



DILLON
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MIRROR NS
FEP/WSF Closure Review

November 30, 2020



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FEP/WSF Closure Review

Dillon Consulting Limited (Dillon) is pleased to submit an update to our 2018 review of potential issues associated with the proposed closure of the Front End Processor (FEP) and Waste Stabilization Facility (WSF) at Halifax Regional Municipality (HRM)'s Otter Lake Waste Processing and Disposal Facility. The update has been prepared to determine if the operations experience gained over the last two years indicates if any of the conclusions and recommendations made in 2018 should be adjusted.

As Dillon has been involved in the ongoing development and operations monitoring of the site since its inception in the 1990s, our firm has a long-standing and detailed understanding of the environmental performance of the Otter Lake Facility.

Yours truly,

DILLON CONSULTING LIMITED



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Executive Summary

Background

Halifax Regional Municipality (HRM)'s Otter Lake Waste Processing and Disposal Facility, originally established in 1999, was unique in that all mixed solid waste delivered to the site (with the exception of select bulky items) passed through a Front End Processor (FEP) and Waste Stabilization Facility (WSF) prior to delivery to a final on-site landfilling location (Residuals Disposal Facility – RDF). In June 2002, in an effort to protect its solid waste infrastructure investments (through the generation of tip fee revenue) and towards meeting the requirements of the Otter Lake Operating Agreement, HRM amended its Solid Waste Resource Collection and Disposal By-Law to prohibit exportation of waste (referred to as “flow control”) to facilities outside of the boundaries of the municipality.

In February 2015, HRM Council discontinued the flow control requirement for Industrial, Commercial and Institutional (ICI) generators within the municipality to direct their mixed solid waste (garbage) to the Otter Lake Waste Processing and Disposal Facility. As a consequence, the total quantity of mixed solid waste arriving at Otter Lake for processing and disposal was dramatically reduced, dropping from 140,323 tonnes in 2012 to 45,787 tonnes in 2019. This significant reduction in the quantity of mixed solid waste materials arriving at Otter Lake since 2015 has brought into question the efficacy and necessity of the FEP and WSF.

In June 2018, Dillon Consulting Limited (Dillon) was engaged by the operator of the Otter Lake facility, MIRROR NS (MIRROR), to conduct an evaluation of the potential of discontinuing the operation of the FEP and WSF, with mixed solid waste materials being delivered directly to the RDF for landfilling. In October 2020, Dillon was retained by MIRROR to prepare an updated assessment based on MIRROR's operating experience since the 2018 evaluation.

Objectives and Key Assumptions of the Review

Objectives

- To define the scope of the proposed operational changes at the FEP/WSF;
- To provide background information on the Otter Lake facility and HRM's waste/resource management program relevant to the assessment of the proposed changes;
- To identify potential issues of concern at the Otter Lake facility associated with the proposed FEP/WSF operational changes along with recommended mitigatory actions; and
- To support discussions on the proposed changes at the Otter Lake facility with the Citizen's Monitoring Committee (CMC), Halifax Regional Municipality, Nova Scotia Environment and other identified stakeholders to allow for the definition of necessary revised design, operational, contractual, regulatory and associated documentation.

Key Assumptions

- The existing tipping fee differential between the Otter Lake facility and other provincially-approved MSW management sites in relative proximity to Halifax (e.g., West Hants Landfill and the Kaizer Meadow Solid Waste Management Facility) will continue to exist for the foreseeable future, maintaining the incentive for the export of ICI-generated waste materials out of HRM for final disposal;
- The proposed operational change to be evaluated is to be based on the quantity and composition of waste arriving at the FEP/WSF as of the end of 2019, namely materials from HRM residential generators and (acknowledging future potential changes associated in population growth and per capita waste generation) which amounts to approximately 46,000 tonnes/year. ICI-generated waste materials will continue to be delivered to the existing transfer station component of the Otter Lake facility for hauling to provincially-approved disposal locations outside of HRM;
- All existing Provincially-stipulated design requirements associated with MSW landfills will remain applicable to future cells at Otter Lake's Residuals Disposal Facility (RDF) (e.g., double composite liner system, final cap); and
- A continued commitment by the Owner (HRM) and Operator (MIRROR) of the Otter Lake facility to current levels of environmental and community protection.

Strategy Development and Facility Definition

In 1994, Halifax County (one of four area municipalities prior to amalgamation, along with the City of Halifax, the City of Dartmouth, and the Town of Bedford) initiated a process to develop a regional management strategy, including the identification of siting criteria for new management facilities. Halifax County's effort was led by a Community Stakeholder Committee (CSC) and, following a public engagement process, culminated with the issuing of an *Integrated Waste/Resources Waste Management Strategy* in March 1995.

Founded on the content of the CSC's March 1995 strategy document, Halifax County issued a request for proposals to establish a solid waste/resource system that would deliver the CSC strategy. In consultation with the CSC, and following the selection of MIRROR as the preferred private partner to establish the new solid waste/resource system, HRM (established on April 1, 1996 through the amalgamation of the four municipalities) prepared and issued an updated version of the original strategy document in May 1996. Entitled the *Revised Integrated Waste/Resource Management Strategy*, it provided additional detail to CSC's original plan and maintained its key principles.

A noted element of both the original and revised Integrated Waste/Resource Management Strategies was the expectation that refinements to system components at Otter Lake would occur based on the amount and type of waste materials arriving at the facility.

The March 1995 Integrated Waste/Resources Waste Management Strategy included the following goal with respect to HRM's overall solid waste program:

“Beginning with the approved opening of new residuals disposal facilities, these sites will operate to maximum potential and be scaled down in a planned manner as source-separated centralized composting scales up.”¹

With regard to the FEP/WSF, the May 1996 strategy document stated:

“The most important concern of the original strategy was the size and cost of the FEP/WSF. An important goal of the revised strategy was to create time to allow source separation behaviour to take hold in the Municipality. This would in turn divert materials from the mixed waste stream.”²

2013 Review Documents

In January 2013, Stantec Consulting Limited (Stantec) issued a finalized version of a report entitled Waste Resource Strategy Update to HRM, with the document subsequently being posted on HRM's web page on February 5, 2013. Prior to the issuing of the finalized version of the Waste Resource Strategy Update, HRM engaged SNC Lavalin (SNC Lavalin) Inc. to conduct a peer review of the Stantec findings.

In response to a request from MIRROR, Dillon conducted a review of both the Stantec and SNC Lavalin documents. Dillon identified a number of issues of concern with both the Stantec and SNC Lavalin documents. In contrast to positions put forward by both Stantec and SNC Lavalin, Dillon concluded the Otter Lake facility had operated in a manner consistent with its original design objectives and in compliance with contractual and regulatory obligations.

Waste Quantity and Composition

The total amount of waste material received at the Otter Lake site remained relatively stable (average value of 150,214 tonnes per year) between the commencement of flow control restrictions in 2002 through to the year proceeding its discontinuation, 2014. However, immediately following the discontinuation of flow control, as ICI mixed waste materials began to be exported to lower cost management facilities without Otter Lake's pre-processing component, annual tonnages began to drop

¹ An Integrated Waste/Resource Management Strategy for Halifax County/Halifax/Dartmouth/Bedford, dated March 25, 1995.

² Revised Integrated Solid Waste/Resource Management Strategy as attached to HRM Solid Waste/Resource Advisory Committee report, dated July 2, 1996.

significantly, decreasing from 140,298 tonnes in 2014 (the last full year of flow control) to 45,390 tonnes in 2017; a drop of 68% over three years. As of 2019, the incoming FEP/WSF tonnage stood at 45,787 tonnes.

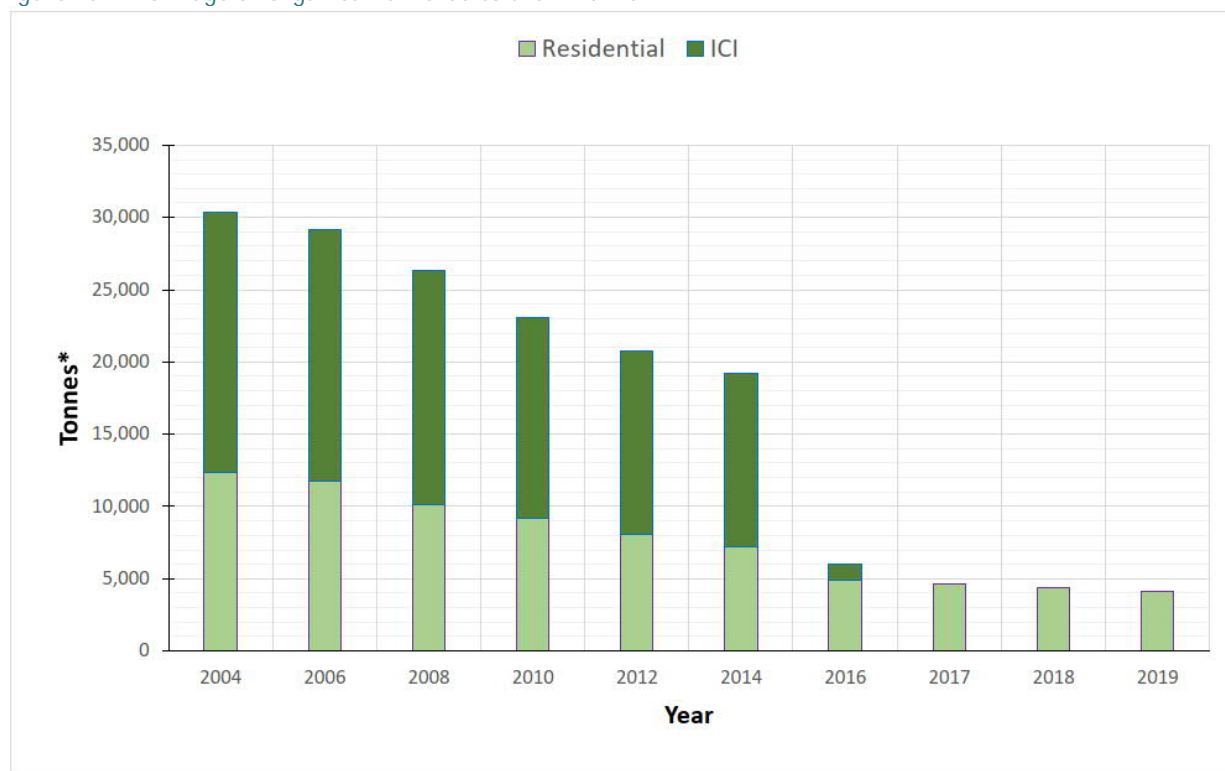
Since 2003/04, 12 characterization audits of HRM's municipal solid waste stream (several as part of province-wide studies) have been completed – of the 12 audits, eight were sponsored or performed by HRM; one by sponsored by the Community Monitoring Committee (CMC); and three sponsored by Divert NS. Four did not include an assessment of HRM's ICI-generated materials. Divert NS sponsored characterization audits in 2011, 2012 and 2017, at municipal waste disposal facilities throughout Nova Scotia (including Otter Lake); however, the categories and material definitions adopted for those studies were inconsistent with those utilized for the majority of the available assessments – most notably with regard to organics and recyclable paper resulting in a much higher “organics” percentage than those presented in other available audit reports. Efforts were made to re-allocate individual items to achieve consistency with the other nine studies, but it was concluded that the definition of recyclable versus compostable paper/fibre used for the Divert NS analysis made adjustment impractical. As a result the Divert NS studies were not included for consideration as part of this review. Notably, the 2017 audit was completed by Bio-Logic Environmental Systems on behalf of the CMC.

By examining the findings of the Otter Lake waste characterization studies since 2003, the following observations can be made:

- In the years from 2003/04 through to 2017, for residential, ICI and combined waste streams, there was an significant decline in the amount of organic (putrescible) material in wastes arriving at the Otter Lake FEP; and
- Over those years, based on the characterization audits analyzed, the percentage of organic materials in residentially-generated wastes was typically lower than that found in ICI sector wastes.

Based on Otter Lake waste audit and weigh scale data, **Figure ES-1** presents the approximate tonnage of putrescible organics that were delivered to the FEP/WSF from 2004 to 2019. The 4,100 tonnes of putrescible organic materials that arrived at Otter Lake in 2019 is approximately 13.5% of the amount of putrescible organic material that was received at the FEP/WSF in 2004. This is a significant reduction and calls into question the continued need for the FEP/WSF.

Figure ES-1: Tonnage of Organics Delivered to the FEP/WSF



*: Yearly putrescible organic tonnages were estimated by using linear trend line regression of the measured waste characterization percentages in combination with the yearly reported tonnages received at the Otter Lake RDF.

Overview of Proposed Revisions

What Will Change

- Operations at the FEP and WSF will be discontinued. Potential alternate uses for the facilities will be evaluated by HRM and MIRROR; and
- Residential waste collection vehicles will no longer deliver their loads to the FEP tipping floor. They will instead proceed directly, via the existing access road network, to the active tipping (disposal) face at the RDF, similar to other MSW landfills in Nova Scotia (e.g., West Hants Landfill, Guysborough Waste Management Facility and Cumberland Central Landfill). Waste materials discharged at the RDF active tipping face will be visually inspected for prohibited materials, with these items being segregated for subsequent appropriate management as required.

What Will Not Change

- The respective ownership (HRM), operator (MIRROR) and community oversight (CMC) roles and responsibilities at the Otter Lake facility;
- MIRROR's obligations related to odour control and management of nuisance issues (i.e., litter and dust) as defined in their operating agreement with HRM;
- Hours and days of operation;

- All waste hauling/collection vehicles arriving at the Otter Lake site will be required to report to the scale house for inspection, weighing, data recording and billing;
- Collection vehicles with ICI wastes will be directed to the Transfer Station tipping floor, with materials subsequently being loaded into a trailer for transport to approved disposal facilities outside of HRM;
- Waste placement, compaction and covering requirements will continue to be facilitated using specialized mobile equipment; and
- All applicable regulatory requirements will remain in place, including design, monitoring, reporting and general performance obligations included within the most current NSE Operating Approval.

Risk Assessment

The proposed operational changes at the Otter Lake facility do, in some instances, present the potential for incremental on-site effects requiring management. When such effects have been identified (e.g., blowing litter, attraction of birds), recommended mitigatory actions, based on design and operational best practice, have been identified. Nevertheless, it is acknowledged that the delivery of unprocessed MSW directly to the RDF does present an incremental degree of risk with regard to objectionable on-site outcomes. It is noted that the review conducted as part of this report did not identify potential off-site (e.g., beyond facility property boundaries) issues of concern.

Risk is commonly defined as the combination of the likelihood of the occurrence of a harm and the severity of that harm. **Tables ES-1** and **ES-2** present on-site and off-site issues risk assessments of the proposed operational changes (incorporating consideration of the proposed mitigatory actions, where applicable) at the Otter Lake facility. The risk assessment matrix used as a basis for the completion of the on and off-site evaluations is presented in **Section 7.0**.

Table ES-1: On-Site Issues Risk Assessment – Proposed FEP/WSF Changes

Operational Activity	Potential Impact/ Issue of Concern	Severity of Impact	Mitigation
6.2 Material Delivery	- Traffic control and worker safety	medium	<ul style="list-style-type: none"> • Provision of instructions to residential collection contractors regarding site traffic rules and restrictions, including the definition of protocols (e.g., warnings, banning from site) for non-compliance. • Establish directional signage from the Scale House to the active tipping face. • Provision of traffic spotters at the active tipping face, acknowledging peak traffic periods.
6.3 Material Placement and Covering	None identified	-	-

Operational Activity	Potential Impact/ Issue of Concern	Severity of Impact	Mitigation
6.4.1 Litter Control	- Increased potential for blowing litter at the tip face	medium	<ul style="list-style-type: none"> • Use of additional portable fencing as well as additional litter collection and removal efforts by site personnel.
6.4.2 Bird and Vector Control	- Enhanced attraction of birds	medium	<ul style="list-style-type: none"> • Enhanced bird and vector control efforts at the general tip face area and at the RDF in general. • Emphasis on minimizing the size of the active disposal area, thorough waste compaction and placement of daily cover at the completion of each working day.
	- Delivery of rodents in waste loads to tip face	low	<ul style="list-style-type: none"> • Implementation of a baiting program for rodents in proximity to the RDF tip face.
6.4.3 Dust Management	None identified	-	-
6.5.1 Landfill Gas Management	None identified	-	-
6.5.2 Odour Management	None identified	-	-
6.6 Leachate Management	None identified	-	-
6.7 Stormwater Management	None identified	-	-
6.8.1 Monitoring	None identified	-	-
6.8.2 Reporting	None identified	-	-

Table ES-2: Off-Site Issues Risk Assessment – Proposed FEP/WSF Changes

Operational Activity	Potential Impact/ Issue of Concern	Severity of Impact	Mitigation
6.2 Material Delivery	None identified	-	-
6.3 Material Placement and Covering	None identified	-	-
6.4.1 Litter Control	None identified	-	-
6.4.2 Bird and Vector Control	None identified	-	-
6.4.3 Dust Management	None identified	-	-
6.5.1 Landfill Gas Management	None identified	-	-
6.5.2 Odour Management	None identified	-	-
6.6 Leachate Management	None identified	-	-
6.7 Stormwater Management	None identified	-	-
6.8.1 Monitoring	None identified	-	-
6.8.2 Reporting	None identified	-	-

With reference to **Table ES-1**, it is noted that potential on-site issues associated with material delivery, litter control and bird/vector control present relatively modest risk “significance” scores and are readily mitigated through the implementation of established best-practice operational procedures. As illustrated in **Table ES-2**, no off-site risk issues were identified as associated with the proposed closure of the FEP/WSF.

Summary of Proposed Operational Measures

To address potential concerns associated with the proposed operational revisions, the following measures are recommended:

Increase in RDF Vehicle Traffic

- Provision of instructions to residential collection contractors regarding site traffic rules and restrictions, including the definition of protocols (e.g., warnings, banning from site) for non-compliance;
- Establish directional signage from the Scale House to the active tipping face; and
- Provision of traffic spotters at the active tipping face, acknowledging peak traffic periods.

Increased Potential for Blowing Litter

- Use of additional portable fencing as well as additional litter collection and removal efforts by site personnel.

Increased Attractiveness of the Disposal Area to Birds

- Enhanced bird and vector control efforts at the general tip face area and at the RDF in general; and
- Emphasis on minimizing the size of the active disposal area, thorough waste compaction and placement of daily cover at the completion of each working day.

Rodents Arriving at the RDF Tip Face in Collection Vehicles

- Implementation of a baiting program for rodents in proximity to the RDF tip face.

Conclusion

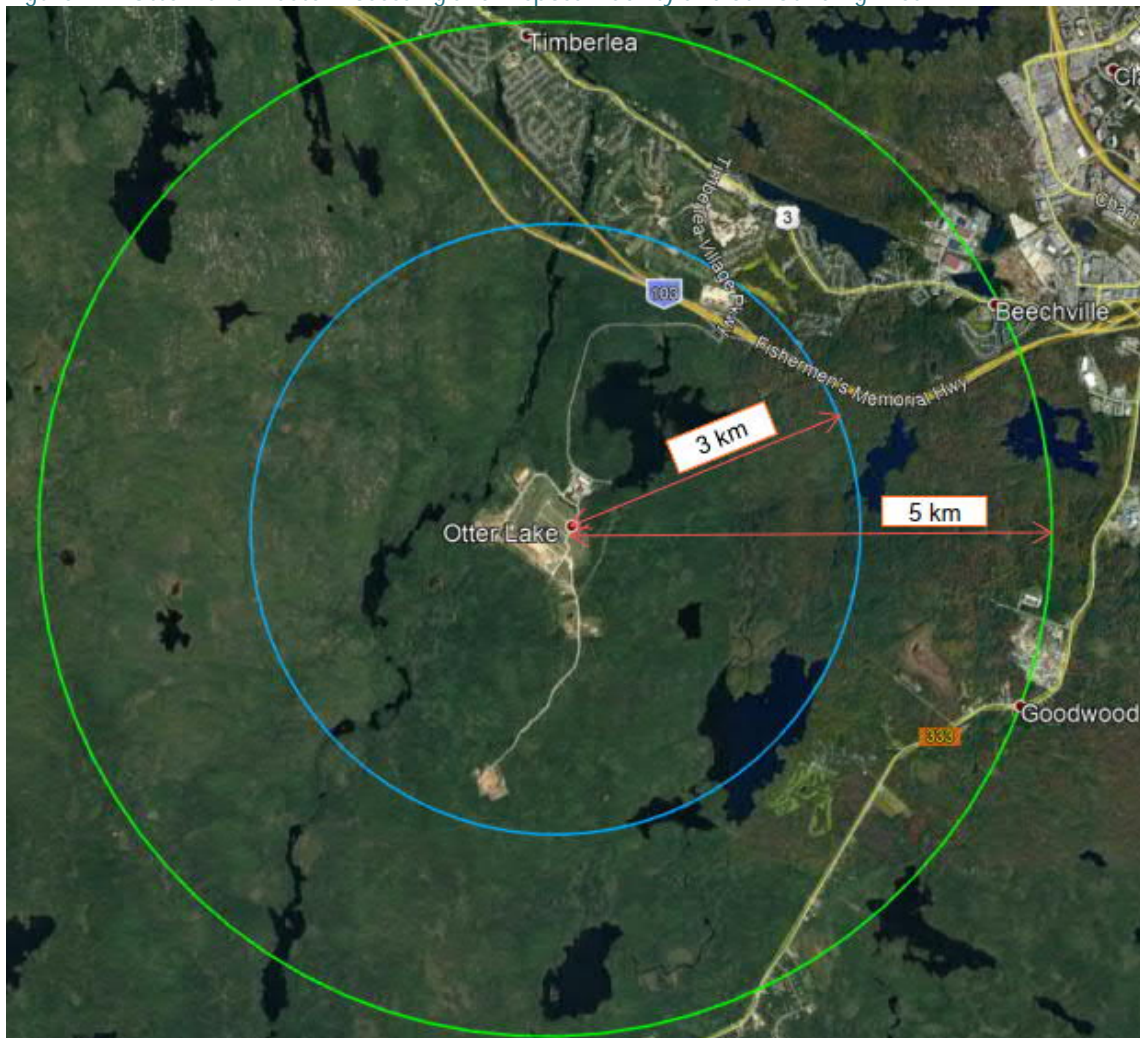
Based on the results of this analysis, there does not appear to be any significant benefit to the continued operations of the FEP/WSF. Further, there does not appear to be any increased risk to public health and the environment if the FEP/WSF operations are terminated. Therefore, it is recommended that operations at the FEP and WSF be discontinued.

1.0 Introduction

1.1 Background

Halifax Regional Municipality (HRM)'s Otter Lake Waste Processing and Disposal Facility (see **Figure 1-1**), originally established in 1999, was unique in that all mixed solid waste delivered to the site (with the exception of select bulky items) passed through a Front End Processor (FEP) and Waste Stabilization Facility (WSF) prior to delivery to a final on-site landfilling location (Residuals Disposal Facility – RDF).

Figure 1-1: Otter Lake Waste Processing and Disposal Facility and Surrounding Area



Notes:

3 km - Definition of the required distance between the Residual Disposal Facility (RDF) and "Buildings on a Well Water Supply" as presented in the Documentation Report for the Residuals Disposal Facility, Community Stakeholders Committee, October 1995.

5 km - Definition of the boundary for "Area Residents" as presented in the Agreement for Community Monitoring of Solid Waste Facilities between HRM and the Halifax Waste/Resource Society, February 1999.

In February 2015, HRM Council discontinued the requirement (referred to as “flow control”) for Industrial, Commercial and Institutional (ICI) generators within the municipality to direct their mixed solid waste (garbage) to the Otter Lake Waste Processing and Disposal Facility. Through an amendment of By-Law S-600, HRM allowed the export of ICI mixed solid waste to landfills outside of HRM and a transfer station was established at Otter Lake in 2016. As a consequence, the total quantity of mixed solid waste arriving at Otter Lake for processing and disposal was dramatically reduced, dropping from 140,323 tonnes in 2012 to 45,787 tonnes in 2019. In fact, by 2017 and continuing on through to 2020, all ICI-sourced mixed solid waste materials arriving at Otter Lake were transferred to facilities outside of HRM for subsequent disposal with the remaining portion directed to the FEP, WSF and RDF consisting entirely of materials from residential (as defined in Section 5 of HRM By-Law L-600) generators.

This significant reduction in the quantity of mixed solid waste materials arriving at Otter Lake since 2015 has brought into question the efficacy and necessity of the FEP and WSF. In June 2018, Dillon Consulting Limited (Dillon) was engaged by the operator of the Otter Lake facility, MIRROR, to conduct an evaluation of the potential of discontinuing the operation of the FEP and WSF, with mixed solid waste materials being delivered directly to the RDF for landfilling. In October 2020, Dillon was retained by MIRROR to prepare an updated version of the 2018 evaluation in order to determine if the operating experience obtained during the past two years would impact the original assessment’s conclusions and recommendations.

1.2 Objectives and Key Assumptions

Objectives

- To define the scope of the proposed operational changes at the FEP/WSF;
- To provide background information on the Otter Lake facility and HRM’s waste/resource management program relevant to the assessment of the proposed changes;
- To identify potential issues of concern at the Otter Lake facility associated with the proposed FEP/WSF operational changes along with recommended mitigatory actions; and
- To support discussions on the proposed changes at the Otter Lake facility with the Citizen’s Monitoring Committee (CMC), Halifax Regional Municipality, Nova Scotia Environment and other identified stakeholders to allow for the definition of necessary revised design, operational, contractual, regulatory and associated documentation.

Key Assumptions

- The existing tipping fee differential between the Otter Lake facility and other provincially-approved MSW management sites in relative proximity to Halifax (e.g., West Hants Landfill and the Kaizer Meadow Solid Waste Management Facility) will continue to exist for the foreseeable future, maintaining the incentive for the export of ICI-generated waste materials out of HRM for final disposal;
- The operational change to be evaluated is to be based on the quantity and composition of waste arriving at the FEP/WSF as of the end of 2019, namely materials from HRM residential generators and (acknowledging future potential changes associated in population growth and per capita waste generation) which amounts to approximately 46,000 tonnes/year. ICI-generated waste materials will continue to be delivered to the existing transfer station component of the Otter Lake facility for hauling to provincially-approved disposal locations outside of HRM;
- All existing Provincially-stipulated design requirements associated with MSW landfills will remain applicable to future cells at Otter Lake's Residuals Disposal Facility (RDF) (e.g., double composite liner system, final cap); and
- A continued commitment by the Owner (HRM) and Operator (MIRROR NS (MIRROR)) of the Otter Lake facility to current levels of environmental and community protection.

2.0 History of the Otter Lake Waste Processing and Disposal Facility

2.1 Strategy Development and Facility Definition

In 1994, after a series of setbacks to identify a new municipal solid waste facility to allow for the closure of the Highway 101 Landfill, Halifax County (one of four area municipalities prior to amalgamation, along with the City of Halifax, the City of Dartmouth and the Town of Bedford) initiated a process to develop a regional management strategy, including the identification of siting criteria for new management facilities. Halifax County's effort was led by a Community Stakeholder Committee (CSC) and, following a public engagement process, culminated with the issuing of an *Integrated Waste/Resources Waste Management Strategy* in March 1995.

Founded on the content of the CSC's March 1995 strategy document, Halifax County issued a request for proposals to establish a solid waste/resource system that would deliver the CSC strategy. In consultation with the CSC, and following the selection of MIRROR as the preferred private partner to establish the new solid waste/resource system, HRM (established on April 1, 1996 through the amalgamation of the four municipalities) prepared and issued an updated version of the original strategy document in May 1996. Entitled the *Revised Integrated Waste/Resource Management Strategy*, it provided additional detail to CSC's original plan and maintained its key principles including "the disposal of only stabilized and inert materials at the RDF" (Residuals Disposal Facility).

In terms of key operational performance criteria for the FEP/WSF (ultimately designed, built, and operated by MIRROR), the Operations Plan that supports the Otter Lake Facility's current NSE Operating Approval specifies the performance criteria as follows:

- Non-recyclable Inert Materials will be separated and disposed of in the RDF;
- Recyclable materials will be extracted and stored separately on the Site pending removal by MIRROR;
- Materials capable of being rendered into Stable Materials through biostabilization will be processed through the WSF; and
- Hazardous Substances and other Prohibited Materials will be extracted and temporarily stored on the site pending removal by MIRROR through a contractor.

A noted element of both the original and Revised Integrated Waste/Resource Management Strategies was the expectation that refinements to system components at Otter Lake would occur based on the amount and type of waste materials arriving at the facility.

The March 1995 Integrated Waste/Resources Waste Management Strategy included the following goal with respect to HRM's overall solid waste program:

*"Beginning with the approved opening of new residuals disposal facilities, these sites will operate to maximum potential and be scaled down in a planned manner as source-separated centralized composting scales up."*¹

With regard to the FEP/WSF, the May 1996 strategy document stated:

*"The most important concern of the original strategy was the size and cost of the FEP/WSF. An important goal of the revised strategy was to create time to allow source separation behaviour to take hold in the Municipality. This would in turn divert materials from the mixed waste stream."*²

3.0 2013 System Review

In January 2013, Stantec Consulting Limited (Stantec) issued a finalized version of a report entitled Waste Resource Strategy Update to HRM, with the document subsequently being posted on HRM's web page on February 5, 2013. Prior to the issuing of the finalized version of the Waste Resource Strategy Update, HRM engaged SNC Lavalin (SNC Lavalin) Inc. to conduct a peer review of the Stantec findings. The SNC Lavalin report, entitled A Peer Review of the January 2013 Stantec Report "Waste Resource Strategy Update", dated April 17, 2013, was subsequently posted on HRM's website.

As stated in Section 1.1 of the Stantec document, the focus of their assignment was *"to complete a review of current (waste management) programs and services, and to recommend opportunities for improvement over the next 10-20 years."* Towards that requirement, their report included a review and analysis of all components of HRM waste management system, including the Otter Lake Waste Processing and Disposal Facility, design requirements for landfills with specific consideration of the RDF and opportunities to create a regional waste resource campus. With regards to the SNC Lavalin peer review, its scope was defined as *"a comprehensive assessment of the analysis, advice, options, conclusions and recommendation as provided in the (Stantec) report for Section 3.0 Otter Lake Waste Processing and Disposal Facility, and Section 4.0 Landfill Design."*

In response to a request from MIRROR, Dillon conducted a review of both the Stantec and SNC Lavalin documents. A primary element of the Dillon review was to evaluate assumptions made by both Stantec and SNC Lavalin in support of their analysis, ensuring relevance to the Otter Lake context as well as consistency with actual operating requirements and documented performance results at the FEP/WSF and RDF. In May 2013, and with a focus on the Stantec document, Dillon issued Waste Resource Strategy Update, Document Review Report. Dillon's review of the SNC Lavalin report followed in September 2013 with the submission of Peer Review of the Waste Resource Strategy Update, Document Review Report.

Dillon identified a number of issues of concern with both the Stantec and SNC Lavalin documents. In contrast to positions put forward by both Stantec and SNC Lavalin, Dillon concluded the Otter Lake facility had operated in a manner consistent with its original design objectives and in compliance with contractual and regulatory obligations.

During 2015, and in acknowledgement of the anticipated impacts of the discontinuation of ICI flow control restrictions, an updated contractual agreement between HRM and MIRROR for the operation of the Otter Lake facility was negotiated. This agreement came into effect in April 2016.

Applicable Regulations, Agreements and Guidelines

Design and operational requirements of the Otter Lake Waste Processing and Disposal Facility are defined primarily by obligations prescribed in Provincial regulations (and their supporting guidelines), HRM By-Laws and a contractual agreement between MIRROR and HRM. A summary of the highlights of these documents is provided below. It is acknowledged that a municipal solid waste transfer station (to transport ICI-generated materials to approved facilities outside of HRM) was established at Otter Lake in 2016; thus, documents relevant to transfer station operation have been included in the summary.

Federal

- Regulations
 - Migratory Birds Regulations
 - Defining permit requirements to manage migratory birds via scaring devices and restricted culling.

Provincial

- Regulations
 - Solid Waste-Resource Management Regulations (last revised July 2018)
 - Established under Section 102 of the Environment Act.
 - Organized under four divisions; Division I – Solid Waste Reduction, Division II – Disposal of Municipal Solid Waste, Division III – Regional Solid Waste-Resource Management Plans and Division IV – Financial Assistance.
 - With regard to activities at the Otter Lake facility, Division II is of primary relevance, identifying materials banned from disposal (and as presented in Schedule “B” of the regulation) and defining the submission requirements to acquire an approval from NSE to operate a landfill for the disposal of municipal solid waste.
 - The Regulations do not include a requirement to incorporate a front end processing and/or waste stabilization component as part of the development of a municipal solid waste disposal facility in Nova Scotia.
- Guidelines
 - Municipal Solid Waste Landfill Guidelines (October 1997)
 - Defines design and operational requirements for MSW landfills.
 - Identifies the process to obtain an approval from NSE to construct and operate a MSW landfill.
 - Provides a detailed description of all facility elements including the landfill liner, final cover system, leachate management system, landfill gas management system and surface water management system. Front end processing and/or waste stabilization systems are not identified as a required landfill facility element in the guidelines.

- Specifies quality control/assurance requirements for the installation of landfill liner and cap components.
- Defines all operational, environmental effects (e.g., ground and surface water) monitoring, data recording and reporting requirements.
- Identifies the requirement to develop a preliminary and final closure plan.
- Guidelines for the Siting and Operation of Waste Transfer Stations (October 2006)
 - Defines design and operational requirements for MSW and organic material transfer stations.
 - Identifies the process to obtain an approval from NSE to construct and operate a waste transfer station.
 - Provides a detailed description of all facility elements separation distances, surface water management systems, leachate management components and odour control features.
 - Defines all operational, environmental effects (e.g., ground and surface water, particulate emissions, sound) monitoring, data recording and reporting requirements.

Municipal

- By-Laws
 - Solid Waste Resource Collection and Disposal By-Law S-600 (last revised August 2015)
 - Defines key items relevant to the management requirements of MSW materials generated within HRM, including waste disposal fee structures as well as “residential” and “industrial/commercial/institutional” waste.

Contractual

- A new operating agreement between HRM and MIRROR was concluded in December 2015 with the agreement coming into effect in January 2016. Highlights of the agreement, which were reviewed with the CMC prior to execution, include the following:
 - MIRROR continues to be responsible for the provision of all the public health and environmental protections included in the original agreement.
 - Municipal Enterprises Ltd. continues to guarantee MIRROR’s obligations.
 - The agreement includes a 12-year extension of the contract to 2035 and two five year extensions possible beyond 2035.
 - A transfer station was authorized to begin operations pending NSE approval. Operations of the transfer station began in April 2016. Haulers of all ICI mixed solid waste generated in Halifax Regional Municipality are authorized to use the transfer station. The ICI waste received at the transfer station is transferred to landfills outside of HRM.
 - In another change to the original contract, MIRROR is now responsible for funding future landfill cell construction and closure works. Prior to this change, Halifax Regional Municipality was responsible for these costs.

- MIRROR continues to be responsible for processing all residential mixed solid waste generated in HRM.
- MIRROR is allowed to terminate this agreement in the event that legal entitlements cannot be amended to remove the obligation to operate the FEP/WSF facilities. The election period starts January 1, 2018 and ends December 31, 2021. The early termination date is December 31, 2023.

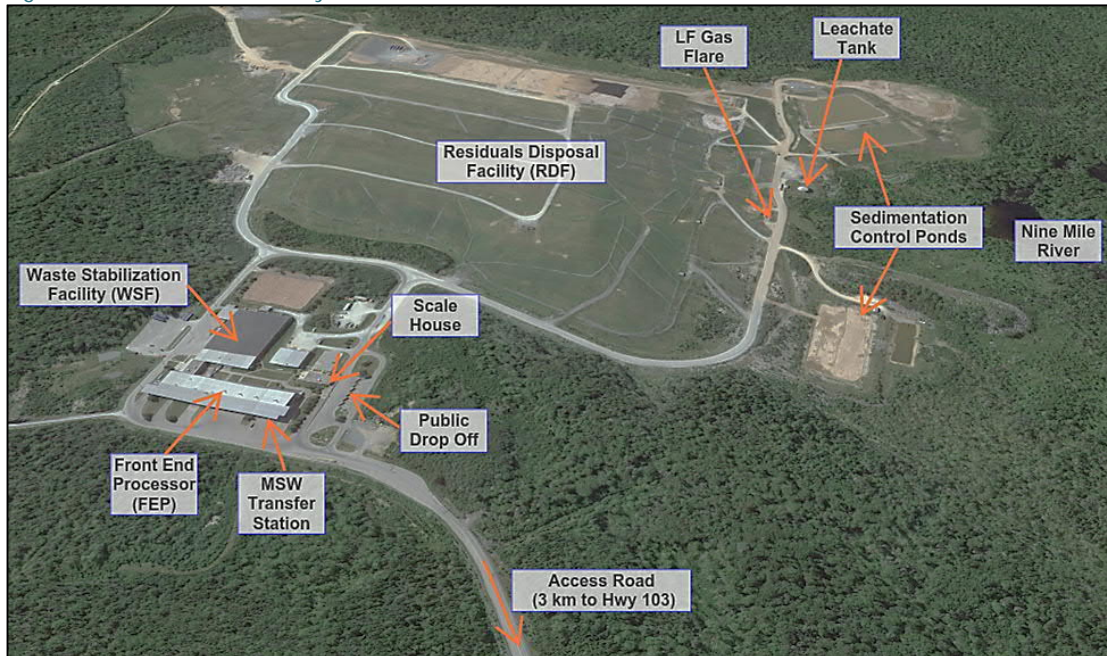
5.0 Current Facility and Waste Stream Status

5.1 Site Infrastructure and Features

The Otter Lake Waste Processing and Disposal Facility is situated on Otter Lake Drive approximately 2.5 km south of the community of Timberlea. As depicted in **Figure 5-1**, the Otter Lake facility includes several key site features:

- Dedicated two lane paved access road (Otter Lake Drive) connecting the site to Exit 3 on Highway 103;
- Scale House;
- Public Drop Off area;
- MSW Transfer Station (for ICI-generated waste materials);
- Front End Processor (FEP);
- Waste Stabilization Facility (WSF);
- Residuals Disposal Facility (RDF);
- Seven cells completed and capped with Cell 7a being currently active;
- Leachate Tank (capturing effluent from the RDF leachate collection system with truck transport off-site for treatment);
- Sedimentation Control Ponds (capturing and treating surface runoff from areas with erodible soil surfaces with ultimate discharge to the Nine Mile River); and
- Landfill Gas Flare (to allow for the flaring of gas captured by the RDF's collection system).

Figure 5-1: Otter Lake Facility Site Features



5.2 Incoming Material Quantity and Composition

Waste Quantity

Table 5-1 provides a summary of the total annual tonnages of waste materials delivered to the Otter Lake Facility from 1999 through to 2019.

Table 5-1: Waste Delivered to Otter Lake, 1999 to 2019

Year	Waste Delivered				Complaints Received	Population ¹	
	Industrial, Commercial & Institutional	Residential	Special	Total Received			
	tonne	tonne	tonne	tonne			
1	1999	88,166	26,424	1,113	115,703	-	352,653
2	2000	87,013	47,622	1,701	136,336	-	355,882
3	2001	86,217	57,248	2,193	145,658	-	359,111
4	2002	87,457	60,491	1,487	149,435	2	361,860
5	2003	89,895	64,574	1,956	156,425	37	364,610
6	2004	89,169	66,559	1,890	157,618	9	367,359
7	2005	92,718	68,013	2,969	163,700	11	370,109
8	2006	90,598	68,163	2,669	161,431	24	372,858
9	2007	87,823	64,117	2,440	154,380	1	376,306
10	2008	89,529	62,887	2,266	154,682	0	379,753
11	2009	85,215	62,264	1,890	149,369	2	383,201
12	2010	81,260	62,169	1,812	145,241	0	386,648
13	2011	79,622	60,139	2,074	140,323	26	390,096
14	2012	78,747	59,535	2,041	140,323	1	392,703
15	2013	78,396	59,152	2,011	139,559	0	395,310
16	2014	79,196	59,462	1,639	140,298	0	397,917
17	2015 ²	56,596	50,374	1,221	108,191	2	400,524
18	2016	7,998	44,587	334	52,919	0	403,131
19	2017	0	45,261	129	45,390	2	431,479
20	2018	0	45,687	217	45,904	1	435,906
21	2019	0	45,608	179	45,787	0	440,332
		1,435,615	1,180,336	34,231	2,648,672	118	

Notes:

1. Populations for non-census years estimated based on assumed linear change between each census. Populations for 2017 to 2019 from <https://novascotia.ca/finance/statistics>.
2. HRM flow control restrictions for ICI generated waste materials discontinued in February 2015.

In June 2002, in an effort to protect its solid waste infrastructure investments and towards meeting the requirements of the Otter Lake Operating Agreement, HRM amended its Solid Waste Resource Collection and Disposal By-Law to prohibit exportation of waste to facilities outside of the boundaries of the municipality. Referred to as “flow control”, it ensured that the significant amount of waste from HRM’s industrial, commercial and institutional (ICI) generators (along with the associated tip fee revenue) would continue to be directed to HRM waste management facilities, including Otter Lake. Given HRM’s obligation to provide collection services to residential generators, delivery of that portion of the overall waste stream to its management facilities was not an area of concern.

As illustrated in **Table 5-1**, the total amount of waste material received at the Otter Lake site remained relatively stable (average value of 150,214 tonnes per year) between the commencement of flow control restrictions in 2002 through to the year proceeding its discontinuation, 2014. However, immediately following the discontinuation of flow control, as ICI materials began to be exported to lower cost management facilities without Otter Lake’s pre-processing component, annual tonnages began to drop significantly, decreasing from 140,298 tonnes in 2014 (the last full year of flow control) to 45,390 tonnes in 2017; a drop of 68% over three years. As of 2019, the incoming FEP/WSF tonnage stood at 45,787 tonnes.

The reduction in incoming waste quantity has served to significantly increase the anticipated life expectancy (capacity) of the landfill.

As presented in **Table 5-1**, there have been 118 complaints received in 21 years of operations, including six since 2012. Noting the site currently receives approximately 46,000 tonnes of waste annually, this represents one complaint for every 22,400 tonnes delivered to Otter Lake since 1999 and one complaint for every 119,700 tonnes since 2012.

Waste Composition

While the significance of the reduction in the amount of waste material arriving at the Otter Lake site is clear, another notable aspect of change, as compared to the original design concept for the facility, has been the character of the waste. Since 2003/04, 12 characterization audits of HRM’s municipal solid waste stream (several as part of province-wide studies) have been completed – of the 12 audits, eight were sponsored or performed by HRM; one by sponsored by the Community Monitoring Committee; and three sponsored by Divert NS. Four did not include an assessment of HRM’s ICI-generated materials. Divert NS sponsored characterization audits in 2011, 2012 and 2017, at municipal waste disposal facilities throughout Nova Scotia (including Otter Lake); however, the categories and material definitions adopted for those studies were inconsistent with those utilized for the majority of the available assessments – most notably with regard to organics and recyclable paper resulting in a much higher “organics” percentage than those presented in other available audit reports. Efforts were made to re-allocate individual items to achieve consistency with the other nine studies, but it was concluded that the definition of recyclable versus compostable paper/fibre used for the Divert NS analysis made

adjustment impractical. As a result the Divert NS studies were not included for consideration as part of this review.

The audits that were examined to develop an understanding of the anticipated character of waste to be affected by the proposed closure of the FEP/WSF are summarized in **Table 5-2**.

Table 5-2: Reviewed Otter Lake Waste Characterization Audits

No.	Audit Year	Report Name	Author	Res, ICI or Both
1	2003/04	Solid Waste Characterization Study Summary Report 2010 ¹	SNC Lavalin Environment Inc.	Both
2	2008 (April)	Solid Waste Characterization Study Summary Report 2010 ¹	SNC Lavalin Environment Inc.	Both
3	2008 (December)	Solid Waste Characterization Study Summary Report 2010 ¹	SNC Lavalin Environment Inc.	Both
4	2009 (August)	Solid Waste Characterization Study Summary Report 2010 ¹	SNC Lavalin Environment Inc.	Both
5	2015 (Fall)	HRM Fall 2016 Waste Characterization Studies Report 2010 ¹	HRM Solid Waste Resources	Res
6	2016 (Summer)	HRM Fall 2016 Waste Characterization Studies Report 2010 ¹	HRM Solid Waste Resources	Res
7	2016 (Fall)	HRM Fall 2016 Waste Characterization Studies Report 2010 ¹	HRM Solid Waste Resources	Res
8	2016/17 (December/January)	Otter Lake Waste Audit	Bio-Logic Environmental Systems ²	Both
9	2017 (Spring)	HRM Spring 2017 Waste Characterization - Audit Results Table	HRM Solid Waste Resources	Res

Notes:

1. Report includes data on earlier characterization studies.
2. The project methodology was based on that used by SNC-Lavalin in the waste characterization studies conducted in 2008/2009 and on the requirements of the Recommended Waste Characterization Methodology for Direct Waste Analysis Studies in Canada prepared or CCME by SENES Consultants Limited in 1999. Completed on behalf of the CMC.

Figures 5-2, 5-3 and 5-4 present the results of the residential (Res), ICI and combined Res and ICI (respectively) characterizations studies. Each horizontal line on the graphs depicts the percentage of one of five sorted materials from the mixed waste arriving at the Otter Lake FEP:

- 1) Organics – food waste, leaf and yard waste, soiled paper, boxboard (moved to paper in 2015);
- 2) Recycling – allowable HRM Blue Bag materials, program electronics;
- 3) Paper – writing/office paper, corrugated cardboard, envelopes, newspapers, flyers;
- 4) Other – household hazardous waste (HHW), paint, sharps, aerosol cans, program electronics; and
- 5) Refuse – composite materials, diapers, pet waste, textiles, non-program electronics, coffee/beverage cups, non-recyclable plastics, C&D materials.

A sixth material category and a subset of the overall organics category, putrescible organics (i.e., food waste and leaf and yard waste), has been added to each graph to highlight the percentage of the Otter Lake mixed waste stream that is most directly linked with issues related to odour as well as gas and leachate management. Notably, this sub-category has been on a more rapid decline than the overall “organics” category (which also includes compostable paper/fibre materials that were deemed to be inappropriate for recycling by sorting personnel) since 2003.

Of the studies reviewed, there were small variations in the sub-categories included within each of the five main categories. In those instances, adjustments were made in an attempt to keep the list of items within each main category consistent.

Figure 5-2: Residential Sector – Waste Characterization Study Results

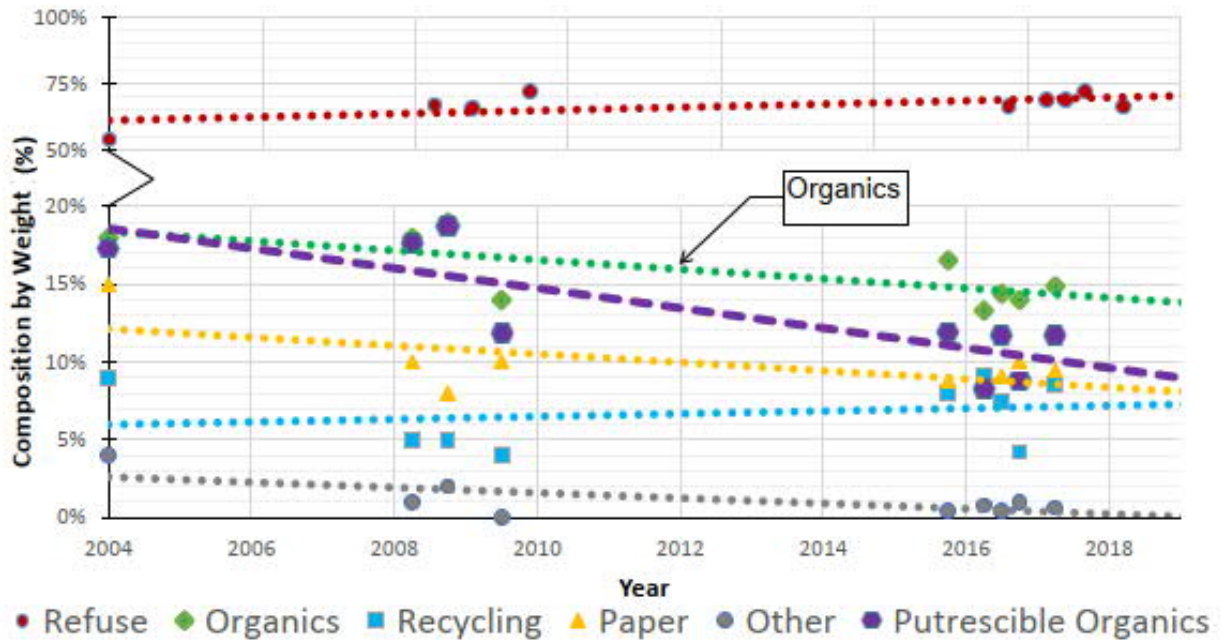


Figure 5-3: ICI Sector – Waste Characterization Study Results

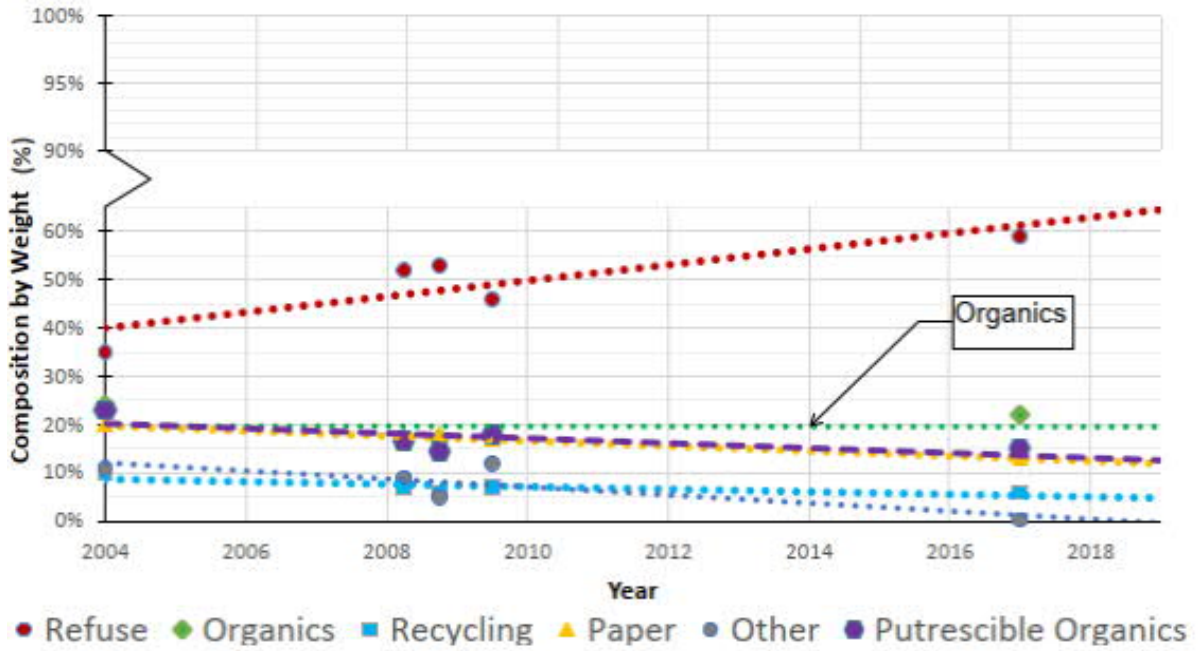
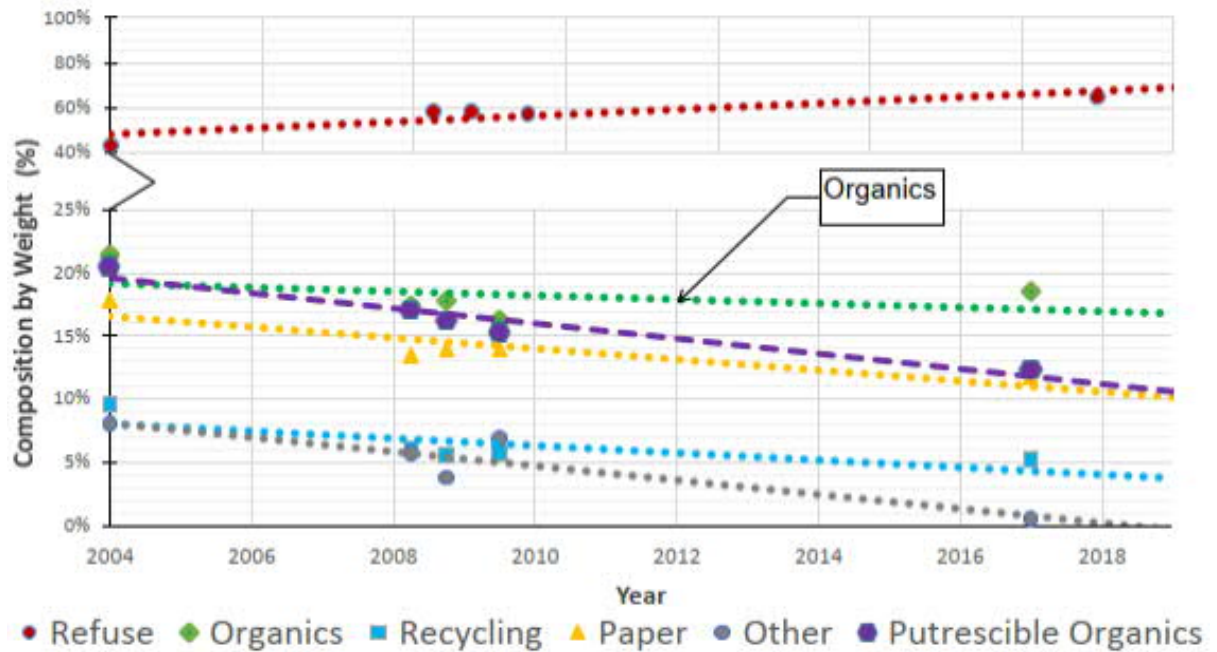


Figure 5-4: Combined ICI and Residential Sector – Waste Characterization Study Results



By examining the findings of the Otter Lake waste characterization studies since 2003, the following observations can be made;

- In the years from 2003/04 through to 2017, for residential, ICI and combined waste streams, there was a significant decline in the amount of organic (putrescible) material in wastes arriving at the Otter Lake FEP; and
- Over those years, based on the characterization audits analyzed, the percentage of organic materials in residentially-generated wastes was typically lower than that found in ICI sector wastes.

Organic materials tend to be the source of most nuisance issues at MSW management facilities, serving as a basis for odour and pest attraction concerns. With ICI residual materials now being (almost entirely) exported to disposal facilities outside of HRM, it is anticipated that wastes arriving at Otter Lake for the foreseeable future will consist of those originating from residential generators. Thus, in comparison to the years prior to the discontinuation of ICI flow control restrictions, it is projected that the composition of waste arriving at Otter Lake will have a primarily residential character (as depicted in **Figure 5-1**), offering reduced concerns typically associated with organic materials.

Based on Otter Lake waste audit and weigh scale data, and using regression analysis of the available information, **Figure 5-5** presents the approximate tonnage of putrescible organics that were delivered to the FEP/WSF from 2004 to 2019. The 4,100 tonnes of putrescible organic materials that arrived at Otter Lake in 2019 is approximately 13.5% of the amount of putrescible organic material that was received at the FEP/WSF in 2004. This is a significant reduction and calls into question the continued need for the FEP/WSF.

Operation of the FEP/WSF also consumes significant amounts of electricity; approximately 1,633,000 kWh at a cost of \$239,000 in 2019. Acknowledging Nova Scotia's current electrical energy sources (and using an emission factor from the National Inventory Report (NIR) for Nova Scotia), 2019's kWh total for the FEP/WSF represents an annual GHG generation impact of approximately 1,240 tonnes of CO₂e.

Figure 5-5: Tonnage of Organics Delivered to the FEP/WSF



*: Yearly putrescible organic tonnages were estimated by using linear trend line regression of the measured waste characterization percentages in combination with the yearly reported tonnages received at the Otter Lake RDF.

The noted decline in the amount of organic materials (as well as recyclable containers/packaging and paper) in the mixed waste stream can be attributed to several factors, including:

- Improved separation efforts by generators as a result of sustained educational and enforcement efforts;
- A “generational” attitudinal change associated with a mature diversion program; and
- The impacts of HRM’s clear bag program (initiated in 2015), providing an additional incentive for generators to properly segregate their organic materials, as well as recyclables.

It is anticipated that the proposed establishment of HRM’s new organics processing facility (to replace existing operations in Burnside and Ragged Lake), will provide a foundation for further education and promotion of the appropriate segregation of compostable materials from the mixed waste stream.

6.0 Proposed Operational Revisions and Associated Management Considerations

6.1 Overview of Proposed Revisions

With reference to **Section 1.0** of this document, and under the headings of “What Will Change” and “What Will Not Change”, a description of proposed operational revisions at the Otter Lake Waste Processing and Disposal Facility are summarized as follows:

What Will Change

- Operations at the FEP and WSF will be discontinued. Potential alternate uses for the facilities will be evaluated by HRM and MIRROR; and
- Residential waste collection vehicles will no longer deliver their loads to the FEP tipping floor. They will instead proceed directly, via the existing access road network, to the active tipping (disposal) face at the RDF, similar to other MSW landfills in Nova Scotia (e.g., West Hants Landfill, Guysborough Waste Management Facility and Cumberland Central Landfill).

What Will Not Change

- The respective ownership (HRM), operator (MIRROR) and community oversight (CMC) roles and responsibilities at the Otter Lake facility;
- MIRROR’s obligations related to odour control and management of nuisance issues (i.e., litter and dust) as defined in their operating agreement with HRM;
- Hours and days of operation;
- All waste hauling/collection vehicles arriving at the Otter Lake site will be required to report to the scale house for inspection, weighing, data recording and billing;
- Collection vehicles with ICI wastes will be directed to the Transfer Station tipping floor, with materials subsequently being loaded into a trailer for transport to approved disposal facilities outside of HRM;
- Waste placement, compaction and covering requirements will continue to be facilitated using specialized mobile equipment; and
- All applicable regulatory requirements will remain in place, including design, monitoring, reporting and general performance obligations included within the most current NSE Operating Approval.

6.2 Material Delivery

Current Approach

- All waste collection vehicles arriving at Otter Lake, after reporting to the Scale House, proceed to either the FEP tipping floor (residential collection vehicles) or the Transfer Station tipping floor (ICI collection vehicles);

- Materials delivered to the Transfer Station (including items from the Public Drop Off area) are subsequently transported via tractor trailer to approved disposal facilities outside of HRM;
- Residential waste materials on the FEP tipping floor are visually inspected (bulky and hazardous items removed) and are then directed to the FEP process line for sorting and removal of recyclables. An organic component is removed using a trommel system and is directed to the WSF for bio-stabilization. The non-divertable residual component is collected at the end of the sort line and directed to the RDF;
- Select bulky items (e.g., mattresses, furniture) are transferred from the FEP tip floor for disposal;
- Following the completion of the biostabilization process at the WSF, the material is transported via on-site tractor-trailer to the RDF active face (approximately three trips per day); and
- Currently, on average, a total of approximately 18 to 28 waste vehicles deliver materials from the FEP/WSF to the RDF per day.

Potential Issues of Concern

On-Site

- Slight increase in vehicle arrivals (estimated at four to nine per day) at the active tip face and associated issues with traffic control and worker safety; and
- Vehicle arrivals tending to be more concentrated at certain times of day (consistent with residential collection schedules) as compared to current conditions.

Off-Site

- None Identified

Recommended Mitigatory Actions

- Provision of instructions to residential collection contractors regarding site traffic rules and restrictions, including the definition of protocols (e.g., warnings, banning from site) for non-compliance;
- Establish directional signage from the Scale House to the active tipping face; and
- Provision of traffic spotters at the active tipping face, acknowledging peak traffic periods.

Proposed Approach

- Consistent with the Current Approach, but with the following changes:
 - All waste collection vehicles arriving at Otter Lake, after reporting to the Scale House, proceed to either the RDF active tipping face (residential collection vehicles) or the Transfer Station tipping floor (ICI collection vehicles). Based on recent records for residential collection vehicle arrivals at Otter Lake, this will equate to approximately 25 to 30 vehicle trips to the RDF per day.
 - Residential waste materials discharged at the RDF active tipping face are visually inspected for prohibited materials, with these items being segregated for subsequent appropriate management as required.

6.3 Material Placement and Covering

Current Approach

- The working face is kept as small as possible to ensure the maximum compaction, reduce cover material requirements and to limit the amount of exposed waste;
- The maximum working face does not exceed 30 m in width;
- Residual materials are deposited in lifts and compacted by multiple passes of the landfill compactor before additional material is spread in order to achieve the maximum practical density;
- Each lift does not exceed about 2.5 m in height and the working face is inclined to be no steeper than the practical working limits of the spreading and compacting equipment, about 1.5 (horizontal) to 1 (vertical);
- At the end of each working day, the compacted residuals are covered with daily cover. Daily cover is defined as:
 - About 150 mm of soil or Construction and demolition debris mix as approved by NSE.
 - Other natural material required for on-residue travel roadways.
 - Plastic tarping or other sheet material used at the working face which is removed at the commencement of the next day's operations.
 - Other materials as approved by NSE.
- Daily cover will be placed over the compacted material during and at the end of each working day. Depressions and low spots in the surface will be filled and the soil surface graded to encourage positive drainage, thus reducing leachate generation;
- Intermediate cover is required to protect residual material already placed and compacted in areas of the RDF which will remain dormant for a period of six months or more. Intermediate cover consists of providing an additional layer of soil above daily cover to create a thickness of about 300 mm; and
- Prior to commencement of filling, as much intermediate cover as possible, typically 225 mm, will be scraped back and stockpiled for reuse when filling is to resume over the same area.

Potential Issues of Concern

On-Site

- None identified.

Off-Site

- None identified.

Recommended Mitigatory Actions

- Not applicable.

Proposed Approach

- Consistent with the Current Approach.

6.4 Nuisance Control Measures

6.4.1 Litter Control

Current Approach

- Inspection of the site will be conducted for evidence of litter when the facility is in operation. Litter will be collected on a daily basis from all areas of the site, particularly from fences, on-site roads, and entrance area; and
- Fixed fences are installed as needed on exterior berms. Portable fences are installed at or near the working face to catch windblown materials. The fencing is cleaned as necessary, typically on a daily basis. Additionally, higher fencing is installed beyond the portable fencing as necessary to catch further wind-blown material.

Potential Issues of Concern

On-Site

- Given the unprocessed nature of the waste (discharged directly from collection vehicles), there is an increased potential for blowing litter at the tip face.

Off-Site

- None identified.

Recommended Mitigatory Actions

- Use of additional portable fencing as well as additional litter collection and removal efforts by site personnel.

Proposed Approach

- Consistent with the Current Approach.

6.4.2 Bird and Vector Control

Current Approach

- The homogenous, processed character of the residual materials delivered to the RDF tip face is of limited attractiveness to birds, rodents and other vectors;
- Acknowledging that seagulls and crows are attracted to open areas without vegetation (e.g., a cultivated field), several bird management measures are conducted in proximity to the active disposal face, including whistler flares, a falconer and culling (consistent with Federal regulations); and
- Regular baiting programs for rodent control are conducted in proximity to the FEP/WSF.

Potential Issues of Concern

On-Site

- The delivery of unprocessed waste directly to the tip face increases the potential to attract birds (due to the increased availability of food as compared to current conditions) and to increase the number of rodents at the tip face area (arriving within collection vehicles).

Off-Site

- None identified.

Recommended Mitigatory Actions

- Enhanced bird and vector control efforts at the general tip face area and at the RDF in general;
- Implementation of a baiting program for rodents in proximity to the RDF tip face; and
- Emphasis on minimizing the size of the active disposal area, thorough waste compaction and placement of daily cover at the completion of each working day.

Proposed Approach

- Consistent with the Current Approach.

6.4.3

Dust Management

Current Approach

- All vehicles delivering waste to the TS/FEP travel on paved roads. Therefore, the accumulation of mud on tires (as potential source for dust) is not considered a concern. Any errant mud that does accumulate is periodically removed using on site equipment;
- The perimeter access road around the RDF and leading to the active tip face is granular. The road circulating the FEP/WSF compound is paved. Minimization of mud build-up on the circular road is accomplished by implementing the following practices:
 - The route from the working face to the public road is long enough to facilitate removal of occasional mud from vehicle tires.
 - Length of travel along the granular access road helps to jar mud loose from vehicle tires and bodies before leaving the facility.
 - Site ditches are maintained to ensure adequate drainage.
 - Access roads are maintained with a good crown on the road to quickly shed rainfall.
 - Additional stone is placed on aggregate surfaced roads as required to maintain separation from underlying soil surfaces.
 - Additional dust suppression measures include the use of water trucks and the annual application of Tembec[®], a biodegradable and non-toxic dust control product.

Potential Issues of Concern

On-Site

- None identified.

Off-Site

- None identified.

Recommended Mitigatory Actions

- Not applicable.

Proposed Approach

- Consistent with the Current Approach.

6.5 Landfill Gas and Odour Management

6.5.1 Landfill Gas Management

Current Approach

- Through to the completion of Cell 5, landfill gas generated from within the RDF waste mass was collected using negatively-pressured vertical extraction wells in combination with a piped header system. Wells were typically installed as a cell reached its final design elevation and as a component of the construction of the final composite cap. Gas was then directed to an on-site blower/flare station. The characteristics of the processed waste material from the WSF (with landfill gas being generated more quickly after waste placement than what is typically experienced at a traditional unprocessed waste site) created a need for the use of an interim collection system with the gas being directed to the flare;
- Beginning with Cell 6, horizontal wells began to be utilized in lieu of the interim collection system following a system assessment by Dillon and SCS Engineers;
- For the currently-active portion of the RDF, Cell 7a, the use of horizontal wells (installed as the cell is filled) and vertical wells (once the final design height is reached) is planned; and
- The original blower/flare station continues to be in operation, but a new blower/flare skid unit near Cell 7 (constructed in 2015) offers an alternate location for the combustion of collected landfill gas.

Potential Issues of Concern

On-Site

- None identified.

Off-Site

- None identified.

Recommended Mitigatory Actions

- Not applicable.

Proposed Approach

- Placement of unprocessed waste (versus processed material from the WSF) may necessitate some refinements to the current gas system installation protocol. As noted, there is a potential that gas generation and associated odour issues may not manifest themselves as quickly after waste placement as what has historically been experienced at the RDF. Regardless, the primary driver for the timing of installation of landfill gas collection components will continue to be MIRROR's commitment to effective odour management at the site.

6.5.2

Odour Management

Current Approach

- Since the commissioning of the Otter Lake facility in 1999, MIRROR has adopted a “presence/absence” approach to odour monitoring and control requirements at the facility. If a complaint is received, or if MIRROR staff identify an on-site odour issue deemed to have the potential for off-site detectability, MIRROR records the incident and takes immediate action to identify the source and mitigate the issue. At Otter Lake, the threshold for reporting and mitigation is reported (or anticipated) off-site detectability;
- Consistent with the presence/absence protocol, MIRROR conducts daily on-site inspections to assist in early detection of odour issues. On-site inspections will focus on identification of odourous areas, as well as localized surface water ponding and/or surface water drainage problems. It is also noted that MIRROR conducts regular “odour patrols” of the communities that surround the Otter Lake site, with any noted concerns being recorded and brought to the immediate attention of site management personnel;
- MIRROR performs specific off-site odour inspections upon receipt of an off-site odour complaint. Such off-site odour inspections take into account prevailing wind speed and direction, and focus inspections on locations downwind of the RDF and at the location of the complaint. Inspections to investigate the cause of complaints received are conducted as soon as practicable after receipt of the complaint. Where odours related to the RDF are detected during such inspections, MIRROR undertakes appropriate actions to abate off-site odours, including:
 - Application of a low permeability cover (e.g., soil or other cover material that serves to inhibit the release of landfill gas) in a timely manner.
 - Application of immediate soil cover over waste loads that are particularly odorous.
 - Use of waste acceptance and rejection procedures as outlined in the FEP/WSF Operations plan and herein.
 - Modification of waste placement operations as necessary to minimize odour emissions.
 - Operation and maintenance of the LFG collection system, including the following:
 - Regular expansion of the LFG collection system with waste placement.

- Adjust the LFG wellfield on a minimum monthly basis with the following operational goals at individual wellheads:
 - Methane: 40-50 percent
 - Oxygen: <1 percent
 - Static pressure: <0.0 inches-water column (in-w.c.)
 - Temperature: <125°F
- Prompt repair or replacement of LFG collection system components as needed.

Potential Issues of Concern

On-Site

- None identified.

Off-Site

- None identified.

Recommended Mitigatory Actions

- Not applicable.

Proposed Approach

- Consistent with the Current Approach.

6.6 Leachate Management

Current Approach

- In an effort to minimize the amount of precipitation entering the landfill waste mass, the working face is kept as small as possible (e.g., <30 m in width) to ensure the maximum compaction, reduce cover material requirements and to limit the amount of exposed waste;
- Liquids originating from within the RDF percolate down through the waste mass and are collected within the leachate collection layer of the landfill cell liner. Perforated and solid wall HDPE pipes direct the leachate to collection sumps at where it is subsequently pumped to a leachate storage tank;
- Leachate from the storage tank is transferred to a tanker truck as required for transport to an approved treatment facility (currently Halifax Water's Mill Cove WWTF). In cases of high flows a temporary holding pond, located near Cell 4, can accept leachate; and
- Regular monitoring of site groundwater and surface water, along with associated reporting to NSE, will continue to allow for validation of the effectiveness of leachate management infrastructure and operations at the site.

Potential Issues of Concern

On-Site

- To determine if there was a potential for changes in leachate quality at the RDF associated with the acceptance of unprocessed municipal solid waste (as compared to residuals from the WSF), leachate data from three “second-generation” (composite-lined) municipal solid waste landfills in Nova Scotia was reviewed with a summary of the data presented in **Table 6-1**. Along with the RDF, leachate analytical data for the following sites was assessed:
 - Colchester Balefill
 - Established in 1995.
 - MSW is baled prior to placement in the landfill.
 - Acceptance of MSW from Colchester County and the Town of Stewiacke.
 - Current incoming waste quantity of approximately 13,000 tonnes per year.
 - Guysborough Landfill
 - Established in 2005.
 - Acceptance of MSW from Region 1 (Cape Breton Region) and 2 (Eastern Region).
 - Current incoming waste quantity of approximately 68,000 tonnes per year.
 - Landfill “A”
 - Request from the Owner that details on this regional MSW landfill not be presented in our report.
 - In operation for over 10 years.
 - Current incoming waste quantity of between 80,000 and 120,000 tonnes per year.

Table 6-1: Landfill Leachate Data Summary

Parameter	Otter Lake RDF		Colchester Balefill		Guysborough Landfill		Landfill “A”	
	Range	Average	Range	Average	Range	Average	Range	Average
pH	6.20-8.61	7.91	6.97-8.50	7.55	7.20-8.72	7.61	6.66-7.56	7.05
TDS	648-8170	4483	1007-6489	3693	1730-6480	3733	1340-25000	4849
Hardness	120-3400	729	52.26-1450	670	577-1060	815	370-3000	936
Chloride	15-1800	938	80-2700	846	147-1440	647	270-13000	1777
Sodium	15-1800	935	94-1340	709	-	-	254-8800	1320
Ammonia	4.20-630	289	0.42-1860	348	1.27-1810	729	34-290	137
Alkalinity	45-4580	2116	286-5200	2587	799-4110	2303	560-2900	1587
Manganese	0.087-10.6	1.8	0.05-11100	2400	4-5970	1099	3.6-14	6.1
Nitrate	0.04-290	26.36	0.05-13.57	3.31	0.05-31.9	4.50	0.058-1.5	0.36
Nitrite	0.01-190	15.72	0.08-1.93	0.98	-	-	0.017-0.15	0.06
BOD	-	-	-	-	20-3370	281	12-150	42
COD	-	-	-	-	86-3230	955	150-2700	605
Zinc	0.056-2.5	0.39	0.008-1.27	0.12	76-328	180.86	0.0079-0.20	0.06

- As noted in **Table 6-1**, significant differences (e.g., in terms of an obligation to collect and treat the effluent) in the character of the leachate amongst the four reviewed facilities were not identified. Where differences are noted for specific parameters, it is believed that they are associated with differences in the periodic acceptance of select residuals and/or specific operational activities at individual sites. The provincially-specified liner system, complete with a dedicated leachate collection system with transfer to the on-site storage tank (and subsequent transport to an off-site treatment facility) will continue to be utilized at Otter Lake. Thus, changes in leachate management requirements at the RDF are not expected should unprocessed waste begin to be landfilled at this location.

Off-Site

- None identified.

Recommended Mitigatory Actions

- Not applicable.

Proposed Approach

- Consistent with the Current Approach.

6.7 Stormwater Management

Current Approach

- The stormwater management system serving the RDF and surrounding area includes ditch, swale, pipe and pond infrastructure intended to ensure that the site drains freely and that operations and vehicle movement is not impeded during frequent rainfall events;
- The completed RDF (Cells 1 to 5 and Cell 6 are surrounded by perimeter ditching that collects runoff from the surface of the landfill cells. These perimeter ditches are directed toward one of two retention structures, the North and South Sedimentation Ponds;
- Runoff generated from the covered landfill areas is transported to the ponds both as overland and channelized flow. Runoff from Cells 1 and 2 generally remain as overland flow over the vegetated cover material until entering the perimeter ditches and flowing to the North Sedimentation Pond. Runoff from the top of Cells 3, 4 and 5 and portions of 6 are directed towards a series of geomembrane-lined “chutes” (five in total) located along the western slope of the landfill. Flow entering these chutes is deposited into collection ditches along the western toe of slope and ultimately discharge to the South Sedimentation Pond;
- Both the North and South Sedimentation Ponds direct their final discharge to the Nine Mile River;
- A recirculation system is also used to add a flocculent solution and recirculate treated effluent upstream before discharging to the environment. SternPac is the primary flocculent solution used, however a proprietary additive has been used to enhance the flocculation and suspended sediment removal during winter conditions. The additive is now used year round to enhance the flocculation and settlement of suspended sediments in both the North and South Ponds;

- A vegetated cover (similar to existing) provides adequate erosion protection of the landfill cover material. Temporary erosion protection (erosion protection blankets, etc.) are periodically required during the establishment of vegetation; however, this can be mitigated through the use of sod, or seed along with some form of temporary erosion control measures (erosion control blankets and/or coir coconut husk fibre mats);
- Monthly inspections are undertaken to ensure that pipes and ditches are free of obstructions and that there is no visible damage to the system. The culverts are inspected to ensure that there are no blockages. If the culvert has been crushed, it is to be repaired or replaced. The on-site roadside ditches are periodically regraded to prevent standing water and ensure adequate capacity. If sediment has accumulated in pipes or inlets, they are cleaned out in an appropriate manner. After each storm event, the erosion and sedimentation control devices are inspected, and, if found to be damaged, they are repaired or replaced as soon as possible; and
- Regular monitoring of site surface water, along with associated reporting to NSE, will continue to allow for validation of the effectiveness of stormwater management infrastructure and operations at the site.

Potential Issues of Concern

On-Site

- None identified.

Off-Site

- None identified.

Recommended Mitigatory Actions

- Not applicable.

Proposed Approach

- Consistent with the Current Approach.

6.8 Monitoring and Reporting

6.8.1 Monitoring

Current Approach

- Monitoring requirements (location, parameters and frequency of collection) for the Otter Lake facility are detailed in its current NSE Operating Approval. As defined by NSE, all sampling and analysis procedures associated with monitoring activities are conducted using standards and methods approved by the regulator. With a focus on the RDF, monitoring and data collection at the Otter Lake facility includes the following:
 - Incoming waste data - customer, quantity, waste type.

- Surface Water - collection of samples and laboratory analysis for targeted parameters, including total suspended solid (TSS) and pH.
- Leachate quantity and quantity.
- Leachate head depth on the cell liner - maximum 300 mm.
- Groundwater - hydraulic head level and collection of samples and laboratory analysis for targeted parameters, including general inorganic chemistry and trace metals.
- Odour monitoring efforts are described in **Section 6.5.2**.

Potential Issues of Concern

On-Site

- None identified.

Off-Site

- None identified.

Recommended Mitigatory Actions

- Not applicable.

Proposed Approach

- Consistent with the Current Approach.

6.8.2

Reporting

Current Approach

- Reporting requirements (document content and submission frequency) for the Otter Lake facility are detailed in its current NSE Operating Approval;
- An operations report and an environmental monitoring report for the Otter Lake facility is prepared annually and submitted to NSE annually. The report covers the 12-month period preceding each anniversary of the site opening. The annual report includes the following:
 - Any changes to the approved facility design, the reasons for, and NSE approval of such changes.
 - A summary of the volume and weight of all wastes handled at the site.
 - A summary of any waste rejection notices issued and the reasons for issuance.
 - A periodic review of contingency plans and measures.
 - A summary of complaints received during the past year.
 - A description of significant environmental and operational issues encountered during the past year, and any mitigative actions taken.
 - A statement as to the compliance with all conditions of the operating permits.
- The environmental monitoring report (prepared by a qualified, specialist firm) includes the results of an interpretive analysis of all monitoring data collected and will include any deviations from the proposed monitoring program and reasons for such deviations.

Potential Issues of Concern

On-Site

- None identified.

Off-Site

- None identified.

Recommended Mitigatory Actions

- Not applicable.

Proposed Approach

- Consistent with the Current Approach.

7.0 Risk Assessment Matrix

As described in **Section 6.0**, the proposed operational changes at the Otter Lake facility do, in some instances, present the potential for on-site effects requiring management. When potential effects have been identified (e.g., blowing litter, attraction of birds), recommended mitigatory actions, based on design and operational best practice, have been identified. Nevertheless, it is acknowledged that the delivery of unprocessed MSW directly to the RDF does present a degree of risk with regard to objectionable on-site outcomes. It is noted that the review conducted in **Section 6.0** did not identify potential off-site (e.g., beyond facility property boundaries) issues of concern.

Risk is commonly defined as the combination of the *likelihood* of the occurrence of harm and the *severity* of that harm. An assessment of risk can be completed through the use of a risk matrix, similar to the one presented in **Table 7-1**.

Table 7-1: Risk Assessment Matrix

Likelihood	Severity of Impact				
	Incidental (1)	Minor (2)	Serious (3)	Major (4)	Catastrophic (5)
Frequent (5)	medium	high	very high	very high	very high
Occasional (4)	medium	medium	High	very high	very high
Seldom (3)	Low	medium	high	High	very high
Remote (2)	Low	low	medium	High	high
Unlikely (1)	Low	low	medium	Medium	high

With reference to the headings and supporting text presented in **Section 6.0** and using the severity and likelihood numerical scores presented in **Table 7-1**, **Tables 7-2** and **7-3** present an on-site and off-site issues risk assessment of the proposed operational changes (incorporating consideration of the proposed mitigatory actions, where applicable) at the Otter Lake facility.

With reference to **Table 7-2**, it is noted that potential on-site issues associated with material delivery, litter control and bird/vector control present relatively modest risk “significance” scores and are readily mitigated through the implementation of established best-practice operational procedures. As illustrated in **Table 7-3**, no off-site risk issues were identified as associated with the proposed closure of the FEP/WSF.

Table 7-2: On-Site Issues Risk Assessment – Proposed FEP/WSF Changes

Operational Activity	Potential Impact/ Issue of Concern	Severity (A)	Likelihood (B)	Significance* (A)x(B)	Severity of Impact	Mitigation
6.2 Material Delivery	- Traffic control and worker safety	4	1	4	medium	<ul style="list-style-type: none"> Provision of instructions to residential collection contractors regarding site traffic rules and restrictions, including the definition of protocols (e.g., warnings, banning from site) for non-compliance. Establish directional signage from the Scale House to the active tipping face. Provision of traffic spotters at the active tipping face, acknowledging peak traffic periods.
6.3 Material Placement and Covering	None identified	-	-	-	-	-
6.4.1 Litter Control	- Increased potential for blowing litter at the tip face	1	4	4	medium	<ul style="list-style-type: none"> Use of additional portable fencing as well as additional litter collection and removal efforts by site personnel. Enhanced bird and vector control efforts at the general tip face area and at the RDF in general.
6.4.2 Bird and Vector Control	- Enhanced attraction of birds	2	4	8	medium	<ul style="list-style-type: none"> Emphasis on minimizing the size of the active disposal area, thorough waste compaction and placement of daily cover at the completion of each working day.
	- Delivery of rodents in waste loads to tip face	1	3	3	low	<ul style="list-style-type: none"> Implementation of a baiting program for rodents in proximity to the RDF tip face.
6.4.3 Dust Management	None identified	-	-	-	-	-

Operational Activity	Potential Impact/ Issue of Concern	Severity (A)	Likelihood (B)	Significance* (A)x(B)	Severity of Impact	Mitigation
6.5.1 Landfill Gas Management	None identified	-	-	-	-	-
6.5.2 Odour Management	None identified	-	-	-	-	-
6.6 Leachate Management	None identified	-	-	-	-	-
6.7 Stormwater Management	None identified	-	-	-	-	-
6.8.1 Monitoring	None identified	-	-	-	-	-
6.8.2 Reporting	None identified	-	-	-	-	-

*: highest potential Significance score = 25.

Table 7-3: Off-Site Issues Risk Assessment – Proposed FEP/WSF Changes

Operational Activity	Potential Impact/ Issue of Concern	Severity (A)	Likelihood (B)	Significance* (A)x(B)	Severity of Impact	Mitigation
6.2 Material Delivery	None identified	-	-	-	-	-
6.3 Material Placement and Covering	None identified	-	-	-	-	-
6.4.1 Litter Control	None identified	-	-	-	-	-
6.4.2 Bird and Vector Control	None identified	-	-	-	-	-
6.4.3 Dust Management	None identified	-	-	-	-	-
6.5.1 Landfill Gas Management	None identified	-	-	-	-	-

Operational Activity	Potential Impact/ Issue of Concern	Severity (A)	Likelihood (B)	Significance* (A)x(B)	Severity of Impact	Mitigation
6.5.2 Odour Management	None identified	-	-	-	-	-
6.6 Leachate Management	None identified	-	-	-	-	-
6.7 Stormwater Management	None identified	-	-	-	-	-
6.8.1 Monitoring	None identified	-	-	-	-	-
6.8.2 Reporting	None identified	-	-	-	-	-

*: highest potential Significance score = 25.

Summary of Proposed Revisions

Based on the results of this analysis, there does not appear to be any significant benefit to the continued operations of the FEP/WSF. Further, there does not appear to be any increased risk to public health and the environment if the FEP/WSF operations are terminated.

To acknowledge the significant reduction in incoming waste tonnages at the Otter Lake Waste Processing and Disposal Facility since 2015, and thus the efficacy of the FEP/WSF, the following operational revisions are proposed:

- Operations at the FEP and WSF should be discontinued. Potential alternate uses for the facilities will be evaluated by HRM and MIRROR; and
- Residential waste collection vehicles will no longer deliver their loads to the FEP tipping floor. They will instead proceed directly, via the existing access road network, to the active tipping (disposal) face at the RDF, similar to other MSW landfills in Nova Scotia (e.g., West Hants Landfill, Guysborough Waste Management Facility and Cumberland Central Landfill).

To address potential on-site issues associated with the proposed operational revisions, the following measures are recommended.

Increase in RDF Vehicle Traffic

- Provision of instructions to residential collection contractors regarding site traffic rules and restrictions, including the definition of protocols (e.g., warnings, banning from site) for non-compliance;
- Establish directional signage from the Scale House to the active tipping face; and
- Provision of traffic spotters at the active tipping face, acknowledging peak traffic periods.

Increased Potential for Blowing Litter

- Use of additional portable fencing as well as additional litter collection and removal efforts by site personnel.

Increased Attractiveness of the Disposal Area to Birds

- Enhanced bird and vector control efforts at the general tip face area and at the RDF in general; and
- Emphasis on minimizing the size of the active disposal area, thorough waste compaction and placement of daily cover at the completion of each working day.

Rodents Arriving at the RDF Tip Face in Collection Vehicles

- Implementation of a baiting program for rodents in proximity to the RDF tip face.