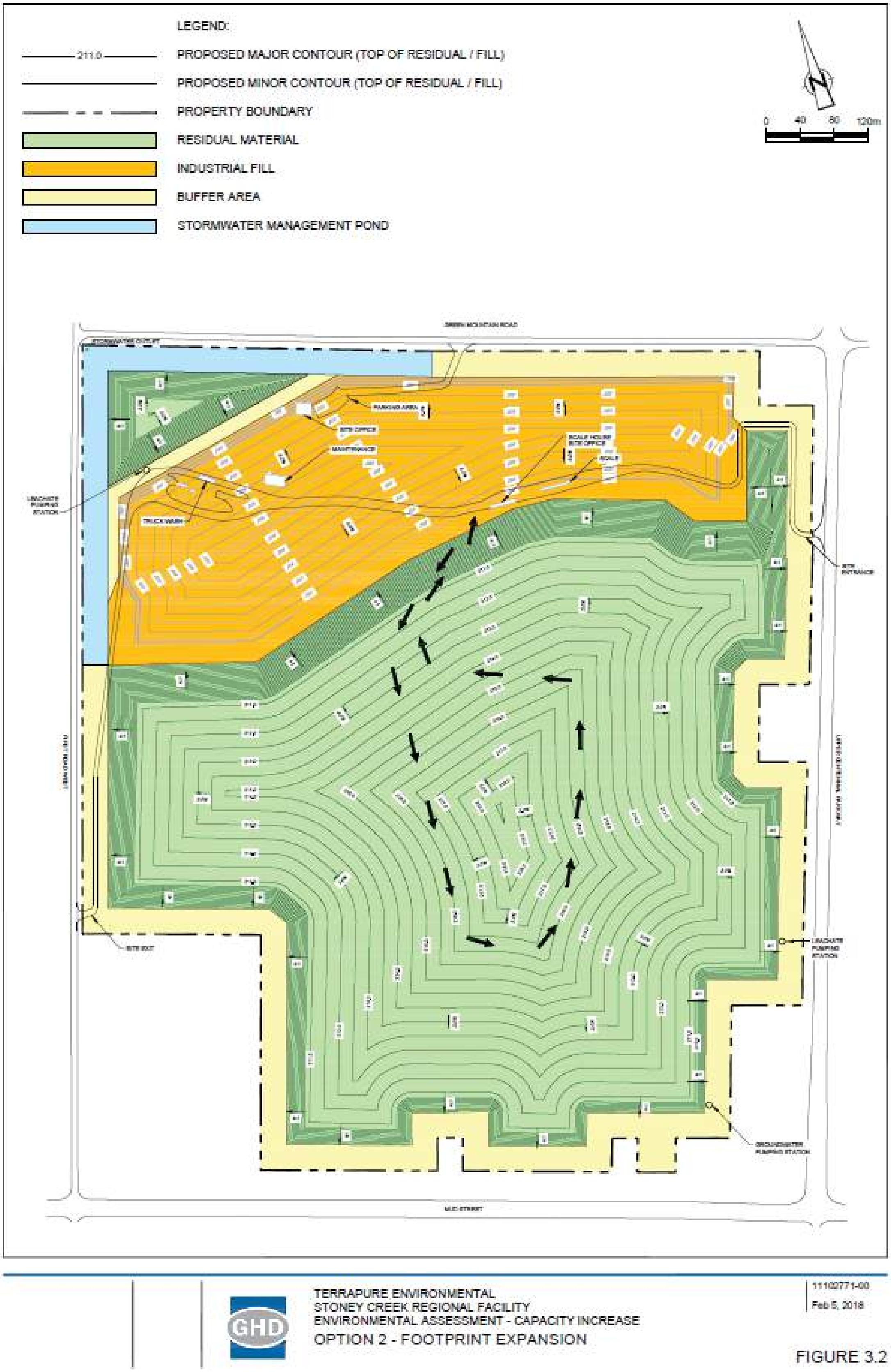

Figure 3.2 Option 2 – Footprint Expansion

Figure 3.3 Option 3 – Height Increase

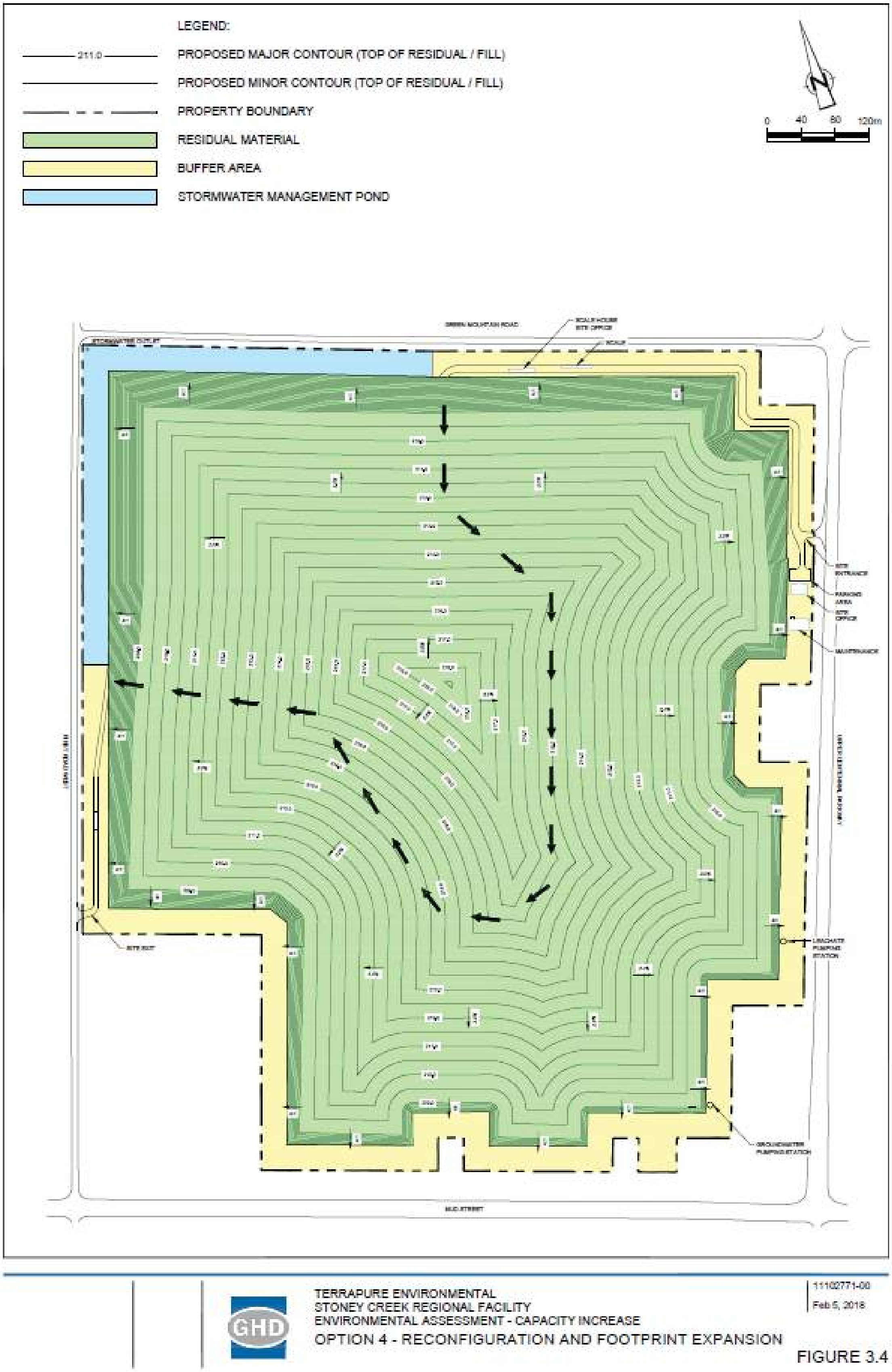

Figure 3.4 Option 4 – Reconfiguration and Footprint Expansion

Figure 3.5 Option 5 – Reconfiguration and Height Increase

Figure 3.6 Option 6 – Footprint Expansion and Height Increase

4. Summary

A summary table comparing the details of each of the Options is presented in **Table 4.1**

Table 4.1 Comparison of Alternatives

Option No.	Description	Volume (m^3)		Footprint Area (ha)		Peak Elevation (mAMSL)	Height Relative to Surrounding Area (m)		Stormwater Management	Leachate Management	Construction Considerations	Traffic
		Residual Material	Industrial Fill	Residual Material	Industrial Fill		Green Mountain & First Road (192 mAMSL)	Upper Centennial & Mud (205 mAMSL)				
-	Existing Approved	6,320,000	2,000,000	41.5	12.9	219.5	26.5	13.5				
1	> Replace industrial fill area with residual material > No horizontal or vertical expansion	8,6[illegible],000	N/A	54.4	N/A	219.5	26.5	13.5	> Drainage ditches around perimeter of residual material area. > Reconfiguration of existing stormwater management ponds in northeast corner of site. > Discharge to First Rd. W. storm sewer	> Extension of existing leachate collection system at base of residual material area. > Approximate leachate generation rate of 7.4 L/s during active operation. > Approximate leachate generation rate of 5.0 L/s post-closure. > Leachate collection via existing leachate pumping station in southeast of residual material area. > Leachate discharge to existing/new sanitary sewer.	> Requires staged relocation/closure of existing site infrastructure (i.e., scale facility, maintenance area, wheelwash facility, site office, site access). > May require liner perforation for pumping well M4. > Residual material area extends over existing clay plug.	> Approximately 103,423 trucks associated with residual material. > Approximately 64,914 trucks associated with construction.
2	> Maintain industrial fill area. > Expand limits of residual material area horizontally, maintaining minimum 30 m buffer > Maintain currently approved peak elevation.	7,420,000	2,000,000	48.4	12.9	219.5	26.5	13.5	> Drainage ditches around perimeter of residual material areas. > Drainage ditches around perimeter of industrial fill area. > Construction of new stormwater management ponds in east buffer and north buffer. > Discharge to First Rd. W. storm sewer	> Extension of existing leachate collection system at base of main residual material area. > Construction of new leachate collection system at base of secondary residual material area. > Approximate leachate generation rate of 6.4 L/s during active operation. > Approximate leachate generation rate of 4.4 L/s post-closure. > Leachate collection via existing leachate pumping station in southeast of main residual material area. > Construction of new leachate pumping station in secondary residual material area. > Leachate discharge to existing/new sanitary sewer.	> Requires staged relocation/closure of existing site infrastructure (i.e., scale facility, maintenance area, wheelwash facility, site office, site access). > Requires excavation (i.e., residual material, soil, bedrock) to extend base liner system in east buffer and south buffer. > Requires reconfiguration of screening berms/fences in east buffer and south buffer.	> Approximately 95,731 trucks associated with residual material. > Approximately 226,154 trucks associated with industrial fill material. > Approximately 65,074 trucks associated with construction.
3	> Maintain industrial fill area. > Maintain current limit of residual material area > Increase peak elevation of residual material area.	10,000,000	2,000,000	41.5	12.9	228.5	37.5	24.5	> Drainage ditches around perimeter of residual material area. > Drainage ditches around perimeter of industrial fill area. > Reconfiguration of existing stormwater management ponds in northeast corner of site. > Discharge to First Rd. W. storm sewer	> Maintain existing leachate collection system at base of residual material area. > Approximate leachate generation rate of 5.5 L/s during active operation. > Approximate leachate generation rate of 3.3 L/s post-closure. > Leachate collection via existing leachate pumping station in southeast of residual material area. > Leachate discharge to existing/new sanitary sewer.	> Requires staged relocation/closure of existing site infrastructure (i.e., scale facility, maintenance area, wheelwash facility, site office, site access).	> Approximately 255,323 trucks associated with residual material. > Approximately 226,154 trucks associated with industrial fill material. > Approximately 27,675 trucks associated with construction.
4	> Replace industrial fill area with residual material > Expand limits of residual material area horizontally, maintaining minimum 30 m buffer > Maintain currently approved peak elevation.	3,580,000	N/A	62.3	N/A	219.5	26.5	13.5	> Drainage ditches around perimeter of residual material area. > Construction of new stormwater management ponds in east buffer and north buffer. > Discharge to First Rd. W. storm sewer	> Extension of existing leachate collection system at base of residual material area. > Approximate leachate generation rate of 8.5 L/s during active operation. > Approximate leachate generation rate of 5.3 L/s post-closure. > Leachate collection via existing leachate pumping station in southeast of residual material area. > Leachate discharge to existing/new sanitary sewer.	> Requires staged relocation/closure of existing site infrastructure (i.e., scale facility, maintenance area, wheelwash facility, site office, site access). > Requires excavation (i.e., residual material, soil, bedrock) to extend base liner system in east buffer and south buffer. > Requires reconfiguration of screening berms/fences in east buffer and south buffer. > May require liner perforation for pumping well M4.	> Approximately 282,846 trucks associated with residual material. > Approximately 33,370 trucks associated with construction.
5	> Replace industrial fill area with residual material > Increase peak elevation of residual material area.	10,000,000	N/A	54.4	N/A	223.0	23.0	16.0	> Drainage ditches around perimeter of residual material area. > Reconfiguration of existing stormwater management ponds in northeast corner of site. > Discharge to First Rd. W. storm sewer	> Extension of existing leachate collection system at base of residual material area. > Approximate leachate generation rate of 7.4 L/s during active operation. > Approximate leachate generation rate of 5.0 L/s post-closure. > Leachate collection via existing leachate pumping station in southeast of residual material area. > Leachate discharge to existing/new sanitary sewer.	> Requires staged relocation/closure of existing site infrastructure (i.e., scale facility, maintenance area, wheelwash facility, site office, site access). > May require liner perforation for pumping well M4. > Residual material area extends over existing clay plug.	> Approximately 255,323 trucks associated with residual material. > Approximately 64,914 trucks associated with construction.
6	> Maintain industrial fill area. > Expand limits of residual material area horizontally, maintaining minimum 30 m buffer > Increase peak elevation of residual material area.	10,000,000	2,000,000	48.4	12.9	226.8	34.8	21.8	> Drainage ditches around perimeter of residual material areas. > Drainage ditches around perimeter of industrial fill area. > Construction of new stormwater management ponds in east buffer and north buffer. > Discharge to First Rd. W. storm sewer	> Extension of existing leachate collection system at base of main residual material area. > Construction of new leachate collection system at base of secondary residual material area. > Approximate leachate generation rate of 6.4 L/s during active operation. > Approximate leachate generation rate of 4.4 L/s post-closure. > Leachate collection via existing leachate pumping station in southeast of main residual material area. > Construction of new leachate pumping station in secondary residual material area. > Leachate discharge to existing/new sanitary sewer.	> Requires staged relocation/closure of existing site infrastructure (i.e., scale facility, maintenance area, wheelwash facility, site office, site access). > Requires excavation (i.e., residual material, soil, bedrock) to extend base liner system in east buffer and south buffer. > Requires reconfiguration of screening berms/fences in east buffer and south buffer.	> Approximately 266,923 trucks associated with residual material. > Approximately 226,154 trucks associated with industrial fill material. > Approximately 65,074 trucks associated with construction.

Appendix A
Leachate Generation

Table A.1
Leachate Generation

Option No.	Figure No.	Footprint Area (ha)	Leachate Generation Rate (m^3/year)		Leachate Generation Rate (litres per second)	
		Residual Material	Active Operation	Post-Closure	Active Operation	Post-Closure
1	Figure 3.1	54.4	233,376	158,848	7.4	5.0
2	Figure 3.2	47.3	202,917	138,116	6.4	4.4
3	Figure 3.3	41.5	178,035	121,180	5.6	3.8
4	Figure 3.4	63.2	271,128	184,544	8.6	5.9
5	Figure 3.5	54.4	233,376	158,848	7.4	5.0
6	Figure 3.6	47.3	202,917	138,116	6.4	4.4

Assumptions:

1) Only Residual Material contribute to leachate generation.
2) Modeled based on the following conditions:

Scenario	Precipitation (mm/year)	Runoff (mm/year)	Evapotranspiration (mm/year)	Infiltration (mm/year)	Leachate Generation (mm/year)
Active Operation	918	208	489	221	429
Post-Closure	918	205	421	292	292

Appendix B
Traffic Levels

Table B.1
Traffic Levels

Option No.	Figure No.	Volume (m^3)		Footprint Area (ha)		Construction Quantities (m^3)					No. of Vehicles			
		Residual Material	Industrial Fill	Residual Material	Industrial Fill	Liner Clay	Aggregate	Engineered Fill	Cover Clay	Topsoil	Residual Material	Industrial Fill Material	Construction	Total
1	Figure 3.1	8,830,000	0	54.4	0	258,000	154,800	150,000	260,400	65,100	183,423	0	64,914	248,337
2	Figure 3.2	7,630,000	2,000,000	47.3	12.9	116,000	69,600	200,000	217,800	54,450	95,731	226,154	48,074	369,958
3	Figure 3.3	10,000,000	2,000,000	41.5	12.9	0	0	150,000	183,000	45,750	268,923	226,154	27,678	522,755
4	Figure 3.4	9,780,000	0	63.2	0	434,000	260,400	200,000	313,200	78,300	252,846	0	93,970	346,816
5	Figure 3.5	10,000,000	0	54.4	0	258,000	154,800	150,000	260,400	65,100	268,923	0	64,914	333,837
6	Figure 3.6	10,000,000	2,000,000	47.3	12.9	116,000	69,600	200,000	217,800	54,450	268,923	226,154	48,074	543,151

Assumptions:

1) Any excess materials generated by the excavation of existing materials are assumed to be managed on-site.
2) Construction of the currently approved base liner system footprint is assumed to be completed.
3) Construction of 11 hectares of completed final cover assumed to be completed.
4) Truck types, usage, and capacities as follows:

Truck Type	Truck Usage (%)	Truck Capacity (m^3)
Tri-Axle	60%	12
Roll-Off	20%	10
Tractor Traile	20%	65

5) Minimum site life based on maximum 250 trucks/day, 250 operating days/year.

Appendix B

Draft Comparative Analysis Technical Memos

Draft Comparative Evaluation Methodology Narrative for Geology and Hydrogeology

Memorandum

Draft for Review

This document is in draft form. A final version of this document may differ from this draft. As such, the contents of this draft document shall not be relied upon. GHD disclaims any responsibility or liability arising from decisions made based on this draft document.

March 21, 2018 Reference No. 11102771

Subject: **Stoney Creek Regional Facility EA (Terrapure Environmental) – Draft Comparative Evaluation Methodology Narrative for Geology and Hydrogeology**

1. Introduction

This memo documents the assessment and evaluation of the six landfill footprint alternatives for the Stoney Creek Regional Facility (SCRF) Environmental Assessment (EA) from a Land Use and Economic perspective. The Minister approved amended Terms of Reference (ToR) included a preliminary description of the methodology for evaluating the alternative methods (i.e., alternative landfill footprint options (See Section 7.1 of the approved amended ToR, November 2017). This memo is one of 10 memos that outline the evaluation of the alternative landfill footprint options from the perspective of each discipline. These memos will be used in concert with one another, along with their evaluation tables, as supporting documents to the Alternative Methods Report. Memos were prepared for the following environmental components:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use and Economic;
- Atmospheric Environment (Air Quality and Odour);
- Atmospheric Environment (Noise);
- Human Health;
- Transportation;
- Archaeology and Built Heritage; and,
- Design and Operations.

Each of the above disciplines also prepared existing conditions reports that were utilized in assessing and evaluating the alternative landfill footprint options. Further, the disciplines referred to the Conceptual Design Report (CDR) that was prepared from a Site Design and Operations perspective in order to provide the appropriate level of detail on each of the alternative landfill footprints. The CDR will also form a supporting document to the Alternative Methods Report.

Each discipline is following the requirements as stated in the draft work plans that were presented in Appendix D of the approved amended ToR. The work plan presents the scope of work required to complete the EA, including the scope of technical studies for each of the environmental components, and the evaluation of alternative methods (alternative landfill footprints/option).

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1.1 Documentation

The results of these individual memos will be documented in separate stand-alone technical memorandums during the EA. The final alternative methods evaluation will form a chapter of the EA Report with each of the stand-alone memorandums becoming supporting documents/appendices to the EA Report.

2. Assessment and Evaluation of the Alternative Landfill Footprint Options

2.1 Methodology

The assessment and evaluation of the alternative landfill footprints was conducted in three steps:

Step 1: Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during Open House events and confirmed for application to each of the landfill footprint alternatives. Evaluation criteria were developed for each Environmental Component listed above.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the 'alternative methods' (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out consisting of the following activities:

- Identify potential effects (based on measures) on the environment;
- Develop and apply avoidance/ mitigation/ compensation/ enhancement measures; and,
- Determine net effects on the environment.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another in order to identify a "recommended landfill footprint". The comparison of net effects was completed using a "Reasoned Argument" or "Trade-off" evaluation methodology, as provided for in the approved SCRF EA ToR.

Each alternative was assessed based on the evaluation criteria, indicators and measures.

The criteria and indicators developed for the Geology and Hydrogeology components of this evaluation include the following:

- **Groundwater Quality:** predicted effects to groundwater quality at property boundaries and off-site
- **Groundwater Flow:** predicted groundwater flow characteristics

In order to fully characterize these indicators and to adopt measures by which potential effects could be identified, several considerations were developed for each indicator. These considerations are shown below in Table 4.1:

Table 4.1 Considerations for Indicators

Criteria	Indicators	Considerations
Groundwater Quality	• Predicted effects to groundwater quality at property boundaries and off-site • Predicted effects to Source Water Protection Area	• Leachate generation estimates • Leachate quality – how will leachate leakage from the SCRF affect existing groundwater quality? • Existing groundwater quality – what is background groundwater quality? Is it impacted by the existing landfill or other sources? What is the predicted future quality? • Leachate breakthrough – how does the design of the Alternatives affect the ability for leachate to break through the liner? • Monitorability – the ability to define, identify and monitor the hydrostratigraphic units; to understand the groundwater flow gradients & velocities; to define low head areas; and to distinguish impacts from the new landfill versus other sources. • Ability to mitigate effects on groundwater quality
Groundwater Flow	• Predicted effects to groundwater flow at property boundary and off-Site	• Hydraulic characteristics of hydrostratigraphic units – ability to identify units; hydraulic conductivity, flow directions • Results of flow modelling – predicted changes to the groundwater flow with each alternative

The potential effects for each alternative were then identified on the basis of these considerations.

3. Secondary Sources and Background Conditions

Available secondary sources of information were collected and reviewed to characterize the existing geologic and hydrogeologic conditions within the study areas. The following sources of secondary information were collected and reviewed:

- Jackman Geoscience Inc, 2017. Closed Hamilton (Stoney Creek) Landfill, Environmental Compliance Approval Number A130404 Annual Report 2016.
- Jackman Geoscience Inc, 2017. Hamilton (Stoney Creek) Landfill, Environmental Compliance Approval Number A181008 Annual Report 2016.
- Ontario Geological Survey 2000. Quaternary geology, seamless coverage of the Province of Ontario; Ontario Geological Survey, Data Set 14 --- Revised.
- Gao, C. et al., 2006. Bedrock topography and overburden thickness mapping, southern Ontario; Ontario Geological Survey, Miscellaneous Release – Data 207.

- Water Well Information System (WWIS), 2017. Ontario Ministry of the Environment and Climate Change (Accessed January 2017).
- Brunton, F.R., 2009. Update of Revisions to Early Silurian Stratigraphy of the Niagara Escarpment: Integration of Sequence Stratigraphy, Sedimentology and Hydrogeology to Delineate Hydrogeologic Units. Ontario Geological Survey. Open File Report 6240, Sedimentary Geoscience Section (25), Project Unit 08-004. 19p., pgs 5, 11-13.
- Armstrong, D.K. and Carter, T.R. 2010. The Subsurface Paleozoic Stratigraphy of Southern Ontario; Ontario Geological Survey, Special Volume 7, 301p., pgs 24, 59-67.
- Brunton, F.R., et al., 2013. Stratigraphic Architecture of the Lockport Group in Ontario and Michigan – A New Interpretation of Early Silurian 'Basin Geometrics' & 'Guelph Pinnacle Reefs'.
- Ministry of the Environment and Climate Change (MOECC) Technical Guideline and Standards.

3.1 Existing Geology and Hydrogeology Conditions

The existing SCRF is located within fractured bedrock of the Niagara Escarpment in a former quarry. The closed Terrapure landfill, historically referred to as the "West Landfill" (closed landfill), located to the west of the SCRF, (across First Road West) is also located within a former quarry. The SCRF and closed landfill are underlain by a sequence of shale and dolostone of the Lockport and Clinton formations.

A prominent geologic feature within the Site Study Area is a small escarpment known as the Eramosa Scarp, located along the northern extent of both the SCRF and closed landfill. The Eramosa Scarp was formed by the removal of some rock units at the surface during glacial advancement. Subsequent glacial activity has resulted in burial of the Eramosa Scarp beneath a veneer of overburden.

Previous investigations have identified 5 distinct bedrock groundwater flow zones within the Local Study Area. The following table summarizes these flow zones by name and associated lithologic unit.

Table 3.1 Groundwater Flow Zones

Flow Zone	Lithology Unit	Notes
Eramosa Flow Zone	Eramosa Dolostone	Water table aquifer within uppermost bedrock unit
Vinemount Flow Zone	Vinemount Shale	Upper 0.5 m of a 5 m thick shale to shaley dolostone unit is horizontally permeable. The upper 1m zone represents the Vinemount Flow Zone
Goat Island Upper Flow Zone	Goat Island Dolostone	1.5 m layer of interbedded dolostone and shale within the upper portion of Goad Island Unit
Goat Island Mid Flow Zone	Goat Island Dolostone	Later split into Upper Mid and Lower Mid Flow Zones
Goat Island Lower Flow Zone	Ancaster Chert Beds	

The flow zones and their respective lithologic units are also illustrated on Figure 9.

To the north of the Eramosa Scarp, the Eramosa Dolostone and Vinemount Shale do not exist, as they were eroded by glacial advancement. Where these units do not exist, the water table generally occurs within the overburden, however seasonal fluctuations have historically dropped the water table to within the Goat Island Dolostone during drier periods.

Beneath the Ancaster Chert Beds lie the Gasport Dolostone and Decew Dolostones. These units are interpreted to be less than 2 m in thickness in the Local Study Area and do not represent significant groundwater flow zones. A Unit known as the Rochester Shale underlies the Decew Dolostone. Previous studies have determined that the Rochester Shale has a horizontal hydraulic conductivity of less than 10^{-8} cm/sec. Vertical hydraulic conductivities have been estimated between 10^{-8} and 10^{-10} cm/sec. On this basis, the Rochester Shale is interpreted to be an effective aquitard and represents the bottom of active groundwater flow within the Local Study Area.

Natural groundwater flow direction in these flow zones within the Local Study Area would be to the northwest towards the Niagara Escarpment; however there are several natural and man-made features that influence the movement of groundwater in the vicinity of the Local Study Area. These features are discussed in detail in the following section. Prior to quarry development and construction of several sub-surface infrastructure projects, groundwater flow was likely consistently northwest in all five flow zones.

To the north of the Local Study Area, closer to the Niagara Escarpment, the rock units are more fractured and interconnected. This interconnecting of units results in a more vertical component of groundwater flow (downward) prior to reaching the Escarpment. As a result, groundwater springs along the Escarpment face are infrequent to the north of the Local Study Area.

Beyond the Niagara Escarpment, groundwater flow discharges to Lake Ontario.

3.1.1 Potential Man-Made Influences on Groundwater Movement

Various construction and infrastructure projects in the vicinity of the Local Study Area have influenced local groundwater flow directions and/or gradients. For example, construction of sewers within or below groundwater flow zones can influence groundwater flow by creating preferential pathways for groundwater movement within the granular trench bedding. The following points summarize the construction projects that have intersected the groundwater flow zones and thus affected the movement of groundwater:

- A 2.1 m diameter storm sewer was installed within the median of Mud Street to the south of the landfill during 1994. Construction of this sewer involved removal of portions of the Eramosa Dolostone and the Vinemount Shale.
- A 42.7 m deep vertical sanitary sewer drop shaft was constructed as part of the Upper Stoney Creek subdivision development in the vicinity of the Local Study Area. This drop shaft connects the sanitary sewer at the top of the Niagara Escarpment to the sanitary sewer system at the base of the Escarpment. Construction of this vertical shaft involved blasting and excavating through rock and thus resulted in connection of the various groundwater flow zones in the immediate vicinity of the vertical shaft.
- A similar vertical shaft was constructed in the vicinity of Green Mountain Road West and Highway 20 between 2011 and 2012. The Centennial Parkway Truck Sanitary Sewer was extended by boring into the base of the Niagara Escarpment. Three vertical shafts were required for this extension. The Centennial Parkway Trunk Sanitary Sewer construction has been on-going, extending from Green Mountain Road to the south towards the Town of Binbrook. Ongoing monitoring will determine what effects this construction will have on the groundwater flow system.
- A former quarry dewatering sump referred to as the South Sump was excavated into the Vinemount Shale within the footprint of the SCRF. The South Sump has been operating during construction of four

of the landfill cells in order to keep conditions dry for construction. This sump is connected to a series of granular trenches constructed for the purpose of expanding groundwater collection below the SCRF liner system. It should be noted that this construction took place early on in the life of the site.

- A lower quarry excavation located within the footprint of the SCRF was completed into the Goat Island Dolostone for aggregate production in the early 1980s. The eastern portion of this excavation included a 9m deep dewatering sump. At the completion of quarrying this lower portion, the excavation was backfilled with rubble and capped with a 3 m thick clay plug in 1991. The clay plug was placed at the elevation of the Vinemount shale. Despite placement of a clay plug, the perimeter of the excavation represents a vertical connection between the Upper and Lower flow zones. A pumping well (M4) was installed below the clay plug in 1993 in order to use the highly permeable lower excavation as a source of groundwater capture.
- A series of Containment Wells are operated along the northern limit of the closed landfill for the purpose of groundwater collection. Operation of these wells affects groundwater flow.
- A Perimeter Drain was installed between the closed landfill and the operating SCRF for the purpose of mitigating the movement of impacted groundwater from the closed landfill to the operating SCRF. Eastward movement of groundwater from the closed landfill to the operating SCRF is the result of active groundwater pumping at the South Sump and pumping well M4. The Perimeter Drain system includes groundwater collection trenches and a grout curtain installed to reduce movement of groundwater in the Vinemount and Upper Flow zones.

3.1.2 Remedial Systems

Previous investigations undertaken within the Site Study Area identified groundwater impacts related to the closed landfill to the west of the existing SCRF. The impacts are the result of infiltrated rainwater coming into direct contact with buried waste within the un-engineered landfill cells. No impacts to groundwater from the SCRF are evident as the SCRF is fully lined and under-drained. Historically, impacts from the closed site have been primarily noted within the Eramosa, Vinemount, Upper and Mid Flow Zones. In response to the identified impacts, several groundwater remediation strategies have been implemented. The principal groundwater remediation strategy is through active leachate or groundwater extraction and control in the areas of identified impact. The following points summarize the groundwater remediation systems currently in place at the closed landfill.

- A series of several Containment Wells are located along the northern boundary of the closed landfill. The locations of these wells correspond largely with the presence of the buried Eramosa Scarp. A total of seven Containment Wells have been installed and historically operated with groundwater pumped and discharged to the sanitary sewer system. With implementation of the Shatter Trench system (described below) and progressive closure of the closed landfill, decreases in available drawdown have been observed at the Containment Wells. These effects, combined with decreased performance due to mineral precipitation have reduced the active network from 7 to 2 wells as of 2014. Currently, only CW3 and CW16 continue to actively pump.
- A groundwater collection trench and grout curtain was constructed between the closed landfill and operating SCRF for the purpose of reducing migration of impacted water from the closed landfill to the east. The groundwater collection trench is part of a network of groundwater collection trenches that are

constructed within shallow bedrock around and within the footprint of the SCRF. These shallow groundwater collection trenches are connected to a central groundwater pumping station and allow complete collection of groundwater from the Vinemount Flow Zone within the footprint of the SCRF.

- Operation of pumping well M4, located within the lower excavation to the north of the operating SCRF. Operation of this pumping well controls groundwater impacts within the Vinemount Flow Zone, as well as the Upper and Mid Flow Zones.
- Operation of pumping well L1 near the west side of the closed landfill. L1 was installed in 1995 and has been in continuous operation since with the exception of interruptions for maintenance, etc. L1 draws water from the Lower Flow Zone.
- Operation of pumping wells within a Shatter Trench located to the north of the closed landfill. The Shatter Trench pumping wells remove groundwater from the Upper Flow Zone and the Upper-Mid Flow Zone. Currently, two pumping wells actively remove groundwater from the Shatter Trench (M5A, M5R).

The locations of these measures are presented in profile on Figure 10 (where possible) and in plan view on Figure 11 (where possible).

3.1.3 Groundwater Flow

Due to the various influences on groundwater movement in the Local Study Area, groundwater flow is complex. The following description is taken from the 2016 Annual Report (Jackman, 2017) for the SCRF and provides a conceptual description of the movement of groundwater through the Local Study Area.

Groundwater flow in the vicinity of the SCRF is generally from the southeast to the northwest towards the Niagara Escarpment. It is expected that as groundwater approaches the Niagara Escarpment that downward movement between flow zones increases due to the presence of more and larger interconnected fractures which increase vertical permeability. This results in the groundwater flow moving into the deeper formations prior to reaching the edge of the escarpment. In the immediate vicinity of the SCRF, geologic evidence suggests that interconnections between the flow zones are less pronounced and the predominant direction of groundwater flow is interpreted to be horizontal within these flow zones.

As discussed above, there are several man-made influences on groundwater flow that affect the horizontal and vertical movement of groundwater within the flow zones.

The interpreted shallow groundwater flow in the immediate vicinity of the SCRF is affected by the absence of the upper rock units within the landfill footprint and by the active pumping of the M4 containment well. This containment well contributes inward flow of shallow groundwater to the lower excavation portion of the SCRF. The collected groundwater is pumped to the sanitary sewer connection located at the north side of the SCRF.

Groundwater flow in the deeper bedrock flow zones within the Site Study Area is also largely affected by the groundwater remediation systems currently in operation, with some influences from off-Site infrastructure projects being apparent (e.g., vertical sewer shaft at Green Mountain West and Highway 20). The dominant horizontal hydraulic gradients in the lower flow zones indicate an overall groundwater flow direction from southeast to northwest towards the Niagara Escarpment.

As described above, the two groundwater criteria (groundwater quality and groundwater flow) were assessed by evaluating the indicators presented in Table 4.1. The following sections explains the evaluation methodology used to assess the criteria.

3.1.4 Groundwater Quality

The effects on groundwater quality for each alternative were assessed by:

- Estimating the leachate generation rate;
- Predicting the leachate discharge through the liner;
- Assessing the leachate quality; and,
- Determining the effect on downgradient groundwater quality.

The groundwater quality was assessed for each alternative under closed conditions (i.e., final cover in place) and assumed the leachate collection system was operating to minimize leachate head. The alternatives were assessed under closure conditions in order to allow a comparative analysis of the effects of each alternative on the indicators.

The leachate generation rate was estimated using the Hydrologic Evaluation of Landfill Performance (HELP) model for each of the alternatives. The HELP model is a USEPA recognized program that is commonly used to estimate water balance for landfill sites. Local or site-specific data is used in the calculations, including precipitation, vegetation, soil/ geosynthetic liner types, layer thicknesses, hydraulic conductivities, and slopes. The HELP model was used to calculate daily, monthly, and annual averages for the amount of surface water runoff, evapotranspiration, drainage, and leachate collection. The HELP model was also used to predict the leachate discharge through the liner. Separate HELP models were created to simulate the differing final landfill configurations for each alternative. A more detailed description of the HELP modelling undertaken as part of this evaluation is included in Attachment A.

In order to estimate groundwater quality at the downgradient Site boundary for the various Site closure configurations, a generalized water balance and mass balance approach was used. A water balance was developed to quantify the hydrogeologic characteristics and functioning in the vicinity of the landfill. The water balance was used to estimate groundwater flow (flux) beneath the landfill and to incorporate predicted leachate discharge through the liner (calculated using the HELP model). A contaminant mass balance using the groundwater flux and predicted leachate discharge (mass loading) was used to calculate the contaminant concentrations at the Site boundary. Contaminant concentrations were compared to established trigger levels for the Site in order to identify potential compliance issues for each alternative.

3.1.5 Groundwater Flow

Groundwater flow could be impacted by the alternatives by affecting the groundwater flow direction and/or groundwater flow rates. The direction and flow rate of groundwater is dependent on hydraulic conductivities, saturated thicknesses, and hydraulic gradients (i.e., the change in hydraulic head over a horizontal length).

Of these parameters, the hydraulic gradient is the variable that could potentially be impacted. An increase in leachate leakage through the liner could affect the distribution of hydraulic head under the landfill footprint, and thus changing horizontal hydraulic gradients. The results of the HELP modeling were used to calculate the potential change in hydraulic head through the use of the estimated leakage rate through the liner system under each alternative. The change in hydraulic head was used to determine the potential alterations of hydraulic gradients and subsequently, impacts on groundwater flow rates and direction. A detailed description of the groundwater flow calculations is provided in Attachment A.

3.1.6 Contaminating Lifespan

In order to evaluate the differences in contaminating lifespans for the various alternatives, the contaminating lifespan for each alternative was calculated using two different modelling approaches. The first approach involved simulating the degradation of leachate indicator parameters utilizing the 1DTRANSEN model (One-Dimensional Mass Transport and Sensitivity Analysis). The second approach utilized a model developed by Rowe (1991), which projects the decrease in leachate strength for a conservative contaminant species (e.g., chloride) where the decrease in strength is essentially due to dissolution as water infiltrates through the waste over time. A detailed description of the contaminating lifespan calculations using the models referenced above is provided in Attachment A.

4. Evaluation Results

4.1 Groundwater Quality

This section discusses the evaluation results in terms of the predicted effects of each alternative on groundwater quality. Discussions of predicted leachate generation and leakage through the liner are included as these are integral parts of the groundwater quality evaluation.

4.1.1 Leachate Generation

As discussed in Section 4, the HELP model was used to predict the leachate generation rates for each alternative. Leachate generation rates are provided by the HELP model as leakage through the final cover system into the waste mound. Based on the HELP modelling conducted, Table 4.1 summarizes the predicted leachate generation rates under closure conditions for the six alternatives as well as the existing approved configuration.

Table 4.1 Predicted Leachate Generation Rates

Landfilling Section	Area (ha)	Leachate Generation Rate (m^3/yr)
Existing Approved	54.4	158,790
Alternative 1	54.4	158,891
Alternative 2	59.3	175,784
Alternative 3	54.4	158,829
Alternative 4	62.3	184,576
Alternative 5	54.4	158,895
Alternative 6	59.3	175,780

The results presented in Table 4.1 demonstrate that leachate generation rates for all six alternatives being considered are similar. Alternatives 2, 4 and 6 result in greater leachate generation than the remainder of the alternatives.

4.1.2 Leachate Leakage Through Liner

The HELP model was also used to predict the rates of theoretical leachate discharge to the natural groundwater flow system for each alternative. Theoretical leachate leakage rates are provided by the HELP model as the potential leakage through the liner system (done for modeling purposes as opposed to an actual leakage through the liner). Based on the HELP modelling conducted, Table 4.2 summarizes the predicted theoretical leachate leakage rates under closure conditions for the six alternatives.

Table 4.2 Predicted Leachate Leakage Rates

Landfilling Section	Area (ha)	Theoretical Leachate Leakage Rate (m^3/yr)
Existing Approved	54.4	34.74
Alternative 1	54.4	34.82
Alternative 2	59.3	38.49
Alternative 3	54.4	34.74
Alternative 4	62.3	40.45
Alternative 5	54.4	34.82
Alternative 6	59.3	38.44

The results presented in Table 4.2 demonstrate that theoretical leachate leakage rates for all six alternatives being considered are substantially similar.

4.1.3 Effects on Downgradient Water Quality

A generalized water balance and mass balance approach was used to estimate groundwater quality at the downgradient Site boundary for each of the 6 alternatives. The water balance considered the primary inputs, and movements of water across the Site using both Site hydrogeologic data and theoretical calculations. The water balance and groundwater flow beneath the landfill was estimated by using Site specific groundwater elevations, gradients, and hydraulic conductivities. Based on the groundwater flux and contaminant mass loadings from predicted leachate leakage, downgradient groundwater quality was then estimated for each alternative.

A detailed description of calculation methodology and individual parameter results are provided in Attachment A.

Additional contaminant mass from leachate leakage increases contaminant concentrations at the downgradient boundaries. The alternative options modeled in HELP resulted in leachate leakage rates ranging from 34.74 m^3/year (0.10 m^3/day) to 40.45 m^3/year (0.11 m^3/day) (Alternatives 3 and 4, respectively). Increased leakage rates result in increased mass loading to the underlying aquifer which, in turn, increases parameter concentrations in groundwater downgradient of the landfill footprint.

For the purposes of this comparison, chloride has been selected as a surrogate for leachate impact on groundwater quality. Chloride is a contaminant species where changes in concentration are due to physical, non-destructive, processes (e.g., mechanical dispersion, dilution) and is not subject to biochemical breakdown, precipitation, or adsorption. Thus, chloride provides a conservative estimate of potential future impacts under each of the alternative options. Table 4.3 provides a summary of the forecasted chloride concentrations in monitoring wells located at the downgradient boundary under final development (closure conditions) for each alternative. The table provides a summary of the monitoring wells within the Vinemount Flow Zone (VFZ). The VFZ directly underlies the landfill liner and has comparatively limited upgradient flux. Thus, the VFZ is anticipated to be most affected by leachate mass loading. In order to ensure the results of the projected concentrations are conservative and comparable, the projections have been made assuming all leachate leakage would enter the VFZ.

Table 4.3 Predicted Downgradient Groundwater Quality

Well ID	Existing Approved	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
	(37.71 /	(34.82 /	(38.49 /	(34.74 /	(40.45 /	(34.82 /	(38.44 /
	0.095)	0.095)	0.105)	0.095)	0.111)	0.095)	0.105)
47-III	290	290	300	290	310	290	300
48-V	540	540	560	540	570	540	560
60-III	510	510	530	510	540	510	530
61-III	540	540	560	540	570	540	560

Notes: all concentrations are in mg/L
(m^3/year / m^3/day) leachate leakage rate

As shown in Table 4.3, the predicted downgradient groundwater quality is very similar for all six alternatives. The detailed results for predicted groundwater quality, including general chemistry and metals leachate indicator parameters, are included in Tables A.1 through A.7 within Attachment A. The results included in these tables show a consistent pattern in that the predicted downgradient groundwater quality is very similar for each parameter in all six alternatives.

It is important to note the following with respect to the results of the groundwater quality assessment:

1. The downgradient groundwater quality predictions have not taken into account the groundwater control systems incorporated into the landfill design. These systems are currently in operation and will be expanded as part of continued landfill development. These systems are discussed further in Section 6 (Mitigation Measures).
2. The predicted downgradient groundwater quality for each of the six alternatives is very similar to the predicted downgradient groundwater quality for the existing approval under closure conditions, modelled using the same methodology.

4.2 Groundwater Flow

The estimated leakage rate of leachate through the liner, calculated using the HELP model, was used to determine the potential impacts of each alternatives on groundwater flow. The HELP outputs show that leakage from the landfill liner will contribute approximately 0.064 mm each year. This leakage will predominantly enter the Vinemount Flow Zone (which directly underlies the base of the landfill footprint in each of the six alternatives), which could increase the hydraulic head beneath the landfill footprint. The increase in hydraulic head could affect groundwater flow by altering horizontal hydraulic gradients.

Based on the 2017 groundwater elevations measured at the Site, groundwater levels within the Vinemount Flow Zone are heavily influenced by groundwater extraction at M4 as well as the Phase One Centennial Parkway Trunk Sanitary Sewer (CPTSS) construction; however, historic reports (Taro East Quarry Environmental Assessment Hydrogeological, Impact Assessment Final Report, Gartner Lee, January 1995) show that the baseline potentiometric surface ranges from 201.0 to 192.6 mAMSL across the Site. Thus, the change in hydraulic head across the Site is on the order of several metres across a distance of approximately 900 m (i.e., i = (201mAMSL – 192.6mAMSL) / 900 m = 0.093 m/m).

Under each scenario of landfill expansion (Alternatives 1 through 6), landfill leakage contributes, an additional hydraulic head of 0.064 mm/year. Conservatively assuming this will happen instantaneously, the hydraulic gradient under the various alternatives is equal to the additional hydraulic head added to the downgradient groundwater elevation. Thus, the maximum increase in hydraulic gradient due to leachate leakage under all alternatives is negligible. The change in hydraulic gradient will produce negligible changes to groundwater flow rate and no observable change in direction.

4.3 Contaminating Lifespan

As discussed above, a detailed description of the predicted contaminating lifespan for each alternative is provided in Attachment A. Table 4.4 summarizes the resulting contaminating lifespans for each of the 6 alternatives using the 1DTRASEN model and Table 4.5 summarizes the results using the Rowe (1991) model.

Table 4.4 Contaminating Lifespan using the IDTRANSEN Model

Contaminant of Concern	ODWQS Criteria (mg/L)	Contaminating Life Span (years)		
		Maximum	Average	Median
Chloride	250	38	19	8
Sulfate	500	16	3	NA
Alkalinity	500	13	NA	NA
TOC	5.5	19	14	6

Note that the results showing NA indicate concentrations that are already below the Ontario Drinking Water Quality Standard (ODWQS) (i.e., negative contaminating lifespan). The calculated values were rounded up to the nearest whole number. All scenarios predict a contaminating lifespan of less than the minimum 25 years under the 1DTRANSEN model, with the exception of the maximum chloride concentration in leachate. Given the nature of this model, all alternatives share the same inputs (i.e., decay constant, initial and target concentrations). As such, the CLS values shown in Table 4.4 are representative of the approved design and all six alternatives.

Three scenarios were modeled using the Rowe Model, as follows.

- Scenario 1: Maximum anticipated indicator parameter concentration in leachate and average indicator parameter percentage in waste

- Scenario 2: Average anticipated indicator parameter concentration in leachate and average indicator parameter percentage in waste
- Scenario 3: Maximum anticipated indicator parameter concentration in leachate and maximum indicator parameter percentage in waste

The Rowe model differentiates between alternatives by taking into consideration waste area, volume and mass. The following table summarizes the contaminating lifespans calculated for chloride, as estimated using the Rowe Model, for each of the three scenarios for the approved existing conditions and the six alternatives.

Table 4.5 Contaminating Lifespan using the Rowe Model

Alternative Option	Contaminating Lifespan (years)		
	Scenario 1	Scenario 2	Scenario 3
Approved	19	31	29
Alternative 1	19	31	30
Alternative 2	19	31	29
Alternative 3	26	43	41
Alternative 4	18	30	28
Alternative 5	21	35	34
Alternative 6	19	32	30

A comparison of the contaminating lifespan values indicates that Alternatives 1, 2, 4, 5 and 6 perform similarly to the existing approved design. Calculated contaminating lifespans are longer for Alternative 3 as it involves a height increase without an expansion of the landfill footprint. The contaminating lifespan for Alternative 3 is significantly higher than the other options, primarily due to the increased elevation, and subsequent waste thickness, relative to the other options.

4.4 Potential Environmental Effects

4.4.1 Alternative Option 1

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns.

4.4.2 Alternative Option 2

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns.

4.4.3 Alternative Option 3

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns.

4.4.4 Alternative Option 4

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns.

4.4.5 Alternative Option 5

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns.

4.4.6 Alternative Option 6

Minor increases in leachate indicator parameters in downgradient groundwater quality, as well as reaching upgradient limits reaching wellhead protection area.

No changes in groundwater flow as the proposed alternative will have minimal effect on groundwater recharge patterns.

5. Mitigation Measures

The evaluation of potential environmental effects provided above has been completed without taking into consideration several environmental control systems incorporated into the landfill design. These control systems are important aspects of the Site's groundwater protection strategy and accordingly they are being taken into consideration as mitigation measures for each of the six alternatives. The following paragraphs describe the environmental control systems in place at the SCRF and their relevance to the predicted environment performance of the six alternatives.

Groundwater Extraction Well M4

Around 1985, the Lower Excavation portion of the active quarry (at the time), was made through the Vinemount Shale floor to allow access to the Goat Island Dolostone. Dewatering for this quarrying operation from the Lower Excavation created a draw of impacted groundwater from the closed landfill located immediately to the west. The Lower Excavation ceased to be used and was backfilled in 1990 with clean rock rubble with a 3m thick clay plug installed to simulate the low permeability of the former Vinemount Shale floor of the quarry. The contact between the clay plug was imperfect and flow from the VFZ and UFZ mixed within the rock rubble with groundwater from the lower flow zones. In order to control movement and extract contaminated groundwater migrating from the closed landfill, M4 extraction well was established in one corner of the former Lower Excavation.

Based upon observations of the system performance, a target pumping level was set for the M4 pumping well as a means of maintaining inward gradients toward the pumping well. Monitoring well observations during initial testing indicated that monitors across the length of the north boundary responded to the pumping of M4.

Potentiometric groundwater surfaces provided in the 2016 Annual Monitoring Report (Jackman, June 2017) show groundwater flow in each of the flow zones was heavily influenced by the operation of M4. Inwards, horizontal hydraulic gradients are shown across the northern Site boundary of both the SCRF and closed landfill.

In 2016, M4 extracted an average of 70,000 L/day (when in operation) which is greater than the combined flux estimates for the VFZ, UFZ, and UMFZ/LMFZ. It should be noted that in 2016, groundwater levels at the SCRF were being affected by dewatering associated with sewer construction along HWY. 20 which resulted in a historically low extraction volume from M4.

Based on data presented in the 2016 Annual Monitoring Report (Jackman, June 2017) (extraction greater than estimated flux values and measured inward horizontal hydraulic gradients), operation of M4 will be sufficient to capture potential future landfill-related water quality impacts within the VFZ, UFZ, and UMFZ/LMFZ.

Groundwater Collection Trench Network

The existing developed portion of the SCRF includes a network of shallow groundwater collection trenches that surround the landfill footprint and connect through a network of trenches underlying the landfill liner. These trenches are excavated through the VFZ and keyed into the underlying Vinemount Shale aquitard. The trenches are connected to a groundwater pumping station located at the southeast corner of the SCRF. Accordingly, the groundwater collection trench system is capable of containing all groundwater flow within the VFZ below the landfill footprint. As the VFZ would be the primary receptor of direct leachate leakage from the liner, this system is capable of mitigating leakage from the liner, should this condition be observed in the future.

Hydraulic Control Layer

The liner system for the SCRF includes a hydraulic control layer (HCL) between the two 1 m sections of compacted clay liner. The HCL consists of a coarse granular material, which, once fully constructed, will be flooded and maintained at a specified hydraulic head to induce an upward vertical gradient across the upper portion of the compacted clay liner. Maintaining an upward hydraulic gradient across the clay liner will ensure that downward leaking of leachate across the clay cannot occur. Accordingly, operation of the HCL will provide a substantial degree of additional protection against discharge of leachate through the liner into the natural environment.

6. Net Environmental Effects

The following tables summarize the results of the net environmental effects evaluations for each of the six alternatives. The net effects have been determined by applying the mitigation measures described in Section 6 to the predicted potential environmental effects for each alternative described in Sections 5.

6.1 Alternative Option 1

Table 6.1 Alternative Method 1 Geology and Hydrogeology Potential Environmental Effects, Mitigation Measures, and Net Effects

Environmental Component	Evaluation Criteria	Indicator	Potential Effects	Mitigation Measures	Net Effects
Geology and Hydrogeology	Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site	Minor increases in leachate indicator parameters at downgradient wells	Operation of M4 containment well, groundwater collection trench network and HCL	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area.
	Groundwater Flow	Predicted groundwater flow characteristics	No change in groundwater flow		No effects to groundwater flow

6.2 Alternative Option 2

Table 6.2 Alternative Method 2 Geology and Hydrogeology Potential Environmental Effects, Mitigation Measures, and Net Effects

Environmental Component	Evaluation Criteria	Indicator	Potential Effects	Mitigation Measures	Net Effects
Geology and Hydrogeology	Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site	Minor increases in leachate indicator parameters at downgradient wells	Operation of M4 containment well, groundwater collection trench network and HCL	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area.
	Groundwater Flow	Predicted groundwater flow characteristics	No change in groundwater flow		No effects to groundwater flow

6.3 Alternative Option 3

Table 6.3 Alternative Method 3 Geology and Hydrogeology Potential Environmental Effects, Mitigation Measures, and Net Effects

Environmental Component	Evaluation Criteria	Indicator	Potential Effects	Mitigation Measures	Net Effects
Geology and Hydrogeology	Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site	Minor increases in leachate indicator parameters at downgradient wells	Operation of M4 containment well, groundwater collection trench network and HCL	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area.
	Groundwater Flow	Predicted groundwater flow characteristics	No change in groundwater flow		No effects to groundwater flow

6.4 Alternative Option 4

Table 6.4 Alternative Method 4 Geology and Hydrogeology Potential Environmental Effects, Mitigation Measures, and Net Effects

Environmental Component	Evaluation Criteria	Indicator	Potential Effects	Mitigation Measures	Net Effects
Geology and Hydrogeology	Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site	Minor increases in leachate indicator parameters at downgradient wells	Operation of M4 containment well, groundwater collection trench network and HCL	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area.
	Groundwater Flow	Predicted groundwater flow characteristics	No change in groundwater flow		No effects to groundwater flow

6.5 Alternative Option 5

Table 6.5 Alternative Method 5 Geology and Hydrogeology Potential Environmental Effects, Mitigation Measures, and Net Effects

Environmental Component	Evaluation Criteria	Indicator	Potential Effects	Mitigation Measures	Net Effects
Geology and Hydrogeology	Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site	Minor increases in leachate indicator parameters at downgradient wells	Operation of M4 containment well, groundwater collection trench network and HCL	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area.
	Groundwater Flow	Predicted groundwater flow characteristics	No change in groundwater flow		No effects to groundwater flow

6.6 Alternative Option 6

Table 6.6 Alternative Method 6 Geology and Hydrogeology Potential Environmental Effects, Mitigation Measures, and Net Effects

Environmental Component	Evaluation Criteria	Indicator	Potential Effects	Mitigation Measures	Net Effects
Geology and Hydrogeology	Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site	Minor increases in leachate indicator parameters at downgradient wells	Operation of M4 containment well, groundwater collection trench network and HCL	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area.
	Groundwater Flow	Predicted groundwater flow characteristics	No change in groundwater flow		No effects to groundwater flow

7. Comparative Evaluation

Table 7.1 Comparative Evaluation

Environmental Component	Evaluation Criteria	Indicator	Alternative Options					
			Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Geology and Hydrogeology	Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. No net effects	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. No net effects	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. No net effects	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. No net effects	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. No net effects	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. No net effects
	Groundwater Flow	Predicted groundwater flow characteristics	No effects to groundwater flow No net effects	No effects to groundwater flow No net effects	No effects to groundwater flow No net effects	No effects to groundwater flow No net effects	No effects to groundwater flow No net effects	No effects to groundwater flow No net effects
	Criteria Ranking		1st	1st	1st	1st	1st	1st
	Criteria Rationale		The proposed continued use of environmental control systems in place at the SCRF, including the landfill liner, groundwater extraction well (M4), groundwater collection trench network and the hydraulic control layer results in the protection of the groundwater environment at the base of the liner system. No off-site groundwater receptors are anticipated to be affected by any of the six options in terms of groundwater flow or groundwater quality.					

8. Conclusions

Based on the net environmental effects summary presented in Section 7, all six alternatives are considered equivalent from the perspective of net environmental effects on the geologic and hydrogeologic receptors.

Attachment A
Description of Methodology

Appendix A: Detailed Description of Methodology

The following provides a discussion on the detailed methodology for approximating the effects of the alternatives on leachate generation, leachate leakage through the liner, groundwater quality, groundwater flow, and contaminating life span.

1. Leachate Generation and Leakage Rate

The Hydrologic Evaluation of Landfill Performance (HELP) model version 3.07 (Schroeder, et al., 1994a and 1994b) has been used to provide an assessment of leachate generation for the proposed alternative options under site closure conditions.

The HELP model was developed specifically to simulate the hydrologic components related to the operation of a landfill. Therefore, the HELP model is well suited for the purpose of this assessment. The following description of the HELP model, take directly from Schroeder, et al., (1994a), provides an overview of both the landfill design parameters and hydrologic processes that can be simulated by the model:

> *The Hydrologic Evaluation of Landfill Performance (HELP) computer program is a quasi-two-dimensional hydrologic model of water movement across, into, through and out of landfills. The model accepts weather, soil and design data and uses solution techniques that account for the effects of surface storage, snowmelt, runoff, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, leachate recirculation, unsaturated vertical drainage, and leakage through soil, geomembrane or composite liners. Landfill systems including various combinations of vegetation, cover soils, waste cells, lateral drain layers, low permeability barrier soils, and synthetic geomembrane liners may be modeled. The program was developed to conduct water balance analyses of landfills, cover systems, and solid waste disposal and containment facilities. As such, the model facilitates rapid estimation of the amounts of runoff, evapotranspiration, drainage, leachate collection, and liner leakage that may be expected to result from the operation of a wide variety of landfill designs. The primary purpose of the model is to assist in the comparison of design alternatives as judged by their water balances. The model, applicable to open, partially closed, and fully closed sites, is a tool for both designers and permit writers.*

The HELP model was developed by the United States Army Corps of Engineers under endorsement from the United States Environmental Protection Agency (USEPA).

1.1 Model Input Parameters

The HELP model requires three generalized groups of input parameters:

- General Design Data
- Weather/Climatic Data
- Soil & Design Data

Weather/Climatic Data

The HELP model allows for manual input of weather/climatic and general design data, or use of default data for a specific geographical location based on historical results. The user can choose whether to utilize manual data, default data, or a combination to generate synthetic weather/climatic data. The weather/climatic and general design data used in this assessment is SCRF specific manually input data obtained from the Environment and Climate Change Canada 1981-2010 Climate Normals & Averages database (Environment Canada, 2018), specifically the Hamilton A, Ontario station, Climate ID 6153194. All weather/climatic input parameters are summarized in the HELP model output files provided in Attachment A.

Soil & Design Data

The HELP model allows for manual input of soil and design data, or it can use default soil and design data based on material type. The soil and design data include soil layer type and the associated layer properties. The soil profile for the approved existing conditions and expansion options are as follows:

Table 1.1 Final Cover Material Properties

Layer	Layer Type	Layer Thickness	HELP Material Texture No.	USCS Description	Saturated Hydraulic Conductivity (cm/s)
Topsoil	Vertical Percolation	15 cm	4	SM	1.7×10^{-3}
Clay Cap	Barrier Soil Liner	60 cm	User Specified	-	1.0×10^{-5}
Waste	Vertical Percolation	Varies	User Specified	-	1.0×10^{-4}
Leachate Collection	Lateral Drainage	35 cm	21	Gravel	3.0×10^{-1}
HDPE	Geomembrane	0.2 cm	35	HDPE	2.0×10^{-13}
Clay Liner	Barrier Soil Liner	200 cm	28	C (compacted)	1.2×10^{-6}

The model was conducted multiple times in the key landfilling sections identified below and in Figures 3.1 to 3.7 (figures included in main report):

- Residual Material Area (RMA)
- Industrial Fill Area (IFA)

Two models were produced for each of the above noted sections, per expansion option, to determine leachate generation rates for the top of the landfill (3 percent) and the side slopes of the landfill (4H:1V). The models also include the waste layer, leachate collection layer, and landfill liner to determine the rate at which leachate percolated through the base of the landfill and potential leachate collection rates. Waste thicknesses varied based on location and expansion option. For modeling purposes, the landfill liner is comprised of compacted clay with an estimated saturated hydraulic conductivity of 1.2×10^{-6} cm/s. In reality, the compacted clay liner is divided by a 50 cm thick hydraulic control layer consisting of 50 mm clear stone. Given the difficulty of incorporating the hydraulic control layer into the HELP model, the compacted clay liner layers were combined and modeled as a 200 cm thick layer.

2. Effects on Downgradient Water Quality

In order to estimate groundwater quality at the downgradient Site boundary for the various Site closure configurations, a generalized water balance and mass balance approach has been used. The following sections provide discussion of the calculations and assumptions used to assess future groundwater quality at the Site.

2.1 Water Balance

A generalized water balance has been developed for the Site to quantify and characterize the basic hydrogeologic functioning in the vicinity of the Landfill. The water balance considers the primary inputs, and movement of water across the Site using both empirically derived data and theoretical calculations where data is unavailable (e.g., leachate leakage from the landfill after closure). These inputs are then used in combination with forecasted contaminant mass inputs to derive the predicted future groundwater concentrations at the downgradient Site boundary.

The inputs to the water balance are as follows:

- Groundwater flow into the landfill area, below the liner, from upgradient sources, in each of the flow zones that have the potential to receive leachate impacts after landfill closure (i.e. Vinemount Flow Zone [VFZ], Upper Flow Zone [UFZ], Upper Mid Flow Zone [UMFW], Lower Mid Flow Zone [LMFZ], and the Lower Flow Zone [LFZ])
- Precipitation over the landfill area that results in:
  - Leachate generation, which, in turn, results in leakage into the underlying flow zones
  - Leachate generation under each scenario of final Site development has been estimated and the worst case (i.e. largest leachate infiltration estimates) have been used in the mass balance

In addition to using the largest leakage rates through the landfill liner, runoff from the final cap (which will ultimate infiltrate into the shallow flow zones providing dilution of impacts) has not been included in the mass balance equation.

Infiltration of precipitation falling over the downgradient buffer zone will also provide dilution of landfill derived impacts in the shallow flow zones; however, the area downgradient of the landfill footprint is limited and has not been included in the water balance model.

Utilizing the worst-case leakage rates while discounting runoff and downgradient precipitation ensures that the mass balance approach provides a conservative estimate of downgradient water quality following landfill completion.

2.1.1 Groundwater Flow Beneath Landfill

Groundwater flow beneath the landfill footprint was estimated using the groundwater elevations reported in the 2015 and 2016 Annual Monitoring Reports (Jackman Geoscience Inc., June 30, 2016, and June 30, 2017), as well as the flow zone characteristics reported by Gartner Lee Limited in the Taro East Quarry Environmental Assessment, Hydrogeologic Impact Assessment, Final Report (Gartner Lee Limited, 1995c).

The Site-wide groundwater flow direction and gradients were estimated using an average of the 2015 and 2016 hydraulic data. A general southeast to northwest flow direction has been assumed and a gradient of 0.01 m/m has been estimated. Individual flow zone thicknesses were estimated using details from Gartner Lee Limited. Geometric mean hydraulic conductivity values were applied to each flow zone.

To determine cross-sectional area through which groundwater flow occurs in each flow zone beneath the landfill a line perpendicular to the direction of groundwater flow (southwest to northeast), approximately 910 m in length, is multiplied by the thickness of each flow zone.

The groundwater flow passing through the cross-sectional area can be calculated using Darcy's Law and is expressed with the following equation:

Equation 1: Darcy's Law

$$Q = KiA$$

Where,

Q = groundwater flow rate, flux, passing through cross-sectional area, A
A = cross-sectional area though which groundwater is flowing
i = hydraulic gradient

The cross-sectional area for groundwater flow is calculated as follows:

Equation 2: Cross-Sectional Area

$$A = L_x \times d$$

Where,

L_x = source length perpendicular to groundwater flow (910 m)
d = thickness

The majority of groundwater flow in each unit would occur through zones of higher hydraulic conductivity. Thus, using the geometric mean of hydraulic conductivity ranges provides a groundwater flux estimate that is likely low.

2.1.2 Potential Leachate Leakage

Leachate generation rates were estimated using the Hydrologic Evaluation Landfill Performance (HELP) model, as discussed in Section 1, above. Separate HELP models were created to simulate differing final landfill configurations. Leachate leakage rates from each case were used to estimate the leachate mass loading and potential impacts to groundwater quality under landfill configuration alternative.

In order to provide a conservative estimate of the contaminant mass loading, the maximum measured concentrations in leachate were used. Maximum contaminant concentrations were multiplied by individual leakage rates to derive masses that would be added to the underlying aquifer(s) from leachate leakage.

2.2 Contaminant Mass Balance

To assess the future potential groundwater quality and identify potential compliance issues at the downgradient Site boundary, future contaminant concentrations need to be calculated to compare against the established trigger levels for the Site. In order to predict future groundwater contaminant concentrations, a generalized mass balance approach has been utilized to estimate contaminant mass inputs. As trigger levels have been prepared on a well by well basis, changes in groundwater contaminant concentrations must also be estimated on a well by well basis.

Combining flux estimates and current downgradient groundwater quality, for individual flow zones and downgradient monitoring wells, can be used to estimate current contaminant masses at individual monitoring wells, for individual parameters, within each flow zone. Leakage rates and measured leachate characteristics can be used to estimate the total mass of individual contaminants that will be added to the underlying flow zones in the scenario of landfill closure.

The sum of these contaminant mass inputs (from individual monitoring wells added with leachate leakage) can then be divided over the total flux input to derive future groundwater concentrations at specific monitoring wells along the downgradient Site boundary.

In order to apply the results in a 'worst-case' scenario, total contaminant mass from leachate leakage is added to individual flow zone flux estimates. This provides an estimate of groundwater concentration in the scenario that all leachate leakage remains in the one flow zone.

Current downgradient groundwater quality was determined using the median 2016 concentrations reported by Jackman Geosciences. Multiplying the median concentration by the groundwater flux provides an existing mass for each parameter. For example:

Equation 3: Mass Balance

$$M_{Cl\ in\ VFZ} = \bar{C} \times Q_{VFZ}$$

Where,

$M_{CL\ in\ VFZ}$ = *mass of chloride in VFZ*

$\bar{C}$ = *median 2016 measured chloride concentration in the VFZ (mg/L)*

$Q_{in\ VFZ}$ = *estimate flux through the VFZ (L/day)*

Similarly, the mass discharge resulting from leachate leakage can be calculated. In order to provide a conservative estimate of leachate character, the maximum measured leachate concentrations have been multiplied by the leakage rates.

Adding the mass discharge from each of the groundwater flow inputs and dividing by the total volume provides an estimate of the final concentration of each parameter. For example:

Equation 4: Forecasted Groundwater Concentration

$$C_{forecasted} = \frac{M_{leakage} + M_{in\ monitor}}{Q_{in\ VFZ} + Q_{leakage}}$$

Where,

$C_{forecasted}$ = *forecasted concentration in a VFZ monitoring well (mg/L)*

$M_{leakage}$ = *contaminant mass from leachate leakage (mg/day)*

$M_{in\ monitor}$ = *contaminant mass in individual monitoring well (mg/day)*

$Q_{in\ VFZ}$ = *flux through flow zone (VFZ) (L/day)*

$Q_{in\ VFZ}$ = *estimate flux through the VFZ (L/day)*

$Q_{leakage}$ = *landfill leachate leakage rate (L/day)*

Tables A.1 through A.7 provide summaries of the forecasted final contaminant concentrations at the downgradient Site boundary under each of the six alternatives.

2.2.1 Confirmatory Comparison

The water balance method, discussed above was used to compare forecasted concentrations with the current, 2016, concentrations and established trigger levels for the Site.

Tables A.1 through A.7 provide summaries of forecasted concentrations for each Alternative in comparison with established trigger levels. As expected, adding contaminant mass from leachate leakage to the existing mass increases the current concentrations. Contaminant concentrations are increased more significantly in flow zones with lower estimated flux values. This is particularly apparent in the VFZ.

Forecasted concentrations result in numerous exceedances of the established trigger levels, in the downgradient monitoring wells. This is particularly true in the VFZ monitoring wells where current groundwater quality demonstrates many trigger exceedances already.

This ‘worst-case’ forecast shows that, under Scenario 4, an impacted groundwater containment system will be required to ensure downgradient groundwater quality meets the established trigger levels.

2.2.2 Additional Assumptions

In addition to the assumptions described above which ensure a ‘worst-case’ or conservative estimate of water quality, the forecast concentration model does not include an estimate of shallow or Eramosa Flow Zone water quality. It is assumed that the majority of this groundwater flux originating from this unit will be extracted prior to flowing beneath the landfill footprint.

The 2016 Annual Report showed that groundwater elevations at the Site have been influenced/lowered notably by dewatering activities associated with the sewer construction along Hwy. 20. This lowering of elevations may have influence hydraulic gradient estimates and thus influenced the flux estimates listed above. Flux estimates are likely lower as a result.

Contaminant mass from leachate leakage will flow downward into the VFZ; downward vertical hydraulic gradients between the VFZ and underlying flow zones show that flow (and contaminant mass) will likely mix with the lower flow zones. The lower excavation in the northwest corner of the Site also provides a conduit for downward migration. Combining the entire contaminant mass from leachate to a single flow zone provides a very conservative estimate as this mass will be distributed amongst the various flow zones.

3. Groundwater Flow

As discussed in Section 5.1, leachate generation has been estimated for each of the expansion alternatives using HELP modeling. The results of the HELP modeling has also been used to estimate the leakage rates of leachate through the liner system under each alternative (Options 1 through 6). The HELP outputs show that leakage from the landfill liner will contribute an additional 640 to 1,276 mm per hectare each year. This leakage will predominantly enter the Vinemount Flow Zone (which directly underlies the base of the landfill footprint in each of the six Options), which will increase the hydraulic head beneath the landfill footprint.

Horizontal groundwater flow is determined by hydraulic conductivities, saturated thicknesses, and hydraulic gradients (i.e. the change in hydraulic head over a horizontal length). Given that the Vinemount Flow Zone is approximately 1 m thick and is entirely saturated, the only component of the horizontal groundwater flow subject to alteration due to additional leachate leakage is the hydraulic gradient. The equation describing the hydraulic gradients is presented as Equation 5.

Equation 5: Hydraulic Gradient

$$i = \frac{h1 - h2}{l}$$

Where,

i = hydraulic gradient

h1 = the hydraulic head or potential groundwater surface at point 1

h2 = the hydraulic head or potential groundwater surface at point 2

l = the distance between points 1 and 2

Based on the 2017 groundwater elevations measured at the Site, groundwater levels within the Vinemount Flow Zone are heavily influenced by groundwater extraction at M4; however, historic reports (Taro East Quarry Environmental Assessment Hydrogeological, Impact Assessment Final Report, Gartner Lee, January 1995) show that the baseline potentiometric surface ranges from 201 to 192.6 mAMSL across the Site. Thus, the change in h1-h2 is on the order of several metres across a distance of approximately 900 m (i.e. i = (201mAMSL – 192.6mAMSL) / 900 m = 0.093 m/m).

Under each scenario of landfill expansion (Alternatives 1 through 6), landfill leakage contributes, an additional hydraulic head of 0.064 mm/year. Conservatively assuming this will happen instantaneously, the hydraulic gradient under the various alternatives is equal to the additional hydraulic head added to the downgradient groundwater elevation.

Equation 6: Revised Hydraulic Gradient with Leakage

$$\begin{aligned} h2_{(new)} &= h2 + \text{leakage rate} \\ &= 192.6\ mAMSL + 0.064\ mm \\ &= 192.6\ mAMSL \end{aligned}$$

It follows that:

$$i = \frac{201\ mAMSL - 192.66\ mAMSL}{900\ m}$$

$$= 0.0093\ m/m$$

4. Contaminating Life Span

Solid waste landfills need to be managed after closure during the contaminating life span (CLS) of the landfill. This aftercare comprises the treatment and monitoring of residual emissions as well as the maintenance and control of landfill elements. The measures can be terminated when a landfill does not pose a threat to the environment anymore, signifying the end of the CLS of a landfill. The CLS of the Site was determined based on the data provided and models available from the literature review. Specifically, GHD has utilized a first order decay function to determine the CLS of the Site for several parameters including, chloride, sulphate, alkalinity, and total organic carbon (TOC). GHD utilized the Rowe (1995, 2004) CLS model to confirm/evaluate the first order decay results for chloride. The comparison criteria for the CLS evaluation is the Ontario Drinking Water Quality Objectives (ODWQS), as prepared by the Ministry of the Environment and Climate Control (MOECC).

4.1 First Order Decay Model

GHD simulated degradation of leachate indicator parameters utilizing the 1DTRANSEN model (One-Dimensional mass Transport and Sensitivity analysis). The leachate source concentration in the one-dimensional transport model is governed by the time function, as shown in Equation 6:

Equation 7: One-Dimensional Transport Model

$$C_0 = \begin{cases} (t/t_1)C_B + C_A & 0 < t < t_1 \\ C_B & t_1 \le t < t_2 \\ C_B e^{-\mu t} & t \ge t_2 \end{cases}$$

For the purpose of this investigation, GHD focused on the period where $t \ge t_2$, representing Site closure for this investigation. When the simulation time is greater than t_2, the source concentration is assumed to decay exponentially at a rate equal to μ, the first order decay constant. Decay constants for the leachate indicator parameters were obtained from Lu et al. (1981) and Rowe (1994). GHD estimated the initial concentration, C_B, for each leachate indicator parameter, based on Site-specific data. A simple spreadsheet model was developed to calculate the concentrations at various times to determine the CLS of the landfill, utilizing the formula identified for $t \ge t_2$.

In order to simplify the model and provide a security factor to the simulation results, no attenuation factors (such as physical, chemical, and biological processes including adsorption, biodegradation, cation and anion exchange, filtration, and precipitation) have been incorporated into the simulation. As such, the First Order Decay Model represents a conservative estimate of CLS.

4.1.1 Site Parameters

Concentrations of Leachate Indicator Parameters

The landfill leachate strength at any given time depends primarily on waste composition. Concentrations of the leachate indicator parameters were obtained from existing monitoring data and, where necessary, estimated from published data for similar waste streams. GHD compiled data from several ICI landfills and utilized median, average, and maximum concentrations to evaluate the CLS for the Site.

The estimated COC concentrations in leachate were calculated using the maximum, mean, and median concentrations for each parameter from 2016 sample analytical data (Jackman Geoscience, 2017). Note that the ODWQS does not specify criteria for TOC. As such, the CLS for TOC was determined as the time period until TOC concentrations reach mean background groundwater quality levels.

4.2 Rowe Model

4.2.1 Model Based On Rowe (1995, 2004)

Rowe (1991) examined the issue of leachate strength decrease for conservative contaminant species (e.g., chloride) where the decrease in strength is essentially due to dilution (i.e., no biological breakdown or precipitation) as water infiltrated through the waste with time. Assuming that the decrease is due to dilution, the variation in concentration at any time t is given by:

Equation 8: Target Concentration

$$C_t = C_o^{\frac{(-q_o \times t)}{H_r}}$$

Where,

C_t = target concentration [i.e. ODWS] (kg/m^3)
t = time required (yr)
C_o = peak or average indicator parameter concentration (mg/L)
q_o = average rate of infiltration (m/yr)
H_r = reference height of leachate (kg)
$H_r = M_a / (A_o \times C_o)$ (Source: Rowe, 1994)

Where,

M_a = mass of contaminant per unit area (kg)
$M_a = H_w \times \rho_{dw} \times P$
A_o = area (m^2)
H_w = maximum waste thickness (m)
ρ_{dw} = dry density of waste (kg/m^3)
p = proportion of the total mass of waste that is contributed by the indicator parameter

This model was used to validate the results of the First Order Decay Model. Note that this model was utilized for four scenarios, as follows:

- Scenario 1: Maximum anticipated indicator parameter concentration in leachate and average indicator parameter percentage in waste
- Scenario 2: Average anticipated indicator parameter concentration in leachate and average indicator parameter percentage in waste
- Scenario 3: Maximum anticipated indicator parameter concentration in leachate and maximum indicator parameter percentage in waste

Scenario 3 represents the “worst-case” conditions, whereas Scenarios 1 and 2 represent conditions that could be more realistically expected.

4.2.2 Site Parameters

Concentrations of Leachate Indicator Parameters

Chloride concentrations as measured in leachate wells during 2016.

Dry Density of Waste

The estimated dry density of waste, based on expected waste stream, is 1,000 kg/m^3.

Volume of Waste

The anticipated total volume and area of waste varies based on alternative, as follows:

Table 4.1 Waste Volumes

Option	Volume (m3)	Area (ha)
Approved	8,320,000	54.4
Alternative 1	8,422,000	54.4
Alternative 2	9,178,500	60.2
Alternative 3	11,592,000	54.4
Alternative 4	9,306,000	63.2
Alternative 5	9,592,000	54.4
Alternative 6	9,548,500	60.2

Leachate Indicator Parameter Percentage in Waste

The mass of contaminant can be characterized in terms of the mass of waste and proportion of that mass which is the chemical of interest. Rowe (1995) reports that the data on the mass of contaminants in waste are relatively sparse and published data of chloride representative of municipal waste are in the range of 0.07 percent and 0.21 percent of the in-situ mass of refuse. Laner et al. (2011) reported a range of 0.003 to 0.09 percent of chloride in the dry mass of waste. Fellner et al. (2009) reported that chloride in the dry mass of waste is 0.05 percent.

Chloride concentrations within the principal waste streams was taken from waste sample analyses performed by Gartner Lee and reported in the report entitled *"Taro East Quarry Environmental Assessment, Waste and Leachate Characterization Report"* (1995). Chloride was found to be 0.019 percent, 0.019 percent, and 0.074 percent of the total waste in the three main waste streams (approved mixed waste, basic oxygen furnace oxide and contaminated soils). The average measured chloride in the waste at this landfill was 0.04 percent. This parameter is of paramount importance since it determines the mass of chloride present in the landfill which has to be carried out by the infiltration water.

Acceptable Leachate Indicator Parameter Concentration to Reach

It is necessary to define "unacceptable impact" to determine the CLS of a landfill. In the province of Ontario, the MOECC ODWQS identifies the chloride concentration where the contamination from the landfill is assumed to have no unacceptable impact as 250 mg/L.

Draft Comparative Evaluation Methodology Narrative for Surface Water Resources

Memorandum

Draft for Review

This document is in draft form. A final version of this document may differ from this draft. As such, the contents of this draft document shall not be relied upon. GHD disclaims any responsibility or liability arising from decisions made based on this draft document.

March 21, 2018 Reference No. 11102771

Subject: Stone Creek Regional Facility EA (Terrapure Environmental) – Draft Comparative Evaluation for Surface Water Resources

1. Introduction

This memo documents the assessment and evaluation of the six landfill alternatives for the Stoney Creek Regional Facility (SCRF) Environmental Assessment (EA) from the Surface Water Resources perspective. The Minister approved amended Terms of Reference (ToR) included a preliminary description of the methodology for evaluating the alternative methods (i.e., alternative landfill footprint options (See Section 7.1 of the approved amended ToR, November 2017)). This memo is one of 10 memos that outline the evaluation of the alternative landfill footprint options from the perspective of each discipline. These memos will be used in concert with one another, along with their evaluation tables, as supporting documents to the Alternative Methods Report. Memos were prepared for the following environmental components:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use and Economic;
- Atmospheric Environment (Air Quality and Odour);
- Atmospheric Environment (Noise);
- Human Health;
- Transportation;
- Archaeology and Built Heritage; and,
- Design and Operations.

Each of the above disciplines also prepared existing conditions reports that were utilized in assessing and evaluating the alternative landfill footprint options. Further, the disciplines referred to the Conceptual Design Report (CDR) that was prepared from a Site Design and Operations perspective in order to provide the appropriate level of detail on each of the alternative landfill footprints. The CDR will also form a supporting document to the Alternative Methods Report.

Each discipline is following the requirements as stated in the draft work plans that were presented in Appendix D of the approved amended ToR. The work plan presents the scope of work required to complete the EA, including the scope of technical studies for each of the environmental components, and the evaluation of alternative methods (alternative landfill footprints).

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1.1 Documentation

The results of these individual memos will be documented in separate stand-alone technical memorandums during the EA. The final alternative methods evaluation will form a chapter of the EA Report, with each of the stand-alone memorandums becoming supporting documents/appendices to the EA Report.

2. Assessment and Evaluation of the Alternative Landfill Footprint Options

2.1 Methodology

The assessment and evaluation of the alternative landfill footprints was conducted in three steps:

Step 1: Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during the first Open House and confirmed for application to each of the landfill footprint alternatives. Evaluation criteria were developed for each Environmental Component listed above.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the 'alternative methods' (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out consisting of the following activities:

- Identify potential effects (based on measures) on the environment;
- Develop and apply avoidance/ mitigation/ compensation/ enhancement measures;
- Review the feasibility of the stormwater management (SWM) pond layout; and,
- Determine net effects on the environment.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another in order to identify a "recommended landfill footprint". The comparison of net effects was completed using a "Reasoned Argument" or "Trade-off" evaluation methodology, as provided for in the approved SCRF EA ToR.

Each alternative was assessed based on the evaluation criteria, indicators and measures.

Two criteria were evaluated with three indicators for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

- Effect on Surface Water Quality
  - Predicted effects on surface water quality on-site and off-site
- Effect on Surface Water Quantity
  - Predicted change in drainage areas
  - Predicted occurrence and degree of off-site effects

3. Net Effects Analysis

Predictive modelling was performed using PCSWMM Version 7.1 with SWMM5 version 5.1.012 for the current approved design of the SCRF (baseline condition) and each of the alternate methods being considered. This modelling served to evaluate the changes to the peak flows and runoff volumes for each of the alternatives when compared to the baseline condition. The results of the modeling of the peak flows and runoff volume for each condition are summarized in the tables below. The modelling results assume uncontrolled flows, meaning it was assumed that there were no measures to contain and capture the runoff (i.e., perimeter ditches and stormwater management ponds).

Table 3.1 Peak Flow Comparison

	Uncontrolled 2-year Storm		Uncontrolled 100-year Storm	
Options	Peak Flow (m^3/s)	Percent Difference to Baseline	Peak Flow (m^3/s)	Percent Difference to Baseline
Existing/Baseline	0.969	N/A	6.616	N/A
Option 1 (Reconfiguration)	0.967	-0.21%	5.929	-10.38%
Option 2 (Footprint Expansion)	0.929	-4.13%	5.932	-10.34%
Option 3 (Height Increase)	0.971	0.21%	6.927	4.70%
Option 4 (Reconfiguration and Footprint Expansion)	0.925	-4.54%	5.641	-14.74%
Option 5 (Reconfiguration and Height Increase)	0.969	0.00%	6.313	-4.58%
Option 6 (Footprint Expansion and Height Increase)	0.933	-3.72%	6.631	0.23%

Table 3.2 Total Runoff Volume Comparison

Options	Uncontrolled 2-year Storm		Uncontrolled 100-year Storm	
	Runoff Volume (m^3)	Percent Difference to Baseline	Runoff Volume (m^3)	Percent Difference to Baseline
Existing/Baseline	14,051	N/A	57,985	N/A
Option 1 (Reconfiguration)	15,501	10.32%	61,676	6.37%
Option 2 (Footprint Expansion)	14,343	2.08%	58,795	1.40%
Option 3 (Height Increase)	14,108	0.41%	58,069	0.14%
Option 4 (Reconfiguration and Footprint Expansion)	15,881	13.02%	62,624	8.00%
Option 5 (Reconfiguration and Height Increase)	15,564	10.77%	61,735	6.47%
Option 6 (Footprint Expansion and Height Increase)	14,438	2.75%	58,876	1.54%

As can be seen in Tables 3.1 and 3.2, the options that involve reconfiguration or a footprint expansion result in increased runoff volume. Most options showed a decrease in peak flows. This can be attributed to the fact that the average slopes in most of the options was slightly less than in the baseline condition. Generally, an increase in height resulted in an increase in peak flows. In some cases, there was very little or no increase in peak flows due to a height increase and this may be attributed to other factors, such as reconfiguration of the site changing the flow length or travel time of flows over the site and to the outlet.

The changes for each of the options are discussed in further detail below.

3.1 Option 1 - Reconfiguration

Option 1 maintains the same footprint and height as the current approved design of the SCRF (baseline condition). The area currently approved for industrial fill will be used for residual material that will require a less pervious final cover during closure conditions. The final cover for the residual material will produce more runoff than the final cover for industrial fill since the residual material final cover requires a layer of clay that is 600 mm thick. The clay layer will be less pervious than the cover for the industrial fill resulting in a larger runoff volume.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition, as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is total suspended solids (TSS) which occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels. The height of the residual material is also the same as the baseline, which will result in similar peak flows, minimizing any additional TSS that may be collected from the final cover during a storm event.

Surface Water Quantity - Change in Drainage Areas

The overall drainage area is the same as in the baseline condition. The area will be less permeable due to the increased area of residual material with the clay layer as part of the final cover. This will result in an increase in runoff volume.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce a larger runoff volume than the baseline condition. The predicted increase in runoff volume is approximately 10% during the 2-year event and 6% during the 100-year event. There is no expected increase in peak flows due the height of the residual fill staying the same as baseline conditions. Runoff will flow off-site and cause an increase in flows in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Mitigation

The addition of perimeter ditches that can convey up to the 100-year storm event will prevent any flows from leaving the site. A stormwater management pond with two forebays can be designed to treat the runoff to the required levels and to control the release of the 2-year- through 100-year storm events to pre-development levels. This will prevent erosion and flooding off-site and address any water quality issues.

The allocated SWM pond area is large enough to size a pond that can treat and control the site runoff. There may be some complications in the design of the pond due to the elevation difference between the residual material toe of slope and the elevations of the roads adjacent to the SWM pond. The berm separating the SWM pond from Green Mountain Road West and First Road West will need to be redesigned.

The pond design will include emergency shut-off valves so that stormwater will not be released into the storm sewer system below First Road West, which ultimately discharges into Davis Creek, if water quality testing determines that the water quality is not suitable for discharge. Contingency measures include “status quo”, which is to discharge stormwater to the sanitary sewer for treatment at the City’s water pollution control plant.

Net Effect

The SWM pond and perimeter ditches will be able to treat and control the runoff from the site to the same level as the current approved design. The SWM pond design may be more complicated than most standard ponds due to elevation differences. Redesign of the berm separating the SWM pond from Green Mountain Road West and First Road West will be required.

3.2 Option 2 - Footprint Expansion

Option 2 maintains the same height as the current approved design of the SCRF (baseline condition) and the SCRF will continue to receive industrial fill. The buffer area will be reduced to a minimum of 30 m and the SWM pond will be placed within the buffer area in the northwest corner of the site. This results in an increased area for residual material. An increase in residual material area with a final cover that requires a layer of less pervious clay will result in a larger runoff volume.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is TSS that occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels. The height of the residual material is also the same as the baseline that will result in similar peak flows, minimizing any additional TSS that may be collected from the final cover during a storm event.

Surface Water Quantity - Change in Drainage Areas

The overall residual/fill drainage area is larger than the baseline condition. The area will be less permeable due to the increased area of residual material with the clay layer as part of the final cover. This will result in an increase in runoff volume.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce a larger runoff volume than the baseline condition. The predicted increase in runoff volume is approximately 2% during the 2-year event and 1% during the 100-year event. There is no expected increase in peak flows due the height of the residual fill staying the same as baseline conditions. Runoff will flow off-site and cause an increase in flows in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Mitigation

The addition of perimeter ditches that can convey up to the 100-year storm event will prevent any flows from leaving the site. A stormwater management pond with two forebays can be designed to treat the runoff to the required levels and to control the release of the 2-year- through 100-year storm events to pre-development levels. This will prevent erosion and flooding off-site and address any water quality issues.

The allocated SWM pond area is large enough to size a pond that can treat and control the site runoff. There may be some complications in the design of the pond due to the elevation difference between the residual material toe of slope and the elevations of the roads adjacent to the SWM pond. The berm separating the SWM pond from Green Mountain Road West and First Road West will need to have significant design considerations. This may result in a costly design and construction of the SWM pond. Since the SWM pond will be built within the 30 m buffer area, the berm sloping from the SWM pond to the roads will take up more than half the width allocated for the pond, which will create additional design and construction constraints.

The pond design will include emergency shut-off valves so that stormwater will not be released into the storm sewer system below First Road West, which ultimately discharges into Davis Creek, if water quality testing determines that the water quality is not suitable for discharge. Contingency measures include “status quo", which is to discharge stormwater to the sanitary sewer for treatment at the City's water pollution control plant.

Net Effect

The SWM pond and perimeter ditches will be able to treat and control the runoff from the site to the same level as the current approved design. The SWM pond design may be more complicated than most standard ponds due to elevation differences and width restrictions in the buffer zone.

3.3 Option 3 - Height Increase

Option 3 maintains the same footprint area as the current approved design of the SCRF (baseline condition). The SCRF will continue to receive both industrial fill and residual material. The volume of runoff produced from the site will be similar to baseline conditions due to similar areas being reserved for both industrial fill and residual material. The final cover in Option 3 will be similar to the final cover in the currently approved design. The residual material will have a vertical expansion, resulting in a larger area with steeper slopes. This will cause an increase in peak flows.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition, as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is TSS that occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels. The height of the residual material will increase which will result in higher peak flows, which may cause additional TSS to be collected from the final cover during a storm event.

Surface Water Quantity - Change in Drainage Areas

The overall drainage area is the same as in the baseline condition but there will be a height increase. The area will have a similar permeability due to similar areas of industrial fill and residual material. This will result in an increase to peak flows but similar runoff volumes.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce a similar runoff volume than the baseline condition but having higher peak flows. The predicted increase in peak flows is less than 1% during the 2-year event and approximately 5% during the 100-year event. Runoff will flow off-site and cause an increase in peak flows in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Mitigation

The addition of perimeter ditches that can convey up to the 100-year storm event will prevent any flows from leaving the site. A stormwater management pond with two forebays can be designed to treat the runoff to the required levels and to control the release of the 2-year- through 100-year storm events to pre-development levels. This will prevent erosion and flooding off-site and address any water quality issues.

The allocated SWM pond area is large enough to size a pond that can treat and control the site runoff. There may be some complications in the design of the pond due to the elevation difference between the residual material toe of slope and the elevations of the roads adjacent to the SWM pond. The berm separating the SWM pond from Green Mountain Road West and First Road West will need to be redesigned.

The pond design will include emergency shut-off valves so that stormwater will not be released into the storm sewer system below First Road West, which ultimately discharges into Davis Creek, if water quality testing determines that the water quality is not suitable for discharge. Contingency measures include “status quo”, which is to discharge stormwater to the sanitary sewer for treatment at the City’s water pollution control plant.

Net Effect

The SWM pond and perimeter ditches will be able to treat and control the runoff from the site to the same level as the current approved design. The SWM pond design may be more complicated than most standard ponds due to elevation differences. Redesign of the berm separating the SWM pond from Green Mountain Road West and First Road West will be required.

3.4 Option 4 - Reconfiguration and Footprint Expansion

Option 4 maintains the same height as the current approved design of the SCRF (baseline condition) and the SCRF will no longer receive industrial fill. The buffer area will be reduced to a minimum of 30 m and the SWM pond will be placed within the buffer area in the northwest corner of the site. This results in an increased area for residual material. An increase in residual material area with a final cover that requires a layer of less pervious clay will result in a larger runoff volume.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is TSS that occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels. The height of the residual material is also the same as the baseline that will result in similar peak flows, minimizing any additional TSS that may be collected from the final cover during a storm event.

Surface Water Quantity - Change in Drainage Areas

The overall residual material drainage area is larger than the baseline condition. The area will be less permeable due to the increased area of residual material with the clay layer as part of the final cover. This will result in an increase in runoff volume.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce a larger runoff volume than the baseline condition. There is no expected increase in peak flows due the height of the residual fill staying the same as baseline conditions. The predicted increase in runoff volume is approximately 13%

during the 2-year event and 8% during the 100-year event. Runoff will flow off-site and cause an increase in flows in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Mitigation

The addition of perimeter ditches that can convey up to the 100-year storm event will prevent any flows from leaving the site. A stormwater management pond with two forebays can be designed to treat the runoff to the required levels and to control the release of the 2-year- through 100-year storm events to pre-development levels. This will prevent erosion and flooding off-site and address any water quality issues.

The allocated SWM pond area is large enough to size a pond that can treat and control the site runoff. There may be some complications in the design of the pond due to the elevation difference between the residual material toe of slope and the elevations of the roads adjacent to the SWM pond. The berm separating the SWM pond from Green Mountain Road West and First Road West will need to have significant design considerations. This may result in a challenging and costly design and construction of the SWM pond. Since the SWM pond will be built within the 30 m buffer area, the berm sloping from the SWM pond to the roads will take up more than half the width allocated for the pond, which will create additional design and construction constraints.

The pond design will include emergency shut-off valves so that stormwater will not be released into the storm sewer system below First Road West, which ultimately discharges into Davis Creek, if water quality testing determines that the water quality is not suitable for discharge. Contingency measures include “status quo”, which is to discharge stormwater to the sanitary sewer for treatment at the City’s water pollution control plant.

Net Effect

The SWM pond and perimeter ditches will be able to treat and control the runoff from the site to the same level as the current approved design. The SWM pond design may be more complicated than most standard ponds due to elevation differences and width restrictions in the buffer zone.

3.5 Option 5 - Reconfiguration and Height Increase

Option 5 maintains the same footprint area as the current approved design of the SCRF (baseline condition) but there will be an increase in height. SCRF will no longer receive industrial fill so the area currently approved for industrial fill will be used for residual material. The additional residual material will require a less pervious final cover during closure conditions. The final cover for the residual material will produce more runoff than the final cover for industrial fill since the residual material final cover requires a layer of clay that 600mm thick. The clay layer will be less pervious than the cover for the industrial fill resulting in a larger runoff volume. The residual material will have a vertical expansion, resulting in steeper slopes. The reconfiguration of the site to have additional residual area will cause an increase in flow length and travel time of the runoff. This will cause a reduction in peak flows.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition, as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is TSS that occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels.

Surface Water Quantity - Change in Drainage Areas

The overall drainage area is the same as in the baseline condition but there will be a height increase. The area will have lower permeability due the replacement of industrial fill with residual material. This will result in an increase peak flows and runoff volumes.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce more runoff volume and higher peak flows than the baseline condition. The predicted increase in runoff volume is approximately 11% during the 2-year event and 6% during the 100-year event. Runoff will flow off-site and cause increased flows in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Mitigation

The addition of perimeter ditches that can convey up to the 100-year storm event will prevent any flows from leaving the site. A stormwater management pond with two forebays can be designed to treat the runoff to the required levels and to control the release of the 2-year- through 100-year storm events to pre-development levels. This will prevent erosion and flooding off-site an address any water quality issues.

The allocated SWM pond area is large enough to size a pond that can treat and control the site runoff. There may be some complications in the design of the pond due to the elevation difference between the residual material toe of slope and the elevations of the roads adjacent to the SWM pond. The berm separating the SWM pond from Green Mountain Road West and First Road West will need to be redesigned.

The pond design will include emergency shut-off valves so that stormwater will not be released into the storm sewer system below First Road West, which ultimately discharges into Davis Creek, if water quality testing determines that the water quality is not suitable for discharge. Contingency measures include “status quo”, which is to discharge stormwater to the sanitary sewer for treatment at the City’s water pollution control plant.

Net Effect

The SWM pond and perimeter ditches will be able to treat and control the runoff from the site to the same level as the current approved design. The SWM pond design may be more complicated than most standard ponds due to elevation differences. Redesign of the berm separating the SWM pond from Green Mountain Road West and First Road West will be required.

3.6 Option 6 - Footprint Expansion and Height Increase

Option 6 provides an increase in footprint and height from the current approved design of the SCRF (baseline condition). The SCRF will continue to receive industrial fill. The buffer area will be reduced to a minimum of 30 m and the SWM pond will be placed within the buffer area in the northwest corner of the site.

This results in an increased area for residual material. An increase in residual material area with a final cover that requires a layer of less pervious clay will result in a larger runoff volume.

Surface Water Quality

The effect on surface water quality is minimal when compared to the baseline condition, as the same material (post diversion solid, non-hazardous industrial residual material) will continue to be accepted and disposed of. The SCRF will receive final cover with vegetation similar to the current approved design. The only contaminant of concern is TSS that occurs as stormwater flows over the final cover of the SCRF. With a similar cover, there will be similar TSS levels. The height of the residual material will increase which will result in higher peak flows, which may cause additional TSS to be collected from the final cover during a storm event.

Surface Water Quantity - Change in Drainage Areas

The overall residual material drainage area is larger than the baseline condition and there will be a height increase. The area will be less permeable due to the increased area of residual material with the clay layer as part of the final cover. This will result in an increase in peak flows and runoff volume.

Surface Water Quantity - Occurrence and Degree of Off-site Effects

During the 2-year through 100-year storm events, uncontrolled flows from the SCRF (assuming there are no perimeter ditches or stormwater management pond to capture runoff) will produce a larger runoff volume than the baseline condition. There will also be an increase in peak flows due the height increase of the residual fill. The predicted increase in runoff volume is approximately 3% during the 2-year event and 2% during the 100-year event. Peak flows are expected to only increase by less than 1% during the 100-year event. The increased runoff volume will flow off-site which will cause increased peak flows and flow volumes in the roadside ditches and creeks within the local study area. There may also be erosion or flooding in these areas during larger storm events.

Mitigation

The addition of perimeter ditches that can convey up to the 100-year storm event will prevent any flows from leaving the site. A stormwater management pond with two forebays can be designed to treat the runoff to the required levels and to control the release of the 2-year- through 100-year storm events to pre-development levels. This will prevent erosion and flooding off-site and address any water quality issues.

The allocated SWM pond area is large enough to size a pond that can treat and control the site runoff. There may be some complications in the design of the pond due to the elevation difference between the residual material toe of slope and the elevations of the roads adjacent to the SWM pond. The berm separating the SWM pond from Green Mountain Road West and First Road West will need to be redesigned. Since the SWM pond will be built within the 30 m buffer area, the berm sloping from the SWM pond to the roads will take up more than half the width allocated for the pond, which will increase the design and construction constraints.

The pond design will include emergency shut-off valves so that stormwater will not be released into the storm sewer system below First Road West, which ultimately discharges into Davis Creek, if water quality testing determines that the water quality is not suitable for discharge. Contingency measures include “status quo", which is to discharge stormwater to the sanitary sewer for treatment at the City's water pollution control plant.

Net Effect

The SWM pond and perimeter ditches will be able to treat and control the runoff from the site to the same level as the current approved design. The SWM pond design may be more complicated than most standard ponds due to elevation differences and width restrictions in the buffer zone. Redesign of the berm separating the SWM pond from Green Mountain Road West and First Road West will be required.

4. Evaluation Results

Options 1, 3 and 5 have no net effects due to the allocated SWM pond areas being adequately sized to design and build functioning SWM ponds, while Options 2, 4 and 6 are ranked as low net effects due to the restrictive design and implementation requirements of the SWM pond. Perimeter ditches and a SWM pond with two forebays can mitigate all the effects to surface water caused by the various options.

There will be special considerations for the SWM pond in all the options due to the significant elevation drop from the residual/fill and the roads surrounding the SWM pond area. The berms will need to be carefully designed and constructed to ensure that the side walls of the pond do not fail.

The triangular pond layout from Options 1, 3 and 5 have no net effects and are preferred over the narrower "L" shaped layout from Options 2, 4 and 6, which were ranked as low net effects. This preference is due to the limitations and complications that may occur during the design and construction of the SWM pond in the "L" shaped layout within the buffer zone. The berm that will need to be constructed will utilize more than half the area allocated to constructing the SWM pond (conservatively estimated 30% compared to the conservative 50% assumed for the triangular SWM pond layout). This will be slightly more limiting and complex in design and construction that the triangular pond layout. For this reason, Options 1, 3 and 5 were ranked as tied for first since the design and construction of the SWM pond will cause less issues and complications. Options 2, 4 and 6 were therefore ranked as tied for second.

Draft Comparative Evaluation Methodology Narrative for Terrestrial & Aquatic Environment

Memorandum

Draft for Review

This document is in draft form. A final version of this document may differ from this draft. As such, the contents of this draft document shall not be relied upon. GHD disclaims any responsibility or liability arising from decisions made based on this draft document.

March 21, 2018 Reference No. 11102771

Subject: **Stoney Creek Regional Facility EA (Terrapure Environmental) – Draft Comparative Evaluation Methodology for Natural Environment**

1. Introduction

This memo documents the assessment and evaluation of the six landfill alternatives for the Stoney Creek Regional Facility (SCRF) Environmental Assessment (EA) from the Terrestrial and Aquatic Environment perspective. The Minister approved amended Terms of Reference (ToR) included a preliminary description of the methodology for evaluating the alternative methods (i.e., alternative landfill footprint options (See Section 7.1 of the approved amended ToR, November 2017)). This memo is one of 10 memos that outline the evaluation of the alternative landfill footprint options from the perspective of each discipline. These memos will be used in concert with one another, along with their evaluation tables, as supporting documents to the Alternative Methods Report. Memos were prepared for the following environmental components:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use and Economic;
- Atmospheric Environment (Air Quality and Odour);
- Atmospheric Environment (Noise);
- Human Health;
- Transportation;
- Archaeology and Built Heritage; and,
- Design and Operations.

Each of the above disciplines also prepared existing conditions reports that were utilized in assessing and evaluating the alternative landfill footprint options. Further, the disciplines referred to the Conceptual Design Report (CDR) that was prepared from a Site Design and Operations perspective in order to provide the appropriate level of detail on each of the alternative landfill footprints. The CDR will also form a supporting document to the Alternative Methods Report.

Each discipline is following the requirements as stated in the draft work plans that were presented in Appendix D of the approved amended ToR. The work plan presents the scope of work required to complete the EA, including the scope of technical studies for each of the environmental components, and the evaluation of alternative methods (alternative landfill footprints).

1.1 Documentation

The results of these individual memos will be documented in separate stand-alone technical memorandums during the EA. The final alternative methods evaluation will form a chapter of the EA Report with each of the stand-alone memorandums becoming supporting documents/appendices to the EA Report.

2. Assessment and Evaluation of the Alternative Landfill Footprint Options

2.1 Methodology

The assessment and evaluation of the alternative landfill footprints was conducted in three steps:

Step 1: Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during Open House events and confirmed for application to each of the landfill footprint alternatives. Evaluation criteria were developed for each Environmental Component listed above.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the 'alternative methods' (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out consisting of the following activities:

- Identify potential effects (based on measures) on the environment;
- Develop and apply avoidance/ mitigation/ compensation/ enhancement measures; and,
- Determine net effects on the environment.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another in order to identify a "recommended landfill footprint". The comparison of net effects was completed using a "Reasoned Argument" or "Trade-off" evaluation methodology, as provided for in the approved SCRF EA ToR.

Each alternative was assessed based on the evaluation criteria, indicators and measures.

Two criteria were evaluated with five indicators for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

- Effect on Terrestrial Ecosystems
    - Predicted impact on vegetation communities
    - Predicted impact on wildlife habitat
    - Predicted impact on vegetation and wildlife including rare, threatened or endangered species
- Effect on Aquatic Ecosystems
    - Predicted impact on aquatic habitat
    - Predicted impact on aquatic biota

3. Net Effects Analysis

3.1 Effect on terrestrial ecosystems

Through the Net Effects Analysis process, potential effects on terrestrial ecosystems were identified for all alternatives. This included:

- Temporary loss of existing vegetation communities (e.g., marsh, meadow, and thicket habitat) and associated wildlife habitat as a result of regrading activities and expansion into buffer areas (for Alternatives 2, 4 and 6).
- Temporary loss of approximately 13 ha of habitat of a threatened species (eastern meadowlark) in the dry-fresh graminoid meadow ecosite at the south and west portion of the Site.

No off-site impacts are anticipated as a result of any of the alternatives.

The effects were identified as 'Temporary' based on the assumptions that not all vegetated areas will be disturbed simultaneously and that habitats will be re-established on-site following landfill closure.

In order to mitigate these potential effects to terrestrial ecosystems, the following mitigation measures will be employed:

- Conduct any vegetation removal activities outside of the breeding bird window (i.e., no removals between late March - late August);
- Consult with MNRF to determine if there is a need for any registrations, permits or approvals related to the presence of eastern meadowlark to avoid contravention of the provincial *Endangered Species Act*. Incorporate graminoid meadow habitats into the closure landscape plan, managed for grassland birds; and,
- Compensation for the loss of vegetation communities could occur elsewhere on-site where there are areas that could be revegetated. Where possible, salvage plant material for restoration from areas where vegetation is removed.

Implement Best Management Practices (BMPs) that are recommended across all alternatives include the following:

- Use of dust suppressants;
- Installation of protective fencing (where required);
- Conduct a nest survey of on-Site facilities and infrastructure prior to relocation or removal of structures to mitigate impacts to bird species which may use anthropogenic structures for nesting. If nests are found, consult a biologist/MNRF for further direction;
- Any wildlife incidentally encountered during Site operation activities will not be knowingly harmed and will be allowed to move away from the area on its own;
- In the event that an animal encountered during Site operation activities does not move from the area, or is injured, the Site Supervisor, a biologist, and MNRF will be notified;
- In the event that the animal is a known or suspected SAR, the Site Supervisor will contact MNRF SAR biologists for advice; and,
- Include naturalized landscape features into the stormwater management facilities design (e.g., emergent robust vegetation, shallow slope).

With the implementation of these mitigation measures, net effects on terrestrial ecosystems are anticipated to be low.

3.2 Effect on aquatic ecosystems

Through the Net Effects Analysis process, potential effects on aquatic ecosystems were identified for all alternatives. This included:

- Loss of on-Site aquatic habitat and disturbance of aquatic biota associated with open water habitats in stormwater infrastructure due to regrading activities and modifications to stormwater ponds at the northwest corner of the Site (for Alternatives 2, 4 and 6).

No off-site impacts are anticipated as a result of any of the alternatives.

In order to mitigate these potential effects to aquatic ecosystems, the following mitigation measures will be employed:

- Characterize use of on-Site aquatic features by fish and wildlife prior to modification/removal. Obtain necessary permits for and complete fish/wildlife rescue activities prior to initiation of any in-water works, as appropriate.
- Install erosion and sediment control (ESC) measures to mitigate impacts to water quality and to act as wildlife exclusion fencing prior to construction, and maintain them appropriately throughout landfill construction and operation.

With the implementation of these mitigation measures, net effects on aquatic ecosystems are anticipated to below.

4. Evaluation Results

There is no distinction between the Alternatives in terms of their effects on the terrestrial and aquatic environment, as these options would not require a change to the landfilling footprint and existing criteria for operations and quality of discharge from the Site. All are preferred as they would all result in low net effects to the terrestrial and aquatic environment, following the implementation of the recommended mitigation measures. It should be noted though that Alternatives 2, 4 and 6 would result in additional loss of vegetation communities and associated wildlife habitat in buffer areas due to an expansion in landfilling footprint, and additional loss/disturbance of aquatic habitat and biota in the stormwater ponds at the northwest corner of the Site, however after the implementation of mitigation measures, the net effects would be equal for all alternatives.

Draft Comparative Evaluation Methodology Narrative for Land Use and Economic

Memorandum

Draft for Review

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March 21, 2018 Reference No. 11102771

Subject: **Stoney Creek Regional Facility EA (Terrapure Environmental) – Draft Comparative Evaluation Methodology Narrative for Land Use and Economic**

1. Introduction

This memo documents the assessment and evaluation of the six landfill footprint alternatives for the Stoney Creek Regional Facility (SCRF) Environmental Assessment (EA) from a Land Use and Economic perspective. The Minister approved amended Terms of Reference (ToR) included a preliminary description of the methodology for evaluating the alternative methods (i.e., alternative landfill footprint options (See Section 7.1 of the approved amended ToR, November 2017). This memo is one of 10 memos that outline the evaluation of the alternative landfill footprint options from the perspective of each discipline. These memos will be used in concert with one another, along with their evaluation tables, as supporting documents to the Alternative Methods Report. Memos were prepared for the following environmental components:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use and Economic;
- Atmospheric Environment (Air Quality and Odour);
- Atmospheric Environment (Noise);
- Human Health;
- Transportation;
- Archaeology and Built Heritage; and,
- Design and Operations.

Each of the above disciplines also prepared existing conditions reports that were utilized in assessing and evaluating the alternative landfill footprint options. Further, the disciplines referred to the Conceptual Design Report (CDR) that was prepared from a Site Design and Operations perspective in order to provide the appropriate level of detail on each of the alternative landfill footprints. The CDR will also form a supporting document to the Alternative Methods Report.

Each discipline is following the requirements as stated in the draft work plans that were presented in Appendix D of the approved amended ToR. The work plan presents the scope of work required to complete the EA, including the scope of technical studies for each of the environmental components, and the evaluation of alternative methods (alternative landfill footprints/option).

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1.1 Documentation

The results of these individual memos will be documented in separate stand-alone technical memorandums during the EA. The final alternative methods evaluation will form a chapter of the EA Report, with each of the stand-alone memorandums becoming supporting documents/appendices to the EA Report.

2. Assessment and Evaluation of the Alternative Landfill Footprint Options

2.1 Methodology

The assessment and evaluation of the alternative landfill footprints was conducted in three steps:

Step 1: Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during Open House events and confirmed for application to each of the landfill footprint alternatives. Evaluation criteria were developed for each Environmental Component listed above.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the 'alternative methods' (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out consisting of the following activities:

- Identify potential effects (based on measures) on the environment;
- Develop and apply avoidance/ mitigation/ compensation/ enhancement measures; and,
- Determine net effects on the environment.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another in order to identify a "recommended landfill footprint". The comparison of net effects was completed using a "Reasoned Argument" or "Trade-off" evaluation methodology, as provided for in the approved SCRF EA ToR.

Each alternative was assessed based on the evaluation criteria, indicators and measures.

Land Use and Economic criteria were evaluated with indicators for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

Land Use:

- Effect on existing land uses
    - Current land use
- Effect on views of the facility
    - Predicted changes in views of the facility from the surrounding area

Economic:

- Effect on approved/planned land uses
    - Number, extent, and type of approved/planned uses affected
- Economic Benefit to the City of Hamilton and Local Community
    - Employment at site (number and duration)

3. Net Effects Analysis – Land Use (Built Environment)

3.1 Net Effects Analysis – Existing Land Uses

The current land use of the SCRF is designated under the Urban Hamilton Official Plan and is designated as Open Space. The Site is currently zoned as ME-1 under City of Stoney Creek Zoning By-law No. 3692-92, which is a special designation that permits operations associated with non-hazardous waste from industrial, commercial and institutional sources. Land uses within 500 m of the Site and within the 1500 m Local Study Area are identified and consist of a mix of residential, commercial, institutional, recreational, and agricultural uses. For each of the alternatives, the environmental effects with respect to existing land uses are primarily the removal or loss of the existing land uses and their replacement with a waste management facility. There are no mitigation measures proposed with respect to the existing land use indicator; consequently, the potential and net effects are considered the same. Further detail is provided below.

Residential

The nearest existing residential dwelling is approximately 60 m south of the Site (across Mud Street). Approximately 1,200 existing residential units registered under a plan of subdivision post 1996 are located within 500 m of the Site. These residential properties are primarily located within the Urban Area, as identified in the Urban Hamilton Official Plan (2013). The majority of the existing residential uses within the Local Study Area are located south of the SCRF. Lands to the south consist of existing and proposed phases of the Penny Lane Estates subdivision. In accordance with the City of Hamilton's filed registered and draft approved plans of subdivision, there are approximately 6,800 residential units both existing and proposed within the preliminary Study Area. Of the approximate 6,800 residential units within the Local Study Area, approximately 5,800 (registered) residential units currently exist. All landfill footprint options do not physically extend or impede on the existing residential parcel fabric of the Local Study Area. As such, neighbouring residential uses to the site and within the Local Study Area are not subject to direct physical impact requiring alteration of land or change in land use or zoning.

Commercial

A cluster of 11 existing commercial properties resides within 500m of the Site, along the arterial roads along Upper Centennial Parkway and Mud Street towards Red Hill Valley Parkway (i.e., Gas station(s), Golf course, Restaurants, Mixed Use, etc.). The locations of these commercial properties are located in both the Urban Area and Rural Area, as identified in the Urban Hamilton Official Plan (2013). All landfill footprint options do not physically extend or impede on the potential use and/or operations of the 11 commercial facilities within 500m of the Site. As such, the 11 existing commercial facilities are not subject to direct physical impact requiring alteration of land or change in land use or zoning.

Recreational

Heritage Green Community Sports Park, Heritage Green Passive Park, and Heritage Green Community Trust Leash Free Dog Park reside within 500 m of the Site. All landfill footprint options do not physically extend or impede on the potential use and/or operations of the recreational facilities within 500 m. As such, these facilities are not subject to direct physical impact requiring alteration of land or change in land use or zoning.

Parks and recreational facilities located within the Local Study Area include Felker's Falls Conservation Area, Dofasco Park, Felker Park, Maplewood Park, and Maplewood Green Park. All landfill footprint options do not physically extend or impede on the potential use and/or operations of the recreational uses within the Local Study Area. As such, the recreational uses within the Local Study Area are not subject to direct physical impact requiring alternation of land or change in land use or zoning.

Institutional

Institutional uses within 500 m of the Site include St. James the Apostle Catholic Elementary School. This property is not subject to direct physical impact requiring alternation of land or change in land use or zoning.

The Local Study Area consists of 15 existing institutional uses, including primary and secondary schools, public facilities and community services. Institutional uses within the Local Study Area are not subject to direct physical impact requiring alternation of land or change in land use or zoning. As such, no net effects to the physical location of institutional uses resulting from the landfill footprint options considered are anticipated.

Agricultural

Four agricultural properties/parcels are located within 500 m of the Site and are located along Upper Centennial Parkway between Mud Street and Green Mountain Rd. and at the corner of Mud St. As per the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) soil classifications, the four agricultural properties consist of Class 1, 2, and 6 soils. Soil Classes 1 and 2 are described as moderately high to high productivity of common field crops. Soil class 6 is consistent with severe limitations to soil capabilities. All landfill footprint options do not physically extend or impede on the potential use and operations of the four agricultural properties within 500m of the Site. As such, no net effects to agricultural lands as a result of the landfill footprint options considered are anticipated.

A total of 41 additional properties within the Local Study Area are currently zoned for agricultural use, as in accordance with City of Hamilton Zoning By-law No. 05-200 and City of Stoney Creek Zoning By-law No. 3692-92. All landfill footprint options do not physically extend or impede on the potential use and operations of the agricultural properties within Local Study Area. As such, no net effects to agricultural lands within the Local Study Area as a result of the landfill footprint options considered are anticipated.

Existing Land Use Net Effects Summary and Mitigation

All landfill footprint options considered do not warrant a change to the existing land use designation or zoning designation of the Site and do not warrant a change to existing land use designations or zoning designations of the adjacent properties, properties and land uses within 500m, and properties and land uses within the Local Study Area. As such, no physical impact to properties or change in land use of properties within the Local Study Area are anticipated resulting from the potential implementation of the landfill footprint options considered.

Mitigation Measures are not required for existing land uses within the Local Study Area, since each landfill footprint option and relative 30 m buffer requirement is not anticipated to expand or impede on these properties. Mitigation measures would be established to manage any potential nuisance influenced by site operations of each landfill footprint options relative to noise, air quality (including odour), and traffic, as described in the Comparative Analysis Memos for noise, air quality, and traffic.

3.2 Net Effects Analysis – Views of the SCRF (Visual Perspectives)

Photographic renderings of the six options were developed (Attachment A) to show what each of the options would look like from various viewpoints. Photographic renderings of potential mitigation measures were developed for the Recommended Option (Attachment B), which demonstrate screening through the use of berms and vegetation. The viewpoints include:

- First Road West looking south
- Morrissey Blvd. looking south
- Green Mountain Rd. West looking south
- Green Mountain Rd. West and Centennial Parkway looking southwest
- First Rd. East Looking west
- Upper Centennial Parkway and Mud Street East looking northwest
- Trafalgar Drive Looking north
- Mud Street East and First Rd. West Looking northeast
- Heritage Green Community Trust Leash Free Dog Park looking east

The visual net effects analysis used these renderings to determine how the views of the facility might change.

Option 1 does not result in a height change, but a reconfiguration of the waste within the landfill. Views are therefore minimally affected by the reconfiguration. Application of visual screening and vegetation would mitigate the views and result in low effects.

Option 2 maintains the same height as the current approved design of the SCRF (baseline condition) but requires a change to the current footprint and the buffer areas are reduced to 30 m minimum. The change in footprint results in increased views of the facility from neighboring residential properties, as the residual material will be closer to the property boundary. Application of visual screening and vegetation would mitigate the views and result in low effects.

Option 3 maintains the same footprint area and buffer areas as the current SCRF (baseline condition), but results in a height increase of 12 m. From a visual perspective, a 12 m increase results in a noticeable change to the views of the facility from adjacent and surrounding properties in all directions. The residual material would be highly visible from all viewpoints. The installation of additional visual screens will help to mitigate some of the view, however, some views will still be visible particularly from adjacent residential properties along Mud Street and Green Mountain Road. Option 3 results in High Net Effects.

Option 4 maintains the same height as the current approved design of the SCRF (baseline condition) but requires a change to the current footprint and the buffer areas are reduced to 30 m minimum. The views of the facility are minimally affected by the reconfiguration and expansion. Application of visual screening and vegetation would mitigate the views and result in low effects.

Option 5 results in a small height increase of 2.5 m and reconfiguration, but maintains current buffers and footprint. The slight height increase will result in slight view change to the facility in all directions. However, the application of additional visual screens will mitigate the view. Application of visual screening and vegetation would mitigate the views and result in low effects.

Option 6 results in a height increase of 8 m, and the buffer areas are reduced to 30 m minimum. The height increase as well as changes to the current footprint will result in changes to views of the facility. The residual material will not only become closer to the property boundary, but will also become quite visible with an 8 m increase. The material will be visible from all directions, but particularly from adjacent properties. Installation of visual screens and added vegetation will mitigate views, but will not be able to mitigate all views. Option 6 results in a high change to the viewsheds analyzed.

Visual Net Effects Summary and Mitigation

In regards to visual impacts, it was determined that there would be varying levels of effects from the options. All of the Options will cause a change to view sheds from neighboring and adjacent properties. However, Options 3 and 6 will result in high effects as the height increases will be difficult to mitigate completely. A combination of earth berms, vegetation, and fences are established around the perimeter of the site to screen the views of the SCRF from the surrounding built-up areas. Installation of additional visual screening elements, such as adding additional vegetation or increasing the berm height would help to mitigate the view from surrounding areas. However, visual mitigation measures may not be able to sufficiently block or mitigate all changing views, particularly for Options 3 and 6.

4. Net Effects Analysis – Economic Environment

4.1 Net Effects Analysis – Approved/Planned Land Uses

Located within 500m of the Site are several planned residential and institutional uses. The net effects of the landfill footprint options considered on these planned land uses, relative to potential economic implications, is further assessed, as follows:

Residential

The closest residential dwelling (currently under construction) is located approximately 35 m north of the Site.

There are currently four draft approved plans of subdivision within the Local Study Area, as well as eight proposed plans of subdivision currently under municipal review, totaling approximately 2,100 future residential units to be developed within the Local Study Area. This includes a development application (ZAC-17-077) to re-zone 50 Green Mountain Road West from ND (Neighbourhood Development) to RM-3 (Multiple Residential). The effects on approved/planned and proposed residential uses within the Local Study Area is contingent on direct physical impact requiring alteration of land or change in land use or zoning required as a result of the landfill footprint options considered. However, all landfill footprint options considered, and relative 30 m buffer, do not physically extend or impede on planned residential uses. Therefore, no net effects to the physical location of planned residential uses resulting from the landfill footprint options considered are anticipated. Further, application of landfill operation best management practices and mitigation measures from other environmental components (i.e., noise, dust, traffic) will ensure there are no effects on future planned land uses.

Institutional

In accordance with the Nash Neighbourhood Secondary Plan, an institutional land use designation is present at the northwest corner of Green Mountain Road West and First Road West (435 First Road West). This land is reserved for the future development of a school (zoned Neighbourhood Institutional (I1), as approved by council on November 11, 2015, By-law No. 15-260); however, at this time the property is owned by a developer. All landfill footprint options do not physically extend or impede on the potential future use and/or operation of 435 First Road West. As such, no net effects to the physical location or site alteration of this property resulting from the options considered are anticipated. Further, application of landfill operation best management practices and mitigation measures from other environmental components (i.e., noise, dust, traffic) will ensure there are no effects on future planned land uses.

Approved/Planned Land Use Net Effects Summary and Mitigation

In regards to the economic indicators, specifically the potential effect on approved/planned land uses including; number, extent, and type of approved/planned land uses affected, all six of the alternative options result in no net effects. Landfill operation best management practices and mitigation measures, such as stormwater management pond, landfill liner system, dust and noise control measures will ensure potential effects to land uses are managed and mitigated. None of the presented landfill footprint options results in a change to proposed land uses within the site or local study area. Therefore, there are no net effects and no mitigation steps required for the approved/land use indicator.

Mitigation Measures are not required for approved/planned and/or proposed land uses within the Local Study Area, since each landfill footprint option and relative 30 m buffer requirement is not anticipated to expand or impede on these properties. Mitigation measures would be established to manage any potential nuisance influenced by site operations of each landfill footprint options relative to noise, air quality (including odour), and traffic, as described in the Comparative Analysis Memos for noise, air quality, and traffic.

4.2 Net Effects Analysis – Economic Benefits to the City of Hamilton and Local Community

Option 1 allows for an increase in capacity at the SCRF, but does not meet the economic opportunity for Terrapure. The economic benefits to the City and local community are low as the City and community compensation would be reduced based on the current $ per tonne agreements. Further, reduced expansion capacity would not allow for maximum economic activity as demonstrated through the economic analysis.[1] Employment opportunities at the site would be reduced (year over year) under Option 1 based on the reduced amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 180 years.

Option 2 allows for an increase in capacity at the SCRF, but does not meet the economic opportunity for Terrapure. The economic benefits to the City and local community are low as the City and community compensation would be reduced based on the current $ per tonne agreements. Further, reduced expansion capacity would not allow for maximum economic activity as demonstrated through the economic analysis (RIAS Inc). Employment opportunities at the site would be reduced (year over year) under Option 2 based on the reduced amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 170 years.

Option 3 allows for an increase in capacity at the SCRF and meets the economic opportunity for Terrapure to allow for a 3.68 million m^3 increase in capacity. Option 3 would result in total economic activity of $349 million to $372 million, with GDP from $218 million to $232 million. The economic benefits to the City and local community are high as the City and community compensation would be maintained and maximized based on the current $ per tonne agreements. Employment opportunities at the site would be increased (year over year) under Option 3 based on the increased amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 250 years.

Option 4 allows for an increase in capacity at the SCRF, but does meet the economic opportunity for Terrapure (slightly under the increase of 3.68 million m^3) Option 4 would result in total economic activity

[1] Economic Impacts of the Stoney Creek Regional Facility, RIAS Inc., 2017

similar to Options 3, 5 and 6 based on the total increase in capacity for post diversion solid, non-hazardous residual material. The economic benefits to the City and local community are high as the City and community compensation ($ per tonne) would be slightly lower than other options based on the total increase in capacity. Employment opportunities at the site would be increased (year over year) under Option 4 based on the increased amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 240 years.

Option 5 allows for an increase in capacity at the SCRF and meets the economic opportunity for Terrapure to allow for a 3.68 million m^3 increase in capacity. Option 5 would result in total economic activity of $349 million to $372 million, with GDP from $218 million to $232 million. The economic benefits to the City and local community are high as the City and community compensation would be maintained and maximized based on the current $ per tonne agreements. Employment opportunities at the site would be increased (year over year) under Option 5 based on the increased amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 250 years.

Option 6 allows for an increase in capacity at the SCRF and meets the economic opportunity for Terrapure to allow for a 3.68 million m^3 increase in capacity. Option 6 would result in total economic activity of $349 million to $372 million, with GDP from $218 million to $232 million. The economic benefits to the City and local community are high as the City and community compensation would be maintained and maximized based on the current $ per tonne agreements. Employment opportunities at the site would be increased (year over year) under Option 6 based on the increased amount of employees required for the amount of residual material that this Option could be expanded by. Staffing requirements would be 15 full-time equivalents on site while the total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 250 years.

Economic Net Effects Summary

In regards to the potential economic benefit to the City of Hamilton and local community, specifically in regards to total economic activity, city and community compensation and employment at the site, all of the options presented result in positive effects. An economic impact assessment was completed in 2017 (RIAS Inc.) regarding the reconfiguration and vertical expansion of the SCRF and the potential output to the local economy. Based on the historical fill rate, it was determined that the current SCRF site generates $28.7 million in economic activity in the Hamilton area, adding 17.9 million in GDP and 51 jobs for local workers. Based on the current configuration and remaining lifespan, the SCRF will generate between $94 and $104 million in total economic activity and 164 to 190 local jobs. It was concluded in the assessment that if an expansion of 3.68 million m^3 of residual material was approved, total economic activity is expected to range between $349 and $372 million, with GDP from $218 million to $232 million and an estimated total jobs between 662 and 671 (RIAS Inc., 2017). Further, the options that allow for Terrapure to realize the economic opportunity for the SCRF (i.e., increase the capacity by 3.68 million m^3) would ensure maximum return with respect to the compensation agreements ($ per tonne). Based on the above estimated figures, it was determined that Options 3,5 and 6 result in high positive effects as the option allows for potential capacity of 3.68 million m^3 of residual material. Option 1, 2 and 4 were ranked as having medium positive effects because although they will result in increased residual material, they would not yield the 3.68 million m^3 of residual material and therefore would yield a lower overall economic benefit and would result in fewer jobs.

Mitigation Measures are not applicable to the relative economic benefits of each landfill footprint option.

5. Evaluation Results

5.1 Land Use (Built Environment)

All options tie or are preferred from a current land use perspective, as no change or effects to the current land use both on site and to surrounding properties. From a visual perspective, Options 1,2,4 and 5 are tied for 1st (preferred) as they will result in minor visual effects.

5.2 Economic Environment

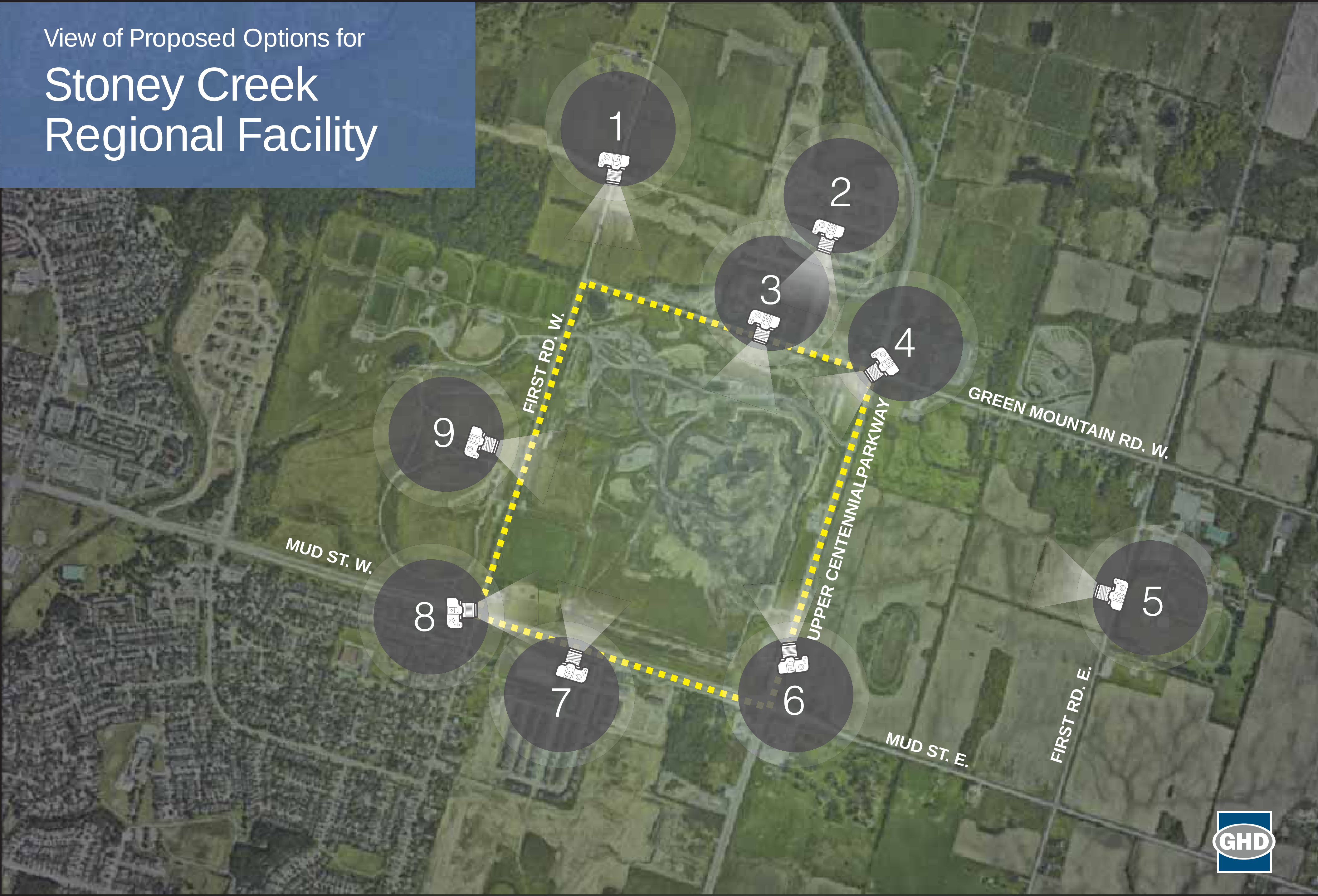
Option 3, 5 and 6 are ranked as the preferred options (tied for 1st) from an Economic perspective, since all options yield positive economic effects on the City of Hamilton and local community.

Overall, based on comparative analysis Option 5 is ‘preferred’ for its high economic benefits, since Options 3 and 6 are not preferred due to their net negative visual impact.

Attachment A
Photographic Renderings of the Six Options

View of Proposed Options for

Stoney Creek Regional Facility



Location 1

First Road West Looking South

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Location 1

First Road West Looking South

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Location 2

Morrissey Boulevard Looking South

Location 2

Morrissey Boulevard Looking South

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Location 3

Green Mountain Road West Looking South

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6

Location 3

Green Mountain Road West Looking South

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Location 3

Green Mountain Road West Looking South

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Green Mountain Road West and Centennial Parkway Looking Southwest

Location 4

Green Mountain Road West and Centennial Parkway Looking Southwest

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Green Mountain Road West and Centennial Parkway Looking Southwest

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Location 4 — Green Mountain Road West and Centennial Parkway Looking Southwest

Location 4

Green Mountain Road West and Centennial Parkway Looking Southwest

Location 5

First Road East Looking West

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Upper Centennial Parkway and Mud Street East Looking Northwest

Upper Centennial Parkway and Mud Street East Looking Northwest

Location 6

Upper Centennial Parkway and Mud Street East Looking Northwest

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Location 8

Mud Street East and First Road West Looking Northeast

Mud Street East and First Road West Looking Northeast

Location 8

Mud Street East and First Road West Looking Northeast

Location 8

Mud Street East and First Road West Looking Northeast

Location 8

Mud Street East and First Road West Looking Northeast

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Location 9

Heritage Green Community Trust Leash Free Dog Park Looking East

Location 9

Heritage Green Community Trust Leash Free Dog Park Looking East

Heritage Green Community Trust Leash Free Dog Park Looking East

Heritage Green Community Trust Leash Free Dog Park Looking East

Heritage Green Community Trust Leash Free Dog Park Looking East

Location 9

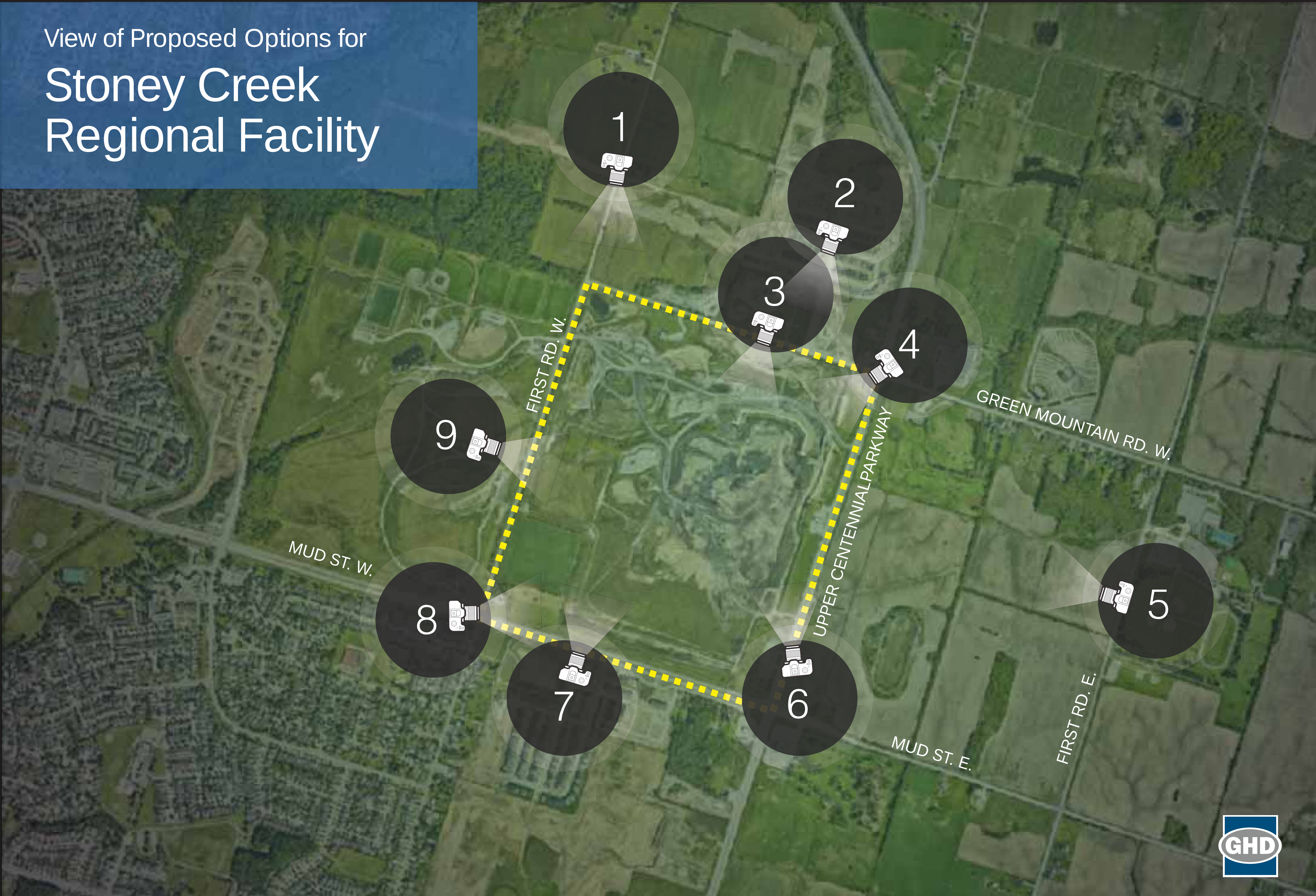
Heritage Green Community Trust Leash Free Dog Park Looking East

Existing View | Existing Approved | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 | HOME

Attachment B
Photographic Renderings of Potential Mitigation Measures for Option 5

View of Proposed Options for

Stoney Creek Regional Facility



Draft Comparative Evaluation Methodology Narrative for Air Quality and Odour

Memorandum

Draft for Review

This document is in draft form. A final version of this document may differ from this draft. As such, the contents of this draft document shall not be relied upon. GHD disclaims any responsibility or liability arising from decisions made based on this draft document.

March 21, 2018 Reference No. 11102771

Subject: Stoney Creek Regional Facility EA (Terrapure Environmental) – Draft Comparative Evaluation Methodology for Air Quality

1. Introduction

This memo documents the assessment and evaluation of the six landfill alternatives for the Stoney Creek Regional Facility (SCRF) Environmental Assessment (EA) from the Atmospheric Environment (Air Quality, and Odour) perspective. The Minister approved amended Terms of Reference (ToR) included a preliminary description of the methodology for evaluating the alternative methods (i.e., alternative landfill footprint options (See Section 7.1 of the approved amended ToR, November 2017)). This memo is 1 of 10 memos that outline the evaluation of the alternative landfill footprint options from the perspective of each discipline. These memos will be used in concert with one another, along with their evaluation tables, as supporting documents to the Alternative Methods Report. Memos were prepared for the following environmental components:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use and Economic;
- Atmospheric Environment (Air Quality and Odour);
- Atmospheric Environment (Noise);
- Human Health;
- Transportation;
- Archaeology and Built Heritage; and,
- Design and Operations.

Each of the above disciplines also prepared existing conditions reports that were utilized in assessing and evaluating the alternative landfill footprint options. Further, the disciplines referred to the Conceptual Design Report (CDR) that was prepared from a Site Design and Operations perspective, in order to provide the appropriate level of detail on each of the alternative landfill footprints. The CDR will also form a supporting document to the Alternative Methods Report.

Each discipline is following the requirements as stated in the draft work plans that were presented in Appendix D of the approved amended ToR. The work plan presents the scope of work required to complete the EA, including the scope of technical studies for each of the environmental components, and the evaluation of alternative methods (alternative landfill footprints).

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1.1 Documentation

The results of these individual memos will be documented in separate stand-alone technical memorandums during the EA. The final alternative methods evaluation will form a chapter of the EA Report, with each of the stand-alone memorandums becoming supporting documents/appendices to the EA Report.

2. Assessment and Evaluation of the Alternative Landfill Footprint Options

2.1 Methodology

The assessment and evaluation of the alternative landfill footprints was conducted in three steps:

Step 1: Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during Open House events and confirmed for application to each of the landfill footprint alternatives. Evaluation criteria were developed for each Environmental Component listed above.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the 'alternative methods' (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public, to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out consisting of the following activities:

- Identify potential effects (based on measures) on the environment;
- Develop and apply avoidance/ mitigation/ compensation/ enhancement measures; and
- Determine net effects on the environment.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another, in order to identify a "recommended landfill footprint". The comparison of net effects was completed using a "Reasoned Argument" or "Trade-off" evaluation methodology, as provided for in the approved SCRF EA ToR.

Each alternative was assessed based on the evaluation criteria, indicators and measures.

Atmospheric Environment criteria were evaluated with indicators for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

- Effect of Air Quality on Off-Site Receptors
  - Predicted off-site point of impingement concentrations of particulate matter size fractions
- Effect of Odours on Off-Site Receptors
  - Predicted off-site point of impingement concentrations of volatile organic compounds

Assumptions comprised in the assessment for each indicator include the following, for each alternative:

- Air Quality
  - Predicted concentrations of three size fractions of particulate matter (TSP, PM_{10} and $PM_{2.5}$) at off-site receptors compared to the Ministry of Environment and Climate Change (MOECC) Point of Impingement Standards and Ambient Air Quality criteria (for 24-hour and annual averaging periods).
  - Likelihood of predicted concentrations of the particulates to be similar to, greater than, or less than the concentrations resulting from the currently approved plan for the Facility.
  - Location and extent of potentially affected off-site receptors.
  - The maximum permitted 250 trucks per day was assumed for all alternative landfill footprints – this is highly conservative, as the vehicle movements on-site are typically half. This was used as a starting point and will be refined during the impact assessment stage, in concert with mitigation measures to more realistic and current truck per day movements.
- Odour
  - Predicted concentrations of volatile and semi-volatile compounds present in the impacted leachate (such as benzene, toluene, xylenes and others which are odourous).
  - Likelihood of predicted concentrations of odourous species to be similar to, greater than, or less than the concentrations resulting from the currently approved plan for the Facility.
  - Location and extent of potentially affected off-site receptors.

3. Net Effects Analysis

3.1 Assessment Assumptions

The following assumptions were made for the emissions estimates and dispersion modelling:

- All numerical modelling was carried out using the U.S. EPA AERMOD model (v. 16216r, for the inclusion of annual averages), and MOECC-provided terrain and meteorological data for the vicinity of the Facility.
- Operational hours of the landfill are from 7 AM to 5 PM (10 hours per day).
- A single footprint and elevation was assessed for each alternative. Elevations were assumed to conform to final (maximum) elevations.

- Unpaved roads were assumed for all scenarios.
- The maximum permitted 250 trucks per day was assumed for all alternative landfill footprints – this is highly conservative, as the vehicle movements on-site are typically half. This was used as a starting point and will be refined during the impact assessment stage, in concert with mitigation measures to more realistic and current truck per day movements.
- The active area was assumed to be within the area defined by the proposed haul route for each alternative.
- Material handling was assumed to consist of drop operations, as 250 trucks per day unloaded their waste; and earth moving/bulldozing of the waste material into the working area – this is highly conservative, as the vehicle movements on-site are typically half. This was used as a starting point and will be refined during the impact assessment stage, in concert with mitigation measures to more realistic and current truck per day movements
- The annual average was assessed assuming maximum daily operations at the site, 365 days per year – this is a **conservative estimate**, as the site's ECA allows for normal operating hours from Monday to Friday only (The ECA explicitly states that the site shall be closed on weekends and statutory holidays).
- Odour emissions were assumed to be mostly originating from the leachate pumping station, where pre-treated leachate is brought to the surface for treatment, prior to be being pumped back underground, and diverted to holding areas or the municipal sanitary sewer.

These assumptions are **highly conservative**, and take into account Best Management Practices (BMP), but will require more specific mitigation measures at the impact assessment stage (discussed further in Section 3.2), and so a qualitative analysis has been undertaken, comparing the worst-case for each option. It is understood that a refinement to the existing customized BMP for dust mitigation will be required for the Facility, which will ensure suitable and appropriate mitigation is implemented to allow the Facility to operate within MOECC guidelines.

The greatest differences between the various alternative scenarios consisted of the location and length of the on-site haul route and the final elevation of the landfill. Two alternatives also included the addition of a second pre-treatment leachate pumping station, potentially affecting the emission of odourous compounds.

3.2 Preliminary Results

Under short-term worst-case (maximum) operating conditions, with minimum dust mitigation, predicted off-site concentrations of particulate species (TSP, PM_{10}, and $PM_{2.5}$) were predicted to exceed existing AAQC or POI standards at one or more off-site receptors for all options. Once a recommended option is selected, more detailed and specific mitigation measures will be designed, in order for the Facility to meet MOECC air quality criteria. Mitigation measures and effectiveness will be determined based on the recommended alternative, and will maintain existing BMPs, as well as other options including:

- Paving on-site haul roads
- Road cleaning (watering, application of calcium chloride or other dust suppressants)

- Re-routing on-site haul roads so they are further from the site fenceline
- Limiting vehicle speeds on on-site roads
- Reviewing the number of vehicles accessing the site on a daily basis
- Detailed assessment of the progression of the site operations for the preferred alternative
- Other options as identified during the design of the preferred option.

Based on the identified mitigation required for the preferred option, a refined Dust Management Plan will be developed and implemented at the Facility.

From an odour perspective, there is little difference between the identified options for this site. The addition of a second leachate pumping station at the opposite side of the site may potentially reduce some odours, because pre-treatment leachate will be split between the two pumping stations. Odours are not anticipated to change significantly between the proposed options and currently approved operations. Odour mitigation measures currently implemented at the site will be required to be adequately maintained and operated in order for the Facility to meet MOECC odour guidelines.

Through application of the BMP mitigation measures as described above, effects to Air Quality for all six Options can be mitigated to acceptable MOECC requirements, and no effects to odour is expected.

4. Evaluation Results

From an atmospheric environment perspective, the Facility will be required to meet MOECC criteria for air quality and odour. Through the implementation of effective and best practice mitigation measures, the Facility will operate in accordance with MOECC criteria for air quality. All six Options are tied for 1st, as the mitigation measures will reduce off-site exceedances to acceptable and approvable levels, and all Options can be mitigated to meet MOECC criteria.

Draft Comparative Evaluation Methodology Narrative for Noise

Memorandum

Draft for Review

This document is in draft form. A final version of this document may differ from this draft. As such, the contents of this draft document shall not be relied upon. GHD disclaims any responsibility or liability arising from decisions made based on this draft document.

March 21, 2018 Reference No. 11102771

Subject: **Stone Creek Regional Facility EA (Terrapure Environmental) – Draft Comparative Evaluation Methodology for Atmospheric Environment (Noise)**

1. Introduction

This memo documents the assessment and evaluation of the six landfill alternatives for the Stoney Creek Regional Facility (SCRF) Environmental Assessment (EA) from the Atmospheric Environment (Noise) perspective. The Minister approved amended Terms of Reference (ToR) included a preliminary description of the methodology for evaluating the alternative methods (i.e., alternative landfill footprint options (See Section 7.1 of the approved ToR, November 2017)). This memo is one of 10 memos that outline the evaluation of the alternative landfill footprint options from the perspective of each discipline. These memos will be used in concert with one another, along with their evaluation tables, as supporting documents to the Alternative Methods Report. Memos were prepared for the following environmental components:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use and Economic;
- Atmospheric Environment (Air Quality and Odour);
- Atmospheric Environment (Noise)
- Human Health;
- Transportation;
- Archaeology and Built Heritage; and,
- Design and Operations.

Each of the above disciplines also prepared existing conditions reports that were utilized in assessing and evaluating the alternative landfill footprint options. Further, the disciplines referred to the Conceptual Design Report (CDR) that was prepared from a Site Design and Operations perspective in order to provide the appropriate level of detail on each of the alternative landfill footprints. The CDR will also form a supporting document to the Alternative Methods Report.

Each discipline is following the requirements as stated in the draft work plans that were presented in Appendix D of the approved amended ToR. The work plan presents the scope of work required to complete the EA, including the scope of technical studies for each of the environmental components, and the evaluation of alternative methods (alternative landfill footprints).

1.1 Documentation

The results of these individual memos will be documented in separate stand-alone technical memorandums during the EA. The final alternative methods evaluation will form a chapter of the EA Report, with each of the stand-alone memorandums becoming supporting documents/appendices to the EA Report.

2. Assessment and Evaluation of the Alternative Landfill Footprint Options

2.1 Methodology

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Step 1: Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during Open House events and confirmed for application to each of the landfill footprint alternatives. Evaluation criteria were developed for each Environmental Component listed above.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the 'alternative methods' (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public to ensure that an appropriate level of scrutiny and rigor was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out consisting of the following activities:

- Identify potential effects (based on measures) on the environment;
- Develop and apply avoidance/ mitigation/ compensation/ enhancement measures; and,
- Determine net effects on the environment.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another in order to identify a "recommended landfill footprint". The comparison of net effects was completed using a "Reasoned Argument" or "Trade-off" evaluation methodology, as provided for in the approved SCRF EA ToR.

Each alternative was assessed based on the evaluation criteria, indicators and measures.

Two sets of criteria were evaluated with associated indicators for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

- Modelled Noise Level at Off-site Receptors
  - Predicted off-site noise level compared to the respective limit and existing conditions
  - Number of off-site receptors potentially affected (residential properties, public facilities, businesses, and institutions)
- Noise Mitigation Measures Required
  - Type, size and extent of noise mitigation required
  - Number of off-site receptors that require noise mitigation to show compliance with noise limits

3. Net Effects Analysis

This section documents the net effects assessment for the Alternative Methods from a Noise perspective.

3.1 General Assumptions

The worst-case equipment locations were selected based on proximity and elevated line-of-sight exposure to the off-site residential dwellings. The worst-case elevation was selected based on landfill cell development and the corresponding topography detail.

The analysis also accounts for the potential residential development on the residentially zoned vacant lots to the north and the agricultural zoned lot to the East which allows a single detached dwelling to be built.

3.2 Potential Environmental Effects and Mitigation Measures Beyond Those Incorporated into the Design

Up to 75 off-site residential dwellings located in the Study Area will be potentially impacted by noise from the landfill activities. The predicted noise impacts at the residential areas range from 40 to 59 dBA (rounded). The existing and potential residences near the northwest corner of the landfill are the most impacted, as they are either approaching or exceeding the 55 dBA daytime noise limit for the six landfill design Alternatives.

From a potential noise impact exposure perspective, Alternative Methods 1, 2 and 4 are nearly identical, as the final landfill height is similar to existing conditions as discussed below. However, the now shortened separation distance from Site activities to adjacent residential areas, due to the expansion will result in a potential change to the line-of-sight noise impact exposure for the off-site residential dwellings.

The increased height of the final landfill in addition to the shortened separation distances to residential areas for Alternative Methods 3, 5 and 6 will result in a potential changes to the line-of-sight noise impact exposure to the off-site residential dwellings.

Landfill activities and on-site operations are compared directly against a daytime one-hour Leq sound level limit of 55 dBA for landfill operations that are limited to 7 a.m. to 7 p.m. under the MOECC "Noise Guidelines for Landfill Sites" (N-1).

In order to meet the noise limit, the north property line berm height needs to be constructed at an appropriate height to block the line of sight to the residential areas to the north. The required height of the berm varies between 7 and 10 m above the base landfill elevations.

3.2.1 Alternative Method 1

Potential change to the predicted off-site noise impacts occur due to increased line-of-sight, due to the landfill reconfiguration associated with Alternative Method 1 and the decrease in the separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 7 m above existing base elevations (199m ASL to 207m ASL).

3.2.2 Alternative Method 2

Potential changes to the predicted off-site noise impacts occur due to the Footprint Expansion associated with Alternative Method 2 and the decrease in the separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 10 m above existing base elevations (203m ASL to 210m ASL).

3.2.3 Alternative Method 3

Potential changes to the predicted off-site noise impacts occur due increased line-of-sight due to the elevation change associated with Alternative Method 3 and the decrease in the separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 7 m above existing base elevations (200m ASL to 207m ASL).

3.2.4 Alternative Method 4

Potential changes to the predicted off-site noise impacts occur due to the Reconfiguration and Footprint Expansion associated with Alternative Method 4 and the decrease in the separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 9 m above existing base elevations (201m ASL to 208m ASL).

3.2.5 Alternative Method 5

Potential changes to the predicted off-site noise impacts occur due increased line-of-sight from the elevation change associated with Alternative Method 5 and the decrease in the separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 8 m above existing base elevations (201m ASL to 208m ASL).

3.2.6 Alternative Method 6

Potential changes to the predicted off-site noise impacts occur due increased line-of-sight from the elevation change associated with Alternative Method 6 and the decrease in separation distance between the landfill activities and the adjacent residential properties.

Potential noise mitigation measures include berms at the landfill perimeter to the north. The height of barriers and/or berm are required to be an additional 9 m above existing base elevations (202m ASL to 209m ASL).

4. Evaluation Results

The Minister approved ToR states that the comparative evaluation of the Alternative Methods will be carried out using a “Reasoned Argument” or “trade-off” method, with evaluation criteria as the basis for comparison. Under the Reasoned Argument approach, the differences in the net effects associated with each Alternative Method are highlighted in the Comparative Evaluation Table. Based on these differences, the advantages and disadvantages of each alternative can be identified according to the evaluation of trade-offs between the various evaluation criteria and indicators.

Each Alternative Method is compared against the others to distinguish relative differences in impacts to the environment, taking into account possible mitigation measures. The mitigation measure considered in this assessment are building a barrier on top of the future built screening berm at landfill perimeter at the North of the landfill perimeter. The most preferred Alternative Method would require the lowest barrier height, shortest horizontal length and have the furthest separation distance between landfill activities and nearest sensitive receptor resulting in the lowest worst-case sound level.

All of the alternatives can achieve the required noise limits. The construction of a berm along the north property line will effectively shield the residences to the north. The height of the berm is dependent on the alternative and the final detailed design put forward for approval.

Draft Comparative Evaluation Methodology Narrative for Human Health

Memorandum

Draft for Review

This document is in draft form. A final version of this document may differ from this draft. As such, the contents of this draft document shall not be relied upon. GHD disclaims any responsibility or liability arising from decisions made based on this draft document.

March 21, 2018 Reference No. 11102771

Subject: Stoney Creek Regional Facility EA (Terrapure Environmental) – Draft Comparative Evaluation Methodology for Human Health

1. Introduction

This memo documents the assessment and evaluation of the six landfill alternatives for the Stoney Creek Regional Facility (SCRF) Environmental Assessment (EA) from a Human Health perspective. The Minister approved amended Terms of Reference (ToR) included a preliminary description of the methodology for evaluating the alternative methods (i.e., alternative landfill footprint options (See Section 7.1 of the approved amended ToR, November 2017)). This memo is 1 of 10 memos that outline the evaluation of the alternative landfill footprint options from the perspective of each discipline. These memos will be used in concert with one another, along with their evaluation tables, as supporting documents to the Alternative Methods Report. Memos were prepared for the following environmental components:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use and Economic;
- Atmospheric Environment (Air Quality and Odour);
- Atmospheric Environment (Noise);
- Human Health;
- Transportation;
- Archaeology and Built Heritage; and,
- Design and Operations.

Each of the above disciplines also prepared existing conditions reports that were utilized in assessing and evaluating the alternative landfill footprint options. Further, the disciplines referred to the Conceptual Design Report (CDR) that was prepared from a Site Design and Operations perspective in order to provide the appropriate level of detail on each of the alternative landfill footprints. The CDR will also form a supporting document to the Alternative Methods Report.

Each discipline is following the requirements as stated in the draft work plans that were presented in Appendix C of the approved ToR. The work plan presents the scope of work required to complete the EA, including the scope of technical studies for each of the environmental components, and the evaluation of alternative methods (alternative landfill footprints).

1.1 Documentation

The results of these individual memos will be documented in separate stand-alone technical memorandums during the EA. The final alternative methods evaluation will form a chapter of the EA Report, with each of the stand-alone memorandums becoming supporting documents/appendices to the EA Report.

2. Assessment and Evaluation of the Alternative Landfill Footprint Options

2.1 Methodology

The assessment and evaluation of the alternative landfill footprints was conducted in three steps:

Step 1: Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during the first Open House and confirmed for application to each of the landfill footprint alternatives. Evaluation criteria were developed for each Environmental Component listed above.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the ‘alternative methods’ (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out consisting of the following activities:

- Predict impacts to air quality and their potential effects on Human Health;
- Predict effects of leachate quality (inorganic and organic chemicals) on Human Health;
- Predict impacts to groundwater quality and their potential effects on Human Health;
- Predict impacts to surface water quality and their potential effects on Human Health; and,
- Predict impacts to soil and their potential effects on Human Health.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another, in order to identify a “recommended landfill footprint”. The comparison of net effects was completed using a “Reasoned Argument” or “Trade-off” evaluation methodology, as provided for in the approved SCRF EA ToR.

Each alternative was assessed based on the evaluation criteria, indicators and measures.

Five criteria were evaluated for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

- Effect on Air Quality
  - Predict impacts to air quality and their potential effects on Human Health
- Effect of Leachate Quality
  - Predict effects of leachate quality (inorganic and organic chemicals) on Human Health
- Effect on Groundwater Quality
  - Predict impacts to groundwater quality and their potential effects on Human Health
- Effect on Surface Water Quality
  - Predict impacts to surface water quality and their potential effects on Human Health
- Effect on Soil Quality
  - Predict impacts to soil and their potential effects on Human Health

3. Net Effects Analysis

Information from the Air Quality, Surface Water, and Hydrogeology analyses were used to provide data for the net effect analysis related to Human Health impacts.

The changes for each of the options are discussed in further detail below.

3.1 Option 1 - Reconfiguration

Option 1 maintains the same footprint and height as the current approved design of the SCRF (baseline condition). The area at the SCRF currently approved for receiving industrial fill would be replaced with post-diversion solid, non-hazardous industrial residual material. As a result, the SCRF would no longer be approved to receive industrial fill.

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (i.e., 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations. Standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

Marginal increase in larger particulate size fractions (i.e., PM10) compared to the existing approved landfill design with the potential for transient short-term health concerns. All of the other criteria do not result in any net effects when compared to the existing approved landfill design.

3.2 Option 2 - Footprint Expansion

Option 2 maintains the same height as the current approved design of the SCRF (baseline condition) and the SCRF will continue to receive industrial fill. The area at the SCRF currently approved for receiving industrial fill would remain unchanged. Therefore, the SCRF would still be approved to receive industrial fill with this option. The areas at the SCRF not currently approved for receiving either industrial fill or residual material would be expanded into so that they would be able to receive post-diversion solid, non-hazardous industrial residual material. A minimum 30 m buffer would be established around the entire area for receiving industrial fill or post-diversion solid, non-hazardous industrial residual material.

Therefore, this option would include a horizontal expansion, but not a vertical expansion – with the peak height currently approved would remain unchanged.

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (i.e., 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations. Standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

Marginal increase in larger particulate size fractions (i.e., PM10) compared to the existing approved landfill design with the potential for transient short-term health concerns. All of the other criteria do not result in any net effects when compared to the existing approved landfill design.

3.3 Option 3 - Height Increase

Option 3 maintains the same footprint area as the current approved design of the SCRF (baseline condition). The SCRF will continue to receive both industrial fill and residual material. The area at the SCRF currently approved for receiving residual material would be expanded vertically so that additional post-diversion solid, non-hazardous industrial residual material could be received. Therefore, this option would not include a horizontal expansion, but would include a vertical expansion, increasing the overall height of the area currently approved to receive post-diversion solid, non-hazardous industrial residual material.

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of the PM10 and PM2.5 size fractions would be marginally higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that standard mitigative measures be employed to minimize dust generation, as well as standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

No predicted net effects when compared to existing approved landfill design.

3.4 Option 4 - Reconfiguration and Footprint Expansion

Option 4 maintains the same height as the current approved design of the SCRF (baseline condition) and the SCRF will no longer receive industrial fill. The currently approved area at the SCRF for receiving industrial fill would be replaced with post-diversion solid, non-hazardous industrial residual material. In addition, the areas at the SCRF not currently approved for receiving either industrial fill or residual material would be expanded into so that they would be able to receive post-diversion solid, non-hazardous industrial residual material.

A minimum 30 m buffer would be established around the entire area for receiving post-diversion solid, non-hazardous industrial residual material. Therefore, this option would include a horizontal expansion, but would not include a vertical expansion, with the peak height currently approved remaining unchanged.

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (i.e., 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations. Standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

Marginal increase in larger particulate size fractions (i.e., PM10) compared to the existing approved landfill design with the potential for transient short-term health concerns. All of the other criteria do not result in any net effects when compared to the existing approved landfill design.

3.5 Option 5 - Reconfiguration and Height Increase

Option 5 maintains the same footprint area as the current approved design of the SCRF (baseline condition) but there will be an increase in height. SCRF will no longer receive industrial fill so the area currently approved for industrial fill will be used for residual material. The entire area at the SCRF currently approved for receiving either industrial fill or post-diversion solid, non-hazardous industrial residual material would be expanded vertically so that additional residual material could be received.

A minimum 30 m buffer would be established around the entire area for receiving post-diversion solid, non-hazardous industrial residual material. Therefore, this option would not include a horizontal expansion, but would include a vertical expansion, with the peak height currently approved being increased.

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (i.e., 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations. Standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

Marginal increase in larger particulate size fractions (i.e., PM10) compared to the existing approved landfill design with the potential for transient short-term health concerns. All of the other criteria do not result in any net effects when compared to the existing approved landfill design.

3.6 Option 6 - Footprint Expansion and Height Increase

Option 6 provides an increase in footprint and height from the current approved design of the SCRF (baseline condition). The SCRF will continue to receive industrial fill. The area at the SCRF currently approved for receiving post-diversion solid, non-hazardous industrial residual material would be expanded vertically, and the areas at the SCRF not currently approved for receiving either industrial fill or post-diversion solid, non-hazardous industrial residual material would be expanded into so that they would be able to receive post-diversion solid, non-hazardous industrial residual material.

A minimum 30 m buffer would be established around the entire area for receiving industrial fill or post-diversion solid, non-hazardous industrial residual material. Therefore, this option would include both horizontal and vertical expansions, thus increasing the currently approved peak height.

Air Quality

Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design.

Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (i.e., 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.

Leachate Quality

As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.

Groundwater Quality

Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.

Surface Water Quality

Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.

Soil Quality

Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations, based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.

Mitigation

It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations. Standard planned leachate treatment and management is required to prevent direct exposure to leachate. Finally, continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines to prevent soil quality impacts over the lifetime of the landfill.

Net Effect

Marginal increase in larger particulate size fractions (i.e., PM10) compared to the existing approved landfill design with the potential for transient short-term health concerns. All of the other criteria do not result in any net effects when compared to the existing approved landfill design.

4. Evaluation Results

All of the options, except Option 3, have low net effects due to a marginal increase in larger airborne particulate size fractions (i.e., PM10) modelled in the surrounding community compared to the existing approved landfill design with the potential for transient short-term health concerns. Option 3 did not have this concern. However, it is expected that these predicted exceedances are due to conservatism built into the Air Quality assessment.

Based on these results, Option 3 would be ranked 1st, with all of the other options collectively ranked 2nd, marginally behind Option 3.

Draft Comparative Evaluation Methodology Narrative for Transportation

Memorandum

Draft for Review

This document is in draft form. A final version of this document may differ from this draft. As such, the contents of this draft document shall not be relied upon. GHD disclaims any responsibility or liability arising from decisions made based on this draft document.

March 21, 2018 Reference No. 11102771

Subject: **Stoney Creek Regional Facility EA (Terrapure Environmental) – Draft Comparative Evaluation Methodology for Transportation**

1. Introduction

This memo documents the assessment and evaluation of the six landfill alternatives for the Stoney Creek Regional Facility (SCRF) Environmental Assessment (EA) from the transportation perspective. The Minister approved amended Terms of Reference (ToR) included a preliminary description of the methodology for evaluating the alternative methods (i.e., alternative landfill footprint options (See Section 7.1 of the approved amended ToR, November 2017)). This memo is one of 10 memos that outline the evaluation of the alternative landfill footprint options from the perspective of each discipline. These memos will be used in concert with one another, along with their evaluation tables, as supporting documents to the Alternative Methods Report. Memos were prepared for the following environmental components:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use and Economic;
- Atmospheric Environment (Air Quality and Odour);
- Atmospheric Environment (Noise);
- Human Health;
- Transportation;
- Archaeology and Built Heritage; and,
- Design and Operations.

Each of the above disciplines also prepared existing conditions reports that were utilized in assessing and evaluating the alternative landfill footprint options. Further, the disciplines referred to the Conceptual Design Report (CDR) that was prepared from a Site Design and Operations perspective in order to provide the appropriate level of detail on each of the alternative landfill footprints. The CDR will also form a supporting document to the Alternative Methods Report.

Each discipline is following the requirements as stated in the draft work plans that were presented in Appendix D of the approved amended ToR. The work plan presents the scope of work required to complete the EA, including the scope of technical studies for each of the environmental components, and the evaluation of alternative methods (alternative landfill footprints/options).

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1.1 Documentation

The results of these individual memos will be documented in separate stand-alone technical memorandums during the EA. The final alternative methods evaluation will form a chapter of the EA Report, with each of the stand-alone memorandums becoming supporting documents/appendices to the EA Report.

2. Assessment and Evaluation of the Alternative Landfill Footprint Options

2.1 Methodology

The assessment and evaluation of the alternative landfill footprints was conducted in three steps:

Step 1: Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during Open House events and confirmed for application to each of the landfill footprint alternatives. Evaluation criteria were developed for each Environmental Component listed above.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the ‘alternative methods’ (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out consisting of the following activities:

- Identify potential effects (based on measures) on the environment;
- Develop and apply avoidance/ mitigation/ compensation/ enhancement measures; and,
- Determine net effects on the environment.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another in order to identify a “recommended landfill footprint”. The comparison of net effects was completed using a “Reasoned Argument” or “Trade-off” evaluation methodology, as provided for in the approved SCRF EA ToR.

Each alternative was assessed based on the evaluation criteria, indicators and measures.

One criteria was evaluated with two indicators for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

- Effect on Traffic
  - Potential for traffic collisions
  - Level of Service at intersections around the SCRF

3. Net Effects Analysis

With respect to the “Potential for traffic collisions” indicator, the expected effect of each alternative option on future frequency and severity of traffic collisions within the Local Study Area was assessed. All alternative options are not expected to impact average daily SCRF truck volumes. Therefore with no expected change in SCRF truck volumes within the Local Study Area for any of the alternative options, all alternative options are considered to have an equally negligible impact on the potential for traffic collisions in the Local Study Area. No mitigation measures are required, with no resulting net effects.

New residential housing is being planned and built adjacent to the property in the North and it is expected that this new housing will bring additional traffic to the area. However, despite an increase in background traffic, the number of trucks on the site will not be increasing and therefore potential for collisions will not increase. For example, if 10 site trucks occur in one hour, with each Alternative, the maximum number of collisions with a site truck is still 10.

With respect to the “Level of Service at intersections around the SCRF” indicator, the expected effect of each alternative option on intersection Level of Service within the Local Study Area was assessed. Level of Service, with respect to intersection traffic operations, is a measure of the average delay for each turning movement at the selected intersection. As per the completed Existing Traffic Conditions Report, it was concluded that existing SCRF truck volumes servicing the Site are not having any negative identifiable operational impact on the Local Study Area intersections, including with respect to Level of Service among other key measures. All alternative options are not expected to impact average daily SCRF truck volumes. Therefore with no expected change in SCRF truck volumes within the Local Study Area for any of the alternative options, all alternative options are considered to have an equally negligible impact on the Level of Service at intersections in the Local Study Area. No mitigation measures are required, with no resulting net effects. A summary for all Alternatives is provided as follows:

Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
Effect on Traffic	Potential for traffic collisions Level of Service at intersections around the SCRF	Increases in traffic around site due to background development. No increases in trucks to site so no change in potential for collisions or to the existing level of road user safety and intersection Level of Service within the Local Study Area.	No mitigation measures required.	Despite an increase in background development traffic, the number of potential collisions is not expected to increase as the number of trucks to and from site will not increase.

4. Evaluation Results

There is no distinction between the alternative options in terms of their effects on the potential for collisions and Level of Service at intersections in the Local Study Area. All six alternative options are therefore preferred as they would all results in no net effects with respect to the potential for collisions and Level of Service at intersections in the Local Study Area.

Draft Comparative Evaluation Methodology Narrative for Archaeology and Built Heritage

Memorandum

Draft for Review

This document is in draft form. A final version of this document may differ from this draft. As such, the contents of this draft document shall not be relied upon. GHD disclaims any responsibility or liability arising from decisions made based on this draft document.

March 21, 2018 Reference No. 11102771

Subject: **Stoney Creek Regional Facility EA (Terrapure Environmental) – Draft Comparative Evaluation Methodology for Built Heritage and Archaeology**

1. Introduction

This memo documents the assessment and evaluation of the six landfill footprint alternatives for the Stoney Creek Regional Facility (SCRF) Environmental Assessment (EA) from the Built Heritage and Archaeological perspective. The Minister approved amended Terms of Reference (ToR) included a preliminary description of the methodology for evaluating the alternative methods (i.e., alternative landfill footprint options (See Section 7.1 of the approved amended ToR, November 2017)). This memo is 1 of 10 memos that outline the evaluation of the alternative landfill footprint options from the perspective of each discipline. These memos will be used in concert with one another, along with their evaluation tables, as supporting documents to the Alternative Methods Report. Memos were prepared for the following environmental components:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use and Economic;
- Atmospheric Environment (Air Quality and Odour);
- Atmospheric Environment (Noise);
- Human Health;
- Transportation;
- Archaeology and Built Heritage; and,
- Design and Operations.

Each of the above disciplines also prepared existing conditions reports that were utilized in assessing and evaluating the alternative landfill footprint options. Archaeology and Built Heritage completed the Cultural Heritage Screening Checklists, rather than an existing conditions report, due to the nature of the proposed undertaking coupled with the sites previous use/disturbance. The disciplines referred to the Conceptual Design Report (CDR) that was prepared from a Site Design and Operations perspective, in order to provide the appropriate level of detail on each of the alternative landfill footprints. The CDR will also form a supporting document to the Alternative Methods Report.

Each discipline is following the requirements as stated in the draft work plans that were presented in Appendix D of the approved amended ToR. The work plan presents the scope of work required to complete the EA, including the scope of technical studies for each of the environmental components, and the evaluation of alternative methods (alternative landfill footprints/option).

1.1 Documentation

The results of these individual memos will be documented in separate stand-alone technical memorandums during the EA. The final alternative methods evaluation will form a chapter of the EA Report, with each of the stand-alone memorandums becoming supporting documents/appendices to the EA Report.

2. Assessment and Evaluation of the Alternative Landfill Footprint Options

2.1 Methodology

The assessment and evaluation of the alternative landfill footprints was conducted in three steps:

Step 1: Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during Open House events and confirmed for application to each of the landfill footprint alternatives. Evaluation criteria were developed for each Environmental Component listed above.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the 'alternative methods' (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public, to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out consisting of the following activities:

- Identify potential effects (based on measures) on the environment;
- Develop and apply avoidance/ mitigation/ compensation/ enhancement measures; and
- Determine net effects on the environment.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another, in order to identify a "recommended landfill footprint". The comparison of net effects was completed using a "Reasoned Argument" or "Trade-off" evaluation methodology, as provided for in the approved SCRF EA ToR.

Each alternative was assessed based on the evaluation criteria, indicators and measures.

The Archaeology and Built Heritage criteria were evaluated with specific indicators for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

- Effect on Known or Potential Significant Archaeological Resources
  - Number and type of potentially significant, known archaeological sites affected
  - Area (ha) of archaeological potential (i.e., lands with the potential for the presence of significant archaeological resources) affected
- Effect on Built Heritage Resources and Cultural Heritage Landscapes
  - Number and type of built heritage resources and cultural heritage landscapes displaced or disrupted

3. Net Effects Analysis

Alternative Option 1

Option 1 does not require a change to the current footprint. The site has been previously excavated and quarried, and only one cultural heritage landscape exists within 1.5 km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 1 does not affect a known or potential archaeological resource, and therefore no mitigation measures are required.

Alternative Option 2

Option 2 requires a slight change to the footprint. However, the change in footprint occurs within previously excavated lands. One cultural heritage landscape exists within 1.5 km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 2 does not affect a known or potential archaeological resource, and therefore no mitigation measures are required.

Alternative Option 3

Option 3 does not require a change to the current footprint. The site has been previously excavated and quarried, and only one cultural heritage landscape exists within 1.5 km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 3 does not affect a known or potential archaeological resource, and therefore no mitigation measures are required.

Alternative Option 4

Option 4 requires a slight change to the footprint. However, the change in footprint occurs within previously excavated lands. One cultural heritage landscape exists within 1.5 km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 4 does not affect a known or potential archaeological resource, and therefore no mitigation measures are required.

Alternative Option 5

Option 5 requires a slight change to the footprint. However, the change in footprint occurs within previously excavated lands. One cultural heritage landscape exists within 1.5 km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 5 does not affect a known or potential archaeological resource, and therefore no mitigation measures are required.

Alternative Option 6

Option 6 requires a slight change to the footprint. However, the change in footprint occurs within previously excavated lands. One cultural heritage landscape exists within 1.5 km of the SCRF (Billy Green House), which will not be impacted, displaced or disturbed. Due to the previous disturbance on-site (excavation for quarry operation), Option 6 does not affect a known or potential archaeological resource, and therefore no mitigation measures are required.

3.1 Summary of Net Effects

The current SCRF site is located within a former quarry, and is therefore considered to be previously disturbed from a Cultural Heritage and Archaeological perspective. A copy of the quarry license and permit is included as **Appendix A** to demonstrate the extent of the quarry limits/disturbed area, relative to the alternative footprint options. All of the lands have been previously excavated, and therefore it is concluded that there will be no potentially significant or known archeological sites or lands with the presence of archaeological resources disturbed or affected. No Net Effects or Mitigation measures are anticipated or required from an archaeological perspective.

A review of the designated culturally significant built heritage and cultural landscapes was completed to assist in the *Land Use Existing Conditions Report*. The review determined that there was only one designated built heritage resource, known as the Billy Green House, 30 Ridge Rd (**Appendix B**), located within the 1.5 km of the SCRF. None of the six Options will result in the designated resource to be disturbed or displaced, and therefore No Net Effects and no mitigation measures are anticipated or required from a built/cultural heritage resource perspective.

It should be noted that as part of the 1996 Taro East EA, which established the currently approved Facility, the Ministry of Culture, Tourism and Recreation (now known as Ministry of Tourism, Culture and Sport) confirmed that there was a low potential for impacting cultural heritage resources on site, due to the fact that the study area (for the landfill footprint) is limited to an exhausted quarry pit[1].

4. Evaluation Results

All six alternative landfill footprints are ranked as the preferred (tied for 1st) from an Archaeological and Built Heritage perspective. All of the alternative landfill footprint changes will occur on already previously excavated and quarried lands, and the one designated heritage landscape (located off-site) will not be disturbed or displaced.

[1] See Supporting Document #2 to the Stoney Creek Regional Facility Environmental Assessment Minister Approved Amended Terms of Reference for correspondence.

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March 21, 2018 Reference No. 11102771

Subject: **Stoney Creek Regional Facility EA (Terrapure Environmental) – Draft Comparative Evaluation for Design and Operations**

1. Introduction

This memo documents the assessment and evaluation of the six landfill alternatives for the Stoney Creek Regional Facility (SCRF) Environmental Assessment (EA) from the Design and Operations perspective. The Minister approved amended Terms of Reference (ToR) included a preliminary description of the methodology for evaluating the alternative methods (i.e., alternative landfill footprint options (See Section 7.1 of the approved amended ToR, November 2017)). This memo is one of 10 memos that outline the evaluation of the alternative landfill footprint options from the perspective of each discipline. These memos will be used in concert with one another, along with their evaluation tables, as supporting documents to the Alternative Methods Report. Memos were prepared for the following environmental components:

- Geology and Hydrogeology;
- Surface Water Resources;
- Terrestrial and Aquatic Environment;
- Land Use and Economic;
- Atmospheric Environment (Air Quality and Odour);
- Atmospheric Environment (Noise);
- Human Health;
- Transportation;
- Archaeology and Built Heritage; and,
- Design and Operations.

Each of the above disciplines also prepared existing conditions reports that were utilized in assessing and evaluating the alternative landfill footprint options. Further, the disciplines referred to the Conceptual Design Report (CDR) that was prepared from a Site Design and Operations perspective, in order to provide the appropriate level of detail on each of the alternative landfill footprints. The CDR forms a supporting document to the Alternative Methods Report and is also the basis of this memo.

Each discipline is following the requirements as stated in the draft work plans that were presented in Appendix D of the approved amended ToR. The work plan presents the scope of work required to complete the EA, including the scope of technical studies for each of the environmental components, and the evaluation of alternative methods (alternative landfill footprints/ option).

1.1 Documentation

The results of these individual memos will be documented in separate stand-alone technical memorandums during the EA. The final alternative methods evaluation will form a chapter of the EA Report, with each of the stand-alone memorandums becoming supporting documents/appendices to the EA Report.

2. Assessment and Evaluation of the Alternative Landfill Footprint Options

2.1 Methodology

The assessment and evaluation of the alternative landfill footprints was conducted in three steps:

Step 1: Confirm Evaluation Criteria and Indicators/Measures

Prior to undertaking the net effects analysis, the evaluation criteria, indicators, and measures previously developed in the ToR were reviewed with the public during the first Open House and confirmed for application to each of the landfill footprint alternatives. Evaluation criteria were developed for each Environmental Component listed above.

The approved SCRF ToR set out the draft criteria and indicators for evaluating the 'alternative methods' (i.e., alternative landfill footprint options) in the EA. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the landfill footprint alternatives.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public, to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the landfill footprint alternatives. In doing so, the results of the evaluation phase will consist of clearly defined net effects for each landfill footprint alternative.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the alternative landfill footprint options was carried out consisting of the following activities:

- Identify potential effects (based on measures) on the environment;
- Develop and apply avoidance/ mitigation/ compensation/ enhancement measures;
- Review the feasibility of the stormwater management (SWM) pond layout; and,
- Determine net effects on the environment.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each alternative landfill footprint option in Step 2 were compared to one another, in order to identify a "recommended landfill footprint". The comparison of net effects was completed using a "Reasoned Argument" or "Trade-off" evaluation methodology, as provided for in the approved SCRF EA ToR.

Each alternative was assessed based on the evaluation criteria, indicators and measures.

Seven criteria were evaluated with seven indicators for each landfill footprint alternative (including number and significance) to support the reasoned argument in the comparative rankings:

- Potential to Provide Service for Disposal
  - Ability of Alternative Methods to provide disposal capacity for post-diversion, solid, non-hazardous residual material
- Cost of Facility
  - Approximate relative cost of Alternative Methods
- Leachate Management
  - Design and operating complexity
- Stormwater Management
  - Design and operating complexity
- Construction
  - Complexity and constructability of components
- Site Operations
  - Complexity and operability of components
- Closure and Post-Closure
  - Flexibility of design and operations

3. Net Effects Analysis

The net effects analysis serves to assess the changes to the additional design and operational requirements associated with each of the options when compared to the current approved design of the SCRF (baseline condition).

The changes for each of the options are discussed in further detail below.

3.1 Option 1 - Reconfiguration

Option 1 maintains the same footprint and peak height for the residual material area as the current approved design of the SCRF, but also expands the residual material area to the north to include the area currently approved for industrial fill. Industrial fill would no longer be accepted at the site under Option 1.

Potential to Provide Service for Disposal

Option 1 only provides 8,830,000 m^3 of total disposal capacity for residual material. Option 1 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 1 requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are generally uniform. The larger footprint of the residual material area will see a moderate increase to the leachate generation rate.

Stormwater Management

Option 1 includes a triangular stormwater pond layout which is consistent with the current approved design. The layout of the stormwater pond provides design and operational flexibility.

Construction

Option 1 will require the construction of additional base liner and leachate collection system for the expanded residual material area. Option 1 does not require expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has an open layout with a simple configuration and dedicated areas for the various components.

Site Operations

Option 1 does not include the importing of industrial fill, meaning that this material will no longer need to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond provides operational flexibility. Access and egress from the site will be maintained in their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 1 reflects an open and uniform configuration that will simplify site closure requirements. The overall layout and contours of the site do not limit the flexibility of potential post-closure uses.

Cost of Facility

Option 1 will see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be no additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure. Potential savings could be realized by no longer having to manage industrial fill material.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 1, the magnitude of the potential effects is anticipated to be small relative to the current approved layout, since many aspects of the site will only require minor modifications from their existing configuration.

Net Effect

Option 1 will have low net effects relative to the current approved layout since many aspects of the site will only require minor modifications from their existing configuration. However, Option 1 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

3.2 Option 2 - Footprint Expansion

Option 2 maintains the same peak height for the residual material area, as the current approved design of the SCRF. The residual material area will be expanded horizontally to include other areas of the site, maintaining a minimum 30 m buffer to the property line. This option also maintains the same footprint and peak height for the industrial fill material area.

Potential to Provide Service for Disposal

Option 2 only provides 7,420,000 m^3 of total disposal capacity for residual material. Option 2 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 2 requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in two separate areas with two separate leachate pumping stations. The shape and contours of the residual area are irregular. The larger footprint of the residual material area will see a small increase to the leachate generation rate.

Stormwater Management

Option 2 includes an “L” shaped stormwater pond layout which is not consistent with the current approved design. The layout of the stormwater pond limits design and operational flexibility.

Construction

Option 2 will require the construction of additional base liner and leachate collection system for the expanded residual material area. Option 2 requires expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has a complex layout with an integrated configuration of the various components.

Site Operations

Option 2 includes the importing of industrial fill, meaning that this material will continue to be managed. Leachate will be managed from two separate areas with two separate leachate pumping stations. The proposed layout of the stormwater management pond limits operational flexibility. Access and egress from the site will be modified from their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 2 reflects a complex layout with an integrated configuration that may complicate site closure requirements. The overall layout and contours of the site limit the flexibility of potential post-closure uses.

Cost of Facility

Option 2 will see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 2, the magnitude of the potential effects is anticipated to be large relative to the current approved layout, since many aspects of the site will require significant modifications from their existing configuration.

Net Effect

Option 2 will have high net effects relative to the current approved layout, since many aspects of the site will require significant modifications from their existing configuration. However, Option 2 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

3.3 Option 3 - Height Increase

Option 3 maintains the same footprint for the residual material area as the current approved design of the SCRF. The residual material area will be expanded vertically, increasing the peak elevation. This option also maintains the same footprint and peak height for the industrial fill material area.

Potential to Provide Service for Disposal

Option 3 provides 10,000,000 m^3 of total disposal capacity for residual material. Option 3 meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 3 does not require the design and construction of additional base liner and leachate collection system for an expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are irregular. Since the footprint of the residual material area is consistent with the current approved design, the leachate generation rate is also expected to remain relatively consistent with the current rate.

Stormwater Management

Option 3 includes a triangular stormwater pond layout which is consistent with the current approved design. The layout of the stormwater pond provides design and operational flexibility.

Construction

Option 3 will not require the construction of additional base liner and leachate collection system for an expanded residual material area. Option 3 does not require expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has a complex layout with an integrated configuration of the various components.

Site Operations

Option 3 includes the importing of industrial fill, meaning that this material will continue to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond provides operational flexibility. Access and egress from the site will be maintained in their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 3 reflects a complex layout with an integrated configuration that may complicate site closure requirements. The overall layout and contours of the site limit the flexibility of potential post-closure uses.

Cost of Facility

Option 3 will not see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be no additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 3, the magnitude of the potential effects is anticipated to be small relative to the current approved layout, since some aspects of the site will require modifications from their existing configuration.

Net Effect

Option 3 will have low net effects relative to the current approved layout, since many aspects of the site will only require minor modifications from their existing configuration. Option 3 also meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

3.4 Option 4 - Reconfiguration and Footprint Expansion

Option 4 maintains the same peak height for the residual material area as the current approved design of the SCRF. This option expands the residual material area to the north to include the area currently approved for industrial fill. The residual material area will also be expanded horizontally to include other areas of the site, maintaining a minimum 30 m buffer to the property line. Industrial fill would no longer be accepted at the site under Option 4.

Potential to Provide Service for Disposal

Option 4 only provides 9,580,000 m^3 of total disposal capacity for residual material. Option 4 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 4 requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are generally uniform. The larger footprint of the residual material area will see a large increase to the leachate generation rate.

Stormwater Management

Option 4 includes an “L” shaped stormwater pond layout which is not consistent with the current approved design. The layout of the stormwater pond limits design and operational flexibility.

Construction

Option 4 will require the construction of additional base liner and leachate collection system for the expanded residual material area. Option 4 requires expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has an open layout with a simple configuration and dedicated areas for the various components.

Site Operations

Option 4 does not include the importing of industrial fill, meaning that this material will no longer need to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond limits operational flexibility. Access and egress from the site will be modified from their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 4 reflects an open and uniform configuration that will simplify site closure requirements. The overall layout and contours of the site do not limit the flexibility of potential post-closure uses.

Cost of Facility

Option 4 will see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will also be additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure. Potential savings could be realized by no longer having to manage industrial fill material.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 4, the magnitude of the potential effects is anticipated to be small relative to the current approved layout, since some aspects of the site will require modifications from their existing configuration.

Net Effect

Option 4 will have medium net effects relative to the current approved layout, since some aspects of the site will require significant modifications from their existing configuration. However, Option 4 does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

3.5 Option 5 - Reconfiguration and Height Increase

Option 5 maintains the same footprint for the residual material area as the current approved design of the SCRF, but also expands the residual material area to the north to include the area currently approved for industrial fill. The residual material area will also be expanded vertically, increasing the peak elevation. Industrial fill would no longer be accepted at the site under Option 5.

Potential to Provide Service for Disposal

Option 5 provides 10,000,000 m^3 of total disposal capacity for residual material. Option 5 meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 5 requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are generally uniform. The larger footprint of the residual material area will see a moderate increase to the leachate generation rate.

Stormwater Management

Option 5 includes a triangular stormwater pond layout which is consistent with the current approved design. The layout of the stormwater pond provides design and operational flexibility.

Construction

Option 5 will require the construction of additional base liner and leachate collection system for the expanded residual material area. Option 5 does not require expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has an open layout with a simple configuration and dedicated areas for the various components.

Site Operations

Option 5 does not include the importing of industrial fill, meaning that this material will no longer need to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond provides operational flexibility. Access and egress from the site will be maintained in their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 5 reflects an open and uniform configuration that will simplify site closure requirements. The overall layout and contours of the site do not limit the flexibility of potential post-closure uses.

Cost of Facility

Option 5 will see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be no additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure. Potential savings could be realized by no longer having to manage industrial fill material.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 5, the magnitude of the potential effects is anticipated to be small relative to the current approved layout, since some aspects of the site will require modifications from their existing configuration.

Net Effect

Option 5 will have low net effects relative to the current approved layout, since many aspects of the site will only require minor modifications from their existing configuration. Option 5 also meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

3.6 Option 6 - Footprint Expansion and Height Increase

Option 6 expands the residual material area horizontally to include other areas of the site, maintaining a minimum 30 m buffer to the property line. The residual material area will also be expanded vertically, increasing the peak elevation. This option also maintains the same footprint and peak height for the industrial fill material area.

Potential to Provide Service for Disposal

Option 6 provides 10,000,000 m^3 of total disposal capacity for residual material. Option 6 meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

Leachate Management

Option 6 requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in two separate areas with two separate leachate pumping stations. The shape and contours of the residual area are irregular. The larger footprint of the residual material area will see a small increase to the leachate generation rate.

Stormwater Management

Option 6 includes an “L” shaped stormwater pond layout which is not consistent with the current approved design. The layout of the stormwater pond limits design and operational flexibility.

Construction

Option 6 will require the construction of additional base liner and leachate collection system for the expanded residual material area. Option 6 requires expanding the base liner and leachate collection system horizontally to include other areas of the site. This option has a complex layout with an integrated configuration of the various components.

Site Operations

Option 6 includes the importing of industrial fill, meaning that this material will continue to be managed. Leachate will be managed from two separate areas with two separate leachate pumping stations. The proposed layout of the stormwater management pond limits operational flexibility. Access and egress from the site will be modified from their current configuration. Development of the site will require the relocation or removal of existing infrastructure.

Closure and Post-Closure

Option 6 reflects a complex layout with an integrated configuration that may complicate site closure requirements. The overall layout and contours of the site limit the flexibility of potential post-closure uses.

Cost of Facility

Option 6 will see increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will also be additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure.

Mitigation

The potential effects associated with design and operational changes to the SCRF can only be mitigated through modifications to the site's design and/or operation. There are also design and operating limitations that can affect the ability to mitigate these effects. For Option 6, the magnitude of the potential effects is anticipated to be high relative to the current approved layout, since some aspects of the site will require significant modifications from their existing configuration.

Net Effect

Option 6 will have medium net effects relative to the current approved layout, since some aspects of the site will require significant modifications from their existing configuration. Option 6 also meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.

4. Evaluation Results

The results of the evaluation for each option are summarized as follows:

- Option 1 has low net effects relative to the current layout, but does not provide sufficient additional disposal capacity for residual material to meet the economic opportunity put forward by Terrapure.
- Option 2 has high net effects relative to the current layout, but does not provide sufficient additional disposal capacity for residual material to meet the economic opportunity put forward by Terrapure.
- Option 3 has low net effects relative to the current layout and provides sufficient additional disposal capacity for residual material to meet the economic opportunity put forward by Terrapure.
- Option 4 has medium net effects relative to the current layout, but does not provide sufficient additional disposal capacity for residual material to meet the economic opportunity put forward by Terrapure.
- Option 5 has low net effects relative to the current layout and provides sufficient additional disposal capacity for residual material to meet the economic opportunity put forward by Terrapure.
- Option 6 has medium net effects relative to the current layout and provides sufficient additional disposal capacity for residual material to meet the economic opportunity put forward by Terrapure.

Options 2 and 4 have high and medium net effects, respectively, and neither option satisfies the minimum capacity requirement for residual material. For these reasons, Option 2 is ranked 6th, and Option 4 is ranked 5th.

Option 1 has low net effects, but does not satisfy the minimum capacity requirement for residual material. For these reasons, Option 1 is ranked 4th.

Option 6 has medium net effects and satisfies the minimum capacity requirement for residual material. For these reasons, Option 6 is ranked 3rd.

Options 3 and 5 both had low net effects and both satisfied the minimum capacity requirement for residual material. However, Option 3 has a more complex configuration than Option 5 and will have additional design and operations considerations. For these reasons, Option 3 is ranked 2nd and Option 5 is ranked 1st.

Appendix C

Draft Net Effects Tables

Stoney Creek Regional Facility EA (Terrapure Environmental)
Draft Net Effects Table

	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
Alternative Option 1 – Reconfiguration						
Natural	Geology and Hydrogeology	Effect on Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site Predicted effects to Source Water Protection Area	Minor increases in leachate indicator parameters at downgradient wells Minor increases in leachate indicator parameters reaching upgradient limits reaching wellhead protection area	The existing landfill liner system will be expanded to accommodate new waste placement areas. The landfill liner design has been developed to ensure that leachate will be collected to eliminate leakage. Operation of the M4 containment well, along with the groundwater collection trench network will ensure that any leakage through the liner system will be contained and suitably managed. Development and implementation of an Environmental Monitoring Plan (EMP) appropriate to the option will verify the leachate and groundwater control systems are effectively managing impacts to groundwater. The above referenced leachate and groundwater control systems will mitigate the potential migration of impacts to the off-Site source water protection area.	No off-site groundwater receptors will be affected. No effects to groundwater within source water protection area.
		Effect on Groundwater Flow	Predicted effects to groundwater flow at property boundaries and off-site	No change in groundwater flow because proposed expansion alternatives will have minimal effect on groundwater recharge patterns	No mitigation measure required.	No off-site groundwater receptors will be affected.
	Surface Water Resources	Effect on Surface Water Quality	Predicted effects on surface water quality on-site and off-site	Surface quality to be similar to baseline since additional residual material will have final cover. Contaminants of concern in the runoff are total suspended solids (TSS).	The existing stormwater management pond will be altered as required (provide adequate permanent pool volume and active storage volume) to treat TSS from the stormwater runoff Stormwater from the pond will not be released to surface water body (i.e., storm sewer system that drains into Davis Creek) until testing determines all parameters have been met to discharge. Contingency measures include “status quo”, which is to discharge stormwater to sanitary sewer for treatment at the City’s water pollution control plant.	Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations.
		Effect on Surface Water Quantity	Predicted change in drainage areas Predicted occurrence and degree of off-site effects	The increased area of residual material results in an increase in impermeable area due to the residual material final cover. This will produce an increase runoff volume of 10% during the 2-year storm event and 6% during the 100-year storm event. Increased runoff volume will result in flooding within the roadside ditches to the northwest, in the sewer system below First Road West and Davis Creek. Erosion of the creek and ditches may also occur because of the increased runoff volume.	Perimeter ditches will keep the increased runoff on-site and direct flows to the modified stormwater management pond. The stormwater management pond will be sized to capture the 2-year through 100-year storm events and control the release rate to prevent flooding and erosion off-site. Contingency measures include “status quo”, which is to discharge excess stormwater to sanitary sewer for conveyance to the City’s water pollution control plant.	No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek
	Terrestrial and Aquatic Environment	Effect on terrestrial ecosystems	Predicted impact on vegetation communities Predicted impact on wildlife habitat Predicted impact on vegetation and wildlife including rare, threatened or endangered species	Temporary (assumed not all vegetated areas will be disturbed simultaneously) loss of existing vegetation communities (e.g., marsh, meadow, and thicket habitat) and associated wildlife habitat as a result of regrading activities. Temporary loss (it is assumed habitat will be restored following landfill closure) of approximately 13 ha of habitat of a threatened species (eastern meadowlark) in the dry-fresh graminoid meadow ecosite at the south and west portion of the Site. No off-Site impacts anticipated.	Conduct any vegetation removal activities outside of the breeding bird window (i.e., no removals between late March - late August). Compensation for the loss of vegetation communities could occur elsewhere on-site where there are areas that could be revegetated. Where possible, salvage plant material for restoration from areas where vegetation is removed. Consult with MNRF to determine if there is a need for any registrations, permits or approvals related to the presence of eastern meadowlark to avoid contravention of the provincial Endangered Species Act. Incorporate graminoid meadow habitats into the closure landscape plan. Implement BMP’s including: • Use of dust suppressants • Installation of protective fencing (where required) • Conduct a nest survey of on-Site facilities and infrastructure prior to relocation or removal of structures to mitigate impacts to bird species which may use anthropogenic structures for nesting. If nests	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.

Alternative Option 1 – Reconfiguration						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
					are found, consult a biologist/MNRF for further direction. • Any wildlife incidentally encountered during Site operation activities will not be knowingly harmed and will be allowed to move away from the area on its own. • In the event that an animal encountered during Site operation activities does not move from the area, or is injured, the Site Supervisor, a biologist, and MNRF will be notified. • In the event that the animal is a known or suspected SAR, the Site Supervisor will contact MNRF SAR biologists for advice. • Include naturalized landscape features into the stormwater management facilities design (e.g., emergent robust vegetation, shallow slope)	
		Effect on aquatic ecosystems	Predicted impact on aquatic habitat Predicted impact on aquatic biota	Loss of on-Site aquatic habitat and disturbance of aquatic biota associated with open water habitats in stormwater infrastructure due to regrading activities. No off-Site impacts anticipated.	Characterize use of on-Site aquatic features by fish and wildlife prior to modification/removal. Obtain necessary permits for/complete fish/wildlife rescue activities prior to initiation of any in-water works, as appropriate. Install erosion and sediment control (ESC) measures to mitigate impacts to water quality and to act as wildlife exclusion fencing prior to construction, and maintain them appropriately throughout landfill construction and operation.	Loss of on-site aquatic habitat and biota will be minimized through mitigation measures.
	Atmospheric Environment	Effect of air quality on off-site receptors	Predicted off-Site point of impingement concentrations (ug/m^3) of indicator compounds Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	There is a potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria. Primarily has the potential to affect receptors north of Green Mountain Road This scenario predicts higher concentrations of particulate species than the maximum allowable operations permitted under the current license due to changed on-site road and material handling area layout	Implement Fugitive Dust BMP to include controls such as; • Paving on-site roads • Road cleaning (watering, application of calcium chloride or other dust suppressants) • Re-routing on-site roads so they are further from the site fenceline • Limiting vehicle speeds on on-site roads • Review of the number of vehicles accessing the site on a daily basis • Detailed assessment of the progression of the site operations for the preferred alternative • Other options as identified during the design of the preferred option. Review number of vehicles accepted daily as part of further impact assessment. Models were completed using highly conservative amount of 250 trucks per/day. Average trucks currently to site is approximately 90.	Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.
		Effect of odours on off-site receptors	Predicted off-Site odour concentrations (ug/m^3 and odour units) Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	This scenario is not anticipated to be different from the current license from an odour perspective	Maintain the operational measures currently in place to reduce/mitigate odour impacts from the Site during the vertical expansion including current mitigation activities, including complaint handling and monitoring program	This scenario is not anticipated to be different from the current license from an odour perspective.
		Effect of noise on off-site receptors	Predicted off-Site noise level	Potential change to the predicted off-site noise impact based on increased line-of-sight due to reconfiguration and the decrease in the separation distance between the landfill activities and the adjacent residential properties. POR1=58 dBA POR2=43 dBA POR3=52 dBA POR4=41 dBA POR5=54 dBA POR6=53 dBA	**Existing Residential Properties**: No Mitigation measures required. **Potential Future Development of Surrounding Properties:** Barriers and/or berms at landfill perimeter to the north. Height of barrier and/or berm (north of site): 7 meter above existing grade (199m ASL to 207m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.

Stoney Creek Regional Facility EA (Terrapure Environmental)
Draft Net Effects Table

Alternative Option 1 – Reconfiguration

	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Net sound level change for up to 200 off-Site receptors is 2 dBA or lower: • Approximately 75 residences (to the north): + 2 dBA change • POR5=54 dBA	Construction of a 7 meter tall barrier and/or berm to north above existing grade (199m ASL to 207m ASL).Increasing north property line barrier/berm height by an additional 2 meters above the proposed future screening berm	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.
Built	Land Use	Effect on existing land use	Current land use	No change to the current land use designation (Open Space/Commercial) and no change to Land Use Zoning (ME-1).	No mitigation measures required	No change in current land uses
		Effect on views of the facility	Predicted changes in views of the facility from the surrounding area	No change in height, but reconfiguration of material on site. Visibility increased for sensitive receptors adjacent to site including residential dwellings to South on Green Mountain Rd. as well as homes along Mud Street.	Additional vegetation/fencing may be added to the berm to screen views even further. Implementation of screening berm along southern property line for noise will also assist with visual screening from sensitive receptors.	Installation of visual screening elements would obscure views of the facility from sensitive receptors.
Social	Human Health	Effect on Air Quality	Predicted impacts to air quality and their potential effects on human health	Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (*i.e.*, 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case.	It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase such as Dust BMPs (as referenced under Air Quality) to reduce ambient PM10 particulate concentrations.	Mitigation measures such as Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.
		Leachate Quantity	Predicted effects of leachate quality (inorganic and organic chemicals) on human health	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.	Existing leachate treatment and management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for leachate treatment and proposed mitigation measures for geology/hydrogeology will mitigate effects of leachate.
		Groundwater Quality	Predicted impacts to groundwater quality and their potential effects on human health	Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.	Existing groundwater mitigation management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for groundwater and proposed mitigation measures for geology/hydrogeology will mitigate effects of on groundwater quality.
		Surface Water Quality	Predicted impacts to surface water quality and their potential effects on human health	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.	Existing and proposed surface water mitigation management practices.	Existing and proposed landfill measures for surface water will mitigate effects of on surface water quality.
		Soil Quantity	Predicted impacts to soil and their potential effects on human health	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.	Continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines	Existing and proposed particulate/dust control mitigation measures with ongoing monitoring will mitigate effects to soil quality.
	Transportation	Effect on Traffic	Potential for traffic collisions Level of Service at intersections around the SCRF	Increases in traffic around site due to background development. No increases in trucks to site so no change in potential for collisions or to the existing level of road user safety and intersection Level of Service within the Local Study Area.	No mitigation measures required.	Despite an expected increase in traffic associated to development of residential neighbourhoods in the adjacent properties, potential collisions is not expected to increase as the number of trucks to and from site will not increase.
Economic	Economic	Effect on approved/planned land uses	Number, extent, and type of approved/planned land uses affected	Approximately 1,200 residential dwellings, 11 commercial units, 4 agricultural properties, 1 recreational, 1 institutional within 500m of site. No anticipated effects to these land uses through various landfill operation mitigation measures.	Basic landfill operation mitigation measures including; storm water management, leachate treatment, dust and noise control will assist in mitigating effects to surrounding properties.	No effects to approved/planned land uses.
Economic		Economic benefit to the City of Hamilton and the local community	Employment at site (number and duration)	Expansion and reconfiguration would not allow for maximum economic activity and economic benefits to Community reduced based on $ per tonne agreements. Staffing would be 15 full-time equivalents, with total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 180 years.	No mitigation measures required	Employment reduced (year over year). Low economic benefits to City and Local Community.
Cultural	Archaeology and Built Heritage	Effect on known or potential significant archaeological resources	Number and type of potentially significant, known archaeological sites affected	Site was previously excavated for Quarry extraction. No significant archaeological sites or resources on site.	No mitigation measures required.	No impacts to archaeological sites or resources.

Alternative Option 1 – Reconfiguration						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
			Area (ha) of archaeological potential (i.e., lands with potential for the presence of significant archaeological resources) affected			
		Effect on built heritage resources and cultural heritage landscapes	Number and type of built heritage resources and cultural heritage landscapes displaced or disrupted	Only 1 cultural heritage landscape within 1.5km Site Area.	Due to proximity of the heritage landscape, no interaction will occur, therefore no mitigation is required.	No impacts on cultural heritage resources
Technical	Design and Operations	Potential to Provide Service for Disposal	Ability to provide 3,680,000 m^3 of additional disposal capacity for post diversion solid, non-hazardous industrial residual material	Only provides 8,830,000 m^3 of total capacity for residual material. Does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.	No mitigation measures possible.	Only provides 8,830,000 m^3 of total capacity for residual material. Does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.
		Leachate Management	Design and operating complexity	Requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are generally uniform. The larger footprint of the residual material area will see a moderate increase to the leachate generation rate.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Small increase in complexity relative to current leachate management system associated with: additional base liner and leachate collection system; increased leachate generation rate.
		Stormwater Management	Design and operating complexity	Includes a triangular stormwater pond layout which is consistent with the current approved design. The layout of the stormwater pond provides design and operational flexibility.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	No increase in complexity relative to current stormwater management system.
		Construction	Complexity and constructability of components	Requires the construction of additional base liner and leachate collection system for the expanded residual material area. Does not require expanding the base liner and leachate collection system horizontally to include other areas of the site. Open layout with a simple configuration and dedicated areas for the various components.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Small increase in complexity relative to current construction requirements associated with: additional base liner and leachate collection system.
		Site Operations	Complexity and operability of components	Does not include the importing of industrial fill, meaning that his material will no longer need to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond provides operational flexibility. Access and egress from the site will be maintained in their current configuration. Development of the site will require the relocation or removal of existing infrastructure.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	No increase in complexity relative to current site operations.
		Closure and Post-Closure	Flexibility of design and operations	Open and uniform configuration that will simplify site closure requirements. The overall layout and contours of the site do not limit the flexibility of potential post-closure uses.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Simplified closure requirements and increased flexibility of post-closure uses relative to current design.
		Cost of Facility	Approximate relative cost of Alternative Methods	Increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be no additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure. Potential savings could be realized by no longer having to manage industrial fill material.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Small increase to costs relative to current design associated with: additional base liner and leachate collection system.

Alternative Option 2 – Footprint Expansion						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
Natural	Geology and Hydrogeology	Effect on Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site Predicted effects to Source Water Protection Area	Minor increases in leachate indicator parameters at downgradient wells Minor increases in leachate indicator parameters reaching upgradient limits reaching wellhead protection area	The existing landfill liner system will be expanded to accommodate new waste placement areas. The landfill liner design has been developed to ensure that leachate will be collected to eliminate leakage. Operation of the M4 containment well, along with the groundwater collection trench network will ensure that any leakage through the liner system will be contained and suitably managed. Development and implementation of an Environmental Monitoring Plan (EMP) appropriate to the option will verify the leachate and groundwater control systems are effectively managing impacts to groundwater. The above referenced leachate and groundwater control systems will mitigate the potential migration of impacts to the off-Site source water protection area	No off-site groundwater receptors will be affected. No effects to groundwater within source water protection area.
		Effect on Groundwater Flow	Predicted effects to groundwater flow at property boundaries and off-site	No change in groundwater flow because proposed expansion alternatives will have minimal effect on groundwater recharge patterns	No mitigation measure required.	No off-site groundwater receptors will be affected.
	Surface Water Resources	Effect on Surface Water Quality	Predicted effects on surface water quality on-site and off-site	Surface quality to be similar to baseline since additional residual material will have final cover.	A new stormwater management pond will be constructed within the northwest buffer area to treat TSS from the stormwater runoff The pond will provide adequate permanent pool volume and active storage volume. Stormwater from the pond will not be released to surface water body (i.e., storm sewer system that drains into Davis Creek) until testing determines all parameters have been met to discharge. Contingency measures include “status quo”, which is to discharge stormwater to sanitary sewer for treatment at the City's water pollution control plant.	Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations
		Effect on Surface Water Quantity	Predicted change in drainage areas Predicted occurrence and degree of off-site effects	The residual material footprint will be increased. This results in an increase in impermeable surface due to the residual material final cover. This will produce an increase runoff volume of 2% during the 2-year storm event and 1% during the 100-year storm event. Increased runoff volume will result in flooding in the roadside ditches to the northwest, in the sewer below First Road West and Davis Creek. Erosion of the creek and ditches may also occur because of the increased runoff volume.	Perimeter ditches will keep the increased runoff on-site and direct flows to the new stormwater management pond. The new stormwater management pond will be sized to capture the 2-year through 100-year storm events and control the release rate to prevent flooding and erosion off-site. Contingency measures include “status quo”, which is to discharge excess stormwater to sanitary sewer for conveyance to the City's water pollution control plant.	No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek
	Terrestrial and Aquatic Environment	Effect on terrestrial ecosystems	Predicted impact on vegetation communities Predicted impact on wildlife habitat Predicted impact on vegetation and wildlife including rare, threatened or endangered species	Temporary loss of existing vegetation communities (e.g., marsh, meadow, and thicket habitat) and associated wildlife habitat as a result of regrading activities and expansion into buffer areas. Temporary loss of approximately 13 ha of habitat for a threatened species (eastern meadowlark) in the dry-fresh graminoid meadow ecosite at the south and west portion of the Site. No off-Site impacts anticipated.	Conduct any vegetation removal activities outside of the breeding bird window (i.e., no removals between late March - late August). Compensation for the loss of vegetation communities could occur elsewhere on-site where there are areas that could be revegetated. Where possible, salvage plant material for restoration from areas where vegetation is removed. Consult with MNRF to determine if there is a need for any registrations, permits or approvals related to the presence of eastern meadowlark to avoid contravention of the provincial Endangered Species Act. Incorporate graminoid meadow habitats into the closure landscape plan. Implement BMP's including: • Use of dust suppressants • Installation of protective fencing (where required) • Conduct a nest survey of on-Site facilities and infrastructure prior to relocation or removal of structures to mitigate impacts to bird species which may use anthropogenic structures for nesting. If nests	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.

Alternative Option 2 – Footprint Expansion						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
					are found, consult a biologist/MNRF for further direction. • Any wildlife incidentally encountered during Site operation activities will not be knowingly harmed and will be allowed to move away from the area on its own. • In the event that an animal encountered during Site operation activities does not move from the area, or is injured, the Site Supervisor, a biologist, and MNRF will be notified. • In the event that the animal is a known or suspected SAR, the Site Supervisor will contact MNRF SAR biologists for advice. • Include naturalized landscape features into the stormwater management facilities design (e.g., emergent robust vegetation, shallow slope)	
		Effect on aquatic ecosystems	Predicted impact on aquatic habitat Predicted impact on aquatic biota	Loss of on-Site aquatic habitat and disturbance of aquatic biota associated with open water habitats in stormwater infrastructure due to regrading activities. No off-Site impacts anticipated.	Characterize use of on-Site aquatic features by fish and wildlife prior to modification/removal. Obtain necessary permits for/complete fish/wildlife rescue activities prior to initiation of any in-water works, as appropriate. Install erosion and sediment control (ESC) measures to mitigate impacts to water quality and to act as wildlife exclusion fencing prior to construction, and maintain them appropriately throughout landfill construction and operation.	Loss of on-site aquatic habitat and biota will be minimized through mitigation measures.
	Atmospheric Environment	Effect of air quality on off-site receptors	Predicted off-Site point of impingement concentrations (ug/m^3) of indicator compounds Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	There is a potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria. Primarily has the potential to affect receptors near the northeast corner of the site, and north of Green Mountain Road. This scenario predicts higher concentrations of particulate species than the maximum allowable operations permitted under the current license due to changed on-site road and material handling area layout	Implement Fugitive Dust BMP to include controls such as; • Paving on-site roads • Road cleaning (watering, application of calcium chloride or other dust suppressants) • Re-routing on-site roads so they are further from the site fenceline • Limiting vehicle speeds on on-site roads • Review of the number of vehicles accessing the site on a daily basis • Detailed assessment of the progression of the site operations for the preferred alternative • Other options as identified during the design of the preferred option. Review number of vehicles accepted daily as part of further impact assessment. Models were completed using highly conservative amount of 250 trucks per/day. Average trucks currently to site is approximately 90.	Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.
		Effect of odours on off-site receptors	Predicted off-Site odour concentrations (ug/m^3 and odour units) Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	This scenario is not anticipated to be different from the current license from an odour perspective	Maintain the operational measures currently in place to reduce/mitigate odour impacts from the Site during the vertical expansion including current mitigation activities, including complaint handling and monitoring program	This scenario is not anticipated to be different from the current license from an odour perspective.
		Effect of noise on off-site receptors	Predicted off-Site noise level	Potential change to the predicted off-site noise impact due to the Footprint Expansion associated with Alternative Method 2 and the decrease in the separation distance between the landfill activities and the adjacent residential properties. POR1=57 dBA POR2=43 dBA POR3=55 dBA POR4=41 dBA POR5=55 dBA POR6=57 dBA	**Existing Residential Properties**: Barrier and/or berms at landfill perimeter to the north. Height of barrier and/or berm (north of site): 10 meter tall above existing grade (203m ASL to 210m ASL). **Potential Future Development of Surrounding Properties:** Barriers and/or berms at landfill perimeter to the north. Height of barrier and/or berm (north of site): 10 meter tall above existing grade (203m ASL to 210m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.

Alternative Option 2 – Footprint Expansion						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Net sound level change for up to 200 off-Site receptors is 1 dBA or lower: • Approximately 75 residences (to the north): +1 dBA change (based on worst case operation scenario) • POR5=55 dBA	Construction of a 10 meter tall barrier and/or berm above existing grade (203m to 210m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.
Built	Land Use	Effect on existing land use	Current land use	No change to the current land use designation (Open Space/Commercial) and no change to Land Use Zoning (ME-1).	No mitigation measures required	No change in current land uses
		Effect on views of the facility	Predicted changes in views of the facility from the surrounding area	No change in height, but property buffers reduced to 30m minimum. Visibility increased for sensitive receptors and properties adjacent to site including residential dwellings to South on Green Mountain Rd. as well as homes along Mud Street.	Implementation of screening berm along southern property line for noise will assist with visual screening from residential areas Further vegetation/fencing may be added to the berm to screen views from sensitive receptors.	Installation of visual screening elements would obscure views of the facility from sensitive receptors.
Social	Human Health	Effect on Air Quality	Predicted impacts to air quality and their potential effects on human health	Results of the air quality assessment indicate that this VOC emissions from this method would be less than those predicted for the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (*i.e.*, 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case.	It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase such as Dust BMPs (as referenced under Air Quality) to reduce ambient PM10 particulate concentrations.	Mitigation measures such as Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.
		Leachate Quantity	Predicted effects of leachate quality (inorganic and organic chemicals) on human health	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.	Existing leachate treatment and management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for leachate treatment and proposed mitigation measures for geology/hydrogeology will mitigate effects of leachate.
		Groundwater Quality	Predicted impacts to groundwater quality and their potential effects on human health	Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.	Existing groundwater mitigation management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for groundwater and proposed mitigation measures for geology/hydrogeology will mitigate effects of on groundwater quality.
		Surface Water Quality	Predicted impacts to surface water quality and their potential effects on human health	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.	Existing and proposed surface water mitigation management practices.	Existing and proposed landfill measures for surface water will mitigate effects of on surface water quality.
		Soil Quantity	Predicted impacts to soil and their potential effects on human health	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.	Continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines	Existing and proposed particulate/dust control mitigation measures with ongoing monitoring will mitigate effects to soil quality.
	Transportation	Effect on Traffic	Potential for traffic collisions Level of Service at intersections around the SCRF	Increases in traffic around site due to background development. No increases in trucks to site so no change in potential for collisions or to the existing level of road user safety and intersection Level of Service within the Local Study Area.	No mitigation measures required.	Despite an expected increase in traffic associated to development of residential neighbourhoods in the adjacent properties, potential collisions is not expected to increase as the number of trucks to and from site will not increase.
Economic	Economic	Effect on approved/planned land uses	Number, extent, and type of approved/planned land uses affected	Approximately 1,200 residential dwellings, 11 commercial units, 4 agricultural properties, 1 recreational, 1 institutional within 500m of site. No anticipated effects to these land uses through various landfill operation mitigation measures.	Basic landfill operation mitigation measures including; storm water management, leachate treatment, dust and noise control will assist in mitigating effects to surrounding properties.	No approved/planned land uses affected.
		Economic benefit to the City of Hamilton and local community	Employment at site (number and duration)	Expansion and reconfiguration would not allow for maximum economic activity and economic benefits to Community reduced based on $ per tonne agreements. Staffing would be 15 full-time equivalents, with total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 170 years.	No mitigation measures required	Employment reduced (year over year). Low economic benefits to City and Local Community.
Cultural	Archaeology and Built Heritage	Effect on known or potential significant archaeological resources	Number and type of potentially significant, known archaeological sites affected Area (ha) of archaeological potential (i.e., lands with	Site was previously excavated for Quarry extraction. No significant archaeological sites or resources.	No mitigation measures required.	No archaeological sites or resources affected.

Alternative Option 2 – Footprint Expansion						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
			potential for the presence of significant archaeological resources) affected			
		Effect on built heritage resources and cultural heritage landscapes	Number and type of built heritage resources and cultural heritage landscapes displaced or disrupted	Only 1 cultural heritage landscape within 1.5km Site Area.	Due to proximity of the heritage landscape, no interaction will occur, therefore no mitigation is required.	No cultural heritage resources affected.
Technical	Design and Operations	Potential to Provide Service for Disposal	Ability to provide 3,680,000 m^3 of additional disposal capacity for post diversion solid, non-hazardous industrial residual material	Only provides 7,420,000 m^3 of total capacity for residual material. Does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.	No mitigation measures possible.	Only provides 7,420,000 m^3 of total capacity for residual material. Does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.
		Leachate Management	Design and operating complexity	Requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in two separate areas with two separate leachate pumping stations. The shape and contours of the residual area are irregular. The larger footprint of the residual material area will see a small increase to the leachate generation rate.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Moderate increase in complexity relative to current leachate management system associated with: additional base liner and leachate collection system; separate leachate pumping systems; irregular shape/contours; increased leachate generation rate.
		Stormwater Management	Design and operating complexity	Includes an “L” shaped stormwater pond layout which is not consistent with the current approved design. The layout of the stormwater pond limits design and operational flexibility.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Moderate increase to complexity relative to current stormwater management system.
		Construction	Complexity and constructability of components	Requires the construction of additional base liner and leachate collection system for the expanded residual material area. Requires expanding the base liner and leachate collection system horizontally to include other areas of the site. Complex layout with an integrated configuration of the various components.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Large increase in complexity relative to current construction requirements associated with: additional base liner and leachate collection system; expansion of base liner and leachate collection system into other areas of the site; complex layout and integration of other components such as the stormwater management pond.
		Site Operations	Complexity and operability of components	Includes the importing of industrial fill, meaning that his material will continue to be managed. Leachate will be managed from two separate areas with two separate leachate pumping stations. The proposed layout of the stormwater management pond limits operational flexibility. Access and egress from the site will be modified from their current configuration. Development of the site will require the relocation or removal of existing infrastructure.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Large increase in complexity relative to current site operations associated with: two separate leachate pumping stations; layout of the stormwater management pond; site access and egress.
		Closure and Post-Closure	Flexibility of design and operations	Complex layout with an integrated configuration that may complicate site closure requirements. The overall layout and contours of the site limit the flexibility of potential post-closure uses.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Moderate increase to closure requirements and reduced flexibility of post-closure uses relative to current design.
		Cost of Facility	Approximate relative cost of Alternative Methods	Increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Large increase to costs relative to current design associated with: expansion of base liner and leachate collection system into adjacent areas of the site; layout of stormwater pond.

Alternative Option 3 – Height Increase						
	Environmental Component	**Criteria**	**Indicators**	**Potential Effects**	**Mitigation Measures**	**Net Effects**
Natural	Geology and Hydrogeology	Effect on Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site Predicted effects to Source Water Protection Area	Minor increases in leachate indicator parameters at downgradient wells Minor increases in leachate indicator parameters reaching upgradient limits reaching wellhead protection area	The existing landfill liner system will be expanded to accommodate new waste placement areas. The landfill liner design has been developed to ensure that leachate will be collected to eliminate leakage. Operation of the M4 containment well, along with the groundwater collection trench network will ensure that any leakage through the liner system will be contained and suitably managed. Development and implementation of an Environmental Monitoring Plan (EMP) appropriate to the option will verify the leachate and groundwater control systems are effectively managing impacts to groundwater. The above referenced leachate and groundwater control systems will mitigate the potential migration of impacts to the off-Site source water protection area	No off-site groundwater receptors will be affected. No effects to groundwater within source water protection area.
		Effect on Groundwater Flow	Predicted effects to groundwater flow at property boundaries and off-site	No change in groundwater flow because proposed expansion alternatives will have minimal effect on groundwater recharge patterns	No mitigation measure required.	No off-site groundwater receptors will be affected.
	Surface Water Resources	Effect on Surface Water Quality	Predicted effects on surface water quality on-site and off-site	Surface quality to be similar to baseline since residual material will have final cover as in baseline condition. Increased SCRF height will result in higher peak flows that may cause slightly higher levels of contaminants in runoff. Contaminants of concern in the runoff are TSS.	The existing stormwater management pond will be altered as required (provide adequate permanent pool volume and active storage volume) to treat TSS from the stormwater runoff. Stormwater from the pond will not be released to surface water body (i.e., storm sewer system that drains into Davis Creek) until testing determines all parameters have been met to discharge. Contingency measures include “status quo”, which is to discharge stormwater to sanitary sewer for treatment at the City’s water pollution control plant.	Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations
		Effect on Surface Water Quantity	Predicted change in drainage areas Predicted occurrence and degree of off-site effects	There is no change in drainage areas, only increased SCRF height. Increased SCRF height will result in higher peak flows. The peak flows will increase by less than 1% during the 2-year storm event and 5% during the 100-year storm event. Runoff volume will remain similar to baseline conditions (increases are less than 1%). Higher peak flows will result in increased flooding in the roadside ditches to the northwest, in the sewer below First Road West and in Davis Creek. Erosion of the creek and ditches may also occur because of the increased peak flows.	Perimeter ditches will keep the increased runoff on-site and direct flows to the modified stormwater management pond. The stormwater management pond will be sized to capture the 2-year through 100-year storm events and control the release rate to prevent flooding and erosion off-site. Contingency measures include “status quo”, which is to discharge excess stormwater to sanitary sewer for conveyance to the City’s water pollution control plant.	No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek
	Terrestrial and Aquatic Environment	Effect on terrestrial ecosystems	Predicted impact on vegetation communities Predicted impact on wildlife habitat Predicted impact on vegetation and wildlife including rare, threatened or endangered species	Temporary loss of existing vegetation communities (e.g., marsh, meadow, and thicket habitat) and associated wildlife habitat as a result of regrading activities. Temporary loss of approximately 13 ha of habitat of a threatened species (eastern meadowlark) in the dry-fresh graminoid meadow ecosite at the south and west portion of the Site. No off-Site impacts anticipated.	Conduct any vegetation removal activities outside of the breeding bird window (i.e., no removals between late March - late August). Compensation for the loss of vegetation communities could occur elsewhere on-site where there are areas that could be revegetated. Where possible, salvage plant material for restoration from areas where vegetation is removed. Consult with MNRF to determine if there is a need for any registrations, permits or approvals related to the presence of eastern meadowlark to avoid contravention of the provincial Endangered Species Act. Incorporate graminoid meadow habitats into the closure landscape plan. Implement BMP’s including: • Use of dust suppressants • Installation of protective fencing (where required) • Conduct a nest survey of on-Site facilities and infrastructure prior to relocation or removal of structures to mitigate impacts to bird species which may use anthropogenic structures for nesting. If nests are found, consult a biologist/MNRF for further direction.	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.

	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
Alternative Option 3 – Height Increase						
					• Any wildlife incidentally encountered during Site operation activities will not be knowingly harmed and will be allowed to move away from the area on its own. • In the event that an animal encountered during Site operation activities does not move from the area, or is injured, the Site Supervisor, a biologist, and MNRF will be notified. • In the event that the animal is a known or suspected SAR, the Site Supervisor will contact MNRF SAR biologists for advice. • Include naturalized landscape features into the stormwater management facilities design (e.g., emergent robust vegetation, shallow slope)	
		Effect on aquatic ecosystems	Predicted impact on aquatic habitat Predicted impact on aquatic biota	Loss of on-Site aquatic habitat and disturbance of aquatic biota associated with open water habitats in stormwater infrastructure due to regrading activities. No off-Site impacts anticipated.	Characterize use of on-Site aquatic features by fish and wildlife prior to modification/removal. Obtain necessary permits for/complete fish/wildlife rescue activities prior to initiation of any in-water works, as appropriate. Install erosion and sediment control (ESC) measures to mitigate impacts to water quality and to act as wildlife exclusion fencing prior to construction, and maintain them appropriately throughout landfill construction and operation.	Loss of on-site aquatic habitat and biota will be minimized through mitigation measures.
	Atmospheric Environment	Effect of air quality on off-site receptors	Predicted off-Site point of impingement concentrations (ug/m^3) of indicator compounds Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	There is a potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria. Primarily has the potential to affect receptors north of Green Mountain Road, and near site entry and exit points This scenario predicts similar concentrations of particulate species to the maximum allowable operations permitted under the current license due to similarities in the on-site road and material handling area layout	Implement Fugitive Dust BMP to include controls such as; • Paving on-site roads • Road cleaning (watering, application of calcium chloride or other dust suppressants) • Re-routing on-site roads so they are further from the site fenceline • Limiting vehicle speeds on on-site roads • Review of the number of vehicles accessing the site on a daily basis • Detailed assessment of the progression of the site operations for the preferred alternative • Other options as identified during the design of the preferred option. Review number of vehicles accepted daily as part of further impact assessment. Models were completed using highly conservative amount of 250 trucks per/day. Average trucks currently to site is approximately 90.	Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.
		Effect of odours on off-site receptors	Predicted off-Site odour concentrations (ug/m^3 and odour units) Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	This scenario is not anticipated to be different from the current license from an odour perspective	Maintain the operational measures currently in place to reduce/mitigate odour impacts from the Site during the vertical expansion including current mitigation activities, including complaint handling and monitoring program	This scenario is not anticipated to be different from the current license from an odour perspective
		Effect of noise on off-site receptors	Predicted off-Site noise level	Potential change to the predicted off-site noise impact due increased line-of-sight due to the +12 m elevation change associated with Alternative Method 3 and the decrease in the separation distance between the landfill activities and the adjacent residential properties. POR1=58 dBA POR2=41 dBA POR3=53 dBA POR4=43 dBA POR5=54 dBA POR6=53 dBA	**Existing Residential Properties**: No mitigation measures required. **Potential Future Development of Surrounding Properties:** Barriers and/or berms at landfill perimeter to the north. Height of barrier and/or berm (north of site): 7 meter tall above existing grade (200m ASL to 207m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.
			Number of off-Site receptors potentially affected (residential	Net sound level change for up to 200 off-Site receptors is 2 dBA or lower:	Construction of a 7 meter tall barrier and/or berm above existing grade (200m to 207m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.

Alternative Option 3 – Height Increase						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
			properties, public facilities, businesses and institutions)	• Approximately 75 residences (to the north): +2 dBA change (based on worst case operation scenario) • POR5=54 dBA		
Built	Land Use	Effect on existing land use	Current land use	No change to the current land use designation (Open Space/Commercial) and no change to Land Use Zoning (ME-1).	No mitigation measures required	No change in current land uses
		Effect on views of the facility	Predicted changes in views of the facility from the surrounding area	Large change height (12m), but property buffers do not change. Visibility increased for all properties and sensitive receptors in all directions.	Implementation of screening berm along southern property line for noise will assist with visual screening from residential areas, but will not be able to mitigate views completely. Additional screening guards and vegetation can also help to mitigate views, but will not block them completely.	Installation of visual screening elements would not be able to sufficiently obscure views of the facility from sensitive receptors.
Social	Human Health	Effect on Air Quality	Predicted impacts to air quality and their potential effects on human health	Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of the PM10 and PM2.5 size fractions would be marginally higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community.	Standard Dust BMPs (as referenced under Air Quality) to minimize dust generation.	Mitigation measures such as Dust BMPs would mitigate effects to air quality.
		Leachate Quantity	Predicted effects of leachate quality (inorganic and organic chemicals) on human health	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.	Existing leachate treatment and management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for leachate treatment and proposed mitigation measures for geology/hydrogeology will mitigate effects of leachate.
		Groundwater Quality	Predicted impacts to groundwater quality and their potential effects on human health	Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.	Existing groundwater mitigation management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for groundwater and proposed mitigation measures for geology/hydrogeology will mitigate effects of on groundwater quality.
		Surface Water Quality	Predicted impacts to surface water quality and their potential effects on human health	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.	Existing and proposed surface water mitigation management practices.	Existing and proposed landfill measures for surface water will mitigate effects of on surface water quality.
		Soil Quantity	Predicted impacts to soil and their potential effects on human health	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.	Continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines	Existing and proposed particulate/dust control mitigation measures with ongoing monitoring will mitigate effects to soil quality.
	Transportation	Effect on Traffic	Potential for traffic collisions Level of Service at intersections around the SCRF	Increases in traffic around site due to background development. No increases in trucks to site so no change in potential for collisions or to the existing level of road user safety and intersection Level of Service within the Local Study Area.	No mitigation measures required.	Despite an expected increase in traffic associated to development of residential neighbourhoods in the adjacent properties, potential collisions is not expected to increase as the number of trucks to and from site will not increase.
Economic	Economic	Effect on approved/planned land uses	Number, extent, and type of approved/planned land uses affected	Approximately 1,200 residential dwellings, 11 commercial units, 4 agricultural properties, 1 recreational, 1 institutional within 500m of site. No anticipated effects to these land uses through various landfill operation mitigation measures.	Basic landfill operation mitigation measures including; storm water management, leachate treatment, dust and noise control will assist in mitigating effects to surrounding properties.	No effects to approved/planned land uses.
		Economic benefit to the City of Hamilton and local community	Employment at site (number and duration)	Expansion and reconfiguration would result in maximum economic activity and economic benefits to the Community based on $ per tonne agreements. Staffing would be 15 full-time equivalents, with total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 250 years.	No mitigation measures required	Employment increased (year over year). Increased economic benefits to City and Local Community.
Cultural	Archaeology and Built Heritage	Effect on known or potential significant archaeological resources	Number and type of potentially significant, known archaeological sites affected Area (ha) of archaeological potential (i.e., lands with potential for the presence of significant archaeological resources) affected	Site was previously excavated for Quarry extraction. No significant archaeological sites or resources.	No mitigation measures required.	No effects to archaeological sites or resources.

Stoney Creek Regional Facility EA (Terrapure Environmental)
Draft Net Effects Table

Alternative Option 3 – Height Increase						
	Environmental Component	**Criteria**	**Indicators**	**Potential Effects**	**Mitigation Measures**	**Net Effects**
		Effect on built heritage resources and cultural heritage landscapes	Number and type of built heritage resources and cultural heritage landscapes displaced or disrupted	Only 1 cultural heritage landscape within 1.5km Site Area.	Due to proximity of the heritage landscape, no interaction will occur, therefore no mitigation is required.	No effects on cultural heritage resources
Technical	Design and Operations	Potential to Provide Service for Disposal	Ability to provide 3,680,000 m^3 of additional disposal capacity for post diversion solid, non-hazardous industrial residual material	Provides 10,000,000 m^3 of total capacity for residual material. Meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.	No mitigation measures possible.	Provides 10,000,000 m^3 of total capacity for residual material. Meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.
		Leachate Management	Design and operating complexity	Does not require the design and construction of additional base liner and leachate collection system for an expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are irregular. Since the footprint of the residual material area is consistent with the current approved design, the leachate generation rate is also expected to remain relatively consistent with the current rate.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	No increased complexity relative to current leachate management system
		Stormwater Management	Design and operating complexity	Includes a triangular stormwater pond layout which is consistent with the current approved design. The layout of the stormwater pond provides design and operational flexibility.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	No increase in complexity relative to current stormwater management system.
		Construction	Complexity and constructability of components	Does not require the construction of additional base liner and leachate collection system for an expanded residual material area. Does not require expanding the base liner and leachate collection system horizontally to include other areas of the site. Complex layout with an integrated configuration of the various components.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	No increase in complexity relative to current construction requirements.
		Site Operations	Complexity and operability of components	Includes the importing of industrial fill, meaning that his material will continue to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond provides operational flexibility. Access and egress from the site will be maintained in their current configuration. Development of the site will require the relocation or removal of existing infrastructure.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	No increase in complexity relative to current site operations.
		Closure and Post-Closure	Flexibility of design and operations	Complex layout with an integrated configuration that may complicate site closure requirements. The overall layout and contours of the site limit the flexibility of potential post-closure uses.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Small increase to closure requirements and reduced flexibility of post-closure uses relative to current design.
		Cost of Facility	Approximate relative cost of Alternative Methods	No increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. No additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	No increase to costs relative to current design.

Alternative Option 4 – Reconfiguration and Footprint Expansion						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
Natural	Geology and Hydrogeology	Effect on Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site Predicted effects to Source Water Protection Area	Minor increases in leachate indicator parameters at downgradient wells Minor increases in leachate indicator parameters reaching upgradient limits reaching wellhead protection area	The existing landfill liner system will be expanded to accommodate new waste placement areas. The landfill liner design has been developed to ensure that leachate will be collected to eliminate leakage. Operation of the M4 containment well, along with the groundwater collection trench network will ensure that any leakage through the liner system will be contained and suitably managed. Development and implementation of an Environmental Monitoring Plan (EMP) appropriate to the option will verify the leachate and groundwater control systems are effectively managing impacts to groundwater. The above referenced leachate and groundwater control systems will mitigate the potential migration of impacts to the off-Site source water protection area	No off-site groundwater receptors will be affected. No effects to groundwater within source water protection area.
		Effect on Groundwater Flow	Predicted effects to groundwater flow at property boundaries and off-site	No change in groundwater flow because proposed expansion alternatives will have minimal effect on groundwater recharge patterns	No mitigation measure required.	No off-site groundwater receptors will be affected.
	Surface Water Resources	Effect on Surface Water Quality	Predicted effects on surface water quality on-site and off-site	Surface quality to be similar to baseline since additional residual material will have final cover. Contaminants of concern in the runoff are TSS.	A new stormwater management pond will be constructed within the northwest buffer area to treat suspended solids from the stormwater runoff. The pond will provide adequate permanent pool volume and active storage volume. Stormwater from the pond will not be released to surface water body (i.e., storm sewer system that drains into Davis Creek) until testing determines all parameters have been met to discharge. Contingency measures include “status quo”, which is to discharge stormwater to sanitary sewer for treatment at the City’s water pollution control plant. .	Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations
		Effect on Surface Water Quantity	Predicted change in drainage areas Predicted occurrence and degree of off-site effects	The increased area and footprint of residual material results in an increase in impermeable area due to the residual material final cover. This will produce an increase runoff volume of 13% during the 2-year storm event and 8% during the 100-year storm event. Increased runoff volume will result in increased flooding in the roadside ditches to the northwest, in the sewer below First Road West and Davis Creek. Erosion of the creek and ditches may also occur because of the increased runoff volume.	Perimeter ditches will keep the increased runoff on-site and direct flows to the new stormwater management pond. The new stormwater management pond will be sized to capture the 2-year through 100-year storm events and control the release rate to prevent flooding and erosion off-site. Contingency measures include “status quo”, which is to discharge excess stormwater to sanitary sewer for conveyance to the City’s water pollution control plant.	No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek
	Terrestrial and Aquatic Environment	Effect on terrestrial ecosystems	Predicted impact on vegetation communities Predicted impact on wildlife habitat Predicted impact on vegetation and wildlife including rare, threatened or endangered species	Temporary loss of existing vegetation communities (e.g., marsh, meadow, and thicket habitat) and associated wildlife habitat as a result of regrading activities and expansion into buffer areas. Temporary loss of approximately 13 ha of habitat for a threatened species (eastern meadowlark) in the dry-fresh graminoid meadow ecosite at the south and west portion of the Site. No off-Site impacts anticipated.	Conduct any vegetation removal activities outside of the breeding bird window (i.e., no removals between late March - late August). Compensation for the loss of vegetation communities could occur elsewhere on-site where there are areas that could be revegetated. Where possible, salvage plant material for restoration from areas where vegetation is removed. Consult with MNRF to determine if there is a need for any registrations, permits or approvals related to the presence of eastern meadowlark to avoid contravention of the provincial Endangered Species Act. Incorporate graminoid meadow habitats into the closure landscape plan. Implement BMP’s including: • Use of dust suppressants • Installation of protective fencing (where required) • Conduct a nest survey of on-Site facilities and infrastructure prior to relocation or removal of structures to mitigate impacts to bird species which may use	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.

Alternative Option 4 – Reconfiguration and Footprint Expansion						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
					anthropogenic structures for nesting. If nests are found, consult a biologist/MNRF for further direction. • Any wildlife incidentally encountered during Site operation activities will not be knowingly harmed and will be allowed to move away from the area on its own. • In the event that an animal encountered during Site operation activities does not move from the area, or is injured, the Site Supervisor, a biologist, and MNRF will be notified. • In the event that the animal is a known or suspected SAR, the Site Supervisor will contact MNRF SAR biologists for advice. • Include naturalized landscape features into the stormwater management facilities design (e.g., emergent robust vegetation, shallow slope)	
		Effect on aquatic ecosystems	Predicted impact on aquatic habitat Predicted impact on aquatic biota	Loss of on-Site aquatic habitat and disturbance of aquatic biota associated with open water habitats in stormwater infrastructure due to regrading activities and modifications to stormwater ponds at the northwest corner of the Site. No off-Site impacts anticipated.	Characterize use of on-Site aquatic features by fish and wildlife prior to modification/removal. Obtain necessary permits for/complete fish/wildlife rescue activities prior to initiation of any in-water works, as appropriate. Install erosion and sediment control (ESC) measures to mitigate impacts to water quality and to act as wildlife exclusion fencing prior to construction, and maintain them appropriately throughout landfill construction and operation.	Loss of on-site aquatic habitat and biota will be minimized through mitigation measures.
	Atmospheric Environment	Effect of air quality on off-site receptors	Predicted off-Site point of impingement concentrations (ug/m^3) of indicator compounds Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	There is a potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria. Primarily has the potential to affect receptors near the northeast of the site and along First Rd. West This scenario predicts higher concentrations of particulate species than the maximum allowable operations permitted under the current license due to changed on-site road and material handling area layout	Implement Fugitive Dust BMP to include controls such as; • Paving on-site roads • Road cleaning (watering, application of calcium chloride or other dust suppressants) • Re-routing on-site roads so they are further from the site fenceline • Limiting vehicle speeds on on-site roads • Review of the number of vehicles accessing the site on a daily basis • Detailed assessment of the progression of the site operations for the preferred alternative • Other options as identified during the design of the preferred option. Review number of vehicles accepted daily as part of further impact assessment. Models were completed using highly conservative amount of 250 trucks per/day. Average trucks currently to site is approximately 90.	Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.
		Effect of odours on off-site receptors	Predicted off-Site odour concentrations (ug/m^3 and odour units) Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	This scenario is not anticipated to be different from the current license from an odour perspective	Maintain the operational measures currently in place to reduce/mitigate odour impacts from the Site during the vertical expansion including current mitigation activities, including complaint handling and monitoring program	This scenario is not anticipated to be different from the current license from an odour perspective
		Effect of noise on off-site receptors	Predicted off-Site noise level	Potential change to the predicted off-site noise impact and the decrease in the separation distance between the landfill activities and the adjacent residential properties. POR1=57 dBA POR2=43 dBA POR3=52 dBA POR4=42 dBA POR5=56 dBA POR6=57 dBA	**Existing Residential Properties:** Barriers and/or berms at landfill perimeter to the north. Height of barrier and/or berm (north of site): 9 meter tall above existing grade (201m ASL to 208m ASL). **Potential Future Development of Surrounding Properties:** Barriers and/or berms at landfill perimeter to the north. Height of barrier and/or berm (north of site): 9 meter tall above existing grade (201m ASL to 208m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.

Alternative Option 4 – Reconfiguration and Footprint Expansion						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Net sound level change for up to 200 off-Site receptors is 1 dBA or lower: • Approximately 75 residences (to the north): +1 dBA change (based on worst case operation scenario) • POR5=56 dBA	Construction of a 9 meter tall barrier and/or berm above existing grade (201m ASL to 208m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.
Built	Land Use	Effect on existing land use	Current land use	No change to the current land use designation (Open Space/Commercial) and no change to Land Use Zoning (ME-1).	No mitigation measures required	No change in current land uses
		Effect on views of the facility	Predicted changes in views of the facility from the surrounding area	No height increase but property buffers are reduced to 30m and material is reconfigured. Visibility increased for sensitive receptors and properties adjacent to site including residential dwellings to South on Green Mountain Rd. as well as homes along Mud Street.	Implementation of screening berm along southern property line for noise will assist with visual screening from residential areas, but will not be able to mitigate views completely. Additional screening guards and vegetation can be implemented to further mitigate views for sensitive receptors.	Installation of visual screening elements would not be able to completely obscure views of the facility from sensitive receptors.
Social	Human Health	Effect on Air Quality	Predicted impacts to air quality and their potential effects on human health	Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (*i.e.*, 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case.	It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase such as Dust BMPs (as referenced under Air Quality) to reduce ambient PM10 particulate concentrations.	Mitigation measures such as Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.
		Leachate Quantity	Predicted effects of leachate quality (inorganic and organic chemicals) on human health	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.	Existing leachate treatment and management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for leachate treatment and proposed mitigation measures for geology/hydrogeology will mitigate effects of leachate.
		Groundwater Quality	Predicted impacts to groundwater quality and their potential effects on human health	Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.	Existing groundwater mitigation management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for groundwater and proposed mitigation measures for geology/hydrogeology will mitigate effects of on groundwater quality.
		Surface Water Quality	Predicted impacts to surface water quality and their potential effects on human health	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.	Existing and proposed surface water mitigation management practices.	Existing and proposed landfill measures for surface water will mitigate effects of on surface water quality.
		Soil Quantity	Predicted impacts to soil and their potential effects on human health	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.	Continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines	Existing and proposed particulate/dust control mitigation measures with ongoing monitoring will mitigate effects to soil quality.
	Transportation	Effect on Traffic	Potential for traffic collisions Level of Service at intersections around the SCRF	Increases in traffic around site due to background development. No increases in trucks to site so no change in potential for collisions or to the existing level of road user safety and intersection Level of Service within the Local Study Area.	No mitigation measures required.	Despite an expected increase in traffic associated to development of residential neighbourhoods in the adjacent properties, potential collisions is not expected to increase as the number of trucks to and from site will not increase.
Economic	Economic	Effect on approved/planned land uses	Number, extent, and type of approved/planned land uses affected	Approximately 1,200 residential dwellings, 11 commercial units, 4 agricultural properties, 1 recreational, 1 institutional within 500m of site. No anticipated effects to these land uses through various landfill operation mitigation measures.	Basic landfill operation mitigation measures including; storm water management, leachate treatment, dust and noise control will assist in mitigating effects to surrounding properties.	No effects to approved/planned land uses.
		Economic benefit to the City of Hamilton and local community	Employment at site (number and duration)	Expansion and reconfiguration would allow for increased economic activity and economic benefits to Community based on $ per tonne agreements. Staffing would be 15 full-time equivalents, with total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 240 years.	No mitigation measures required	Employment increased (year over year). Increased economic benefits to City and Local Community.
Cultural	Archaeology and Built Heritage	Effect on known or potential significant archaeological resources	Number and type of potentially significant, known archaeological sites affected	Site was previously excavated for Quarry extraction. No significant archaeological sites or resources.	No mitigation measures required.	No effects to archaeological sites or resources.

Alternative Option 4 – Reconfiguration and Footprint Expansion						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
			Area (ha) of archaeological potential (i.e., lands with potential for the presence of significant archaeological resources) affected			
		Effect on built heritage resources and cultural heritage landscapes	Number and type of built heritage resources and cultural heritage landscapes displaced or disrupted	Only 1 cultural heritage landscape within 1.5km Site Area.	Due to proximity of the heritage landscape, no interaction will occur, therefore no mitigation is required.	No impacts on cultural heritage resources
Technical	Design and Operations	Potential to Provide Service for Disposal	Ability to provide 3,680,000 m^3 of additional disposal capacity for post diversion solid, non-hazardous industrial residual material	Only provides 9,580,000 m^3 of total capacity for residual material. Does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.	No mitigation measures possible.	Only provides 9,580,000 m^3 of total capacity for residual material. Does not meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.
		Leachate Management	Design and operating complexity	Requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are generally uniform. The larger footprint of the residual material area will see a large increase to the leachate generation rate.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Moderate increase in complexity relative to current leachate management system associated with: additional base liner and leachate collection system; increased leachate generation rate.
		Stormwater Management	Design and operating complexity	Includes an “L” shaped stormwater pond layout which is not consistent with the current approved design. The layout of the stormwater pond limits design and operational flexibility.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Moderate increase to complexity relative to current stormwater management system.
		Construction	Complexity and constructability of components	Requires the construction of additional base liner and leachate collection system for the expanded residual material area. Requires expanding the base liner and leachate collection system horizontally to include other areas of the site. Open layout with a simple configuration and dedicated areas for the various components.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Large increase in complexity relative to current construction requirements associated with: additional base liner and leachate collection system; expansion of base liner and leachate collection system into other areas of the site; complex layout of stormwater management pond.
		Site Operations	Complexity and operability of components	Does not include the importing of industrial fill, meaning that his material will no longer need to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond limits operational flexibility. Access and egress from the site will be modified from their current configuration. Development of the site will require the relocation or removal of existing infrastructure	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Moderate increase in complexity relative to current site operations associated with: layout of the stormwater management pond; site access and egress.
		Closure and Post-Closure	Flexibility of design and operations	Open and uniform configuration that will simplify site closure requirements. The overall layout and contours of the site do not limit the flexibility of potential post-closure uses.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Simplified closure requirements and increased flexibility of post-closure uses relative to current design.
		Cost of Facility	Approximate relative cost of Alternative Methods	Increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will also be additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure. Potential savings could be realized by no longer having to manage industrial fill material.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Large increase to costs relative to current design associated with: expansion of base liner and leachate collection system into adjacent areas of the site; layout of stormwater pond.

Alternative Option 5 – Reconfiguration and Height Increase						
	Environmental Component	**Criteria**	**Indicators**	**Potential Effects**	**Mitigation Measures**	**Net Effects**
Natural	Geology and Hydrogeology	Effect on Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site Predicted effects to Source Water Protection Area	Minor increases in leachate indicator parameters at downgradient wells Minor increases in leachate indicator parameters reaching upgradient limits reaching wellhead protection area	The existing landfill liner system will be expanded to accommodate new waste placement areas. The landfill liner design has been developed to ensure that leachate will be collected to eliminate leakage. Operation of the M4 containment well, along with the groundwater collection trench network will ensure that any leakage through the liner system will be contained and suitably managed. Development and implementation of an Environmental Monitoring Plan (EMP) appropriate to the option will verify the leachate and groundwater control systems are effectively managing impacts to groundwater. The above referenced leachate and groundwater control systems will mitigate the potential migration of impacts to the off-Site source water protection area	No off-site groundwater receptors will be affected. No effects to groundwater within source water protection area.
		Effect on Groundwater Flow	Predicted effects to groundwater flow at property boundaries and off-site	No change in groundwater flow because proposed expansion alternatives will have minimal effect on groundwater recharge patterns	No mitigation measure required.	No off-site groundwater receptors will be affected.
	Surface Water Resources	Effect on Surface Water Quality	Predicted effects on surface water quality on-site and off-site	Surface quality to be similar to baseline since additional residual material will have final cover. Contaminants of concern in the runoff are TSS.	The existing stormwater management pond will be altered as required (provide adequate permanent pool volume and active storage volume) to treat TSS from the stormwater runoff. Stormwater from the pond will not be released to surface water body (i.e., storm sewer system that drains into Davis Creek) until testing determines all parameters have been met to discharge. Contingency measures include “status quo”, which is to discharge stormwater to sanitary sewer for treatment at the City’s water pollution control plant.	Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations
		Effect on Surface Water Quantity	Predicted change in drainage areas Predicted occurrence and degree of off-site effects	The increased area of residual material results in an increase in impermeable area due to the residual material final cover. This will produce an increase runoff volume of 11% during the 2-year storm event and 6% during the 100-year storm event. Increased runoff volume will result in increased flooding ditches to the northwest, in the sewer below First Road West and Davis Creek. Erosion of the creek and ditches may also occur because of the increased runoff volume.	Perimeter ditches will keep the increased runoff on-site and direct flows to the modified stormwater management pond. The stormwater management pond will be sized to capture the 2-year through 100-year storm events and control the release rate to prevent flooding and erosion off-site. Contingency measures include “status quo”, which is to discharge excess stormwater to sanitary sewer for conveyance to the City’s water pollution control plant.	No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek

Alternative Option 5 – Reconfiguration and Height Increase					
Environmental Component	**Criteria**	**Indicators**	**Potential Effects**	**Mitigation Measures**	**Net Effects**
Terrestrial and Aquatic Environment	Effect on terrestrial ecosystems	Predicted impact on vegetation communities Predicted impact on wildlife habitat Predicted impact on vegetation and wildlife including rare, threatened or endangered species	Temporary loss of existing vegetation communities (e.g., marsh, meadow, and thicket habitat) and associated wildlife habitat as a result of regrading activities. Temporary loss of approximately 13 ha of habitat of a threatened species (eastern meadowlark) in the dry-fresh graminoid meadow ecosite at the south and west portion of the Site. No off-Site impacts anticipated.	Conduct any vegetation removal activities outside of the breeding bird window (i.e., no removals between late March - late August). Compensation for the loss of vegetation communities could occur elsewhere on-site where there are areas that could be revegetated. Where possible, salvage plant material for restoration from areas where vegetation is removed. Consult with MNRF to determine if there is a need for any registrations, permits or approvals related to the presence of eastern meadowlark to avoid contravention of the provincial Endangered Species Act. Incorporate graminoid meadow habitats into the closure landscape plan. Implement BMP's including: • Use of dust suppressants • Installation of protective fencing (where required) • Conduct a nest survey of on-Site facilities and infrastructure prior to relocation or removal of structures to mitigate impacts to bird species which may use anthropogenic structures for nesting. If nests are found, consult a biologist/MNRF for further direction. • Any wildlife incidentally encountered during Site operation activities will not be knowingly harmed and will be allowed to move away from the area on its own. • In the event that an animal encountered during Site operation activities does not move from the area, or is injured, the Site Supervisor, a biologist, and MNRF will be notified. • In the event that the animal is a known or suspected SAR, the Site Supervisor will contact MNRF SAR biologists for advice. • Include naturalized landscape features into the stormwater management facilities design (e.g., emergent robust vegetation, shallow slope)	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.
	Effect on aquatic ecosystems	Predicted impact on aquatic habitat Predicted impact on aquatic biota	Loss of on-Site aquatic habitat and disturbance of aquatic biota associated with open water habitats in stormwater infrastructure due to regrading activities. No off-Site impacts anticipated.	Characterize use of on-Site aquatic features by fish and wildlife prior to modification/removal. Obtain necessary permits for/complete fish/wildlife rescue activities prior to initiation of any in-water works, as appropriate. Install erosion and sediment control (ESC) measures to mitigate impacts to water quality and to act as wildlife exclusion fencing prior to construction, and maintain them appropriately throughout landfill construction and operation.	Loss of on-site aquatic habitat and biota will be minimized through mitigation measures.
Atmospheric Environment	Effect of air quality on off-site receptors	Predicted off-Site point of impingement concentrations (ug/m^3) of indicator compounds Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	There is a potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria. Primarily has the potential to affect receptors north of Green Mountain Road This scenario predicts higher concentrations of particulate species than the maximum allowable operations permitted under the current license due to changed on-site road and material handling area layout	Implement Fugitive Dust BMP to include controls such as; • Paving on-site roads • Road cleaning (watering, application of calcium chloride or other dust suppressants) • Re-routing on-site roads so they are further from the site fenceline • Limiting vehicle speeds on on-site roads • Review of the number of vehicles accessing the site on a daily basis • Detailed assessment of the progression of the site operations for the preferred alternative • Other options as identified during the design of the preferred option. Review number of vehicles accepted daily as part of further impact assessment. Models were completed using highly conservative amount of 250 trucks per/day. Average trucks currently to site is approximately 90.	Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.

Alternative Option 5 – Reconfiguration and Height Increase						
	Environmental Component	**Criteria**	**Indicators**	**Potential Effects**	**Mitigation Measures**	**Net Effects**
		Effect of odours on off-site receptors	Predicted off-Site odour concentrations (ug/m^3 and odour units) Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	This scenario is not anticipated to be different from the current license from an odour perspective	Maintain the operational measures currently in place to reduce/mitigate odour impacts from the Site during the vertical expansion including current mitigation activities, including complaint handling and monitoring program	This scenario is not anticipated to be different from the current license from an odour perspective
		Effect of noise on off-site receptors	Predicted off-Site noise level	Potential change to the predicted off-site noise impact due increased line-of-sight from the +2.5 m elevation change and the decrease in the separation distance between the landfill activities and the adjacent residential properties. POR1=59 dBA POR2=44 dBA POR3=53 dBA POR4=40 dBA POR5=53 dBA POR6=53 dBA	**Existing Residential Properties**: No mitigation measures required. **Potential Future Development of Surrounding Properties:** Barriers and/or berms at landfill perimeter to the north. Height of barrier and/or berm (north of site): 8 meter tall above existing grade (201m ASL to 208m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Net sound level change for up to 200 off-Site receptors is 3 dBA or lower: • Approximately 75 residences (to the north): +3 dBA change (based on worst case operation scenario) • POR5=54 dBA	Construction of a 8 meter tall barrier and/or berm above existing grade (201m to 208m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.
Built	Land Use	Effect on existing land use	Current land use	No change to the current land use designation (Open Space/Commercial) and no change to Land Use Zoning (ME-1).	No mitigation measures required	No change in current land uses
		Effect on views of the facility	Predicted changes in views of the facility from the surrounding area	Slight height increase and property buffers are maintained. Visibility increased mostly for sensitive receptors and properties adjacent to site including residential dwellings to South on Green Mountain Rd. as well as homes along Mud Street.	Implementation of screening berm along southern property line for noise will assist with visual screening from residential areas, but will not be able to mitigate views completely. Additional screening guards and vegetation can be implemented to mitigate views for sensitive receptors.	Installation of visual screening elements would sufficiently obscure views of the facility from sensitive receptors.
Social	Human Health	Effect on Air Quality	Predicted impacts to air quality and their potential effects on human health	Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (*i.e.*, 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case.	It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase such as Dust BMPs (as referenced under Air Quality) to reduce ambient PM10 particulate concentrations.	Mitigation measures such as Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.
		Leachate Quantity	Predicted effects of leachate quality (inorganic and organic chemicals) on human health	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.	Existing leachate treatment and management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for leachate treatment and proposed mitigation measures for geology/hydrogeology will mitigate effects of leachate.
		Groundwater Quality	Predicted impacts to groundwater quality and their potential effects on human health	Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.	Existing groundwater mitigation management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for groundwater and proposed mitigation measures for geology/hydrogeology will mitigate effects of on groundwater quality.
		Surface Water Quality	Predicted impacts to surface water quality and their potential effects on human health	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.	Existing and proposed surface water mitigation management practices.	Existing and proposed landfill measures for surface water will mitigate effects of on surface water quality.
		Soil Quantity	Predicted impacts to soil and their potential effects on human health	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.	Continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines	Existing and proposed particulate/dust control mitigation measures with ongoing monitoring will mitigate effects to soil quality.
	Transportation	Effect on Traffic	Potential for traffic collisions	Increases in traffic around site due to background development. No increases in trucks to site so no change in potential for collisions or to the	No mitigation measures required.	Despite an expected increase in traffic associated to development of residential neighbourhoods in the

Alternative Option 5 – Reconfiguration and Height Increase						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
			Level of Service at intersections around the SCRF	existing level of road user safety and intersection Level of Service within the Local Study Area.		adjacent properties, potential collisions is not expected to increase as the number of trucks to and from site will not increase.
Economic	Economic	Effect on approved/planned land uses	Number, extent, and type of approved/planned land uses affected	Approximately 1,200 residential dwellings, 11 commercial units, 4 agricultural properties, 1 recreational, 1 institutional within 500m of site. No anticipated effects to these land uses through various landfill operation mitigation measures.	Basic landfill operation mitigation measures including; storm water management, leachate treatment, dust and noise control will assist in mitigating effects to surrounding properties.	No effects to approved/planned land uses.
		Economic benefit to the City of Hamilton and local community	Employment at site (number and duration)	Expansion and reconfiguration would result in maximum economic activity and economic benefits to the Community based on $ per tonne agreements. Staffing would be 15 full-time equivalents, with total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 250 years.	No mitigation measures required	Employment increased (year over year). Increased economic benefits to City and Local Community.
Cultural	Archaeology and Built Heritage	Effect on known or potential significant archaeological resources	Number and type of potentially significant, known archaeological sites affected Area (ha) of archaeological potential (i.e., lands with potential for the presence of significant archaeological resources) affected	Site was previously excavated for Quarry extraction. No significant archaeological sites or resources.	No mitigation measures required.	No effects to archaeological sites or resources.
		Effect on built heritage resources and cultural heritage landscapes	Number and type of built heritage resources and cultural heritage landscapes displaced or disrupted	Only 1 cultural heritage landscape within 1.5km Site Area.	Due to proximity of the heritage landscape, no interaction will occur, therefore no mitigation is required.	No effects on cultural heritage resources
Technical	Design and Operations	Potential to Provide Service for Disposal	Ability to provide 3,680,000 m^3 of additional disposal capacity for post diversion solid, non-hazardous industrial residual material	Provides 10,000,000 m^3 of total capacity for residual material. Meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.	No mitigation measures possible.	Provides 10,000,000 m^3 of total capacity for residual material. Meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.
		Leachate Management	Design and operating complexity	Requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in a single area with one leachate pumping station. The shape and contours of the residual area are generally uniform. The larger footprint of the residual material area will see a moderate increase to the leachate generation rate.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Small increase in complexity relative to current leachate management system associated with: additional base liner and leachate collection system; increased leachate generation rate.
		Stormwater Management	Design and operating complexity	Includes a triangular stormwater pond layout which is consistent with the current approved design. The layout of the stormwater pond provides design and operational flexibility.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	No increase in complexity relative to current stormwater management system.
		Construction	Complexity and constructability of components	Requires the construction of additional base liner and leachate collection system for the expanded residual material area. Does not require expanding the base liner and leachate collection system horizontally to include other areas of the site. Open layout with a simple configuration and dedicated areas for the various components.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Small increase in complexity relative to current construction requirements associated with: additional base liner and leachate collection system.
		Site Operations	Complexity and operability of components	Does not include the importing of industrial fill, meaning that his material will no longer need to be managed. Leachate will be managed from a single area with one leachate pumping station. The proposed layout of the stormwater management pond provides operational flexibility. Access and egress from the site will be maintained in their current configuration. Development of the site will require the relocation or removal of existing infrastructure.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	No increase in complexity relative to current site operations.
		Closure and Post-Closure	Flexibility of design and operations	Open and uniform configuration that will simplify site closure requirements. The overall layout and contours of the site do not limit the flexibility of potential post-closure uses.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Simplified closure requirements and increased flexibility of post-closure uses relative to current design.
		Cost of Facility	Approximate relative cost of Alternative Methods	Increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be no additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure. Potential savings could be realized by no longer having to manage industrial fill material.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Small increase to costs relative to current design associated with: additional base liner and leachate collection system.

Alternative Option 6 – Footprint Expansion and Height Increase						
	Environmental Component	**Criteria**	**Indicators**	**Potential Effects**	**Mitigation Measures**	**Net Effects**
Natural	Geology and Hydrogeology	Effect on Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site Predicted effects to Source Water Protection Area	Minor increases in leachate indicator parameters at downgradient wells Minor increases in leachate indicator parameters reaching upgradient limits reaching wellhead protection area	The existing landfill liner system will be expanded to accommodate new waste placement areas. The landfill liner design has been developed to ensure that leachate will be collected to eliminate leakage. Operation of the M4 containment well, along with the groundwater collection trench network will ensure that any leakage through the liner system will be contained and suitably managed. Development and implementation of an Environmental Monitoring Plan (EMP) appropriate to the option will verify the leachate and groundwater control systems are effectively managing impacts to groundwater. The above referenced leachate and groundwater control systems will mitigate the potential migration of impacts to the off-Site source water protection area	No off-site groundwater receptors will be affected. No effects to groundwater within source water protection area.
		Effect on Groundwater Flow	Predicted effects to groundwater flow at property boundaries and off-site	No change in groundwater flow because proposed expansion alternatives will have minimal effect on groundwater recharge patterns	No mitigation measure required.	No off-site groundwater receptors will be affected.
	Surface Water Resources	Effect on Surface Water Quality	Predicted effects on surface water quality on-site and off-site	Surface quality to be similar to baseline since residual material will have final cover as in baseline condition. Increased SCRF height will result in higher peak flows that may cause slightly higher levels of contaminants in runoff. Contaminants of concern in the runoff are TSS.	A new stormwater management pond will be constructed in the northwest buffer area to treat suspended solids from the stormwater runoff. The pond will provide adequate permanent pool volume and active storage volume. Stormwater from the pond will not be released to surface water body (i.e., storm sewer system that drains into Davis Creek) until testing determines all parameters have been met to discharge. Contingency measures include “status quo”, which is to discharge stormwater to sanitary sewer for treatment at the City’s water pollution control plant.	Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations
		Effect on Surface Water Quantity	Predicted change in drainage areas Predicted occurrence and degree of off-site effects	The increased area and footprint of residual material results in an increase in impermeable area due to the residual material final cover. This will produce an increase runoff volume of 3% during the 2-year storm event and 2% during the 100-year storm event. The increase in SCRF height will result in slightly higher peak flows during the 100-year event (less than 1%). Increased runoff volume and peak flows will result in increased flooding in the roadside ditches to the northwest, in the sewer below First Road West and Davis Creek. Erosion of the creek and ditches may also occur because of the increased runoff volume and peak flows.	Perimeter ditches will keep the increased runoff on-site and direct flows to the new stormwater management pond. The new stormwater management pond will be sized to capture the 2-year through 100-year storm events and control the release rate to prevent flooding and erosion off-site. Contingency measures include “status quo”, which is to discharge excess stormwater to sanitary sewer for conveyance to the City’s water pollution control plant.	No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek
	Terrestrial and Aquatic Environment	Effect on terrestrial ecosystems	Predicted impact on vegetation communities Predicted impact on wildlife habitat Predicted impact on vegetation and wildlife including rare, threatened or endangered species	Temporary loss of existing vegetation communities (e.g., marsh, meadow, and thicket habitat) and associated wildlife habitat as a result of regrading activities and expansion into buffer areas. Temporary loss of approximately 13 ha of habitat for a threatened species (eastern meadowlark) in the dry-fresh graminoid meadow ecosite at the south and west portion of the Site. No off-Site impacts anticipated.	Conduct any vegetation removal activities outside of the breeding bird window (i.e., no removals between late March - late August). Compensation for the loss of vegetation communities could occur elsewhere on-site where there are areas that could be revegetated. Where possible, salvage plant material for restoration from areas where vegetation is removed. Consult with MNRF to determine if there is a need for any registrations, permits or approvals related to the presence of eastern meadowlark to avoid contravention of the provincial Endangered Species Act. Incorporate graminoid meadow habitats into the closure landscape plan. Implement BMP’s including: • Use of dust suppressants • Installation of protective fencing (where required) • Conduct a nest survey of on-Site facilities and infrastructure prior to relocation or removal of structures to mitigate impacts to bird species which	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.

Alternative Option 6 – Footprint Expansion and Height Increase						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
					may use anthropogenic structures for nesting. If nests are found, consult a biologist/MNRF for further direction. • Any wildlife incidentally encountered during Site operation activities will not be knowingly harmed and will be allowed to move away from the area on its own. • In the event that an animal encountered during Site operation activities does not move from the area, or is injured, the Site Supervisor, a biologist, and MNRF will be notified. • In the event that the animal is a known or suspected SAR, the Site Supervisor will contact MNRF SAR biologists for advice. • Include naturalized landscape features into the stormwater management facilities design (e.g., emergent robust vegetation, shallow slope)	
		Effect on aquatic ecosystems	Predicted impact on aquatic habitat Predicted impact on aquatic biota	Loss of on-Site aquatic habitat and disturbance of aquatic biota associated with open water habitats in stormwater infrastructure due to regrading activities and modifications to stormwater ponds at the northwest corner of the Site. No off-Site impacts anticipated.	Characterize use of on-Site aquatic features by fish and wildlife prior to modification/removal. Obtain necessary permits for/complete fish/wildlife rescue activities prior to initiation of any in-water works, as appropriate. Install erosion and sediment control (ESC) measures to mitigate impacts to water quality and to act as wildlife exclusion fencing prior to construction, and maintain them appropriately throughout landfill construction and operation.	Loss of on-site aquatic habitat and biota will be minimized through mitigation measures.
	Atmospheric Environment	Effect of air quality on off-site receptors	Predicted off-Site point of impingement concentrations (ug/m^3) of indicator compounds Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	There is a potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria. Primarily has the potential to affect receptors northeast of the site, and along First Street West This scenario predicts higher concentrations of particulate species than the maximum allowable operations permitted under the current license due to changed on-site road and material handling area layout	Implement Fugitive Dust BMP to include controls such as; • Paving on-site roads • Road cleaning (watering, application of calcium chloride or other dust suppressants) • Re-routing on-site roads so they are further from the site fenceline • Limiting vehicle speeds on on-site roads • Review of the number of vehicles accessing the site on a daily basis • Detailed assessment of the progression of the site operations for the preferred alternative • Other options as identified during the design of the preferred option. Review number of vehicles accepted daily as part of further impact assessment. Models were completed using highly conservative amount of 250 trucks per/day. Average trucks currently to site is approximately 90.	Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.
		Effect of odours on off-site receptors	Predicted off-Site odour concentrations (ug/m^3 and odour units) Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	This scenario is not anticipated to be different from the current license from an odour perspective	Maintain the operational measures currently in place to reduce/mitigate odour impacts from the Site during the vertical expansion including current mitigation activities, including complaint handling and monitoring program	This scenario is not anticipated to be different from the current license from an odour perspective.
		Effect of noise on off-site receptors	Predicted off-Site noise level	Potential change to the predicted off-site noise impact due increased line-of-sight from the + 8 m elevation and the decrease in separation distance between the landfill activities and the adjacent residential properties. POR1=58 dBA POR2=42 dBA POR3=53 dBA POR4=43 dBA POR5=52 dBA POR6=58 dBA	**Existing Residential Properties**: Barriers and/or berms at landfill perimeter. Height of barriers and/or berm (north of site): 4m above future screening berm. **Potential Future Development of Surrounding Properties:** Barriers and/or berms at landfill perimeter to the north. Height of barrier and/or berm (north of site): 9 meter tall above existing grade (202m ASL to 209m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.

Alternative Option 6 – Footprint Expansion and Height Increase						
	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Net sound level change for up to 200 off-Site receptors is 2 dBA or lower: • Approximately 75 residences (to the north): +2 dBA change (based on worst case operation scenario) • POR5=54 dBA	Construction of a 9 meter tall barrier and/or berm above existing grade (202m to 209m ASL).	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.
Built	Land Use	Effect on existing land use	Current land use	No change to the current land use designation (Open Space/Commercial) and no change to Land Use Zoning (ME-1).	No mitigation measures required	No change in current land uses
		Effect on views of the facility	Predicted changes in views of the facility from the surrounding area	Large change height (8m), but property buffers are reduced to 30m. Visibility increased for all sensitive receptors and properties in all directions.	Implementation of screening berm along southern property line for noise will assist with visual screening from residential areas, but will not be able to mitigate views completely. Additional screening guards and vegetation can also help to mitigate views, but will not block them completely.	Installation of visual screening elements would not be able to sufficiently obscure views of the facility from sensitive receptors.
Social	Human Health	Effect on Air Quality	Predicted impacts to air quality and their potential effects on human health	Results of the air quality assessment indicate that this VOC emissions from this method would be less than those predicted for the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (*i.e.*, 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case.	It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase such as Dust BMPs (as referenced under Air Quality) to reduce ambient PM10 particulate concentrations.	Mitigation measures such as Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to air quality.
		Leachate Quantity	Predicted effects of leachate quality (inorganic and organic chemicals) on human health	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, this alternative method would not be expected to result in any health risks different than the existing approved landfill design.	Existing leachate treatment and management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for leachate treatment and proposed mitigation measures for geology/hydrogeology will mitigate effects of leachate.
		Groundwater Quality	Predicted impacts to groundwater quality and their potential effects on human health	Results of the hydrogeology assessment indicate that this alternative method has leachate leakage rates through the liner that are substantially similar to the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar to the existing approved landfill design.	Existing groundwater mitigation management practices as well as mitigation measures proposed under geology/hydrogeology.	Existing landfill measures for groundwater and proposed mitigation measures for geology/hydrogeology will mitigate effects of on groundwater quality.
		Surface Water Quality	Predicted impacts to surface water quality and their potential effects on human health	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards.	Existing and proposed surface water mitigation management practices.	Existing and proposed landfill measures for surface water will mitigate effects of on surface water quality.
		Soil Quantity	Predicted impacts to soil and their potential effects on human health	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for this proposed Alternative method should not be significantly different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible.	Continue existing particulate/dust control mitigation measures with ongoing monitoring to confirm compliance with ambient guidelines	Existing and proposed particulate/dust control mitigation measures with ongoing monitoring will mitigate effects to soil quality.
	Transportation	Effect on Traffic	Potential for traffic collisions Level of Service at intersections around the SCRF	Increases in traffic around site due to background development. No increases in trucks to site so no change in potential for collisions or to the existing level of road user safety and intersection Level of Service within the Local Study Area.	No mitigation measures required.	Despite an expected increase in traffic associated to development of residential neighbourhoods in the adjacent properties, potential collisions is not expected to increase as the number of trucks to and from site will not increase.
Economic	Economic	Effect on approved/planned land uses	Number, extent, and type of approved/planned land uses affected	Approximately 1,200 residential dwellings, 11 commercial units, 4 agricultural properties, 1 recreational, 1 institutional within 500m of site. No anticipated effects to these land uses through various landfill operation mitigation measures.	Basic landfill operation mitigation measures including; storm water management, leachate treatment, dust and noise control will assist in mitigating effects to surrounding properties.	No effects to approved/planned land uses.
		Economic benefit to the City of Hamilton and local community	Employment at site (number and duration)	Expansion and reconfiguration would result in maximum economic activity and economic benefits to the Community based on $ per tonne agreements. Staffing would be 15 full-time equivalents, with total years of employment for all employees for construction, operation and post-closure monitoring would be approximately 250 years.	No mitigation measures required	Employment increased (year over year). Increased economic benefits to City and Local Community.
Cultural	Archaeology and Built Heritage	Effect on known or potential significant	Number and type of potentially significant, known archaeological sites affected	Site was previously excavated for Quarry extraction. No significant archaeological sites or resources.	No mitigation measures required.	No effects to archaeological sites or resources.

	Environmental Component	Criteria	Indicators	Potential Effects	Mitigation Measures	Net Effects
Alternative Option 6 – Footprint Expansion and Height Increase						
		archaeological resources	Area (ha) of archaeological potential (i.e., lands with potential for the presence of significant archaeological resources) affected			
		Effect on built heritage resources and cultural heritage landscapes	Number and type of built heritage resources and cultural heritage landscapes displaced or disrupted	Only 1 cultural heritage landscape within 1.5km Site Area.	Due to proximity of the heritage landscape, no interaction will occur, therefore no mitigation is required.	No effects on cultural heritage resources
Technical	Design and Operations	Potential to Provide Service for Disposal	Ability to provide 3,680,000 m^3 of additional disposal capacity for post diversion solid, non-hazardous industrial residual material	Provides 10,000,000 m^3 of total capacity for residual material. Meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.	No mitigation measures possible.	Provides 10,000,000 m^3 of total capacity for residual material. Meets the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3.
		Leachate Management	Design and operating complexity	Requires the design and construction of additional base liner and leachate collection system for the expanded residual material area. The residual material is placed in two separate areas with two separate leachate pumping stations. The shape and contours of the residual area are irregular. The larger footprint of the residual material area will see a small increase to the leachate generation rate.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Moderate increase in complexity relative to current leachate management system associated with: additional base liner and leachate collection system; separate leachate pumping systems; irregular shape/contours; increased leachate generation rate.
		Stormwater Management	Design and operating complexity	Includes an "L" shaped stormwater pond layout which is not consistent with the current approved design. The layout of the stormwater pond limits design and operational flexibility.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Moderate increase to complexity relative to current stormwater management system.
		Construction	Complexity and constructability of components	Requires the construction of additional base liner and leachate collection system for the expanded residual material area. Requires expanding the base liner and leachate collection system horizontally to include other areas of the site. Complex layout with an integrated configuration of the various components.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Large increase in complexity relative to current construction requirements associated with: additional base liner and leachate collection system; expansion of base liner and leachate collection system into other areas of the site; complex layout and integration of other components such as the stormwater management pond.
		Site Operations	Complexity and operability of components	Includes the importing of industrial fill, meaning that his material will continue to be managed. Leachate will be managed from two separate areas with two separate leachate pumping stations. The proposed layout of the stormwater management pond limits operational flexibility. Access and egress from the site will be modified from their current configuration. Development of the site will require the relocation or removal of existing infrastructure.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Large increase in complexity relative to current site operations associated with: two separate leachate pumping stations; layout of the stormwater management pond; site access and egress.
		Closure and Post-Closure	Flexibility of design and operations	Complex layout with an integrated configuration that may complicate site closure requirements. The overall layout and contours of the site limit the flexibility of potential post-closure uses.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Moderate increase to closure requirements and reduced flexibility of post-closure uses relative to current design.
		Cost of Facility	Approximate relative cost of Alternative Methods	Increased costs related to the design, construction, operation, and maintenance of additional base liner and leachate collection system. There will be additional construction costs associated with the excavation of adjacent areas of the site to expand the base liner and leachate collection system. Additional costs will be incurred for the relocation or removal of existing infrastructure.	Mitigation through modifications to the SCRF design and/or operation. Restrictions on the SCRF design and operations limit the ability to mitigate these effects.	Large increase to costs relative to current design associated with: expansion of base liner and leachate collection system into adjacent areas of the site; layout of stormwater pond.

Appendix D

Draft Comparative Evaluation Consolidated Table

Appendix D
Draft Comparative Evaluation
Consolidated Table

Stoney Creek Regional Facility EA (Terrapure Environmental)
Draft Comparative Evaluation Table

Environmental Component	Evaluation Criteria	Indicators	Alternative Methods					
			Alternative Method 1	Alternative Method 2	Alternative Method 3	Alternative Method 4	Alternative Method 5	Alternative Method 6
Geology and Hydrogeology	Groundwater Quality	Predicted effects to groundwater quality at property boundaries and off-site Predicted effects to Source Water Protection Area	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. **NO NET EFFECTS**	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. **NO NET EFFECTS**	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. **NO NET EFFECTS**	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. **NO NET EFFECTS**	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. **NO NET EFFECTS**	No off-site groundwater receptors will be affected No effect to groundwater within source water protection area. **NO NET EFFECTS**
	Groundwater Flow	Predicted effects to groundwater flow at property boundaries and off-site	No effects to groundwater flow **NO NET EFFECTS**	No effects to groundwater flow **NO NET EFFECTS**	No effects to groundwater flow **NO NET EFFECTS**	No effects to groundwater flow **NO NET EFFECTS**	No effects to groundwater flow **NO NET EFFECTS**	No effects to groundwater flow **NO NET EFFECTS**
	Criteria Ranking		**Tied for 1^{st}**	**Tied for 1^{st}**	**Tied for 1^{st}**	**Tied for 1^{st}**	**Tied for 1^{st}**	**Tied for 1^{st}**
	Environmental Component Rationale		**All Alternatives are considered equally preferred from a groundwater quality and flow perspective because no adverse effects are expected.**					
Surface Water Resources	Surface Water Quality	Predicted effects on surface water quality on-site and off-site	Stormwater management pond will be sized to treat water to required level. Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations. **NO NET EFFECTS**	Stormwater management pond will be sized to treat water to required level. Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations. May have complications with designing/constructing pond within the allocated area (in buffer). **LOW NET EFFECTS**	Stormwater management pond will be sized to treat water to required level. Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations. **NO NET EFFECTS**	Stormwater management pond will be sized to treat water to required level. Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations. May have complications with designing/constructing pond within the allocated area (in buffer). **LOW NET EFFECTS**	Stormwater management pond will be sized to treat water to required level. Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations. **NO NET EFFECTS**	Stormwater management pond will be sized to treat water to required level. Discharge to either surface water or to sanitary sewer with no increase in TSS and related parameter concentrations. May have complications with designing/constructing pond within the allocated area (in buffer). **LOW NET EFFECTS**
	Surface Water Quantity	Predicted change in drainage areas Predicted occurrence and degree of off-site effects	Perimeter ditches and stormwater management pond will be sized to convey and store the 2-year through 100-year storm event. No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek. **NO NET EFFECTS**	Perimeter ditches and stormwater management pond will be sized to convey and store the 2-year through 100-year storm event. No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek. May have complications with designing/constructing pond within the allocated area (in buffer). **LOW NET EFFECTS**	Perimeter ditches and stormwater management pond will be sized to convey and store the 2-year through 100-year storm event. No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek. **NO NET EFFECTS**	Perimeter ditches and stormwater management pond will be sized to convey and store the 2-year through 100-year storm event. No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek. May have complications with designing/constructing pond within the allocated area (in buffer). **LOW NET EFFECTS**	Perimeter ditches and stormwater management pond will be sized to convey and store the 2-year through 100-year storm event. No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek. **NO NET EFFECTS**	Perimeter ditches and stormwater management pond will be sized to convey and store the 2-year through 100-year storm event. No increase in peak flows to the roadside ditches to the northwest of the site, sewer under First Road West and Davis Creek. May have complications with designing/constructing pond within the allocated area (in buffer). **LOW NET EFFECTS**
	Criteria Ranking		**Tied for 1^{st}**	**Tied for 4^{th}**	**Tied for 1^{st}**	**Tied for 4^{th}**	**Tied for 1^{st}**	**Tied for 4^{th}**
	Environmental Component Rationale		**Alternatives 1,3 and 5 are all tied for first and therefore more preferred because they maintain the site's existing stormwater management ponds, resulting in fewer complications with implementing stormwater management infrastructure. Alternatives 2, 4 and 6 are tied for 2^{nd} and are therefore less preferred because the site's existing stormwater management ponds would need to be redesigned and relocated in the landfill buffer areas.**					
Terrestrial and Aquatic Environment	Terrestrial ecosystems	Predicted impact on vegetation communities Predicted impact on wildlife habitat Predicted impact on vegetation and wildlife including rare, threatened or endangered species	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.	Temporary loss of vegetation and wildlife/ Species At Risk (SAR) habitat. Loss is considered temporary because it is assumed that habitat will be re-established on-site following landfill closure.

Stoney Creek Regional Facility EA (Terrapure Environmental)
Draft Comparative Evaluation Table

Environmental Component	Evaluation Criteria	Indicators	Alternative Methods					
			Alternative Method 1	Alternative Method 2	Alternative Method 3	Alternative Method 4	Alternative Method 5	Alternative Method 6
			LOW NET EFFECTS	**LOW NET EFFECTS**	**LOW NET EFFECTS**	**LOW NET EFFECTS**	**LOW NET EFFECTS**	**LOW NET EFFECTS**
	Aquatic ecosystems	Predicted impact on aquatic habitat Predicted impact on aquatic biota	Minimal loss of aquatic habitat and disturbance to aquatic biota. **LOW NET EFFECTS**	Minimal loss of aquatic habitat and disturbance to aquatic biota. **LOW NET EFFECTS**	Minimal loss of aquatic habitat and disturbance to aquatic biota. **LOW NET EFFECTS**	Minimal loss of aquatic habitat and disturbance to aquatic biota. **LOW NET EFFECTS**	Minimal loss of aquatic habitat and disturbance to aquatic biota. **LOW NET EFFECTS**	Minimal loss of aquatic habitat and disturbance to aquatic biota. **LOW NET EFFECTS**
	Criteria Ranking		**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**
	Environmental Component Rationale		**All Alternatives are equally preferred because they would all have a low potential for adverse effects to the terrestrial and aquatic ecosystems, which would be further minimized through the use of standard mitigation measures.**					
Atmospheric Environment	Air quality on off-site receptors	Predicted off-Site point of impingement concentrations (ug/m^3) of indicator compounds Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Based on preliminary modelling, there is a predicted potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria primarily for receptors north of Green Mountain Road. Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors. **LOW NET EFFECTS**	Based on preliminary modelling, there is a predicted potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria. Primarily for receptors near the northeast corner of the site, and north of Green Mountain Road. Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors **LOW NET EFFECTS**	Based on preliminary modelling, there is a predicted potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria primarily for receptors north of Green Mountain Road, and near site entry and exit points Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors **LOW NET EFFECTS**	Based on preliminary modelling, there is a predicted potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria primarily for receptors near the northeast of the site and along First Rd. West. Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors **LOW NET EFFECTS**	Based on preliminary modelling, there is a predicted potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria primarily for receptors north of Green Mountain Road Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors **LOW NET EFFECTS**	Based on preliminary modelling, there is a predicted potential for off-site concentrations of particulate species (TSP, PM10 and PM2.5) to exceed current criteria primarily for receptors northeast of the site, and along First Street West Application of Dust BMPs and remodelling based on lower daily trucks per day will mitigate effects to acceptable and approvable levels from an air quality for off-site receptors **LOW NET EFFECTS**
	Odours on off-site receptors	Predicted off-Site odour concentrations (ug/m^3 and odour units) Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Odours are not anticipated to change significantly between the proposed options and currently approved operations. No effects to off-site receptors. **NO NET EFFECTS**	Odours are not anticipated to change significantly between the proposed options and currently approved operations. No effects to off-site receptors. **NO NET EFFECTS**	Odours are not anticipated to change significantly between the proposed options and currently approved operations. No effects to off-site receptors. **NO NET EFFECTS**	Odours are not anticipated to change significantly between the proposed options and currently approved operations. No effects to off-site receptors. **NO NET EFFECTS**	Odours are not anticipated to change significantly between the proposed options and currently approved operations. No effects to off-site receptors. **NO NET EFFECTS**	Odours are not anticipated to change significantly between the proposed options and currently approved operations. No effects to off-site receptors. **NO NET EFFECTS**
	Criteria Ranking		**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**
	Environmental Component Rationale		**All Alternatives are tied for 1st and therefore are equally preferred because there would be a low potential for adverse effects to area residents from a dust perspective. Each Alternative will be required to implement Dust BMP's and other mitigation measures to meet the criteria at the property boundary to be acceptable and approvable. All Alternatives can be mitigated to meet MOECC criteria.**					
	Noise on off-site receptors	Predicted off-Site noise level	After mitigation measures (increasing berm height to 7m above existing grade), noise levels at receptors will be below the MOECC's minimum sound level limits. **LOW NET EFFECTS**	After mitigation measures (increasing berm height to 10m above existing grade), noise levels at receptors will be below the MOECC's minimum sound level limits. **LOW NET EFFECTS**	After mitigation measures (increasing berm height to 7m above existing grade), noise levels at receptors will be below the MOECC's minimum sound level limits. **LOW NET EFFECTS**	After mitigation measures (increasing berm height to 9m above existing grade), noise levels at receptors will be below the MOECC's minimum sound level limits. **LOW NET EFFECTS**	After mitigation measures (increasing berm height to 8m above existing grade), noise levels at receptors will be below the MOECC's minimum sound level limits. **LOW NET EFFECTS**	After mitigation measures (increasing berm height to 9m above existing grade), noise levels at receptors will be below the MOECC's minimum sound level limits. **LOW NET EFFECTS**
		Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.	After mitigation measures, noise levels at receptors will be below the MOECC's minimum sound level limits.

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Environmental Component	Evaluation Criteria	Indicators	Alternative Methods					
			Alternative Method 1	Alternative Method 2	Alternative Method 3	Alternative Method 4	Alternative Method 5	Alternative Method 6
			LOW NET EFFECTS	**LOW NET EFFECTS**	**LOW NET EFFECTS**	**LOW NET EFFECTS**	**LOW NET EFFECTS**	**LOW NET EFFECTS**
	Criteria Ranking		**Tied 1st**	**Tied 1st**	**Tied 1st**	**Tied 1st**	**Tied 1st**	**Tied 1st**
	Environmental Component Rationale		**All Alternatives are tied for 1st and therefore are equally preferred as there would be low potential for adverse effects to sensitive receptors from a noise perspective as an increase in noise levels for all off-site receptors will be below the provincial standards (either an increase in more than 3 dBA or greater than 55 dBA).**					
Land Use	Effect on existing land use	Current land use	No change to the current land uses within the Site and Local Study Areas. **NO NET EFFECTS**	No change to the current land uses within the Site and Local Study Areas. **NO NET EFFECTS**	No change to the current land uses within the Site and Local Study Areas. **NO NET EFFECTS**	No change to the current land uses within the Site and Local Study Areas. **NO NET EFFECTS**	No change to the current land uses within the Site and Local Study Areas. **NO NET EFFECTS**	No change to the current land uses within the Site and Local Study Areas. **NO NET EFFECTS**
	Effect on views of the facility	Predicted changes in views of the facility from the surrounding area	Views of facility from sensitive receptors would be mitigated through use of visual screening. **LOW NET EFFECTS**	Views of facility from sensitive receptors would be mitigated through use of visual screening. **LOW NET EFFECTS**	Height increase of 12m, visual screening would not be able to completely mitigate views from sensitive receptors. **HIGH NET EFFECTS**	Views of facility from sensitive receptors would be mitigated through use of visual screening. **LOW NET EFFECTS**	Views of facility from sensitive receptors would be mitigated through use of visual screening. **LOW NET EFFECTS**	Height increase of 8m, visual screening would not be able to completely mitigate views from sensitive receptors. **HIGH NET EFFECTS**
	Criteria Ranking		**Tied for 1st**	**Tied for 1st**	**6th**	**Tied for 1st**	**Tied for 1st**	**5th**
	Environmental Component Rationale		**Alternatives 1,2,4 and 5 are all more preferred because there is either no proposed height increase or a relatively low height increase and the views can be minimized through screening. Alternatives 3 and 6 are less preferred because there is a relatively greater height increase and the views cannot be fully minimized through screening.**					
Human Health	Air Quality	Predicted impacts to air quality and their potential effects on human health	Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (*i.e.*, 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.	Results of the air quality assessment indicate that this VOC emissions from this method would be less than those predicted for the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (*i.e.*, 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient	Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of the PM10 and PM2.5 size fractions would be marginally higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community.	Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (*i.e.*, 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.	Results of the air quality assessment indicate that this VOC emissions from this method would be equivalent to the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (*i.e.*, 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient PM10 particulate concentrations.	Results of the air quality assessment indicate that this VOC emissions from this method would be less than those predicted for the existing approved landfill design. Particulate modelling indicated that while predicted concentrations of PM2.5 size fraction would be higher than the existing approved landfill design, concentrations are still expected to be less than the respective short- and long-term health-based benchmarks at all receptor locations in the surrounding community. When one evaluated the PM10 size fraction, short-term (*i.e.*, 24-hour) concentrations have the potential under worst-case conditions to marginally exceed health-based benchmarks, compared to the existing base case. It is recommended that further refinements to the air dispersion modelling be considered to reduce uncertainties, or further mitigative measures be considered at the design phase to reduce ambient

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Environmental Component	Evaluation Criteria	Indicators	Alternative Methods Alternative Method 1	Alternative Method 2	Alternative Method 3	Alternative Method 4	Alternative Method 5	Alternative Method 6
			LOW NET EFFECTS	PM10 particulate concentrations. **LOW NET EFFECTS**	**NO NET EFFECTS**	**LOW NET EFFECTS**	**LOW NET EFFECTS**	PM10 particulate concentrations. **LOW NET EFFECTS**
	Leachate Quantity	Predicted effects of leachate quality (inorganic and organic chemicals) on human health	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, all of the alternative methods would not be expected to different than each other and the existing approved landfill design. **NO NET EFFECTS**	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, all of the alternative methods would not be expected to different than each other and the existing approved landfill design. **NO NET EFFECTS**	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, all of the alternative methods would not be expected to different than each other and the existing approved landfill design. **NO NET EFFECTS**	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, all of the alternative methods would not be expected to different than each other and the existing approved landfill design. **NO NET EFFECTS**	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, all of the the alternative methods would not be expected to different than each other and the existing approved landfill design. **NO NET EFFECTS**	As humans will not be directly exposed to leachate, and all leachate will be treated and meet municipal discharge standards, all of the alternative methods would not be expected to different than each other and the existing approved landfill design. **NO NET EFFECTS**
	Groundwater Quality	Predicted impacts to groundwater quality and their potential effects on human health	Results of the hydrogeology assessment indicate that each of the 6 alternative methods have leachate leakage rates through the liner that are substantially similar to each other and the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar for all 6 alternatives and the existing approved landfill design. **NO NET EFFECTS**	Results of the hydrogeology assessment indicate that each of the 6 alternative methods have leachate leakage rates through the liner that are substantially similar to each other and the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar for all 6 alternatives and the existing approved landfill design. **NO NET EFFECTS**	Results of the hydrogeology assessment indicate that each of the 6 alternative methods have leachate leakage rates through the liner that are substantially similar to each other and the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar for all 6 alternatives and the existing approved landfill design. **NO NET EFFECTS**	Results of the hydrogeology assessment indicate that each of the 6 alternative methods have leachate leakage rates through the liner that are substantially similar to each other and the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar for all 6 alternatives and the existing approved landfill design. **NO NET EFFECTS**	Results of the hydrogeology assessment indicate that each of the 6 alternative methods have leachate leakage rates through the liner that are substantially similar to each other and the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar for all 6 alternatives and the existing approved landfill design. **NO NET EFFECTS**	Results of the hydrogeology assessment indicate that each of the 6 alternative methods have leachate leakage rates through the liner that are substantially similar to each other and the existing approved landfill design. Furthermore, the predicted downgradient groundwater quality is predicted to be very similar for all 6 alternatives and the existing approved landfill design. **NO NET EFFECTS**
	Surface Water Quality	Predicted impacts to surface water quality and their potential effects on human health	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards. **NO NET EFFECTS**	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards. **NO NET EFFECTS**	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards. **NO NET EFFECTS**	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards. **NO NET EFFECTS**	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards. **NO NET EFFECTS**	Results of the surface water study indicate that stormwater management ponds and perimeter ditches will be sized to the required level, and any discharge will be treated to meet appropriate regulatory standards. **NO NET EFFECTS**
	Soil Quantity	Predicted impacts to soil and their potential effects on human health	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for each of the proposed Alternative methods should not be significantly	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for each of the proposed Alternative methods should not be significantly different	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for each of the proposed Alternative methods should not be significantly	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for each of the proposed Alternative methods should not be significantly	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for each of the proposed Alternative methods should not be significantly different	Results of the Air Quality Assessment indicate that if airborne particulate emissions are sufficiently mitigated to meet ambient guidelines at the fenceline (a condition that is, for the most part, being met under current operations based on ongoing monitoring), then predicted deposition for each of the proposed Alternative methods should not be significantly

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Environmental Component	Evaluation Criteria	Indicators	Alternative Methods					
			Alternative Method 1	Alternative Method 2	Alternative Method 3	Alternative Method 4	Alternative Method 5	Alternative Method 6
			different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible. **NO NET EFFECTS**	than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible. **NO NET EFFECTS**	different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible. **NO NET EFFECTS**	different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible. **NO NET EFFECTS**	than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible. **NO NET EFFECTS**	different than those experienced with the existing approved landfill design. Therefore, predicted impacts on soil quality in the surrounding community would be expected to be negligible. **NO NET EFFECTS**
	Criteria Ranking		**Tied for 2nd**	**Tied for 2nd**	**1st**	**Tied for 2nd**	**Tied for 2nd**	**Tied for 2nd**
	Environmental Component Rationale		**Alternative 3 is considered preferred from a human health perspective. All other options are considered less preferred, but would have a low potential for adverse effects with the continuation of the existing site's mitigation measures augmented with additional Best Management Practices, where proposed, and on-going monitoring.**					
Transportation	Effect on Traffic	Potential for traffic collisions Level of Service at intersections around the SCRF	No change to the existing level of road user safety and intersection Level of Service within the Local Study Area. **NO NET EFFECTS**	No change to the existing level of road user safety and intersection Level of Service within the Local Study Area. **NO NET EFFECTS**	No change to the existing level of road user safety and intersection Level of Service within the Local Study Area. **NO NET EFFECTS**	No change to the existing level of road user safety and intersection Level of Service within the Local Study Area. **NO NET EFFECTS**	No change to the existing level of road user safety and intersection Level of Service within the Local Study Area. **NO NET EFFECTS**	No change to the existing level of road user safety and intersection Level of Service within the Local Study Area. **NO NET EFFECTS**
	Criteria Ranking		**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**
	Environmental Component Rationale		**All Alternatives are equally preferred because the number of trucks permitted at the site would remain unchanged resulting in no adverse effects on road user safety or intersection capacity.**					
Economic	Effect on approved/planned land uses	Number, extent, and type of approved/planned land uses affected	No effect on approved or planned land uses. **NO NET EFFECTS**	No effect on approved or planned land uses. **NO NET EFFECTS**	No effect on approved or planned land uses. **NO NET EFFECTS**	No effect on approved or planned land uses. **NO NET EFFECTS**	No effect on approved or planned land uses. **NO NET EFFECTS**	No effect on approved or planned land uses. **NO NET EFFECTS**
	Economic benefit to the City of Hamilton and Local Community	Total Employment at site (number and duration)	Employment reduced (year over year). Lower economic benefits to City and Local Community. **MODERATE (Negative) NET EFFECTS**	Employment reduced (year over year). Lower economic benefits to City and Local Community. **MODERATE (Negative) NET EFFECTS**	Employment increased (year over year). Increased economic benefits to City and Local Community. **HIGH (Positive) NET EFFECTS**	Employment reduced (year over year). Lower economic benefits to City and Local Community. **MODERATE (Negative) NET EFFECTS**	Employment increased (year over year). Increased economic benefits to City and Local Community. **HIGH (Positive) NET EFFECTS**	Employment increased (year over year). Increased economic benefits to City and Local Community. **HIGH (Positive) NET EFFECTS**
	Criteria Ranking		**5th**	**6th**	**Tied for 1st**	**4th**	**Tied for 1st**	**Tied for 1st**
	Environmental Component Rationale		**Alternatives 3,5 and 6 are all more preferred because they would yield the highest benefit to the City of Hamilton and local economy in terms of economic activity and jobs. Alternatives 1, 2 and 4 are less preferred because they all result in the lowest economic benefit to the City and local economy.**					
Archaeology and Built Heritage	Effect on known or potential significant archaeological resources	Number and type of potentially significant, known archaeological sites affected Area (ha) of archaeological potential (i.e., lands with potential for the presence of significant archaeological resources) affected	Expansion will be occurring into areas that have been previously disturbed/excavated. **NO NET EFFECTS**	Expansion will be occurring into areas that have been previously disturbed/excavated. **NO NET EFFECTS**	Expansion will be occurring into areas that have been previously disturbed/excavated. **NO NET EFFECTS**	Expansion will be occurring into areas that have been previously disturbed/excavated. **NO NET EFFECTS**	Expansion will be occurring into areas that have been previously disturbed/excavated. **NO NET EFFECTS**	Expansion will be occurring into areas that have been previously disturbed/excavated. **NO NET EFFECTS**
	Effect on built heritage resources and cultural heritage landscapes	Number and type of built heritage resources and cultural heritage landscapes displaced or disrupted	No built heritage landscapes will be displaced or disrupted. **NO NET EFFECTS**	No built heritage landscapes will be displaced or disrupted. **NO NET EFFECTS**	No built heritage landscapes will be displaced or disrupted. **NO NET EFFECTS**	No built heritage landscapes will be displaced or disrupted. **NO NET EFFECTS**	No built heritage landscapes will be displaced or disrupted. **NO NET EFFECTS**	No built heritage landscapes will be displaced or disrupted. **NO NET EFFECTS**
	Criteria Ranking		**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**
	Environmental Component Rationale		**All Alternatives are equally preferred from a Cultural Environment perspective because no cultural or heritage landscapes would be disturbed or displaced and the site has been previously excavated and disturbed for quarrying. Therefore, no archaeological resources would be adversely affected.**					
Design and Operations	Potential to Provide Service for Disposal	Ability to provide 3,680,000 m^3 of additional disposal capacity for post	Only provides 8,830,000 m^3 of total capacity for residual material. Does not	Only provides 7,420,000 m^3 of total capacity for residual material. Does not meet the	Provides 10,000,000 m^3 of total capacity for residual material. Meets the	Only provides 9,580,000 m^3 of total capacity for residual material. Does not	Provides 10,000,000 m^3 of total capacity for residual material. Meets the	Provides 10,000,000 m^3 of total capacity for residual material. Meets the

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Environmental Component	Evaluation Criteria	Indicators	Alternative Methods: Alternative Method 1	Alternative Method 2	Alternative Method 3	Alternative Method 4	Alternative Method 5	Alternative Method 6
		diversion solid, non-hazardous industrial residual material	meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3. **HIGH NET EFFECTS**	economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion solid, non-hazardous residual material at the SCRF by 3,680,000 m^3. **HIGH NET EFFECTS**	economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3. **HIGH (Positive) NET EFFECTS**	meet the economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3. **HIGH NET EFFECTS**	economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3. **HIGH (Positive) NET EFFECTS**	economic opportunity put forward by Terrapure to increase the total approved capacity for post-diversion, solid, non-hazardous residual material at the SCRF by 3,680,000 m^3. **HIGH (Positive) NET EFFECTS**
	Leachate Management	Design and operating complexity	Small increase in complexity relative to current leachate management system associated with: additional base liner and leachate collection system; increased leachate generation rate. **LOW NET EFFECTS**	Moderate increase in complexity relative to current leachate management system associated with: additional base liner and leachate collection system; separate leachate pumping systems; irregular shape/contours; increased leachate generation rate. **MODERATE NET EFFECTS**	No increased complexity relative to current leachate management system **NO NET EFFECTS**	Moderate increase in complexity relative to current leachate management system associated with: additional base liner and leachate collection system; increased leachate generation rate. **MODERATE NET EFFECTS**	Small increase in complexity relative to current leachate management system associated with: additional base liner and leachate collection system; increased leachate generation rate. **LOW NET EFFECTS**	Moderate increase in complexity relative to current leachate management system associated with: additional base liner and leachate collection system; separate leachate pumping systems; irregular shape/contours; increased leachate generation rate. **MODERATE NET EFFECTS**
	Stormwater Management	Design and operating complexity	No increase in complexity relative to current stormwater management system. **NO NET EFFECTS**	Moderate increase to complexity relative to current stormwater management system. **MODERATE NET EFFECTS**	No increase in complexity relative to current stormwater management system. **NO NET EFFECTS**	Moderate increase to complexity relative to current stormwater management system. **MODERATE NET EFFECTS**	No increase in complexity relative to current stormwater management system. **NO NET EFFECTS**	Moderate increase to complexity relative to current stormwater management system. **MODERATE NET EFFECTS**
	Construction	Complexity and constructability of components	Small increase in complexity relative to current construction requirements associated with: additional base liner and leachate collection system. **LOW NET EFFECTS**	Large increase in complexity relative to current construction requirements associated with: additional base liner and leachate collection system; expansion of base liner and leachate collection system into other areas of the site; complex layout and integration of other components such as the stormwater management pond. **HIGH NET EFFECTS**	No increase in complexity relative to current construction requirements. **NO NET EFFECTS**	Large increase in complexity relative to current construction requirements associated with: additional base liner and leachate collection system; expansion of base liner and leachate collection system into other areas of the site; complex layout of stormwater management pond. **HIGH NET EFFECTS**	Small increase in complexity relative to current construction requirements associated with: additional base liner and leachate collection system. **LOW NET EFFECTS**	Large increase in complexity relative to current construction requirements associated with: additional base liner and leachate collection system; expansion of base liner and leachate collection system into other areas of the site; complex layout and integration of other components such as the stormwater management pond. **HIGH NET EFFECTS**
	Site Operations	Complexity and operability of components	No increase in complexity relative to current site operations.	Large increase in complexity relative to current site operations associated with: two separate leachate pumping stations; layout of the stormwater management pond; site access and egress.	No increase in complexity relative to current site operations.	Moderate increase in complexity relative to current site operations associated with: layout of the stormwater management pond; site access and egress.	No increase in complexity relative to current site operations.	Large increase in complexity relative to current site operations associated with: two separate leachate pumping stations; layout of the stormwater management pond; site access and egress.

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Environmental Component	Evaluation Criteria	Indicators	Alternative Methods: Alternative Method 1	Alternative Method 2	Alternative Method 3	Alternative Method 4	Alternative Method 5	Alternative Method 6
			NO NET EFFECTS	**HIGH NET EFFECTS**	**NO NET EFFECTS**	**MODERATE NET EFFECTS**	**NO NET EFFECTS**	**HIGH NET EFFECTS**
	Closure and Post-Closure	Flexibility of design and operations	Simplified closure requirements and increased flexibility of post-closure uses relative to current design. **HIGH (Positive) NET EFFECTS**	Moderate increase to closure requirements and reduced flexibility of post-closure uses relative to current design. **MODERATE NET EFFECTS**	Small increase to closure requirements and reduced flexibility of post-closure uses relative to current design. **LOW NET EFFECTS**	Simplified closure requirements and increased flexibility of post-closure uses relative to current design. **HIGH (Positive) NET EFFECTS**	Simplified closure requirements and increased flexibility of post-closure uses relative to current design. **HIGH (Positive) NET EFFECTS**	Moderate increase to closure requirements and reduced flexibility of post-closure uses relative to current design. **MODERATE NET EFFECTS**
	Cost of Facility	Approximate relative cost of Alternative Methods	Small increase to costs relative to current design associated with: additional base liner and leachate collection system. **LOW NET EFFECTS**	Large increase to costs relative to current design associated with: expansion of base liner and leachate collection system into adjacent areas of the site; layout of stormwater pond. **HIGH NET EFFECTS**	No increase to costs relative to current design. **NO NET EFFECTS**	Large increase to costs relative to current design associated with: expansion of base liner and leachate collection system into adjacent areas of the site; layout of stormwater pond. **HIGH NET EFFECTS**	Small increase to costs relative to current design associated with: additional base liner and leachate collection system. **LOW NET EFFECTS**	Large increase to costs relative to current design associated with: expansion of base liner and leachate collection system into adjacent areas of the site; layout of stormwater pond. **HIGH NET EFFECTS**
	Criteria Ranking		3rd	6th	1st	5th	2nd	4th
	Environmental Component Rationale		Alternatives 3 and 5 are both considered more preferred compared to the other Alternatives from a design and operations perspective including their ability to provide the additional capacity being sought through the EA, but Alternative 3 is more preferred because it would be easier to construct and have a lower overall capital cost.					
		Overall Ranking from Most Preferred to Least Preferred	**Less Preferred Alternative**	**Least Preferred Alternative**	**Less Preferred Alternative**	**Less Preferred Alternative**	**Recommended as Most Preferred Alternative**	**Less Preferred Alternative**

Overall Rationale/Key Trade-offs

Using the 'trade-off' or reasoned argument approach, the Recommended Alternative as "Most Preferred" is #5: Reconfiguration and Height Increase. Alternative #5 is Recommended as it represents:

- **A technically feasible design that provides for the additional capacity being sought through the EA. This will allow Terrapure to continue to support the growing local economy by providing disposal capacity for industrial residual material generated within Hamilton and the GTA**
- **A lower height increase compared to Options 3 and 6, which can be screened through such measures as constructed berms, tree plantings, fencing, etc.**
- **A low potential for adverse effects to the natural environment which would be further minimized through the use of standard mitigation measures**
- **Maintains the existing stormwater management ponds**
- **A low potential for adverse effects to area residents which would be further minimized through the use of standard mitigation measures**
- **Maximizes the economic benefits to the City of Hamilton, Upper Stoney Creek, and local industry**